IEEE COMPUTER SOCIETY
STYLE GUIDE

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Usages not identified or adequately defined in accepted external sources
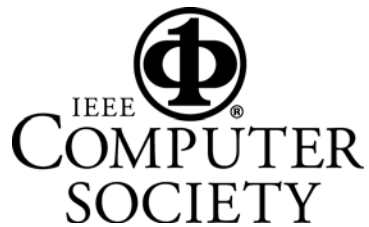
Introduction

Mission statement

The IEEE Computer Society Style Guide Committee's mission is to clarify the editorial styles and standards that the Society's publications use. We maintain and periodically update a style guide to clarify those usages not adequately defined in accepted external sources. Our purpose is to promote coherence, consistency, and identity of style, making it easier for CS editors and our authors to produce quality submissions and publications that communicate clearly to all our readers.

General information

This revised (November 2013) edition of the IEEE Computer Society Style Guide complements these primary references:

- **Preferred dictionary:** *Webster's Collegiate Dictionary*, 11th ed., 2003.

- **General style guide:** *The Chicago Manual of Style*, 16th ed., 2010 (called *CMS* in this style guide).

The CS style guide defines and explains unique IEEE Computer Society usages, particularly where they differ from other usages. It also defines specialized terms to help editors determine proper usage and phraseology.

Entries in the alphabetical listing include commonly used acronyms, definitions, and brief remarks on points of style. Entries for terms are listed with their initial letter in lowercase, unless the term is a proper name or conventionally appears with an initial capital letter. A keyword given in italics denotes entries for remarks on style. Where topics cannot be covered by short explanations, they are presented in the special sections listed in the Table of Contents.

An * denotes entries in the alphabetical listing that can be used as acronyms on first reference. An individual magazine's editorial staff can make determinations about applying this designation to other acronyms on the list. Because some terms look like acronyms and some acronyms look like terms, the style guide provides overlapping entries to make it easier to use. Likewise, the listings include cross-references where necessary.

This style guide will be updated as required. An electronic version is available at www.computer.org/portal/web/publications/styleguide.

The Style Guide Committee is a permanent body with a mandate to rule on questions of style and to provide guidelines where none exist. If you have a question to pose, or you find an entry that needs to be added or changed, please send your request by e-mail to style@computer.org. The committee will endeavor to reply within 30 days.

Resolving differences with authors

The Style Guide Committee's goal is to direct editors to published works and offer guidelines that they should consider and follow, except in cases where they have good reasons to do otherwise. We recognize that each CS publication has its own minor style variations. Moreover, a good editor knows when to bend a good rule in order to maintain clarity of meaning within a written passage.

Authors provide the technical content for Computer Society publications and, together with referees, bear the major responsibility for ensuring technical accuracy. The editor's job is to present the material in the most effective manner possible, consistent with established CS publishing practices.

Computer Society style is not intended to alienate authors, universities, or corporations; its goal is to achieve professionalism and consistency while treating all firms, organizations, and individuals equally. This house style is generally supported by US trademark law.

Occasional author-editor disagreements can be expected, and compromises are often necessary. Each party should recognize that the other has a stake in the outcome: The author's name appears on the book or article for all the world (and numerous colleagues) to see, and the editor must follow guidelines established by senior editors, managers, the publisher, and accepted CS editing practices.

Authors frequently feel that a particular usage is correct because it has appeared in a variety of printed communications. However, if these communications are conference proceedings, in-house technical reports, or unpublished papers that have not been professionally edited, no one has yet applied standard publishing rules. Once in a while, though, CS style may indeed be out of step, and questionable cases should be referred to the Style Guide Committee. Willingness to view a situation from another's vantage point is a big step toward resolving differences.

Editors should be flexible enough to compromise when firm publishing and editing principles are not being violated. If an author's preference violates strict grammar rules or firm CS guidelines, the editor should make clear what that violation is, explain why it is not good practice, and suggest an alternative.

An editor's decisions should not be, or appear to be, arbitrary. Explaining that the Style Guide Committee has given considerable thought to CS policies and has established guidelines intended to enhance the authority, effectiveness, and prestige of CS publications is usually the best way to enlist an author's cooperation in the search for a solution. Unresolved disputes between an equally adamant author and editor should be referred to the department manager.

Acknowledgments

Abbreviations

Styles differ on whether or not periods should be used with particular abbreviations. The Society discourages the use of periods in certain abbreviations, such as those for academic degrees, names of countries, and other abbreviations that are in all capitals. When periods are removed from abbreviations, the internal space should also be removed (for example, *MIT*, *PhD*, *US*). The internal space is also removed from other abbreviations with internal periods, as with author initials. Note that if an abbreviation also spells a word, removing the following period could cause confusion in some contexts (for example: *in., no.*).

Although many style manuals decry the use of abbreviations, some words are seldom spelled out. Among these are abbreviations for affiliations or scholarly degrees after a name (*BA, PhD*), and abbreviations such as *AD, CPA*, and *Ltd*. A symbol or figure beginning a sentence, on the other hand, is usually spelled out; if it cannot be, the sentence is rewritten (Two hundred miles, *not* 200 miles).

Other abbreviation style tips:

The abbreviations *Jr., Sr., II* and so forth do not require a comma because they are part of the person's name (John Smith Jr.).

Mr., Mrs., and *Dr.* are dropped if another title is also used (not Dr. John Smith Jr., PhD).

The preferred format avoids using a descriptor unless the company name might not be clear without it, for example, Data Co. However, if it is necessary to use Limited, Incorporated, Corporation, or Company, they are abbreviated to *Ltd.*, *Inc.*, *Corp.*, or *Co.*, respectively, and the abbreviation is not preceded by a comma.

The abbreviations *Nat'l* and *Int'l* (for *national* and *international*) do not take a period.

The standard abbreviations for most of the degrees we encounter in our authors' biographies are *BS*, *MS*, *MSc*, and *PhD*. For additional rules on abbreviating academic degrees, see the entry under *academic degrees* in the alphabetical section.

Centuries use the ordinal symbol, for example, *21st century*.

Also see the *References* section; for a more complete discussion of abbreviations, see *CMS*, Chapter 10.

Acronyms and Abbreviated Terms

A true acronym is formed by using the first letter from two or more separate words, for example, *DEC* for Digital Equipment Corporation. Articles or prepositions falling in between (for example, *and*, *of*, *in*, *the*) are generally not used as part of the acronym. Use all capitals only for true acronyms.

Many acronyms/abbreviated terms used for measurements are traditionally all lowercase, for example, *cpi* (characters per inch) and *dpi* (dots per inch). A few are mixed, such as *kHz* (kilohertz). Capitalization also can differ depending on meaning, for example, *MW* (megawatt) and *mW* (milliwatt). See the alphabetical section when in doubt.

As a general rule, spell out all acronyms on first use, but don't use initial capitals just because the letters form the acronym. There must be another reason for the caps; for example, the words constitute a proper noun. In other words, CAD is computer-aided design, *not* Computer-Aided Design.

Exceptions to the spell-out-on-first-use rule are acronyms so well known to a particular magazine or publication's readers that spelling them out would be insulting. In the alphabetical section, the Style Guide Committee has determined that acronyms marked with an asterisk are so familiar to all our readers that they don't need to be spelled out on first use. Examples include RAM, ROM, and CD-ROM.

Put the acronym in parentheses immediately after the spelled-out term. In long articles with unfamiliar acronyms, it helps to spell out the words occasionally throughout to refresh readers' memories and aid those who browse. If an article includes many unfamiliar acronyms, consider creating a glossary or sidebar.

Use judgment before allowing a short common term to be reduced to an acronym (for example, operating system to OS). Readers have difficulty with articles that read like alphabet soup.

Provided that an acronym isn't visually distracting (use your judgment), capitalize it as the author submitted it, so long as the CS Style Guide doesn't already prescribe a style for it and its formatting agrees with the official version. (For example, the www.flossproject.org provides the project's preferred capitalization: FLOSS.) When deciding whether to revise acronym capitalization, first consider clarity, followed by author preference.

The alphabetical section of the Style Guide includes combinations of words and acronyms, such as MiniDIP, which generally follow both capitalization and acronym rules.

For units of measurement, you don't need to spell out common abbreviations (such as s, min., and ms). For unfamiliar units of measurement, spell them out on first use.

Authors and Affiliations

For the optional magazines, on an article's first page, list the authors in the order in which they appeared on the original accepted paper's first page. (If no names appeared there, use the order of the author bios, if there are any. Otherwise, contact the authors.) If authors listed next to each other share an affiliation, group them together. If authors share an affiliation but aren't listed next to each other, don't group them together. For example, note the first and third lines of this list:

Khairi Reda and Alessandro Febretti, *University of Illinois at Chicago*

Aaron Knoll, *University of Texas at Austin*

Jillian Aurisano, Jason Leigh, and Andrew Johnson, *University of Illinois at Chicago*

Michael E. Papka and Mark Hereld, *Argonne National Laboratory*

The author order on the first page and in the bios should be the same.

Normally, each author should have only one affiliation on the article's first page—usually, the affiliation at which the research occurred. (You can list other affiliations in the bio.) If the affiliation is an institute or organization associated primarily with a university, use just the university name as the affiliation. However, in *IEEE Software*, you can list Software Engineering Institute as the affiliation without listing Carnegie Mellon University.

The author's name on the first page takes the "AUTHOR" tag; the name in the author bio takes the "vita name" tag. The affiliation on the first page takes the "AUTHOR AFFILIATION" tag (a paragraph tag) if it's on a separate line from the author name or the "author affiliation" tag (a character tag) if it's on the same line. The affiliation in the bio takes the "vita affiliation" tag. **The tagged affiliation in the bio should match the tagged affiliation on the first page.** However, after an affiliation first appears in a bio, you can abbreviate subsequent instances of that affiliation (in that or any following bio) to save space. In this case, the abbreviation should appear in parentheses after the first instance of the affiliation.

If an author must have more than one affiliation on the first page or if the tagged text on the first page and in the bio must differ, inform Monette Velasco or Jennie Zhu-Mai before the issue ships.

Best Practices

Here are a variety of guidelines for editing articles conforming to CS style. Some guidelines are specific to particular magazines.

Abstracts

Print abstracts (the short abstracts that appear at the article's beginning) should have a maximum of 50 words for *Computer Graphics and Applications*, 25 words for *Intelligent Systems*, 80 to 100 words for *Internet Computing* (50 words for department articles), 35 words for *Pervasive Computing*, 35 to 40 words for *Security & Privacy*, and 40 words for *Software*.

Article titles

Capitalize both parts of a hyphenated compound unless the first part is a prefix; in that case, capitalize only the prefix.

Figures

For figure callouts, use "(see Figure X)" if the sentence doesn't already mention the figure. The callout normally shouldn't give the page number.

For figure captions, the preferred style is to use a phrase to describe the figure and a sentence (or more) to describe the figure's significance. For example, "Figure 1. Blue marshmallows. The campers mix blue dye with sugar and the mucilaginous root of the marshmallow, thus turning a pink-flowered European perennial herb into a tasty campfire treat."

For abbreviations in captions, spell them out in the first caption in which they appear (with the abbreviation in parentheses immediately following the related term). Later captions can use just the abbreviation.

To acknowledge outside sources of figures, use this style: "(Source: NameOfSource; used with permission.)"

For program code examples that are part of a figure, input the code into the Word file (and tag it properly) if at all possible. Don't send the code to the layout artist for input.

File and folder conventions—optional mags

Here are examples of the optional magazines' file name format, using the May/June *Computer Graphics and Applications* Harel article as an example:

- g3har.org.pdf (original file that the author sent)

- g3har.tag.doc (original tagged but unedited file)

- g3har.dt.doc (1st edit by Dennis Taylor)

- g3har.dt-bb.doc (2nd read by Brian Brannon. This version usually replaces the previous one.)

- g3har.gal.doc (version sent to author)

- g3har.au.doc (version with author corrections)

- g3har.fin.doc (version ready for layout)

Here are the guidelines for naming electronic folders, with examples.

- First theme: a1-Harel

- Second theme: a2-Jones

- Third theme: a3-Smith

- Nontheme: b-Harris

- Column: c-Opinions

- Department: d-Projects

- Track: t-Virtualization

The electronic folder should contain the current version of the article, figures, and author photos (when necessary), and a Versions folder that holds all the other files. When the layout is ready, move the most recent MS Word file to the Versions folder. You don't need to clean out the folders before they're archived.

For the hard-copy folders, you don't need to keep the materials in any specific order (although some kind of order would be nice), and you don't need to remove anything before the folders are archived.

Software uses "Focus" to indicate theme articles and "Feature" to indicate nontheme articles.

Main text

Introductions should be three paragraphs, although a little longer is okay if necessary.

In the optional magazines, use title caps on first- and second-level headings. In *Computer*, first-level headings use all caps, and second-level headings use just an initial cap.

On multiline headings, try to make the lower lines the longer ones.

Don't indent the paragraph immediately following a first- or second-level heading.

When first referring to a group of more than two authors, use this style: "Jane Doe and her colleagues." For two authors, give their first and last names.

When referring to a specific table or figure in the text, use capitalization: Figure 3, Table 2, and so on.

Avoid having a line with a drop cap on the last line of a column.

Use the appropriate punctuation at the end of a display equation.

When referring to a numbered and displayed item in an article, use an initial capital letter (Figure 1, Table 2, Equation 3, Algorithm 4, …). Otherwise, for nouns accompanied by numbers or letters, don't capitalize the noun (level 5, participant B, step 1, and so on) unless it's a proper noun or it's from a specification or standard.

For a quote that starts in the middle of a sentence, use an ellipsis at the beginning and an initial lowercase letter for the first word.

For names of software patterns, use an initial capital letter and no special formatting.

Use a drop cap, not a heading, to start the conclusion.

Sidebars

For sidebar titles, use normal title capitalization.

For titles of related-work sidebars, use "Related Work in …," not "Related Work on …."

Tables

We no longer use the TABLE ROWz tag.

When referring to table columns or rows in the main text, normally use quotation marks and no capital letters ("In the 'total characters' column, …").

URLs

If you have to put a URL in parentheses after an acronym, use a semicolon to separate the two.

Don't use "http://" in URLs that start with www (unless the author is Tim Berners-Lee and he complains).

Biographical Sketches

Except for transactions, the preferred format for biographical sketches can vary depending on the publication. But full articles should generally follow this format:

//**Author Name**// is a //position// at //name of institution or company, with department name if applicable//. //His/Her// research interests include //list three or four topics//. //Last name// received a //highest academic degree [use an abbreviation if possible]// in //name of discipline [use lowercase]// from //name of degree-granting institution//. //He/She// has received //names of awards//. //He/She// is in on the editorial board of //name of publication// and has been //name of volunteer position// at //name of conference//. //He/She// is a member of //list up to three relevant professional organizations [okay to use an acronym or initialism for organizations]//. Contact //him/her// at //email address//.

Note: If there are space issues—for example, an unusually large number of authors—the professional organizations and research interests can be deleted (in that order).

For columns and departments, *Computing in Science and Engineering*, *Internet Computing*, *IT Pro*, and *Security & Privacy* use the same format as for regular articles. *Computer Graphics and Applications*, *Intelligent Systems*, *Pervasive Computing*, and *Software* follow this format:

//**Author Name**// is a //position// at //name of institution or company, with department name if applicable//. Contact //him/her// at //email//.

Transactions biographies follow this format:

//First name/last name// received the //first to latest sequential degrees in respective disciplines and institutions//. He is a //academic title, institution, or business title, company//. His research interests include //list three or four topics//. He has authored //number of papers or the name of relevant texts//. He is a member of //relevant professional organizations//.

For abbreviations in magazine bios, spell them out in each bio in which they appear. If an abbreviation appears more than once in a bio, place it in parentheses after the first instance of the related term and then use just the abbreviation later in the bio.

Capitalization

The Computer Society style is conservative in the use of capital letters. A company's or public relations firm's wishes about capitalization rarely carry any weight.

For company, product, system, and language names, use an initial capital only. Editors should determine whether the term is really a proper noun or merely descriptive or generic.

Internal capitals

For many years, Computer Society style prohibited the use of internal capitals in words, insisting on an initial capital only for product names, system names, and so forth. Words such as MiniDIP and AutoCAD were accepted as combinations of words and acronyms. This strict approach has not been sustainable in the real world. We now permit *one* internal capital when it is the first letter of another word, as in PostScript, MacDraw, or dBase. Only a few exceptions exist, for example, NeXT and LaTeX. If in doubt, see the alphabetical section of this style guide.

Titles

In the titles of articles, books, and so forth, capitalize nouns, pronouns, adjectives, verbs, adverbs, and first and last words. Function words (articles, coordinate conjunctions, and prepositions) are not capitalized, regardless of their length: "Better Health through Psychotherapy," "Keeping the Peace without Creating Conflict." The exception is following a colon—for example, "Along a Different Path: A Case Study." For hyphenated words in titles, see *CMS* 8.159.

In references, use standard capitalization for titles but don't lowercase internal capitals or improper acronyms that appear as part of a product or system name, even if it conflicts with the style guidelines.

Department names

Names of departments, divisions, laboratories, and so forth are capitalized when used *as part of* an organization's proper name: the University of Pennsylvania Department of Computer Science; the university's computer science department; the IBM Almaden Research Center; Hewlett-Packard's advertising department.

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Phone: +1 732 562 3966; Fax: +1 732 981 8062
e-mail: copyrights@ieee.org

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File Extensions and Their Meanings

.arj	relatively uncommon archive file		.pcx	PC Paintbrush graphic
.bak	backup file		.pdf	portable document format file—Adobe Acrobat
.bin	binhex file—Macintosh		.pdr	printer description file—Macintosh
.bmp	bitmap file		.pfb	Adobe printer font—binary
.cca	cc:Mail archive file		.pfm	Adobe printer font—metric
.cdr	Corel Draw data file		.pif	program information file—Windows shortcut file
.cfg	configuration file		.png	portable network graphics—image file format
.cnt	MS Office file		.ppa	PowerPoint presentation file
.com	command file		.ppd	PostScript printer definition file
.cpl	current privilege level file for WWW		.ppt	PowerPoint document
.dat	data file		.prn	MS Word print file—PostScript format
.dbf	database file		.ps	PostScript file
.dir	directory		.psd	Adobe Photoshop native format file
.dll	dynamic link library—Windows file system		.pub	MS Publisher document
.doc	MS Word document		.qxp	QuarkXPress document
.dos	DOS file		.reg	registry file—Windows file systems
.dot	MS Word template		.rtf	rich text format—a form of text formatting
.drv	printer driver file		.rul	cc:Mail rule file
.eps	encapsulated PostScript file		.sam	AmiPro file
.exe	executable file—a program		.smi	system management interrupt—Intel
.fon	font file		.sty	LaTeX style file
.ftg	MS Office file		.swp	Windows swap file
.gid	MS Access file		.sys	DOS/Windows system file
.gif	graphics interchange format—an art file		.tar	tape archive file—Unix-based compressed file
.gz	G-zipped file—Unix-based compressed file		.taz	.tar file that has been .z compressed
.hgx	Harvard Graphics file		.tbl	Adobe table editor file
.hlp	help file		.tex	LaTeX file—a form of text formatting
.hqx	BinHex compressed file		.tif	tagged information format file—an image file
.htm or .html	hypertext file—WWW page file		.tlb	MS Office executable file
.ico	icon file		.tmp	temporary file—Windows applications
.inf	information file		.ttf	TrueType font file
.ini	initialization file—Windows file		.txt	text file, usually plain ASCII
.jpg	JPEG image file		.vbx	Visual Basic file
.kbd	keyboard layout file		.vxd	virtual driver file—Windows
.lan	local area network file—a Novell system file		.wav	wave sound file
.lha	relatively uncommon archive file		.wk1	Lotus 123 spreadsheet file
.lo	QuarkXPress document—Macintosh		.wks	MS Works file
.log	log file		.wmf	Windows metafile—a graphics file
.lst	list file		.wpd	WordPerfect document
.lzh	relatively uncommon archive file		.wpg	WordPerfect graphic
.mim	mime-encoded file		.wq1	Quattro Pro spreadsheet
.mpl	MS Project data file		.wri	MS Write document
.mpg	MPEG image file		.ws2	WordStart 2 document
.msg	message file		.xls	Excel spreadsheet file
.nlm	NetWare Loadable Module—Novell		.xtg	QuarkXPress document—PC
.nls	NetWare License Server—Novell		.z	compressed file from a Unix-based system
.pcd	photo CD file		.zip	compressed file from WinZip
.pct	PICT graphic		.zoo	relatively uncommon archive file

Lists

How to use punctuation in a list depends on whether the introductory phrase is a dependent clause (it is not a complete sentence) or an independent clause (it is a complete sentence).

If the introductory phrase is a dependent clause, there is no colon.
In the past few months, I've been

- dressing more casually;
- finding unusual combinations of styles, colors, and textures; and
- looking for bargains.

If the introductory phrase is an independent clause, there is a colon.
People describe my wardrobe in many ways:

- sporty,
- colorful, and
- distinctive.

Here's what I think:

- My wardrobe is distinctive.
- I can decide what to wear depending on my mood.
- I need some new clothes.

My wardrobe has many distinct characteristics:

- *Unusual*. Most people would not be comfortable making the same choices.
- *Versatile*. I can dress comfortably for a business meeting or casual Friday.
- *Color-coordinated*. I can mix and match garments to achieve a new look.

The following are examples of formatting alternatives for more complicated lists.

The major architectural components include

- a thin client terminal hosting a Web browser—the client terminals periodically send location updates to the network;
- an application server that delivers Web content prioritized according to user preferences—the application server formats the generated information content and adapts it for display on the client terminal; and
- a context and profile manager (CPM) that tracks the user's dynamic context—the CPM also queries Web services and filters Web content data according to user profile context.

The architecture has three major components:

- A thin client terminal hosts a Web browser. The client terminals periodically send location updates to the network.
- An application server delivers Web content prioritized according to user preferences. The application server formats the generated information content and adapts it for display on the client terminal.
- A context and profile manager (CPM) tracks the user's dynamic context. The CPM also queries Web services and filters Web content data according to user profile context.

The architecture has three major components:

- a thin client terminal,
- an application server, and
- a context and profile manager (CPM).

The client terminal hosts a Web browser and periodically sends location updates to the network. The application server delivers Web content prioritized according to user preferences; it formats the generated information content and adapts it for display on the client terminal. The CPM tracks the user's dynamic context and also queries Web services and filters Web content data according to user profile context.

Note: With the exception of running text—where the state name is spelled out—use of the postal abbreviation is preferred (*CMS* 10.28).

Locations

United States

State	Standard abbreviation	Postal abbreviation
Alabama	Ala.	AL
Alaska	Alaska	AK
Arizona	Ariz.	AZ
Arkansas	Ark.	AR
California	Calif.	CA
Colorado	Colo.	CO
Connecticut	Conn.	CT
Delaware	Del.	DE
District of Columbia	D.C.	DC
Florida	Fla.	FL
Georgia	Ga.	GA
Guam	Guam	GU
Hawaii	Hawaii	HI
Idaho	Idaho	ID
Illinois	Ill.	IL
Indiana	Ind.	IN
Iowa	Iowa	IA
Kansas	Kan.	KS
Kentucky	Ky.	KY
Louisiana	La.	LA
Maine	Maine	ME
Maryland	Md.	MD
Massachusetts	Mass.	MA
Michigan	Mich.	MI
Minnesota	Minn.	MN
Mississippi	Miss.	MS
Missouri	Mo.	MO
Montana	Mont.	MT
Nebraska	Neb.	NE
Nevada	Nev.	NV
New Hampshire	N.H.	NH
New Jersey	N.J.	NJ
New Mexico	N.M.	NM
New York	N.Y.	NY

North Carolina	N.C.	NC
North Dakota	N.D.	ND
Ohio	Ohio	OH
Oklahoma	Okla.	OK
Oregon	Ore.	OR
Pennsylvania	Pa.	PA
Puerto Rico	Puerto Rico	PR
Rhode Island	R.I.	RI
South Carolina	S.C.	SC
South Dakota	S.D.	SD
Tennessee	Tenn.	TN
Texas	Texas	TX
Trust Territories of the Pacific	Trust Territories	TT
Utah	Utah	UT
Vermont	Vt.	VT
Virginia	Va.	VA
Virgin Islands	Virgin Islands	VI
Washington	Wash.	WA
West Virginia	W.Va.	WV
Wisconsin	Wis.	WI
Wyoming	Wyo.	WY

Note: States names with five letters or fewer are never abbreviated. The names of states and territories outside the 48 contiguous US states are abbreviated only when used with a postal code.

Postal code placement: ZIP (Zone Improvement Program) codes follow the state code and are separated by a space: Los Alamitos, CA 90720. The Postal Service has expanded the original five-digit code to nine digits, known as ZIP+4. The added digits follow a hyphen appended to the original code: Los Alamitos, CA 90720-1314.

Canada

Province	Standard abbreviation	Postal abbreviation
Alberta	Alta.	AB
British Columbia	B.C.	BC
Manitoba	Man.	MB
New Brunswick	N.B.	NB
Newfoundland and Labrador	N.L.	NL
Northwest Territories	N.W.T.	NT
Nova Scotia	N.S.	NS
Nunavut		NU
Ontario	Ont.	ON
Prince Edward Island	P.E.I.	PE
Quebec	Que.	QC
Saskatchewan	Sask.	SK
Yukon Territory	Yukon	YT

Note: Quebec used to be abbreviated P.Q. for Province du Québec, but this is now obsolete. Francophones in Québec often use the postal abbreviation Qc.

Postal code placement: Canada's postal code system is similar to the US ZIP code system. Postal codes are placed after the province code. The six-character codes are broken into two groups of three characters separated by a space. The format is letter, number, letter, space, number, letter, number—for example, Kingston, ON K1A 0S2.

United Kingdom

UK postal codes are placed after the country (England, Scotland, Northern Ireland, and Wales) and are separated by a space. Add the nation (UK) after the postal code. The six-character codes are usually broken into two groups of three characters separated by a space. The usual format is letter, letter, number, space, number, letter, letter—for example, Stirling, Scotland FK9 4LA, UK. However, some cities use variations on this format.

Europe

Postal codes are placed before the city name: D-4054 Nettetal, Germany. The number of digits varies among countries. The European postal union includes country prefixes with the postal codes. These prefixes, which are separated from the postal code by a hyphen, include

B	Belgium	I	Italy
CH	Switzerland	N	Norway
D	Germany	NL	Netherlands
DK	Denmark	S	Sweden
E	Spain	UK	United Kingdom
F	France		

Include the state for all US cities except the following: Atlanta, Baltimore, Boston, Chicago, Dallas, Denver, Detroit, Honolulu, Indianapolis, Los Angeles, Miami, Minneapolis, New Orleans, New York, Philadelphia, Phoenix, Pittsburgh, St. Louis, Salt Lake City, San Diego, San Francisco, and Seattle.

Do not list state name or province for cities outside the US and Canada. For most cities located outside the US, list the nation after the city. However, do not include the nation for the following locations:

Amsterdam	Jerusalem	Taiwan
Athens	Rome	Munich
Bangkok	Kyoto	Tokyo
Barcelona	Seoul	Oslo
Beijing	London	Toronto
Berlin	Shanghai	Ottawa
Brussels	Madrid	Vienna
Budapest	Singapore	Paris
Cairo	Melbourne	Warsaw
Copenhagen	Stockholm	Prague
Edinburgh	Mexico City	Zurich
Geneva	Sydney	Reykjavik
Helsinki	Montreal	Rio de Janeiro
Hong Kong	Taipei	
Istanbul	Moscow	

Mathematical Expressions

Most style manuals do not cover mathematical style well. *CMS* has some good suggestions in Chapter 12, but is insufficient. Another reference source is N.J. Higham, *The Handbook of Writing for the Mathematical Sciences*, Society for Industrial and Applied Mathematics, 1998. Although this book is largely about how to *write* mathematics clearly, it also has some suggestions about math typography and other stylistic matters.

Miscellaneous math style issues

If authors use punctuation after mathematical expressions, including displayed equations, leave it in (or revise as necessary).

- Include a space on either side of multiplication signs, equals signs, and other operators when they are at full size, for example, 100×100 matrix, and $a + b = c$. MathType automatically inserts thin spaces around these symbols. In subscripts and superscripts, omit these thin spaces unless the formula becomes confusing without them. Also, when $<$ or $>$ precedes a number in text (that isn't a formula), there should be no space after the symbol.
- If line breaks are needed in equations that appear in a paragraph, they should come after a plus sign, equals sign, or similar character.
- Characters with overbars must be set in MathType. If an article has many symbols with overbars or other symbols that make typesetting difficult, consider asking the author if there is an easier alternative.
- Equation numbers are put in parentheses to the right of displayed formulas. They should not be boldface. Generally speaking, only formulas called out in the text need to be numbered.
- Use italic type for lowercase Greek variables; do not use italic type for uppercase Greek variables.
- Variables that denote vectors are set boldface, not italic. Do not use the small arrows above the variable to denote vectors.
- Set the label that denotes a matrix in italic, for example, A.
- If the vectors are simply mathematical and do not represent physical quantities and direction (that is, they do not need to be clearly differentiated from scalars), boldfacing is less important, and you can use lightface italic type if the author has styled them that way.

If the author consistently uses another scheme, consider going along with it.

Equation formatting guidelines

Display equations can be broken down a number of ways to fit within a column. First, note that each line of an equation must be aligned to either a relation symbol or a binary operator in the first line of the equation (if one exists). These symbols work in a hierarchy: Relation symbols are aligned with other relation symbols, binary operators are aligned with other binary operators, and binary operators are indented from relation symbols. For example:

$$l(s,w) = \sum_{h}^{x} s(x,y)\log(\tau_1) - N_t\theta_t$$

$$p(w_1,z_1) = p(w_1,v_1) + p(v_1,z_1)$$
$$= p(w_2,v_2) + p(v_2,z_2)$$
$$= p(w_2,z_2)$$

$$-\sum_{h}^{w} \log(s(x,y)!)$$

$$+\sum_{h}^{v} s(x,y)\log(\theta_b) - N_b\theta_b$$

$$-\tau_1(x,y)\log(\phi_1)$$

$$\phi^{(3)}(s) + r(s),$$

$$\phi^{(4)}(s) + \Delta r(s) = \frac{dr(s)}{ds},$$

$$\phi^{(5)}(s) + \Delta^2 r(s) = \frac{d^2 r(s)}{ds^2}$$

If there is only one relation symbol or binary operator in an equation, break the equation after the relation symbol or binary operator and indent the second line slightly:

$$\frac{d\lambda^{(\alpha)}}{dt} =$$

$$E_{p(\Gamma;\Pi,\Lambda,\Phi)}\left[H^{(\alpha,1)}\left(\Gamma^{(2)}\right)\right]\frac{\mu_{obs}^{(\alpha)}\mu_{syn}^{(\alpha)}K(B-A)\,p(\Gamma_B;\Phi,\Lambda)}{K(A-B)\,p(\Gamma_A;\Phi,\Lambda)}$$

If there is room, align the equation like this:

$$[x_{l+1}] \le [M_{n+1}] + d_n z(2+x-y)$$
$$+(m-2)(k-3)$$

If a display equation can't be centered, the first line can be made flush left to the column to allow more room for the following lines of the equation to fit. If an equation number won't fit to the right of an equation, it is acceptable to have the equation number fall one line below the equation and to keep it right-justified to the column.

Math guidelines

When should you italicize, when should you use bold, and when should you do neither? If you edit Computer Society articles, you need to have a good handle on the answers to these questions. The detailed answers below are meant to help you see the logic behind these answers, so that you will be able to consistently make the right decisions when confronted with a math-heavy article.

Constants

A *constant* is a letter that represents one distinct value that never changes, no matter what. Don't italicize constants. For example, the letter k is often used to represent Boltzmann's constant, which is always equal to 1.380622×10^{-23} Joules/Kelvin. We use the letter k to avoid having to write out this long number in our equations, but it's not a variable, because its value can never change; it remains constant. In most cases, the author will identify the letter as a constant. If he or she doesn't, you can probably assume it's not a constant. The only exception I can think of is the speed of light (2.997925×10^8 m/s), a constant typically represented by the letter c. Authors probably wouldn't explicitly refer to it as "a constant," but it is, and you should not italicize it. By the way, this is the same c that appears in Einstein's most famous equation, $E = mc^2$. Written properly, the E (energy) and m (mass) should be italicized (because they're variables), but the c (the speed of light) should not be italicized.

Variables

A *variable*, unlike a constant, is a letter that can represent more than one possible value. Italicize all such letters (except uppercase Greek). For example, we could represent time by the letter t, a variable. Time can be 3, 4, 5, … seconds. Time is a variable. Even when we are referring to one instance (for example, $t = 4$), or even if the author says something like "we are keeping the time constant," we should still italicize t because it is *possible* in another situation that t would not be kept constant at 4 ms or whatever. Time is not a constant that is universally always equal to 4. The speed of light, on the other hand, never changes, no matter what. Boltzmann's constant never changes either. That is, it is *impossible* for a constant to be anything except the value it equals. If you can't make this statement, then you're not looking at a constant.

Matrices

Matrices represent an array of numbers (columns and rows), like the desks in a classroom. Make them italic. In addition, the individual elements should be italic (not bold), because they are actually variables. For example, imagine you are in classroom A, a matrix. The person in the 1st row, 1st column is element a_{11}. Second row, first column is element a_{21}. *If you sit in the 2nd row from the front, 3rd column from the left*, you are element a_{23}. Note that rows go across the classroom (side to side), while columns go from front to back (even though, for some reason, in school people call "rows" what are actually columns). Now, the person behind you (3rd row, 3rd column) is element a_{33}. The person to your right (second row, fourth column) is element a_{24}, and so on.

Vectors

Vectors are, in a way, special variables that also have a direction associated with them. However, do not italicize vectors. Instead, make vectors bold—for example, the vector **v**. We typically represent vectors by lowercase letters, whereas we represent matrices by uppercase letters. However, we often represent the elements in a matrix by lowercase letters (but I think I've seen capital letters used for matrix elements as well).

Units

Units are letters that actually stand for words, not numbers. Do not italicize them. For example, when s means second, we should not italicize it. The same goes for Greek letters. We italicize lowercase Greek variables, but we do not italicize lowercase Greek units, such as the µ in µs (meaning microseconds).

Acronyms disguised as variables

Beware of *acronyms disguised as variables*! Don't italicize them. Innocent editors can fall prey to mistakenly italicizing a subscript or superscript that looks like a variable but actually isn't. For example, in V_{DD}, the letter V is a variable and should be italicized, but DD are neither variables nor constants. They are more akin to acronyms. They don't stand for numbers; they stand for words. That's the test. ***If you can't put a number in for a letter, then don't italicize it, because it's not a variable.*** In this case, the DD tells us that this is the drain voltage in a transistor. Now, let's consider V_T. This T probably refers to "temperature," and so is not a variable. You'll have to look at the context surrounding it. However, usually these subscripts are not variables. A common exception is *n* or *i* (or even *t*), when indicating a series of numbers such as V_1, V_2, …, V_n. In this case, a number can indeed be inserted in place of *n*, so we should italicize it. Another example of an acronym in disguise, but one that is not a subscript, is in the following sentence from an article I edited by Sachdev: "The NMOS transistor's source (n+), bulk (p–), and drain (n+) terminals form an npn bipolar transistor." In this case, the n and p are neither variables nor constants. They are, once again, more akin to acronyms but typically appear in lowercase. You cannot substitute a number for either of these.

Control-flow diagrams

Letters in *control-flow diagrams* represent steps, not numbers. Don't italicize them. Once again, a variable is a letter that represents a number. If you can't substitute a number for a letter, then that letter is not a variable and thus should not be italicized. For an example of a control-flow diagram, see Figures 1 and 2 in "Intra-Task Voltage Scheduling for Low-Energy, Hard, Real-Time Applications" (Dongkun Shin, Jihong Kim, and Seongsoo Lee, *IEEE Design & Test*, Mar.-Apr. 2001, pp. 20-21).

Coding math

Always code math from your keyboard or the insert/symbol/Symbol font menu rather than from other menus (such as normal type, Euclid Math, and so on). Hard-coding the symbols using the numeric keypad is also acceptable (for example, you can use Alt 0150 to insert a minus sign); but don't forget to turn NumLock on.

When to use or not use MathType

The general rule of thumb is to resist using MathType. MathType is difficult to set when it is inline—embedded in the text—because the artist must make a small picture box sit inline with the text. Stand-alone display—when a MathType equation sits on a line of its own—also takes more processing by the production artist.

Unavoidable MathType

A few situations always require the use of MathType. If you really think you need to use Math Type but the situation isn't listed here, you might consider getting a second opinion from someone familiar with math.

Stacked equations. In these equations, one string of mathematical operations sits above another:

$$\frac{T_0}{P_\mathrm{w} - P_\mathrm{s}}$$

Always consider whether these can be converted to a single line (using a slash to represent the fraction bar instead of a horizontal line).

Equations that use the square root symbol. An example is $T_\mathrm{be} = \sqrt{T_x}$. Try instead (if the author doesn't object) raising the number to the 1/2 power ($T_\mathrm{be} = T_x^{1/2}$), which is the same as taking the square root.

Characters with overbars. If possible, consider whether the author can make some substitution. Some production artists actually throws out our carefully coded Math Type overbar characters and draw a bar over the letter in Quark. But you still may need to code MathType for SGML.

An exponent of an exponent. An example of this would be $e^{n^{1/3}}$. Unfortunately, there's not much we can do to change this one.

A superscript of a superscript a^{n^x} **or a subscript of a subscript:** a_{t_4} For the latter case, consider asking the author to use, for example, a_{t4}, which can be coded without MathType. For the former (a super of a sub), use MathType.

Common ways to avoid MathType

A character that has both a superscript and a subscript—for example, $G_P{}^A$—does not require MathType. Simply code the *p* as a subscript and code the *A* as a superscript.

Change a stacked equation, such as

$$T_\mathrm{be} = \frac{T_0}{P_\mathrm{w} - P_\mathrm{s}}$$

into a single-line equation: $T_\mathrm{be} = T_0/(P_\mathrm{w} - P_\mathrm{s})$. Note the necessary use of parentheses in this case.

Non-English Words and Phrases

The IEEE Computer Society is a worldwide organization, but its publications are produced in the United States in English. The way Society publications deal with non-English terms and phrases depends on several factors, namely

- the true "foreignness" of the expression—many non-English expressions have entered mainstream English,

- the availability of appropriate accented fonts,

- the staff's familiarity with languages other than English, and

- the extent of the non-English readership of the publication(s) and the degree to which the Society desires to appeal to that audience.

Here are some guidelines for using non-English terms:

- Use accents in anglicized foreign terms when they affect pronunciation or when they will prevent confusion between English words that are spelled the same.

- Italicize terms not commonly accepted in English, but generally use such terms in text only when there is no suitable English equivalent. The way to determine whether a term is commonly accepted in English is to see whether it is in the main body of Webster's dictionary—if it is, don't italicize.

- Transliterate non-Roman languages into the Roman alphabet. Use the transliterated phrase, an English translation, or both.

- For non-English institutional names, use the original name for spellings using the Roman alphabet, providing a translation if the reader might not understand. This approach works well with organizations whose acronyms are well known, such as CCITT (Comité Consultatif International de Télégraphique et Téléphonique), because using a translation (International Consultative Committee for Telegraphy and Telephony) followed by the acronym could confuse some readers. This same guideline applies to university names in bylines and references. In some cases, the non-English acronym is well known and always associated with the English translation. An example is the European Center for Nuclear Research, which is widely known by its French acronym, CERN.

- For non-English references, provide the original title first, but follow it with the English translation in brackets so that English-only readers can understand it. Follow English capitalization rules in the translated title. If you don't have a translation or can't translate the title, query the author of the article (who presumably has read the work and can translate the title). If the author cannot provide a translation, propose deleting the reference.

- For author names, always follow the author's preference. However, if the accents required are not readily available in the Society font list, ask the author for English equivalents.

Numbers and Symbols

Dates

The *IEEE Policies and Procedures* (Jan. 2000) specify the following formats for dates:

- **E-mail and formal correspondence:** day, month, year—for example, *6 January 2004*.
- **Software applications:** four-digit year, two-digit month, two-digit day—for example, *2004-01-06*.
- **Centuries:** Use the symbol for ordinal numbers—for example, *20th century*. Note: *CMS* spells out the century—for example, *twentieth century.*
- **Decades:** The abbreviation is '90s, not '90s. Transactions use the four-digit format: 1990s.

Numerals

Spell out integers *one* through *nine* and use numerals for *10* on, except in the following cases:

As a general rule, numerals should be used even for *one* through *nine* when the integer is coupled with a symbol or unit of measurement (2°, 3 V). By the same token, numerals should be used with percentages even for one through nine (a 5 percent drop; 3 percent responded; 3 to 6 percent). However, in nontechnical passages, numbers less than 10 used with common units, especially time units, may look better spelled out, as do numbers used with approximate measurements:

>   *the program ran in 8 minutes* [exact measurement]

but   *a report from eight years ago said* [nontechnical]

>   *he lives eight miles down the road* [nontechnical]

>   *about eight or nine centimeters* [approximate]

Spell out a number at the beginning of a sentence or recast the sentence.

In general, for units of measure, spell out on first use and abbreviate thereafter.

When a sentence includes both an integer less than nine and an integer greater than nine to describe something in the same category, use numerals for consistency—for example, *The network can have 4, 8, or 16 nodes*.

A compound adjective consisting of a number and an abbreviation is hyphenated. For example, 24-Kbyte memory.

Numbers with four digits or more have commas: 1,000, 10,000. Exceptions include page numbers and dates (*CMS* 9.55). Precede decimal fractions with values of less than one with a zero to prevent the reader from overlooking the period: 0.1 (however, observe the exceptions listed in *CMS* 3.70 and 9.19). And remember, they're singular: 0.1 inch, not 0.1 inches.

Use an *s* to create plurals of numerals:

- the early 1920s

- in twos, threes, and zeros

- he had a collection of 386s and 486s

Fonts and computers are inconsistent in the treatment and availability of fraction symbols. For in-text fractions, therefore, full-size numerals with a slash are usually preferred: 1/2, not ½. In more complicated mathematical expressions set in MathType, built-up fractions are generally used: numerator over denominator, separated by a horizontal line. In mixed numerals, put a hyphen between the integer and the fraction:

- 8-1/2 inches wide

- 24-5/8-mile track

For further reference see *CMS* Chapter 9, especially the parts on scientific and technical usage.

Symbols and signs

Use symbols in text only when you are certain that readers are familiar with them.

Multiplication symbol: Use the multiplication sign "×" instead of "by" when numerals refer to dimensions: 3 × 5 cm box; 3 in. × 5 ft. board.

Spacing of characters for units of measurement and symbols: Abbreviations for units of measurement, even if one letter, are separated from the numeral by a space (3 V, 5 m, 14 mm). Actual symbols, as opposed to abbreviations for units, can be closed up, for example, 42°30′ for 42 degrees, 30 minutes latitude.

Use *sq. ft.*, not "ft^2."

Do not use abbreviations when the reference is indefinite or casual—say "several gigahertz" not "several GHz." However, where brevity is a key factor—for example, in new product write-ups and tables—use symbols liberally.

When defining variables in run-in text, use "is" rather than "="; for example, "where *t* is the temperature," not "where *t* = the temperature."

Use the word "percent" in text; use the % symbol only in figures and tables.

Telephone and fax numbers

The IEEE Policies and Procedures specify the following format for phone and fax numbers:

> In North America: +1 area code xxx xxxx; for example, +1 714 821 8380

> Outside North America: +country code city code xxx xxxx; for example, in Belgium, +32 3 770 2242

Program Code

Most Computer Society publications use a special font called "Program" to set program code—a sequence of coded instructions—whether in text or broken out. (The Transactions Department uses the Courier font for program code.) This monospace type allows consistent vertical alignment of characters. It also makes program code stand out from text (saying "this is not real English, so you're not supposed to understand it as natural language"), and it is easily recognizable as program code by most of our readers.

In text, set program code in a standard column width, using an indent to further set it off from narrative text. The width of the indent should be specified in your publication's style. The justification should always be ragged right.

If the lines of code are longer than a column width, box the code and put it across two or more columns. Magazines with 13-pica columns (three columns per page) often require boxed code. Code presented in this manner should be identified as a figure, and numbered as such, with a caption.

If a program line doesn't fit on a single printed line, break and indent it to indicate the continuation. Never add extra punctuation. Authors will often request continuation lines to be right-justified or will otherwise express strong preferences on this issue.

In general, try to duplicate the spacing, indentation, punctuation, and capitalization in the author's manuscript. Programming languages do not normally recognize boldface or italics, but these may be used by the author simply for emphasis.

Spacing is very important because omitting a space will often prevent a computer from recognizing a command or variable.

Indentations often indicate subsets of the program; although they are not necessary to the computer, indentations make a program easier to understand.

Punctuation

- Do not substitute two single typesetting quotation marks (' ') or normal double typesetting quotation marks (" ") for typewriter quotation marks (").

- Do not substitute a hyphen (-) for a minus sign (−).

- Do not substitute a raised asterisk (*) for a multiplication asterisk (∗).

- Do not substitute an em dash (—) for two hyphens (--), which is a comment symbol in some languages.

Capitalization

Words or letters in programming languages generally represent commands (tokens) or variables. In Fortran and Basic, the general convention is to capitalize commands (such as IF, PRINT, FORMAT, GOTO) and variables (often I, N, X(N)). In C, Algol, and PostScript, these words and letters are lowercase.

Tokens in text

Set program commands or tokens in Program font type to distinguish them in text. Resist using boldface, italics, underlines, or super- and subscripting. If the language is case-sensitive (where a compiler does not see "do," "Do," "dO," and "DO" as equivalent), follow the language's rules. Most popular languages are not case-sensitive.

Case-insensitive

Ada, Algol, Anna, APL, assembly, Basic, Clu, Cobol, Fortran, job-control languages, Lisp (including Common Lisp), Logo, MS-DOS and other operating-system-level command interpreters (micro and mainframe), Occam, Pascal, PL/I, Prolog, SISAL, Snobol, and SQL.

Case-sensitive

ABC, C, C++, Eiffel, Interlisp, Loops (including the Common Loops and Concurrent Loops dialects), Modula-2, Prolog, and Smalltalk. Most case-sensitive languages are object oriented, although some are not (ABC, for example, is not object oriented). Some newer dialects of these languages may *not* be case-sensitive; check with the author.

Punctuation

In general, punctuation is such a complex topic that referring to the appropriate sections in *CMS* is the preferred option. However, here we present some specific guidelines.

Colons

When a colon introduces text within a sentence, the following word starts with a lowercase letter. Otherwise, the following word has an initial cap.

Ellipses

Because the correct use of an ellipsis is sometimes mysterious, the following guidelines are provided:

- For omissions within a sentence when using Word, insert a space, the ellipsis symbol (Insert/Symbol/Symbol), and a space.

- For omissions between sentences, use closing punctuation before an ellipsis if the preceding sentence is grammatically complete. If the preceding sentence is not grammatically complete, do not use closing punctuation. Place a space directly before and after the ellipsis.

For more complete information about using an ellipsis, see *CMS* 13.48–13.56.

Em dashes

In *Internet Computing*, place a space before and after an em dash, owing to font issues.

En dashes

Use en dashes for page ranges and other cases where the *CMS* calls for them; see *CMS* 6.78–681.

Quotation marks

Use double quotation marks for quoted text inside block quotations, decks, headings, and interviews. Don't put quotation marks around the entire quotation, deck, and so on.

Slashes (virgules)

Use your judgment regarding the use of slashes. Normally, there should be no space on either side of the slash. For an exception, see *CMS* 6.104.

References

This special section consists of two subsections: sample formats and general style. The first presents examples of most of the reference types that arise in Computer Society publications. The second delineates the policies and style principles underlying the formats. For Transactions, see "Transactions Department References" (compiled November 2011).

To save time, ask the authors for any missing reference information. If they don't provide it, then search for it if possible.

Sample formats

Article in a collection

A.J. Albrecht, "Measuring Application-Development Productivity," *Programmer Productivity Issues for the Eighties,* 2nd ed., C. Jones, ed., IEEE CS, 1981, pp. 34–43.

Article in a conference proceedings

In general, delete prepositions in conference titles where the meaning is clear without them (see the *Abbreviations* section). Use the ordinal symbol (2nd, 14th, 23rd) for annual conferences. If available, include the conference initialism in parentheses—for example, (ICDE 98)—following the abbreviated name of the conference. Include the sponsor's name if it's part of the official proceedings title. The publisher's name is unnecessary. Use the page numbers, article number, or DOI.

H. Yuan et al., "Sparse Representation Using Contextual Information for Hyperspectral Image Classification," *Proc. 2013 IEEE Conf. Cybernetics* (CYBCONF 13)*,* 2013, pp. 138–143.

N. Zhong, "Toward Web Intelligence," *Advances in Web Intelligence: 1st Int'l Atlantic Web Intelligence Conf.* (AWIC 03), LNCS 2663, 2003, pp. 1–14.

Article in a journal or magazine

Use lowercase for vol. and no. The default is to use the volume and issue number, but for popular publications, you can use the publication date instead. Page numbers through 9999 do not require a comma.

I.E. Sutherland, R.F. Sproull, and R.A. Schumaker, "A Characterization of Ten Hidden-Surface Algorithms," *ACM Computing Surveys,* vol. 6, no. 1, 1974, pp. 1–55.

Blog

To cite the blog itself:

The Official Google Blog, Google; http://googleblog.blogspot.com. (Google is listed as the publisher here.)

M. Watson, *Artificial Intelligence Blog*; http://markwatson.com/aiblog.

Artificial Intelligence and Robots, blog; http://smart-machines.blogspot.com. (no named author or publisher)

Entries in a blog:

M. Sahami, "About the Google Education Summit," blog, 26 Oct. 2007; http://googleblog.blogspot.com/2007/10/about-google-education-summit.html.

M. Watson, "Using the PowerLoom Reasoning System with JRuby," blog, 2 Oct. 2007; http://markwatson.com/aiblog.

"Reinforcement Learning Is Cool," blog; 24 Oct. 2007; http://smart-machines.blogspot.com/2007/10/reinforcement-learning-is-cool.html. (no named author)

Book

W.M. Newman and R.F. Sproull, *Principles of Interactive Computer Graphics,* McGraw-Hill, 1979, p. 402.

M.A. Arbib, ed., *The Handbook of Brain Theory and Neural Networks*, MIT Press, 1998.

Book series

Y. Yao et al., "Web Intelligence (WI): Research Challenges and Trends in the New Information Age," *Web Intelligence: Research and Development,* LNAI 2198, N. Zhong et al., eds., Springer, 2001, pp. 1-17.

R. Focardi and R. Gorrieri, eds., *Foundations of Security Analysis and Design*, LNCS 2171, Springer, 2001.

Note: According to *CMS* 14.128, if the book can be located without it, the series title can be omitted to save space.

CD-ROM

Place the term "CD-ROM" following the publication's title and preceding the publisher's name. Note: Some CD-ROMs will have page numbers.

The format for a book that is available on CD-ROM is:

W.M. Newman and R.F. Sproull, *Principles of Interactive Computer Graphics*, CD-ROM, McGraw-Hill, 1979.

When a proceedings is published on CD-ROM, follow the accepted format for a proceedings, but add CD-ROM:

William Song, "A Semantic Approach to Internal Structure Formation in the Semantic Grid," *Proc. Third Int'l Conf. Semantics, Knowledge, and Grid* (SKG 2007), CD-ROM, IEEE CS, 2007, pp. 248-253.

Dissertation or thesis

B. Fagin, "A Parallel Execution Model for Prolog," PhD dissertation, Dept. Computer Sciences, Univ. of California, Berkeley, 1987.

M. Nichols, *"*The Graphical Kernel System in Prolog*,"* master's thesis, Dept. Computer Science and Eng., Rensselaer Polytechnic Inst., 1985.

Electronic publication

DOIs

Note: If the volume/issue number, date, and page numbers are available, it is not necessary to include the DOI.

Article in a journal

D. Kornack and P. Rakic, "Cell Proliferation without Neurogenesis in Adult Primate Neocortex," *Science*; doi:10.1126/science.1065467.

Article in a conference proceedings

H. Goto, Y. Hasegawa, and M. Tanaka, "Efficient Scheduling Focusing on the Duality of MPL Representation," *Proc. IEEE Symp. Computational Intelligence in Scheduling* (SCIS 07), IEEE, 2007; doi:10.1109/SCIS.2007.367670.

Online-only publication

F. Kaplan, "From Baghdad to Manila: Another Lousy Analogy for the Occupation of Iraq," *Slate*, 21 Oct. 2003; http://slate.msn.com/id/2090114.

Website

R. Bartle, "Early MUD History," Nov. 1990; www.ludd.luth.se/aber/mud-history.html.

URL formatting and punctuation

Verify URLs by copying and pasting them into your browser. Some addresses don't start with http://—other protocols are also legitimate, for example, ftp:—and some addresses don't need or even won't work with www. Omit the http:// if the URL starts with www.

Be sure to include all punctuation exactly as supplied (hyphens and tildes, in particular, are very common in Web addresses).

If a URL must run across more than one line, follow these guidelines:
- Break after a colon or double slash. Do not split the double slash.
- Break before a slash, a tilde, a period, a comma, a hyphen, an underline, a question mark, a number sign, or a percent symbol.
- Break before or after an equals sign or an ampersand.
- Do not introduce hyphens to break words (be very careful about this as Word might try to hyphenate automatically).
- Separating the extension (for example, the html at the end) is discouraged.

Some URL examples using www.web-pac.com/mall/pacific/start.html:

Acceptable:

www.web-pac.com/mall/pacific/start.html

www.web-pac
.com/mall/pacific/start.html

www.web
-pac.com/mall/pacific/start.html

www.web-pac.com/mall
/pacific/start.html

www.web-pac.com/mall/pacific/start
.html

Not acceptable:

www.web-
pac.com/mall/pacific/start.html

www.web-pac.com/mall/paci-
fic/start.html

www.web-pac.com/mall/pacific/start.
html

Legal citations

Note: In text, italicize the names of court cases.

US Supreme Court decisions

- Olmstead v. United States*, US Reports*, vol. 277, 1928, p. 438.
- Olmstead v. United States*, US Reports*, vol. 277, 1928, p. 478 (Justice Brandeis, dissenting).

Lower-court decisions

- US v. Councilman*, Federal Supplement,* 2nd Series, vol. 245, 2003 p. 321 (US District Court for the District of Mass.).
- US v. Councilman*, Federal Reporter,* 3rd Series*,* vol. 373, 2004, p. 204 (US Court of Appeals for the First Circuit).

US laws

- US Code, Title 18, section 3123(a)(1),(2), 2000 and 2002 Supplement.
- Uniting and Strengthening America by Providing Appropriate Tools to Intercept and Obstruct Terrorism, Public Law No. 107-56, section 209, *US Statutes at Large*, vol. 115, 2001, p. 285.

- Omnibus Crime Control and Safe Streets Act of 1968, Public Law No. 90-351, sections 801-804, *US Statutes at Large*, vol. 82, pp. 211-223 (codified as amended in *US Code*, Title 18, sections 2510-2522, 2000 and 2002 Supplement).

Newsletter

J. Butler, "CASE Outlook," *System Development Newsletter,* Applied Computer Research, Phoenix, Ariz., Nov. 1987, p. 3.

Non-English source

Including original title

A.N. Zhirabok and A.E. Shumskii, *Electronnoe Modelirovanie* [Electronic Modeling], Energoatomizdat, Leningrad, 1984 (in Russian).

Original title unprintable

T. Nakayama et al., "NEC Corporation Develops 32-Bit RISC Microprocessor," *Nikkei Electronics,* vol. 6, no. 12, 1995, pp. 111-121 (in Japanese).

Patent

With information about patentee

M. Hoff, S. Mazor, and F. Faggin, *Memory System for Multi-Chip Digital Computer,* US patent 3,821,715, to Intel Corp., Patent and Trademark Office, 1974.

Without patentee information

Digital-to-Analog Converting Unit with Improved Linearity, US patent 5,162,800, Patent and Trademark Office, 1992.

Pending publication

For an article or paper, include the name of the publication and date if known:

R. Lee, "New-Media Processing," to be published in *IEEE Micro,* Nov./Dec. 2012.

For a book, include the publisher and year of publication:

R. Lee, *Writing New Programs*, McMillan, to be published in 2012.

Personal communication and unpublished materials

These are usually not referenced because they are not available to the reader. Authors who insist on attributing material obtained through personal communication should identify the source of the information in the main text (for example, *As Maria Youngblood stated during a conference panel, ...*).

Preprint

J.M.P. Martinez et al., "Integrating Data Warehouses with Web Data: A Survey," *IEEE Trans. Knowledge and Data Eng.*, preprint, 21 Dec. 2007, doi:10.1109/TKDE.2007.190746.

Special issue

Computing in Science & Eng., special issue on computing in optics, Nov./Dec. 2003; http://csdl.computer.org/comp/mags/cs/2003/06/c6toc.htm.

Standard

Recommendation ITU-R BT.601, Encoding Parameters of Digital Television for Studios, Int'l Telecommunication Union, 1992.

IEEE Std. 1596-1992, Scalable Coherent Interface (SCI)*, IEEE, 1992.

IETF working draft

L. Martini et al., "Transport of Layer 2 Frames over MPLS," IETF Internet draft, work in progress, Feb. 2001.

Note: Per IETF guidelines, references to working drafts should not include URLs because they expire after six months; use "work in progress" instead.

Industry specification

C. Evans et al., *Web Services Reliability (WS-Reliability),* v. 1.0, joint specification by Fujitsu, NEC, Oracle, Sonic Software, and Sun Microsystems, Jan. 2003; www.developers.sun.com/sw/platform/technologies/ws-reliability.html.

MPEG specification

MPEG-21 Overview, ISO/MPEG N5231, MPEG Requirements Group, Oct. 2002.

RFC

C. Perkins and E. Guttman, *DHCP Options for Service Location Protocol*, IETF RFC 2610, June 1999; www.rfc-editor.org/rfc/rfc2610.txt.

W3C note

D. Box et al., *Simple Object Access Protocol (SOAP) 1.1*, World Wide Web Consortium (W3C) note, May 2000; www.w3.org/TR/SOAP.

W3C recommendation

N. Mitra, *SOAP v.1.2, Part 0: Primer*, World Wide Web Consortium (W3C) recommendation, June 2003; www.w3.org/TR/soap12-part0.

Supplemental material

K. Xu et al., "Spherical Piecewise Constant Basis Functions for All-Frequency Precomputed Radiance Transfer*," IEEE Trans. Visualization and Computer Graphics*, vol. 14, no. 2, 2008, pp. 454–467, supplemental material; http://csdl.computer.org/comp/trans/tg/2008/02/ttg2008020454s .avi.

Technical memo, technical report, technical or user manual

Include the department name for technical memos, technical reports, and other material that may not be indexed in a company-wide or university-wide library or by an abstracting service.

Technical memo

"Requirements for Software-Engineering Databases," tech. memo, Imperial Software Technology, London, 1983.

Technical report with report number

C. Hoffman and J. Hopcroft, *Quadratic Blending Surfaces,* tech. report TR-85-674, Computer Science Dept., Cornell Univ., 1985.

Technical report without report number

E. Yarwood, *Toward Program Illustration,* tech. report, Computer Systems Research Group, Univ. of Toronto, 1977.

Technical or user manual

The Unix System V Interface Definition, vol. 1, AT&T Bell Laboratories, Murray Hill, N.J., 1991.

White paper

Consolidating the IT Infrastructure, white paper, Oracle Corp., Dec. 2003.

Wikipedia

Avoid citing as a reference if a more standardized source is available.

General style

Author names

Use each author's initials and last name. Leave no space between initials, but do leave a space between the period following the last initial and the first letter of the last name: *E.F. Codd.* For hyphenated first names, use a period for each initial (for example, J.-L. Picard).

If an entry has more than three authors, use the first author's name and follow it with "et al.": *T.G. Lewis et al.*

Dates

Include just the year of publication for books. For periodicals, normally include the volume number, issue number, and year. However, for popular periodicals, include the month and year. If a periodical appears more frequently than monthly, include the date with the month: *15 Mar. 2000.* If a periodical appears quarterly, use the season or issue number, depending on the periodical's usage. For periodicals that appear irregularly, do not use the month: *vol. 16, no. 5, 1997.*

Spell out *May*, *June*, and *July*; abbreviate the other months: *Jan., Feb., Mar., Apr., Aug., Sept., Oct., Nov., and Dec.* Use a slash for bimonthly issues (*Aug./Sept. 2000*) and an en dash for a quarterly (*July–Sept. 2000*). Capitalize the names of seasons: *Winter, Spring, Summer, and Fall*.

Electronic references

References to electronic repositories are acceptable in IEEE Computer Society publications, but they are not the references of choice for formal archival use. If possible, replace such references with references to printed material. However, when this is not possible, cite the electronic address along with as much additional information as possible. If the address itself becomes invalid in the future, the other information might help researchers find the same document elsewhere on the Internet. At the very least, a reference to an electronic source must include the Internet URL.

When citing an electronic reference simply to give the reader a place to go for more information, instead of including it in a formal reference list, noting it within parentheses in the running text is acceptable. Because such references break the flow of the text, use them sparingly and do not set them off in italic, boldface, or typewriter font. If an article includes many electronic references, consider placing them in a sidebar or a broken-out list.

When referring to various portions of a WWW page in text, use an initial cap for the designated item. Do not set it off with quotes, parentheses, or italics. Thus, a sample reference could be, *The proper way to search the page is to click on the Go button*, or *The text can be found in the Publications section of the company's Web site.*

When referring to hypertext links found on a Web page (the highlighted underlined words), put the entire text of the link in quotes. For example, *Click on the "go here" link to reach the table.*

When referring to URLs in a string of text, don't apply extra formatting.

Publications

Italicize names of books (including collections), magazines, journals, newsletters, technical reports, white papers, and manuals. Use quotation marks to enclose names of articles, papers, theses, dissertations, technical notes, and technical memos.

When listing conference abbreviations in a reference, use the conference abbreviation and the last two digits of the year: AAAI 07.

After the name of a book, thesis, proceedings, or other book-like material, list the publisher, year of publication, and inclusive page numbers if applicable. Delete terms such as *Co.*, *& Co.*, *Ltd.*, *S.A.*, *Publisher*, and *Publishing Co.*; retain *Press*. Where the publisher is a university, add its location if needed for clarity, for example, *Miami Univ., Ohio.*

Do not include the editor's name for a conference proceedings unless it is an edited volume published as a book.

References for proceedings should tell where an interested reader can find the source, not where the conference took place. If a proceedings did not use a traditional publisher, provide the sponsoring organization and its location.

Use an en dash to indicate multiple issue numbers, for example, *vol. 5, nos. 1–4.* If the name of a column is cited in the reference, use initial caps without quotation marks, for example, *Embedded Computing.*

Titles

Capitalize the first and last words, and all nouns, pronouns, adjectives, verbs, adverbs, and subordinating conjunctions. Lowercase articles, coordinating conjunctions, and prepositions, regardless of length. Example: *Toward Better Real-Time Programming through Dataflow*.

To make a source easy for researchers to find, use the title as it originally appears. Do not add or remove hyphens, change words to preferred spellings, or lowercase internal capitals.

For foreign-language references, provide the original title first, followed by its English translation (if available) in brackets: *Zur experimentalen Aesthetic* [Toward an Experimental Aesthetic].

For a complete treatment of titles, see *CMS* 8.154-8.195.

Abbreviations in references

Use the following abbreviations in the titles of periodicals and when naming publishing institutions:

Am.	American
Ann.	Annual
Assoc.	Association
Bull.	Bulletin
Comm.	Communications (of)
Conf.	Conference (on)
CS	Computer Society
Dept.	Department (of)
ed.	edition, editor
Eng.	Engineering
Fed.	Federal
Govt.	Government
Inst.	Institute
Int'l	International
J.	Journal (of)
Lab(s)	Laboratory (Laboratories)
Math.	Mathematics, Mathematical
Nat'l	National
no.	Number
Org.	Organization
Proc.	Proceedings (of)
Q.	Quarterly
Rev.	Review
Soc.	Society
Symp.	Symposium (of or on)
Trans.	Transactions (on)
Univ.	University
vol.	Volume

Use "Comm." (for Communications) when the term refers to the type of periodical (and is part of the periodical's name), not when it refers to the topic of communications.

Use "Eng." (for Engineering) in the titles of periodicals and conference proceedings and in the names of professional organizations, not in article or book titles.

Drop the "on" from "Workshop on" constructions. When abbreviating institution names, drop "of" except in "University of" constructions—for example, *Inst. Systems Research, Univ. of Wisconsin*.

Transactions Department References

While IEEE Computer Society journals and IEEE journals have distinct templates and formatting styles, IEEE Computer Society journals follow the IEEE's guidelines for formatting references within the bibliography. For further information about these guidelines, please visit the IEEE's Style Manual at http://www.ieee.org/documents/style_manual.pdf.

A

* Denotes entries for which it is okay to use acronym or abbreviated term on first use

A: ampere, for example, *25 A* (*n*); *25-A current* (*adj*)

AAAI: American Association for Artificial Intelligence

AAAS: American Association for the Advancement of Science

AACP: American Association of Computing Professionals

ABET: Accreditation Board for Engineering and Technology

*   **AC**: alternating current

academic degrees: *BS*, *MS*, and *PhD* are the standard abbreviations for the bachelor's, master's, and doctoral degrees that we encounter in most of our authors' biographies. However, if an author insists, using "BSME" or "BSEE" instead of "BS in mechanical engineering" or "MSc" instead of "MS" is acceptable. These and other variants have the sanction of being included in the *Webster's* list of abbreviations. In general, reproduce non-US degrees as authors submit them (except for periods), for example, *BEng*, *BTech*, and *DPhil*. See also *bachelor's, master's, doctorate*.

accents: Use accents in anglicized non-English terms when important for pronunciation, to avoid confusion with another word, or where context makes it unclear. Use accents in non-English names, especially names of individuals. In general, lean toward the author's preference. See also the *Non-English Words and Phrases* section.

ACE: Advanced Computing Environment

ACID: atomicity, consistency, isolation, and durability (a test)

ACK: acknowledgment

Acknowledgments: not *Acknowledgements*

ACL: Association for Computational Linguistics

ACM: Association for Computing Machinery; includes several special-interest groups (SIGs). With the exception of Siggraph and Sigmod, use the ACM style for each SIG in text or references. See www.acm.org/sigs for a current listing. Use "is a member of ACM" in bios. In references, use ACM instead of ACM Press (old format).

acronyms: See the *Acronyms and Abbreviated Terms* section for general style guidelines.

ACS: Australian Computer Society

ActiveX: software technology from Microsoft

A/D: analog/digital

Ada: a programming language (named for Augusta Ada Lovelace) developed by the US Defense Department

ADAPSO: Association of Data Processing Service Organizations; renamed as Information Technology Association of America (ITAA) in 1991

ADC: analog-to-digital converter

add-in board

Addison-Wesley or **Addison Wesley Longman**; **Addison-Wesley Professional**

add-on (*adj*)

address mode (*n*): the way the processor is addressed; includes sequential, forward, and backward addressing, among other modes; hyphenate when used as an adjective

ADSL: asymmetric digital subscriber line (for fast Internet access)

admin: okay to use instead of "administration" in appropriate cases

AEA: American Electronics Association

AEC (*adj*): architecture-engineering-construction; no hyphens in the acronym

AES: Advanced Encryption Standard; NIST standard for symmetric key encryption

AFCET: Association Française pour la Cybernétique Économique et Technique

AFIPS: American Federation of Information Processing Societies (no longer exists)

agile: not capitalized when it refers to programming techniques

*   **AI**: artificial intelligence; acceptable on first reference if context makes it clear

AIAA: American Institute of Aeronautics and Astronautics

AIChE: American Institute of Chemical Engineers

AIIM: Association for Information and Image Management

AIM: advanced instruction module

AIP: American Institute of Physics

Ajax: Asynchronous JavaScript and XML

A K Peters: Publisher (note: no periods after initials)

Algol: stands for *algorithmic language*

ALPG: algorithmic pattern generator (hardware and software)

Al Qaeda

ALU: arithmetic logic unit

*   **a.m.**: *ante meridiem* "before noon" (also includes 12:00 midnight). See also *p.m.*

ampersand: retain symbol in proper names when the name owner uses it that way; otherwise avoid

Amazon.com

Amazon Mechanical Turk (MTurk)

AMS: American Mathematical Society

AMU: Association of Minicomputer Users

analog: not *analogue*

and/or: avoid this construction

ANOVA: analysis of variance; a statistical test

*   **ANSI**: American National Standards Institute

Ansys: finite-element analysis software by Swanson Analysis Systems

anti-: not hyphenated as a compound modifier unless root word is a proper noun or begins with "i," for example, *antialiasing*, *anti-intellectual*

apa: all points addressable

APDA: Apple Programmers and Developers Association

*   **API**: application programming interface

*   **APL**: A Programming Language

appendices: not appendixes

Apple IIe, **IIgs**; **Macintosh IIc**, **IIcx**, **IIfx**, and so on

apps: acceptable abbreviated term for applications

Arcnet: Attached Resource Computer Network; developed by Datapoint Corp.

ARO: after receipt of order; Army Research Office (preceded by US if spelled out)

ARPA: Advanced Research Projects Agency, a part of the US Defense Department; *DARPA* is the preferred usage.

Arpanet: the oldest of the networks on the Internet; initial capital only

artificial intelligence: AI is acceptable on first reference if the context makes it clear. The term loosely includes expert systems, knowledge bases, natural-language interfaces, pattern recognition (voice, image, and signal), and neural networks.

ASC: American Society for Cybernetics

ASCI: Accelerated Strategic Computing Initiative

*   **ASCII**: American Standard Code for Information Interchange

ASIC: application-specific integrated circuit. Don't spell this out in *Pervasive Computing*.

ASIS: American Society for Information Science and Technology

ASME: American Society of Mechanical Engineers

ASP: application service provider; application-specific processor; Active Server Pages

ASPLOS: Architectural Support for Programming Languages and Operating Systems; the name of a conference

assembly language (lowercase; not *assembler*): a computer language that assembles the assembly-language code, as a compiler compiles high-level code

ASTI: Association for Science, Technology, and Innovation

ATE: automatic test equipment

ATM: asynchronous transfer mode

ATPG: automatic test-pattern generation

AutoCAD: software from Autodesk Inc.; exception to normal style because of common usage

Autoprobe

avatar: graphical image that represents a person

Awk: a language based on the authors' names—Aho, Weinberger, and Kernighan

B

B2B: business-to-business

B2C: business-to-consumer

bachelor's degree

back end (*n*), **back-end** (*adj*)

backplane *(n)*: an electronic circuit board containing circuitry and sockets into which additional electronic devices on other circuit boards or cards can be plugged; generally synonymous with or part of a computer motherboard

backup (*n*, *adj*): for example, *the system served as a backup*; *a backup copy*

back up (*v*): as in, *you can back up the database*

bandwidth

bar code

Basic: a programming language; allegedly stands for "beginner's all-purpose symbolic instruction code," but this is etymologically suspect

BasicA: Microsoft advanced Basic; known as "GW-Basic" on non-IBM, MS-DOS computers

baud (*singular, plural*): transmission speed in units per second, originally used to measure telegraph transmission. In computing, the units are usually bits, hence the common practice of using *baud* and *bps* interchangeably. However, this is technically inaccurate because the unit in a baud can be any discrete element.

BCS: British Computer Society

BDI: beliefs, desires, intentions—a model of human reasoning

BEEP: Blocks Extensible Exchange Protocol

Beijing: the Pinyin form used instead of "Peking"

benchmark: a standardized problem, test, or suite of tests that serves as a basis for the repeatable, objective comparison of hardware or software; examples include Dhrystone, Mflops, Sim, Whetstone

beta site: the secondary (hence *beta*) site

Beta-spline (*n*, *adj*): not the same as a B-spline

beta test (*n, v*)

Bezier: no accent mark on the first syllable

BFL: buffered field-effect transistor logic

BIFS: binary format for scenes

BGP: Border Gateway Protocol

"Big Blue": informal name for IBM

BIOS: basic input/output system; operating system software that handles communications with devices, including monitors, keyboards, disk drives, processors, and ports

Birkhaüser Boston: North American branch of the Swiss publisher, Birkhaüser Publishing

BIST: built-in self-test

bit: a binary digit, 0 or 1; the basic element making up digital data

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-bit (*suffix*): adjectives formed with numbers and *bit* are hyphenated, for example, *64-bit processor*

bitblt: Previous CS Style Guide versions defined this term as "bit block-level transfer," but some authors insist on "bit block transfer."

bitline

bitmap: digital representation of an image in which bits are mapped into pixels; in color graphics, a different bitmap is used for each red, green, and blue value

bitmapped graphics

Bitnet: communications network between universities and research centers. Although it's reputed to stand for "Because It's Time Network," the term is not a true acronym.

bit rate

bit-slice processor

bit-sliced (*adj*)

bitstream (*n, adj*)

bitwise *(n)*: dealing with bits rather than a larger structure such as a byte; bitwise operators are programming commands or statements that work with individual bits

black-and-white (*adj*)

BlackBerry

black box: a complicated electronic device whose internal mechanism is usually hidden from or mysterious to the user

BLAS: basic linear algebra subroutines

blog: a shared online journal

Bluetooth

Blu-ray

BNF: Backus-Naur Form, a metalanguage

boldface: strictly limit use as an emphasis technique; italic type is preferred and should be used whenever possible

Boolean: from George *Boole*; spelling with a capital *B* is preferred

bootup (*n*), **boot up** (*v*): more commonly just *boot*

botnet: jargon term for a collection of software robots, or bots, that run autonomously

bottom-up design: design that starts at the system level as opposed to *top-down design,* which starts at the logic level and works down. In *middle-out design,* design starts at the middle level and proceeds up or down.

boundary scan: a self-test technique; not synonymous with scan

BPEL4WS: Business Process Execution Language for Web Services

bpi: bits per inch, for example, *1,600-bpi magnetic tape unit*; *1,600 bpi*

BPML: Business Process Modeling Language

bps: bits per second, as in, *1,200 bps*; see also *baud*

BPSS: Business Process Specification Schema

BRDF: bidirectional reflectance distribution function

B-rep: boundary representation

broadband (*n*): technique for high-speed data transmission

broadcast bus: sends a single data item to all bus destinations in a unit of time

brute-force attack

BSA: Business Software Alliance

Bsafe: encryption software

BSD: Berkeley Software Distribution, an extended and modified version of AT&T Unix from the University of California, Berkeley

B-spline (*n*, *adj*): not the same as a Beta-spline

Bsquare

b-trieve: random-access search technique used in databases

burn-in (*adj*, *n*); **burn in** (*v*)

bus, **bused**, **busing, buses**: The *s* is not doubled.

byte: an eight-bit string that a processor reads as a group; generally, one byte equals one alphanumeric character

bytecode: one word

C

C: a programming language

C++: a programming language based on C and extended to include object-oriented features (++ is not super- or subscripted)

C³: command, control, and communications

C³I: command, control, communications, and intelligence

C^x: (x is an integer or an algebraic representation of an integer); a mathematical notation referring to the continuity of a function and therefore its differentiability (in calculus) because derivatives are undefined where functions are discontinuous. Less formally, continuity refers to the "smoothness" of a function or curve. C^0 means the function is continuous but its derivatives are not. C^1 means both the function and its first derivative are continuous, but the second derivative might not be. More complicated forms, such as C^{K-1}, also occur. Some authors make the *C* calligraphic, but this is not necessary.

*   **CAD**: computer-aided design

CADAM: computer graphics augmented design and manufacturing system

*   **CAD/CAM**: computer-aided design and computer-aided manufacturing

CADD: computer-aided design and drafting

CAE: computer-aided engineering

CAGD: computer-aided geometric design

CAI: computer-assisted instruction *or* computer-aided instruction

CalArts: California Institute of the Arts; abbreviated term acceptable only on second reference

Calcomp, **Calcomp IGS-500**, **Calcomp 960 plotter**

CALM: Common Assembly Language for Microprocessors

Caltech: California Institute of Technology

CAM: contact addressable memory

CAM-I: Computer-Aided Manufacturing International

Carnegie Mellon University: The Pittsburgh-based university removed the hyphen from its name in 1986.

Cartesian: initial capital

CASE: computer-aided software engineering

CASA/SME: Computer and Automated Systems Association of the Society of Mechanical Engineers

CAT: computer-aided testing (not "computerized axial tomography"); see *CT*

catalog (not catalogue)

CAVE: Cave Automatic Virtual Environment

CavernSoft: note internal cap

CBEMA: Computer Business Equipment Manufacturers Association

CCALI: Center for Computer-Assisted Legal Instruction

CCD: charge-coupled device

CCIA: Computer and Communications Industry Association

CCITT: Comité Consultatif International de Télégraphique et Téléphonique (International Consultative Committee for Telegraphy and Telephony), a Geneva-based division of the International Telecommunications Union, a New York-based United Nations organization; rarely spelled out. Now ITU-T, see listing in the "*I*" section.

CDA: DEC's compound document architecture

CD-I: compact disc-interactive

CDMA: code division multiple access—a wireless communications technology

*   **CD-ROM**: compact-disc read-only memory; preferred spelling is with the hyphen

Cedar: a Xerox programming language

Cedex: a French postal pickup station, used in addresses

cel: clear acetate sheet onto which animators' drawings are traced and painted for photographing

cell phone

century: use symbol for ordinal numbers, for example, *20th century.* Note: *CMS* spells out the century (*twentieth century*).

CerDIP: trademark name for a ceramic dual in-line package

*   **CERN**: Centre Européen des Recherches Nucléaires (European Center for Nuclear Research)

CERT Coordination Center: CERT/CC, a center of Internet security expertise, located at the Software Engineering Institute, Carnegie Mellon University

CGA: color graphics adapter (or array); an IBM color-display standard allowing eight colors

CGI: common gateway interface

CGS: Computer Graphics Society

CHI: The annual Conference on Human Factors in Computing Systems. Don't spell this out in *Pervasive Computing*

child: one of several family words used to describe relationships among nodes in databases; the terms are legitimate—don't edit them out

chipmaker, chipset

CHMOS: Intel's CMOS

CIDR: classless interdomain routing

CIE: International Commission on Illumination (Commission Internationale de l'Eclairage)

CIELUV: perceptually based color space

CIM: computer-integrated manufacturing

ciphertext: no hyphen; *i* not *y*

CIPS: Canadian Information Processing Society

CISC: complex-instruction-set computing

CLB: configurable logic block

cleanroom: a software development approach aimed at producing software with the minimum number of errors

cleanup (*n*, *adj*), **clean up** (*v*)

cleartext (*n*)

client-server: use hyphen, not slash

clk: clock

clock cycle: the time it takes the CPU to fetch and execute an instruction; do not substitute *clock*

closed-loop (*adj*)

(the) cloud; cloud computing

CLUT: color lookup table

CMM: Capability Maturity Model, Levels 1–5. Don't spell this out in *Software*.

    *   **CMOS**: complementary metal-oxide semiconductor

co-: Compounds formed with this prefix are generally not hyphenated. Exceptions are compounds that result in a double *o* (*co-op, co-official*) and a compound such as *co-edition* that could be confusing or suggests infelicitous reading. However, this does not apply to words such as *coincidence* or *cooperate* where the first two letters, through long-standing use, are viewed more as an integral part of the word than as prefixes. See *Webster's* and *CMS* 7.85, Table 4, for other examples.

Co.: abbreviated when used in text as part of a company name; avoid using unless a company's name might not be clear without it, for example, *Data Co.*

CO_2e: equivalent carbon dioxide

Cobol: Common Business-Oriented Language; *Cobol* on all references

CoCom: an informal abbreviation for Coordinating Committee for Multilateral Expert Controls

    *   **Cocomo**: Cost Constructive Model, a project-estimation system developed by Barry Boehm

Codasyl: Conference on Data Systems Languages, an obsolete organization devoted to developing a universal data system language for business; active from 1959 to about 1971

code base

codesign; hardware-software codesign

Codiac: centralized operation deterministic interface access control

colocate: locate together, as in putting two things close together to share common facilities

COM: Component Object Model

compiler: a program that translates code in a high-level language into instructions a machine can execute

complex-instruction-set computing: also **CISC**

compute: resist the tendency to use as an adjective or adverb. Use *computationally intensive* instead of *compute-intensive* and *computation server* instead of *compute server*.

Computer (magazine): not *IEEE Computer*

computer games: Italicize the names of computer games but not the names of other types of games.

Computer Science Press: an imprint of W.H. Freeman; spell out the name to avoid confusion with CS Press.

Computer Society: Use *the IEEE Computer Society* on first reference; *Computer Society* without *IEEE* is acceptable on second reference. The executive staff often uses IEEE-CS in its official communications.

Computer Society publications: use IEEE CS in references

cooltown: A ubiquitous-computing initiative sponsored by Hewlett-Packard. Don't call it "CoolTown."

copyleft: a general method for making a software program free and requiring all modified and extended versions of the program to be free software as well

copyright, ©: See the *Copyrights, Trademarks, and Image Permissions* section.

Corba: common object request broker architecture. Don't spell this out in *Software*.

Corp.: abbreviated when used in text as part of a company name; spelled out when used in a byline or biography. Generally used only if a company's name might not be clear without it, for example, *Logic Corp*.

Cosmic Cube: supercomputer at the University of Illinois

cost-effective: always hyphenated

*   **COTS**: commercial off-the-shelf

counter-: prefix, not hyphenated

Courant Institute of Mathematical Sciences: an institute at New York University

CPA: Computer Press Association

CP/M, **CP/M-86**: two of many early operating systems

cpi: characters per inch

cpl: characters per line; spell it out

cps: characters per second, as in *125-cps printer*

*   **CPU**: central processing unit; plural is CPUs

Cray-1, **Cray-2**, **Cray X-MP/24**, **Cray X-MP/48**, **Cray-MP**: parallel processors from Cray Research (now Cray Inc.)

CRM: customer relationship management

cross-assembler, **cross-compiler**: an assembler or compiler that assembles/ compiles code on one machine for use on another, normally incompatible, machine

crossbar (*adj*)

cross-hair cursor

cross section (*n*), **cross-section** (*adj*)

Crosstalk: communications software

cross validation *(n)*, **cross-validation** *(adj)*

crowdfunding

crowdsource

*   **CRT**: cathode-ray tube; acceptable on first reference; use *VDT* when talking about video displays in general

CS: informal acronym for *IEEE Computer Society;* rarely used alone in publications

CSCW: computer-supported cooperative work

CSE: computational science and engineering; also, "computer science and engineering"

CSG: constructive solid geometry

CSI: Computer Security Institute

CSIC: customer-specific integrated circuit; pronounced "seasick"

CSMA/CA: carrier sense multiple access with collision avoidance

CSnet: Computer Science Network. A network established to connect institutions that have Arpanet to each other and also to those that don't. Merged with Bitnet in 1989.

CS Press: no longer used except for books as of 2011; use IEEE CS in references to conference proceedings

CSS: Cascading Style Sheets; a style sheet language

* **CT**: computerized tomography; a 3D-scanning technique (not *CAT*)

CUDA: (Compute Unified Device Architecture) Not commonly spelled out.

CURE: an algorithm

CUT: circuit under test

cyber: (adj.) relating to computers or computer networks

cyber- (prefix)**:** cyberattack, cyberinfrastructure, cybersecurity, cyberworld

cyber-physical systems

D

DA: design automation

D/A: digital/analog

DAC: digital-analog converter; Design Automation Conference

DAG: directed acyclic graph; a data structure for representing computer graphics

daisy chain (*n*), **daisy-chained** (*adj*)

daisywheel

DAML: DARPA Agent Markup Language

DAML+OIL: DARPA Agent Markup Language + ontology inference layer; spell out on first use

* **DARPA**: US Defense Advanced Research Projects Agency

DASD: direct-access storage device

DASH: Design Aid Schematic Helpmate

data: Follow author preference for use as singular or plural, but maintain consistency within an article (unless context clearly demands inconsistency).

database, datacenter, datapath, dataset, datatype

data-entry (*adj*): as in *data-entry switch*

dataflow (*n*, *adj*)

data mining

Data General: The Westboro, Mass.-based company's products include Eclipse MV/8000, Eclipse MV/1000 superminicomputer, Eclipse S130, and GW/4000 graphics workstation.

daughter: One of several family words used in computer-based relationships. Although preferred usage is the gender-neutral "child," the term is legitimate; do not edit out.

Davic: Digital Audio Video Interactive Council

dB: decibels (*40 dB*)

dBase II, **dBase III**, **dBase III**+: database products produced by Ashton-Tate

DBMS: database management system; plural form is DBMSs

* **DC**: direct current

DCE: Distributed Computing Environment

DCFL: direct coupled field-effect transistor logic

DCOM: Distributed Component Object Model

DCT: discrete cosine transform

DDL: document-description language

DDN: Defense Data Network

DDN PMO: Defense Data Network Program Management Office

DEC: Use *Digital Equipment Corp.* on first reference in text; *DEC* or *Digital* is acceptable for subsequent references.

DEC 10: The DEC 10 is the same computer as the PDP-10. Digital Equipment Corp. changed the name to DEC 10 around 1973.

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decimals: See the *Numbers and Symbols* section.

decision maker (*n*), **decision making** (*n*), **decision-making** (*adj*)

DECnet: A Digital Equipment Corp. facilities' network

DECsystem-10

DECUS: Digital Equipment Corp. Users Society; absorbed into Encompass, an HP users group

deep-submicron *(adj)*

degrees: spell out in text when used as a unit of measure; educational degrees: see *academic degrees*; use symbol for temperatures

Denelcor: a defunct company famous for making the HEP, a parallel processor no longer in production

denial-of-service *(adj)*: abbreviation is DoS

depth buffer: see *z-buffer*

DES: Data Encryption Standard

design by contract *(n)*

desktop

device-independent (*adj*): capable of making I/O requests without regard for the characteristics of I/O equipment

DFM: design for manufacturability

DFT: discrete Fourier transform; design for testability

DHCP: dynamic host configuration protocol

Dhrystone: a benchmark

DHTML: Dynamic HTML

dialog: as in *dialog box*

dialogue: a *conversation*. Be consistent regarding spelling if dialogue and dialog appear in proximity.

dial-up (*adj*)

Diffserv: differentiated services

Digital Equipment Corp.: spell out on first reference in text; use *DEC* or *Digital* for subsequent references

dimensions: Whether you spell out the term or use abbreviations, be consistent: 8 ft. × 5 ft. or eight feet by five feet. See the *Numbers and Symbols* section.

DIMM: dual inline memory module

DIP: dual in-line package; also, **MiniDIP** with no hyphen

disk: preferred, as in *floppy disk*; however, *disc* is the standard in optics, farming, and medical applications

display-list (*adj*)

Disspla: initial cap. only; product of Computer Associates Int'l

distributed computing system: A system in which storage and processing facilities are dispersed and loosely coupled by transmission media; also a system in which many processors perform a computation in parallel

DIVE: Distributed Interactive Virtual Environment

DLL: dynamic linked library

DMA: direct memory access

*   **DNS**: Domain Name System

doctorate: preferred over *doctor's degree*

DoD: Use *Department of Defense* on first reference; consider using *Defense Department* instead; add *US* if context isn't clear.

DoD-Std: Department of Defense standard; not the same as *Mil-Std*

DoE: Use *Department of Energy* on first reference; consider using *Energy Department* instead; add *US* if context isn't clear.

DOF: degrees of freedom

*   **DOI**: digital object identifier

DoJ: Use *Department of Justice* on first reference; consider using *Justice Department* instead; add *US* if context isn't clear.

DOM: document object model

*   **DOS**: disk operating system

DoS: see *denial-of-service*

dot-com: Internet-based business

dot matrix printer: no hyphen

double-buffer (*adj*): as in a *double-buffer scheme*

double buffering

download (*v*)

downtime (*n*)

DPA attack: differential power analysis

dpi: dots per inch

DPMA: Data Processing Management Association

DPMI: DOS protected-mode interface

*   **DRAM**: dynamic RAM (pronounced "dee-ram")

DRAM module: a group of dynamic RAM chips packaged together

DRM: digital rights management

*   **DSL**: digital subscriber line

DSP: digital signal processor (chips); digital signal processing (applications, systems). Don't spell this out in *Pervasive Computing*.

DSS: decision support system

DSSS: direct sequence spread spectrum

DTD: document type definition; an SGML term

DTF: dielectric thin film (filters)

DTR: data terminal ready

DUT: device under test

*   **DVD**: digital video disc or digital versatile disc

DXF: data exchange file (format)

E

E.: "east" in addresses

e-: prefix denoting "electronic," as in *e-commerce*, *e-health, e-learning*, *e-publishing, e-science,* but not in *email*. When using in an article title or headings, capitalize both the "e" and the word following the hyphen, as in "E-Commerce in Asia."

on **Earth** (planet)**,** of the **earth** (soil)

EasyLiving: A ubiquitous-computing project of the Vision Group at Microsoft Research. Don't call it "easy living."

eBay

EBCDIC: extended binary-coded decimal-interchange code; compare with *ASCII*

ECC: error-correcting code

ECL: emitter-coupled logic

E/D: enhancement/depletion mode

EDI: electronic data interchange

editor in chief *(n)*, **editor-in-chief** *(adj)*: Editor in Chief Bill Smith; Bill Smith, the magazine's editor in chief; editor-in-chief position

EDSAC: Electronic Delay Storage Automatic Calculator

EDVAC: Electronic Discrete Variable Automatic Computer

Eeprom: electrically erasable programmable read-only memory

e.g.: *exempli gratia*; substitute *such as* or *for example*

EGA: extended graphics adapter or array; an IBM color-display standard allowing 16 colors

EIA: Electronic Industries Alliance

EIAJ: Electronic Industries Association of Japan

eigen-: prefix meaning "characteristic"

EISA: extended international standard architecture

Eispack: benchmark

EJB: Enterprise JavaBeans

E-JFET: *n*-channel enhancement mode junction field-effect transistor

electron beam (*n*), **electron-beam** (*adj*)

ellipsis: See the *Punctuation* section or *CMS* 13.48-13.56.

email: electronic mail; use curly brackets to list multiple persons at the same email address, for example, {jsmith, pjones, abrown}@computer.org.

EMS: Expanded Memory Specification; a standard developed by Lotus Development, Intel, Microsoft, and AST Research for configuring and addressing memory above the MS-DOS direct-address 640-Kbyte limit. Also known as LIM EMS, from the companies' names. AST became a development partner after the acronym was coined.

end-fire coupling

endpoint (*n*): use in a geometric context and when referring to networks; otherwise, use two words: **end point**

end user (*n*), **end-user** (*adj*): the ultimate user or customer. Use just *user* unless distinguishing different types of users, such as *testing user*, *support user*. Consider substituting *customer.*

* **ENIAC**: Electronic Numerical Integrator and Computer; an early-generation computer

* **EPFL**: Ecole polytechnique fédérale de Lausanne

Eprom: erasable programmable read-only memory

* **EPS**: encapsulated PostScript

ERP: enterprise resource planning

Esprit: European Strategic Programme for Research and Development; retain the spelling of *Programme*

et al.: *et alia*; use for more than three authors in a bibliography, including a period after *al.*; okay to substitute *and colleagues* or *and coauthors* in text

etc.: *et cetera;* substitute *and so forth* or *and so on*

Ethernet: LAN technology; also, Fast Ethernet and Gigabit Ethernet

* **EU**: European Union, formerly the European Community

euclidean: lowercase in most uses except when referring to the Euclidean algorithm

Euler: (pronounced "oiler;" takes *an* as its article); adjective describing a mathematical concept

Euler–Poincaré formula: a graphics algorithm

euro: European monetary unit

EuroASIC: European Conference on Application Specific Integrated Circuits

EuroDAC: European Design Automation Conference

European Federation of National Engineering Associations

EuroVHDL: European Conference on VHSIC Hardware Description Language

EUUG: European Unix Users Group; now known as EurOpen

* **Extensible Markup Language**: XML; okay to use acronym on first use

Extreme Progamming (XP): not eXtreme Programming

F

fail-soft-features

fan-in, fan-out (*n, adj*): types of logic networks

fan in, fan out (*v*)

*   **FAQ**

farad: unit of capacitance

Fastbus: an IEEE standard

Fast Ethernet

fast Fourier transform (FFT): (not hyphenated) decoding algorithm

father: One of several family words used to describe relationships among nodes in databases. Although preferred usage is the gender-neutral *parent*, both terms are legitimate; do not edit out.

fault tolerance (*n*), **fault-tolerant** (*adj*): a system's capability to keep executing in the presence of a limited number of faults

*   **fax**: document facsimile, document facsimile telecommunications equipment

FDDI: Fiber Distributed Data Interface

FDM: frequency-division multiplexing

FEA: finite-element analysis; also acronym for Fast Ethernet Alliance

Fellow: uppercase in "IEEE Fellow" and other similar titles; she's a fellow of IEEE

FEM: finite-element method

femtosecond: one quadrillionth of a second

FET: field-effect transistor; also occurs in combinations, such as MESFET

ff: femtofarad

FF: flip-flop; spell out in text

FFT: fast Fourier transform

Fhourstone: a benchmark

FHSS: frequency hopping spread spectrum

Fibre Channel: computer communications protocol for high-performance information transfer

fiber optic (*n*), **fiber-optic** (*adj*)

field testing (*n*); **field-testing** (*adj, v*); **field-test** (*v*)

FIFO (*adj*): first-in, first-out; for example, *first-in*, *first-out accounting*

filename: can be used as two words when not relevant to computers

file system

finite-element analysis

FIPA: Foundation for Intelligent Physical Agents

FIPS: federal information-processing standard

FIR: finite-length impulse response

FireWire: trademarked name for IEEE 1394, an external bus standard

fixed-bubble memory

fixed-length field

fixed point (*n*): notation in which the position of the point is fixed in relation to the numerals, according to some convention

fixed-point (*adj*): as in *fixed-point arithmetic*

fJ: femtojoule

Flash: proprietary Adobe software platform

flash memory

flat-panel display

Flex/32: system from Flexible Computer Corp.

flip-flop (*n*): circuit or device capable of assuming one of two states at a given time, abbreviated *FF*

flits: flow-control digits

floating point (*n*); **floating-point** (*adj*): notation in which the location of a point is not fixed but is regularly recalculated; the location is usually expressed as a power of the base

floorplan

flops: floating-point operations per second; never *flop*, except when quoting the use of this incorrect form. For example, the 1993 Branscomb Report is titled "From Desktop to Teraflop ..." Don't change the title, but the report talks about building a *teraflops*, not *teraflop*, computer.

flowchart

flow control (*n*), **flow-control** (*adj*): the sequence of operations performed in the execution of an algorithm

flowgraph

flowtime

FOAF: Friend-of-a-Friend Protocol

focused, focusing

follow-up (*n*, *adj*), **follow up** (*v*)

footprint: loosely defined as the amount of space a machine takes on a surface (usually a floor or desktop) or as the system resources an application uses in a computer

foreign: Because the IEEE is an international society, "foreign" is not truly applicable in our publications when referring to nationalities; use "non-US" or "international" instead. Italicize terms that are not commonly accepted in English, but use such terms only when there is no suitable English equivalent. See the *Non-English Words and Phrases* section and *CMS* 7.49-7.53.

formulas: not *formulae*

Forth: a programming language

Fortran: for *for*mula *tran*slator, a programming language; dialects include Fortran 77

FOTS: fiber-optics transmission system

FPGA: field-programmable gate array. Don't spell this out in *Pervasive Computing*.

fps: frames per second. Don't spell this out in *Computer Graphics and Applications* when the context is obvious.

fractions: Use slash notation (1/1000) for a general, rounded-off measurement; use decimals (0.001) for a specific, precise measurement. See the *Numbers and Symbols*

section and appropriate sections in *CMS*.

frame buffer *(n)*

Free Software Foundation: supports GNU Linux

front end (*n*): usually refers to a small computer that serves as an interface between the host system and its peripherals

front-end (*adj*): as in *front-end processing*

FSM: finite-state machine

FTAM: file transfer and management

* **FTP**: File Transfer Protocol

full-scale (*adj*)

full-screen (*adj*)

Futurebus (*n*): IEEE Standard 896 bus

fuzzy set (*n*), **fuzzy-set** (*adj*)

G

G: giga; standard prefix meaning one billion

g: gravity (*6-g acceleration*; *passengers in a BMW are exposed to 2 g*); the gravitational notation, *g*, is often italicized to differentiate it from "g" for "gram" or "grams"

GaAs: gallium arsenide, a semiconducting material, like silicon, used for integrated circuits; spell out on first use

Game Boy; Game Boy Advance; GameCube

gameplay

GB: gigabyte. Use *Gbyte* (instead of GB) or spell out.

Gbit: gigabit. Use *Gbit* or spell out.

Gbps: gigabits per second. Don't spell this out in *Internet Computing*.

GBps: gigabytes per second.

Gbyte: gigabyte. Examples: *25 Gbytes*, *25-Gbyte memory*

GEM: Digital Research's Graphics Environment Manager, an operating environment for MS-DOS PCs

general-purpose processors

genlock: to superimpose computer-generated graphics over videotaped images (from a camera, VCR, or VTR)

Georgia Tech

Gflops: gigaflops

* **GHz**: gigahertz

* **GIF:** graphic interchange format—an electronic file format

giga-: standard prefix meaning one billion

Gigabit Ethernet

GIGI: DEC's General Imaging Generator and Interpreter

GIGO: garbage in, garbage out

GIPS: billion instructions per second

GIS: geographic information system

GKS: Graphical Kernel System, an international graphics standard

GlobeCom: IEEE conference

* **GNP**: gross national product

GNU: supports GNU Linux; GNU's not Unix

googling

GOPS: giga operations per second

GPL: General Public License

GPRS: general packet radio service

* **GPS**: Global Positioning System; a constellation of 24 satellites used for navigation and precise geodetic position measurements

* **GPU**: graphics processing (or processor) unit

graftal: an image constructed using parallel graph grammars to define complex objects

grandparent, **grandmother**, **grandfather**: a group of family words used to describe relationships among nodes in databases. The terms are legitimate—do not edit out. Use gender-neutral *grandparent* when possible.

grand challenge: a difficult problem at the leading edge of a computing field

Grappa: Java graph drawing package from AT&T

gray: not *grey*, except in quoted material

Gray code: binary sequence in which two contiguous numbers differ in only one bit; capitalize *Gray* because it is the inventor's name

gray scale (*n*), **gray-scale** (*adj*): for example, *displayed in gray scale*, *a gray-scale display*

grid; **grid computing**

GSM: Global System for Mobile Communications. Don't spell this out in *Pervasive Computing*.

* **GUI**: graphical user interface

GW-Basic: Microsoft version of Basic for MS-DOS computers; *BasicA* is the IBM version

H

hacker: an expert who explores the details of programmable systems to stretch their capabilities

halfword: half a computer word

halftone: an image reproduced from a photo or similar original medium, comprising a series of lines arrayed in a screen, to facilitate sharp, clear printing of images when producing books. Also the preferred format for images in electronic text for camera-ready and other forms. A 100- to 110-line screen is best; lines per inch is the US unit of measure.

handheld (*adj, n*)

handshaking: identification protocol for modems

hard copy (*n*), **hard-copy** (*adj*)

hardwired: describes circuits with only wire and terminal connections, with no intervening switching (no resistors, inductors, or capacitors)

HarperBusiness, HarperCollins

hashtag

HCI: human-computer interaction. Don't spell this out in *Pervasive Computing*.

HD (adj): high-definition

HDL: hardware description language—any language from a class of computer languages

*   **HDTV**: high-definition TV

head-mounted display

healthcare

help desk

hertz: see *Hz*

Hewlett-Packard Laboratories: either *HP Labs* or *HP* is acceptable. Always use the hyphen when spelled out.

hexadecimal: A numbering system with a base of 16. "A" through "F" represent the decimal numbers 10 through 15.

HID: human interface device

hidden-line removal

hidden Markov model

hidden-surface algorithm

hidden-surface removal: In computer graphics, removing from the display the surfaces that ordinarily would be obscured by the rest of the object.

high level (*n*), **high-level** (*adj*)

high-performance computing

high-speed (*adj*): For example, *high-speed computing*, *high-speed switch*; but *very high speed switch*; also, *International Journal of High Speed Computing*.

HiperLan2

Hippi: high-performance parallel interface; also written as HiPPI and HIPPI—be prepared

to negotiate

hither, yon: In computer graphics, the near and far clipping planes.

HMM: hidden Markov model

homepage

hostname

HPC: high-performance computing

*HPCwire***:** An online weekly publication about high-performance computing. Paper copy does not exist. Italicize it as with the name of any periodical.

HPGL: Hewlett-Packard Graphics Language

* **HTML**: Hypertext Markup Language

* **HTTP**: Hypertext Transfer Protocol; in Web addresses, use lowercase—http://

HVAC: heating, ventilation, and air conditioning; always spell out

hyper- (*prefix*): not hyphenated when used to form a compound

hypercube: a parallel computer architecture

hyphenation: If you can't resolve a hyphenation question by consulting *Webster's*, review *CMS* 7.77-7.85. If you feel a word that technically doesn't require hyphenation (for example, reallocate) might be confusing, consider hyphenating it.

* **Hz**: hertz; the standard term for cycles per second

I

IAB: Internet Architecture Board

IAMA: Internet Assigned Members Authority

IANA: Internet Assigned Numbers Authority

IAP: Internet access provider

IBE: identity-based encryption

* **IBM**: International Business Machines Corporation; sometimes informally referred to as "Big Blue"

IBM 3740-formatted disk, **IBM 370-type controllers** (note hyphenation)

IBM PC, **IBM PC AT**, **IBM PC XT, IBM RT PC**, **IBM PS/2** (Models 25, 30, 50, 60, and 80): no hyphens. **IBM PC AT-compatible** (*adj*).

IBM System/360, IBM System/370: IBM mainframes

IBM T.J. Watson Research Center

IC: integrated circuit; acceptable on first reference if context warrants

* **ICANN**: Internet Corporation for Assigned Names and Numbers

ICASE: Institute for Computer Applications in Science and Engineering, at NASA's Langley Research Center

ICCC: International Council for Computer Communication, Washington, D.C.

ICOT: Japan's Institute of New Generation Computer Technology, the so-called Fifth Generation project. The initials refer to the Japanese transliteration of the program, not the English translation.

* **ICQ**: an instant-messaging program

ICT: information and communications technology

* **ID**: identification

IDC: formerly International Data Corp.

* **I$_{DDQ}$**

IDE: integrated drive electronics; also, integrated development environment. Don't spell this out in *Software* when it means the latter.

IDL: Interface Definition Language

i.e.: *that is*—spell out; accept in Transactions if authors insist

IEC: International Electrotechnical Commission—an international standards organization

IEE: Institution of Electrical Engineers, UK; as of May 2006, renamed as Institution of Engineering and Technology (IET)—merged with Institution of Incorporated Engineers

IEEE 488 bus

* **IEEE**: Institute of Electrical and Electronics Engineers; when used to refer to the publisher of a document, it's no longer IEEE Press—just IEEE.

IESG: Internet Engineering Steering Group

IET: Institution of Engineering and Technology, formerly IEE (see above)

IETF: Internet Engineering Task Force

IFIP: International Federation for Information Processing

IGES: International Graphics Exchange Standard

iff: *if and only if*—spell out; accept in Transactions if authors use it

if-then

IIL: integrated interconnection logic

-**ility, -ilities**: This is a *Software*-related term. On its first appearance in an article, use quotes ("-ilities") but no italics. On subsequent appearances, drop the quotes but keep the hyphen.

Illiac IV: An early computer, retired from NASA use at Ames Research Center, Moffett Field, Calif., in 1985

IMACS: International Association for Mathematics and Computers in Simulation

i-mode: a wireless service

IMP: interface-message processor

implementer

Inc.: abbreviate when used in text as part of a company name, but avoid using it unless a company's name might not be clear without it (*Lisp Inc.*); no longer set off with a comma

inches: Whether you use symbols or spell them out, be consistent when describing dimensions—for example, *three inches by five inches* or *3″ × 5″*. See also the *Numbers and Symbols* section.

indexes: use *indices* in mathematical contexts

informatics: a term often used to refer to computer science

Information Age

INFORMS: the Institute for Operations Research and the Management Sciences; formed in 1995 when the Operations Research Society of America (ORSA) merged with the Institute of Management Sciences (IMS)

infoserver

in-house (*adj.*)

ink-jet printers

inline (*adj*)

*   **input/output**: I/O

in queue: hyphenate when using as an adjective (*an in-queue directory*)

*   **INRIA**: Institut National de Récherche en Informatique et en Automatique (French National Institute for Research in Computer Science and Control)

in-service (*adj*)

INSPEC: Information Services for Physics, Electronics, and Computing, an IEE (UK) database of English-language research papers. Not a true acronym, but handle as one.

integrated circuit: IC is acceptable on first reference

Intel's XScale processor

International standard: use *ISO standard*

Internet: normally "the Internet"; **Internet 2**

Internet Stream Protocol: ST

intranet: internal network

*   **I/O** (*n*, *adj*): input/output

IOP: Internetworking Operating System

IoT: Internet of Things

IP: Internet Protocol; intellectual property

iPhone: acceptable at the beginning of a sentence.

iPSC: parallel processor from Intel

IPsec: Internet Protocol security

IPv6: Internet Protocol version 6

IPX: internetwork packet exchange

IR: infrared. Don't spell this out in *Pervasive Computing*.

IrDA: Infrared Data Association. Don't spell this out in *Pervasive Computing*.

IRDS: information-resource dictionary system, a de facto CASE standard

IRQ: interrupt request

ISAM: indexed sequential access method

iSBX bus: product of Intel

ISDN: Integrated Services Digital Network, a telecommunications service

ISM band: Industry, Science, Medicine band

ISMM: International Society of Mini- and Microcomputers

ISO: International Organization for Standardization (ISO); use ISO when referring to standards (for example, ISO 9000 or "an ISO standard"), but use the entire name with the letters in parentheses when referring to the organization. ISO was originally a true acronym for the International Standards Organization, but the name has been changed and the letters are now only an identifier. Don't spell this out in *Software*.

* **ISP**: Internet service provider

italics: Use sparingly for emphasis or to introduce new terms; use also for foreign expressions not commonly accepted in English (that is, not found in the main body of *Webster's*), single-letter variables, longer variables that might be confused with text if not in italics, book titles (includes manuals), movie titles, and TV-series titles.

* **IT**: information technology

ITC: International Test Conference

item set; some publications use **itemset**

iterator (*n*): a programmed action that sets up a counter to control the number of times the action is performed

*i*th: note no space, no hyphen, no superscript

ITU-T: International Telecommunication Union-Telecommunication Standardization Sector; formerly, CCITT

J

J2EE: Java 2 Enterprise Edition; **J2ME**: Java 2 Micro Edition; **J2SE**: Java 2 Standard Edition. For more information on emerging Java technologies, see http://java.sun.com.

Jabber: streaming XML protocol

Java: cross-platform programming language from Sun Microsystems

JavaOne, JavaBeans, JavaScript, JavaServer Pages (JSP)

Java RMI: Java remote method invocation

JDK: Java development kit

JEDEC: The JEDEC Solid State Technology Assoc., once known as the Joint Electron Device Engineering Council

JEIDA: Japan Electronic Industry Development Association

JFIF: J-PEG file interchange format

jif: an electronic file format

Jini: Java wireless technology

JMS: Java Message Service

John Wiley & Sons

Josephson junction (*n*): an electronic switching device

Jossey-Bass: a subsidiary of John Wiley & Sons

joystick

*   **JPEG**: Joint Photographic Experts Group; also: an electronic file format

Jr.: does not require preceding comma

JSON: JavaScript Object Notation

JTAG: Joint Test Action Group; founders of the boundary scan standard

***j*th**

just-in-time (jit): an inventory management method; no capitals needed; it's almost always used as a modifier

JVM: Java virtual machine

JXTA: platform-independent peer-to-peer distributed networking protocol developed by Sun

Jython

K

K: 1,024, the binary thousand (*25 Kbytes*, *25-Kbyte memory*); also used as temperature designator for Kelvin scale, as in *273 K*. However, when used as $10K (with no space) "K" means 1,000. The use of "K" when referring to monetary quantities is discouraged.

k: 1,000, the decimal thousand (*164 km*); used in metric designations; see *CMS* 10.57

KAoS: knowledgeable agent-oriented system (nonstandard, but accepted acronym)

KB: kilobyte; use *Kbyte* (*25 Kbytes*, *25-Kbyte memory*)

Kb: kilobit; use *Kbit* or spell out, but use *Kbps* for kilobits per second

KBES: knowledge-based expert system (as opposed to rule-based)

Kbit: kilobit; use *Kbit* or spell out

Kbps: kilobits per second, preferred over Kb/s; spell out on first use

Kbyte: kilobyte (*25 Kbytes*, *25-Kbyte memory*). Don't use KB.

KEE: Knowledge Engineering Environment, product of Intellicorp

keiretsu: group of companies

kernel: central part of a program or operating system that does the bulk of the calculations; not to be confused with the mathematical meaning

keyboard, keyframe, keyshare, keystream, keyword

Kflops: thousand floating-point operations per second; spell out or convert to Mflops notation

Khornerstone: benchmark

kHz: kilohertz (*50 kHz*)

kiloWhetstone: measure of floating-point capacity; see *benchmarks*

KIPS: thousand instructions per second; spell out or convert to MIPS notation

*   **KLOC**: thousands of lines of code.

kludge (*n*), **kludgy** (*adj*): a quick fix on a computer or in code

Kluwer Academic Publishers

KM: knowledge management

km^2: okay to use instead of "square kilometers"

***k*-means**: a type of algorithm

knowledge base

KSR1: no internal hyphen; a parallel supercomputer from Kendal Square Research

kVA: kilovoltampere

kW: kilowatt

L

LALR(1): left-to-right scan with one look-ahead token; compare to *LL(1)*

* **LAMP**: an open source Web server software bundle

* **LAN**: local area network

Lapack: a benchmark; see also *ScaLapack*

large-scale integration: see *LSI*

laser disk: preferred spelling over *laser disc* (unless the word appears as a trademark)

LASSO: least absolute shrinkage and selection operator

LaTeX (TeX, PCTeX, PCLaTeX): formatting language for typesetting math-heavy articles; pronounced "la-tech;" do not set in small caps or shift any characters above or below the baseline. LaTeX is a superset of TeX, the original format devised by Donald Knuth.

* **LCD**: liquid crystal display

LCCC: leadless ceramic-chip carriers; chip packaging

LDAP: Lightweight Directory Access Protocol

Lear Siegler: hardware manufacturer

least worst: an acceptable term in decision theory

* **LED**: light-emitting diode

LiDAR: light detection and ranging (scanning technology)

life cycle (*n*), **life-cycle** (*adj*): the software product-development process, usually divided into typical phases: requirements specification, design, validation, development, testing (verification), implementation, and maintenance

LIFO *(adj)*: last-in, first-out

light pen

LIM EMS: Lotus/Intel/Microsoft/AST Research expanded memory specification, a standard for configuring and addressing memory above the MS-DOS direct-address 640-Kbyte limit. AST became a development partner after the acronym was coined.

Lincages: Linkage Interactive Computer Analysis and Graphically Enhanced Synthesis package (not a true acronym, but handle as one); a synthesis program for mechanism design developed at the University of Minnesota

Linpack: see *benchmark*

Linux: open operating system based on the Unix platform

LIPS: logical inferences per second

Lisp: from *list processing*, a programming language used mainly in artificial intelligence

liveness: the quality of making sure that something good happens (not just ensuring that nothing bad happens); liveness ensures, for example, that a calculation's results are returned for use, not just calculated; do not use this term without an explanation; compare with *safety*

LL(1): left-to-right scan with one look-ahead token producing a leftmost derivation; short for "leftmost LALR(1)"; see *LALR(1)*

* **LNAI**: Lecture Notes in Artificial Intelligence

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*   **LNCS**: Lecture Notes in Computer Science; use abbreviation in reference lists

*   **LOC**: lines of code

LOCS: lines of code in service

LoD: learning on demand

login, logon, logout, logoff (*n*, *adj*), **log in, log on, log out, log off** (*verbs*)

look-ahead (*adj*)

lookaside

lookup (*n, adj*); **look up** (*v*): process of matching by computer the words of a text with material stored in memory

LOTOS: logic of temporal ordering system

low-cost (*adj*)

low-end (*adj*)

lowercase (*n*, *adj*)

lpi: lines per inch (*300-lpi resolution*, *300 lpi*)

lpm: lines per minute (*145-lpm printer*, *145 lpm*)

LSI: large-scale integration, about 1,000 to 10,000 circuits per chip

LUT: lookup table, but avoid using the acronym

M

μ: mu; see *mu* and *micro-* entries

M: SI prefix for *million* or *mega* (*40-Mbyte hard disk*, *12 Mbytes of memory*)

m: one one-thousandth or milli- (*18 mm*)

mA: milliampere (*20-mA current loop*, *20 mA*)

MAA: Mathematical Association of America

MAC: media access control

MacDraw, MacPaint, MacWrite

Macintosh: computer from Apple

Macro II: Digital Equipment Corp. assembly language

macro- (*prefix*): not hyphenated when used to form a compound (*macroassembler*); exception is when a double "o" occurs, for example, *macro-object*

Macsyma: a symbolic manipulation program developed at MIT

mainframe: a computer housed in a large frame or cabinet, usually used for multiuser applications, which usually requires a temperature-controlled environment and special power supply. Examples are the Digital Equipment Corporation VAX and IBM System 370 computers; saying "mainframe computer" is redundant.

makefile

MAN: metropolitan area network

manet: mobile ad hoc network; in Transactions, MANET

man-hour, man-month, man-year (*nouns*): try to use a non-gender-specific term, such as *staff-hour*

man-in-the-middle attack; MITM attack

MAP: Manufacturing Automation Protocol; **MAP/TOP**: Manufacturing Automation Protocol/Technical Office Protocol; communications standards supported by General Motors and Boeing; both standards follow OSI (Open Systems Interconnection) protocols

marked up: When it's used as an adjective, hyphenate it when it comes before the word it modifies but not when it comes after.

market research firm

markup (*adj, n*)

mashup (*n*); **mash up** (*v*)

master's degree

master slice (*n*): a nonmetalized wafer containing arrays of circuit elements interconnected to perform different functions

matrices: preferred over *matrixes* in a mathematical context; in other contexts such as structural composition, use *matrixes*; example: *matrixes of materials*

Matlab

matrix, -es: see *matrices*

MB: megabyte; use *Mbyte* (*40-Mbyte hard disk*, *12 Mbytes of memory*)

Mb: megabit; use *Mbit* or spell out

Mbit: megabit; use *Mbit* or spell out

Mbps: megabits per second (spell out on first use, except in *Internet Computing*); Mbps, not *MBPS*.

Mbone: multicast backbone; Internet broadcasting technology

Mbyte: megabyte (*40-Mbyte hard disk*, *12 Mbytes of memory*)

MCAE: mechanical computer-aided engineering

MCM: multichip module

MDA: Model Driven Architecture

MEMS: microelectromechanical systems

MEPS: millions of events per second

meta- (*prefix*): not hyphenated when used to form a compound (*metarule*) unless it looks weird, as when the second term starts with a vowel (*meta-analysis*)

Mflops: megaflops; million floating-point operations per second

MHEG: Multimedia and Hypermedia Experts Group

MHz: megahertz (*50-MHz channel*, *50 MHz*)

micro, micros: acceptable as nouns when referring to microcomputers

micro- (*prefix*): one-millionth part of a specified unit (*microgram*); not hyphenated when used to form a compound (*microelectronics*)

micro-BGA: micro-ball-grid array

microCAD, microCADD: computer-aided design and computer-aided design and drafting performed on a microcomputer—no longer relevant since most CAD/CADD is performed on microcomputers

microelectromechanical: one word, no hyphens or capitals; often seen as *microelectromechanical systems,* abbreviated as MEMS

micrometer (**μm**): SI abbreviation for one-millionth part of a meter; accepted abbreviation is μ

micron: millionth part of a meter, but SI term is *micrometer*; usage varies, for example, *micron* is used in integrated circuit production; can also be written as μ

microphotograph: small photograph normally magnified for viewing (such as microfilm). The field is called micrographics. Do not confuse with "photomicrograph," a magnified picture of small things.

microsecond (**μs**): the letter "u" is not a replacement. If a Greek font is not available, spell out as *mu*. In magazines, spelled-out form is preferred, at least on first reference, except perhaps in tables.

MicroVAX, MicroVAX II, MicroVMS

mid: Check *Webster's* for preferred format.

middle-out design

midframe: a computer housed in a small frame or cabinet, usually used for multiuser applications, that does not require a temperature-controlled environment or special power supply; saying "midframe computer" is redundant

*   **MIDI**: musical instrument digital interface

millisecond: abbreviation is *ms*

Milnet: along with Arpanet, the main constituent of the Defense Data Network (DDN); Minet is the European split-off from Milnet

Mil-Std: military standard; not the same as DoD-Std

MIMD: multiple instruction, multiple data. Pronounced "mimdee" and takes "a" as its article; spell out on first use unless context dictates otherwise; add hyphens when used as a modifier

*   **MIME**: Multipurpose Internet Mail Extensions

MIMO: multiple input, multiple output

mini- (*prefix*): not hyphenated when used to form a compound (*minicartridges*)

MiniDIP: trademark name for a dual in-line package

MINX: Multimedia Information Network Exchange

MIP mapping: multiple texture mapping technique

MIPS: million instructions per second; also, MIPS Technologies Inc., a subsidiary of SGI; use full name when context requires it

*   **MIT**: Massachusetts Institute of Technology; spell out on first use if context dictates

MITI: Japan's Ministry of International Trade and Industry

MITRE: preferred format for this company's name

mL: millilambert

ml: milliliter (*5-ml strip*, *0.5 ml*)

mm: millimeter (*35-mm film*, *0.5 mm*)

MMOG: massively multiplayer online game

MMU: memory management unit

MobiCom: For 1999 and before, the conference acronym format is MobiCom 99; for 2000 and afterwards, the format is MobiCom 2000. The full conference name is, for example, 6th Ann. Int'l Conf. Mobile Computing and Networking (MobiCom 2000), 2000.

mobile phone: not hyphenated, even when it's an adjective

mockup: *(n, adj)*

MODFET: modulation doped field-effect transistor

molecular dynamics: hyphenated when it's an adjective

Moore's law: a theory predicting that the number of transistors on a chip doubles as technology advances

MOPS: million operations per second

Morgan Kaufmann: publisher

MOS (*adj*): metal-oxide-semiconductor

MOSFET: metal-oxide-semiconductor field-effect transistor

MOSI: Microprocessor Operating Systems Interface, IEEE Standard 855-1990

mother: one of several family words used to describe relationships among nodes in databases; preferred usage is gender-neutral *parent*; however, do not change without checking with author

motherboard: a circuit board into which various processor boards are plugged

Motorola: do not follow with "Inc." as there is confusion in the company about whether "Inc." or "Corp." is appropriate, even though company stationery uses "Inc." Use the *MC*

prefix when referring to the specific microprocessor from Motorola, for example, *MC68030*. Use *M68000* when referring to the family of devices that share the M68000 architecture.

Moving Picture Experts Group (MPEG): family of standards for coding audio-visual information

* **MP3, MP4**: audio file formats

* **MPEG-1, MPEG-2, MPEG-3, MPEG-4**

MPI: message passing interface

MPU: microprocessing unit

MPW: an Apple development environment for the Mac

* **MRI**: magnetic resonance imaging

ms: millisecond

* **MS-DOS**: Microsoft's version of DOS; see also *DOS*

MSI: medium-scale integration

MSPS: million searches per second

MTBF: mean time between failures

MTTR: mean time to repair, mean time to restore

MTU: maximum transmission unit

mu (μ): Greek letter used as a symbol for *micron*

multi- (*prefix*): Do not hyphenate when used to form a compound, except with "double-i" combinations (*multimeter; multi-integral*).

Multibus, Multibus II: Intel trademarks; IEEE 796 is the multibus standard

multiplexer (*n*)

MUT: module under test

mux: multiplexer; **muxes** (*plural*): spell out on first reference

MVP: matrix-vector product, the primary operation around which supercomputers are designed

MVS: an IBM mainframe operating system

MW: megawatt (*2 MW*, *2-MW system*)

mW: milliwatt (*200 mW*, *200-mW system*)

Mycin: an expert system that can be programmed with knowledge databases for different domains

N

9/07 Xen: open source virtualization software

9/11; **September 11, 2001**

n: SI prefix for one billionth or nano (*100 ns*)

n: variable designation for an integer; italicized

N.: "north" in addresses

N/A: not applicable

NAA: formerly the National Association of Accountants; reincarnated as the Institute of Management Accountants (IMA)

naive

namespace

nano- (*prefix*): one billionth; do not use hyphen (*nanoseconds*, *100 ns*)

narrow band (*n*), **narrow-band** (*adj*): however, according to the *IEEE Dictionary of Electrical and Electronic Terms*, **narrowband** or **narrow band** are used as adjectives in some contexts.

*   **NASA**: National Aeronautics and Space Administration, Washington, D.C.

    Ames Research Center, Moffett Field, Calif.

    Dryden Research Center, Edwards AFB, Calif.

    Goddard Space Flight Center, Greenbelt, Md.

    Jet Propulsion Lab, Pasadena, Calif.

    Johnson Space Flight Center, Houston

    Kennedy Space Flight Center, Cape Canaveral, Fla.

    Langley Research Center, Hampton, Va.

    Lewis Research Center, Cleveland, Ohio

    Marshall Space Flight Center, Huntsville, Ala.

NASA Massively Parallel Processor

NAT: network address translator

NBS: National Bureau of Standards, an agency of the US Commerce Dept.; obsolete, now known as *NIST*

NC: numerical control

NCCCD: National Center for Computer Crime Data

NCGA: National Computer Graphics Association

n-channel; **n-channel device**: insulated-gate field-effect transistor where source and drain are regions of *n*-type conductivity

NCSA: National Center for Supercomputing Applications

nCube: in preference to nCUBE or *n*CUBE

NCP: Network-Control Protocol

Net: short name for the Internet

.NET

NetBIOS: a product that provides basic I/O services for a network; do not use as a synonym for "network BIOS" or "LAN BIOS," which are generic terms for a BIOS designed for a local area network

Netherlands: use *the*

netlist (*n, adj*): a list of the pin connections (pin network) that appear on a printed circuit board

newsfeed

Newton-Raphson: a well-known algorithm for solving equations

NFS: Network File System (from Sun Microsystems' application, SunSoft)

NGSCB: Microsoft's next-generation secure computing base

NIST: National Institute of Standards and Technology; formerly NBS

nm: nanometer

NMOS: *n*-channel metal oxide semiconductor

no.: abbreviation for *number*; **nos. (plural)**

NOAA: National Oceanic and Atmospheric Administration, an agency in the US Dept. of Commerce; although sometimes pronounced "noah," it takes *an* as an article, as if each letter were pronounced ("*an NOAA study*")

NoD: news on demand

node: family words—*mother, daughter, child*—are used to describe relationships among nodes in databases; the terms are legitimate—don't try to edit them out

non- (*prefix*): not usually hyphenated; be flexible with words that are difficult to read, for example, *non-negligible*, *non-real-time mode*

non–von Neumann: see *von Neumann*; in this case, an en-dash is recommended over a hyphen

NoSQL: not SQL; a generic term

NP-hard; **NP-complete**: classes of difficult problems

n-**queen's solver**

ns: nanoseconds (3,000 ns)

NSA: National Security Agency

NSERC: Natural Sciences and Engineering Research Council; a Canadian research agency similar to the US National Science Foundation

NSF: US National Science Foundation; NSF is acceptable on second reference or on first reference in the acknowledgment section of a feature when used with grant number

NSFnet

NSPE: National Society of Professional Engineers

NuBus

Numbers and Symbols: see special section and *CMS,* Section 9

NTSC: National TV Standards Committee; note: committee and standard use same acronym

Nurbs: nonuniform rational B-spline

Nvidia

NW: northwest in addresses, no periods

NYU/IBS Ultracomputer

O

OASI: Office Automation Society International

OASIS: Organization for the Advancement of Structured Information Standards; www.oasis-open.org

Object Management Group: OMG

Object Modeling Technique: OMT

object orientation

object-oriented (OO): an approach to programming that stresses the creation of functions (objects) that are linked in various relationships, usually in hierarchies, to provide the desired functionality; compare with traditional approaches such as imperative programming, which stresses actions to be taken rather than relationships between objects

Objective-C: a computer language

Occam: language used by Inmos for its transputer chip

OCR: optical character recognition; the machine is an *OCR scanner*

octree: a tree structure that describes the division of a cubic region into smaller cubes

OCX: optical cross-connect

ODBC: open database connectivity

*   **OEM**: original equipment manufacturer

OFDM: orthogonal frequency-division multiplexing

off-chip (*adj*)

offline: all uses, as in *the printer is offline*, *offline equipment*

offload, offscreen, offsite

The Ohio State University: *the Ohio State University* in text

ohm (*n*): a unit of electrical resistance

OIL: ontology inference layer; see also *DAML+OIL*

okay

OLAP: online analytical processing

OLE: object linking and embedding; a Microsoft item

OLED: organic light-emitting diode

OLTP: online transaction processing

OMG: Object Management Group

Omnimax (*n, adj*): a stereoscopic, eggshell-shaped theater

OMT: object modeling technique

ONA: Open Network Architecture

onboard: all uses, as in *onboard regulation*

on-chip (*adj*): as in *on-chip logic*

on-demand: (adj.)

online: all uses, as in *the printer is online*, *online equipment*

ONR: US Office of Naval Research

onscreen, onsite

OO: object-oriented

op amp: operation amplifier; spell out in text on first use

opcode (*n*): operation code

OpenGL: a graphics programming language

open-loop (*adj*): as in *an open-loop program*

open loop (*n*): a system in which there is no feedback mechanism for self-correction as there is in a closed loop

open source (*n, adj*): don't use as a verb (instead, consider wording such as "released X as open source")

order-of-magnitude (*adj*)

ORB: object request broker

ORSA: merged with the Institute of Management Sciences in 1995 to become the Institute for Operations Research and the Management Sciences (INFORMS)

orthogonal: In linear algebra, the term describes a set of vectors that are independent, in that no element is a linear combination of the others. In programming, the term is used more loosely to refer to independent—although possibly related—concepts.

*   **OS**: operating system

OSI: open systems interconnection; a concept whereby different vendors' products work together

OSPF: Open Shortest Path First Protocol

OS X

out queue (*n*), **out-queue** (*adj*)

OWL: Web Ontology Language

P

P2P: peer-to-peer

P3P: Platform for Privacy Preferences; a W3C standard

p: not italicized when used to indicate probability

p: SI prefix for one trillionth or pico (*3 ps*)

p.: abbreviation for page when referred to in text; use **pp.** for multiple pages

PABX: private automated branch exchange, a telephone system

packet: a packed block of data for data transmission

PAD: packet assembler/disassembler

PADL: Part and Assembly Description Language, developed at the University of Rochester

pairwise

PAL: phase alternating line—a European video standard; also the acronym for Paradox Application Language

Palm Pilot

PAN: personal area network

PAR: project authorization request

parameterization: not *parametrization*; to split at the end of a line, note that *parameter* and like words are split after the *m*, for example: *param-eter*; but *parametric* is split before the *m*: *para-metric*; automatic hyphenation programs tend to split *parameter* incorrectly

PARC: Palo Alto Research Center

ParcTab: the first context-sensitive computer, developed at Xerox PARC. Note the capitalization.

parseable (alternate spelling: parsable)

PASC: Portable Applications Standards Committee

Pascal: a programming language (named for mathematician Blaise Pascal)

parent: one of several family words used to describe relationships among nodes in databases. The terms are legitimate; don't try to edit them out.

pass/fail

pathname

Pbps: petabits per second

p-channel (*adj*)

* **PC**: personal computer; see also, *IBM PC*

PC-DOS: IBM's version of MS-DOS

PCB: printed circuit board; plural form is PCBs

* **PCI**: peripheral component interconnect

PCM: pulse-code modulation

PCMCIA: Personal Computer Memory Card International Assoc.

* **PDA**: personal digital assistant

* **PDF**: portable document format

PDL: page-description language

PDP-11, **PDP-11/03**, **PDP-11/70**: Digital Equipment Corporation computers

percent: spell it out; don't use *%*; don't use without a number as a replacement for "percentage"

*   **Perl**: Practical Extraction and Report Language

pervasive computing: when used as an adjective, no hyphen in *Pervasive Computing* but hyphenated in other magazines.

PET: positron emission tomography

peta: a thousand trillion (*petaflops = a thousand teraflops*)

petabit

Petri net (*n*): a graphical model of information flow, showing static and dynamic properties of a system; named after Karl Petri, a German mathematician

pF: picofarad; a unit of capacitance equal to one-trillionth of a farad

PhD: no periods

PHIGS: Programmer's Hierarchical Interactive Graphics System, an ANSI and ISO standard

photo-: no hyphen when used as a modifier (*photomultiplier*)

photomicrograph: magnified picture of small things; do not confuse with *microphotograph*

*   **PHP**: recursive acronym for Hypertext Preprocessor, a scripting language

pico- (*prefix*): one trillionth, no hyphen (*picogram*, *picosecond*)

Pict: an image-file format (generally produced by Apple Macintosh programs); not the same as a .PIC graphics file, which is produced primarily by MS-DOS spreadsheet programs

PID: proportional, integral, derivative

PIM: peripheral interface module; Protocol-Independent Multicast (SM = Sparse Mode; SSM = Single-Source Multicast)

*   **PIN**: personal identification number. Don't use *PIN number*.

pinout

Pisces: parallel implementation of scientific computing environments

Pittsburgh Supercomputing Center: one of the four US national supercomputer centers funded by the National Science Foundation

pixel (*n*): derived from *pix* (short for "picture") and *el*ement, it is the smallest resolvable dot in an image display

PKI: public-key infrastructure

PL/I: a programming language developed by IBM (roman "I" per textbook by developer)

PLA: programmable logic array

plaintext: the intelligible form of an encrypted text, for example, *plaintext contains routing information*; use *plain text* when referring to unencrypted text, for example, *user entries are in italics, the computer's response is in plain text*

PlayStation

plug-in (*n, adj*)

plurals: The general rule is to add an "s": *1980s* (year), *40s* (temperature), *HP-1000s* (name), *Apple IIs* (name); see *CMS* 7.14 and 9.54

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*   **p.m.**: *post meridiem*, meaning "after noon" (also includes 12:00 noon); see also *a.m.*

PMU: processor management unit

PMOS: *p*-channel MOS

PNG: portable network graphics

PnP: plug and play

PO: post office; in addresses, use no periods (*PO Box 33*)

PocketPC: brand name; **pocket PC**: generic term

podcast

policymaker

*   **POP3**: Post Office Protocol, version 3

popup

Posix: IEEE standard for a portable operating systems interface. The initial standard deals with portability standards for C programs on computers running Unix.

post-: no hyphen unless root is based on a proper noun (*postprocessing*, *post-Victorian*)

postmortem

PostScript: a graphics- and font-description language from Adobe Systems, used primarily in desktop publishing

power down (*v*)

PowerPC

pp.: abbreviation for multiple pages; single-page references are denoted by p.

PPP: Point-to-Point Protocol

pre-: no hyphen unless root is based on a proper noun (*preeminent*, *pre-Columbian*)

prefixes: see *CMS* 7.85, Table 4

Prentice Hall

prepositions in titles: see the *Capitalization* section

president: capitalize only when referring to the President of a country

prettyprinting: the process of reformatting source code so that it has a consistent layout

price/performance ratio: written with a slash ("/"), not a hyphen

printed circuit board: board on which most components are connected by printed circuitry; **PCB, PCBs** are acceptable on second reference

printout

Prism: parallel reduced-instruction-set multiprocessing (Apollo architecture)

programs and tokens: see *Program Code* section

Prolog: a logic programming language

PROM: programmable read-only memory

pronouns: *he*, *she*—try to use a gender-neutral alternative, for example, plural, "he or she," or "the user"

ps: picosecond

PS/2: Personal System/2, an IBM PC family based on Intel 80286/80386 processors; unlike the IBM PC AT, it has a proprietary Micro Channel bus; it can run OS/2 or MS-DOS

PSB: parallel system bus

pseudo- (*prefix*): no hyphen when used to form a compound (*pseudorandom*); word

processors might hyphenate after *pseu*, but be careful to hyphenate after *pseudo*

PSN: packet-switch node

PSP: Personal Software Process or PlayStation Portable

PSTN: public switched telephone network

p **test**

pulsewidth: not the same as pulse duration

PUMA: programmable universal mechanical assembly

p **value**

PWB: printed wiring board

Q

Q-bus: from Digital Equipment Corp.

QCD: quantum chromodynamics

QED: quantum electrodynamics; also *quod erat demonstrandum*, "which was to be demonstrated," commonly used at the end of mathematical proofs. However, in Computer Society Transactions, this is usually replaced with a small box, known as the "tombstone" or "halmos symbol."

QoS: *(n)* quality of service; *(adj)* quality-of-service

*　**QR code** *(n)* quick response code

quadword: 48-bit or 32-bit piece of data

quasi, **quasi-**: hyphenated for adjectives (*quasi-parenthetical*), open for nouns, except for some established closed compounds (*quasi system, quasiparticle*)

Quel: a relational calculus language

quicksort routine: memory sorting

QuickTime: the Macintosh movie/animation application

quotation marks: Use around direct quotations, chapter titles, episode titles, words when referred to as words, and letters when referred to as letters. In an article that begins with a quotation, do not use the opening quotation marks with the initial drop cap (an oversized, boldface capital at the beginning of a paragraph), but close the quotation with quotation marks. Block quotations do not take quotation marks. For more information, see *CMS* 13.20-13.22 and 13.37-13.41.

QVGA: quarter VGA

qwerty: the standard typewriter or computer keyboard, with the letters *q*, *w*, *e*, *r*, *t*, and *y* at the upper left; no initial capital

R

R8000: a 64-bit RISC microprocessor introduced in 1994 by MIPS Technologies Inc. It was formerly code-named TFP. Other processors made by MIPS include the R4400 and R4600.

rackmount (adj): computer equipment that is standardized to 19 inches in width

* **RAID**: redundant array of independent disks (originally "inexpensive" disks)

* **RAM**: random-access memory

RAND Corp.: official format for the name of the nonprofit research corporation. In *Security & Privacy*, use *Rand Corporation* in affiliations and bios.

* **R&D**: research and development

raster (*n*): the scan lines that form the graphic output on a computer display; also referred to as bitmap

raster-op: raster operation

ray tracer (*n*): an algorithm for drawing computer-generated shaded or highlighted images (also, a ray-tracing algorithm)

RC: resistance-capacitance

RCS: radar cross-section

RDBMS (plural—**RDBMSs**): relational database management system

RDF: Resource Description Framework

RDFS: RDF Schema

re-: no hyphenation in most cases; see *Webster's* for individual examples; watch context for words such as *resign* (to quit a job) or *re-sign* (to sign again)

readback: a way to ensure the accuracy of output by comparing the transmitted data with the original data

readout (*n*): a visual display of data stored electronically; **read out** (*v*)

read/write

RealNetworks

real time (*n*), **real-time** (*adj*): the actual time during which something takes place

reengineer: to examine and alter a subject system to reconstitute it into a new form and to subsequently implement the new form; contrast with *reverse engineering*

registered trademark (®): see *trademark*

register-transfer (*adj*): as in *register-transfer level*

relational database: a database with data organized into tables

REST: Representational State Transfer, an XML protocol

reverse engineering (*n*), **reverse-engineering** (*adj*), **reverse-engineer** (*v*): to deduce the plans of something already built as opposed to reengineering an entity

Rexx: IBM's Restructured Extended Executor

* **RF:** radio frequency

* **RFC**: request for comments

* **RFID**: radio frequency identification

RFP: request for proposal; spell out on first use

RGB: red, green, blue; an additive color model used in TV and raster displays

RISC: reduced-instruction-set computing or computer

RMI: remote method invocation; see *Java RMI*

road map

ROI: return on investment

rollout (*n*), **roll out** (*v*)

* **ROM**: read-only memory (nonerasable)

roman: a type style that is not italic or boldface; no initial capital when referring to the type style

round-off error

royalty-free images

* **RPC**: Remote Procedure Call; a protocol

RPF: reverse path forwarding

rpm: revolutions per minute

RS-232, **RS-232C**: hardware interface protocols

RS/6000: RISC System/6000, a workstation from IBM; comes in a variety of models, such as the IBM RS/6000 Model 350

RSCS: Remote Spooling and Communications Subsystem, the spooling protocol used in Vnet and Bitnet

* **RSS**: Really Simple Syndication; Rich Site Summary ; RDF Site Summary—a method of describing Web content that is available for distribution or syndication from an online publisher to Web users

RSVP: Resource Reservation Protocol

RT: register transfer

RT-11: operating system for Digital Equipment Corp. PDP-11 computers

RTCP: Real-Time Control Protocol

RTL: register transfer level; also Register Transfer Language

RTP: Real-Time Transfer Protocol

RTSP: Real-Time Streaming Protocol

RTTP: Real-Time Transport Protocol; also seen as **RTP**

rubberbanding: a computer graphics technique that lets lines in an image be stretched and moved as if elastic

rule set

run time (*n*): the time when computer program runs

run-time (*adj*): referring to the time when a computer program runs

runtime (*n*) (*adj*): the measure of the time expended to execute a program

S

s: SI abbreviation for second (for example when part of a compound *30 s, 30 ns*); see *sec*.

S.: "south" in addresses

SaaS: software as a service

SAE: Society of Automotive Engineers

safety: in some computing contexts, a technical term meaning the quality of making sure that nothing bad happens. Safety, for example, ensures that a calculation is performed, but not that the results of the calculation are actually returned to a user or program module. Do not use this term without an explanation; compare with *liveness*.

SAML: Security Assertion Markup Language; an OASIS standard

SAN: storage area network; system area network

SATAN: Security Administrator Tool for Analyzing Networks; do not lowercase the acronym

SAX: Simple API for XML

scalable

ScaLapack: a benchmarking package; see also *Lapack*

scan-in; **scan-out** *(n)*

scan line (*n*): one of the lines that make up a graphics display

scatterplot

Scene: Scientific Computation Environment for Numerical Experimentation, a scientific visualization environment developed at Rutgers

schema: term used in artificial intelligence and in modeling to represent an approach, scheme, or relation precisely and usually diagrammatically. Ensure that the generic *scheme* is inappropriate before using *schema*. Plural is *schemas*, not the Greek *schemata*.

Scheme: an artificial intelligence language

Schrödinger equation: spell with umlaut, not *oe*

SCI: scalable coherent interface

scratchpad: a fast auxiliary computer memory, usually used for temporary data storage

screen dump (*n*), **screenshot** *(n), **screensaver** (*n*)

scroll bar (*n*)

Scrum: a framework for software development

SCSI: Small Computer System Interface; pronounced "skuzzy" and takes *a* as its article

SDI: serial digital interface

SDK: software developer's kit

SDRAM: synchronous DRAM (dynamic random access memory)

SE: "southeast" in addresses

*SEBoK Guide***:** Preferred abbreviated form when referring to the *Systems Engineering Body of Knowledge*

sec.: nontechnical abbreviation for second. Use *s* unless confusion could result.

second sourcing (*n*): in manufacturing, the practice of using an alternate company to

produce something that the original manufacturer designed and produces itself—for example, when the original manufacturer cannot make enough to meet demand

SEI: Software Engineering Institute, a US Defense Dept. research arm (managed by the US Navy) based at Carnegie Mellon University. In *Software*, SEI doesn't need CMU with it.

Semantic Web: an extension of the current Web using standards such as RDF along with ontologies and other mechanisms to define meaning for abstract data to facilitate machine-machine communication

semi-: prefix; do not hyphenate

September 11, 2001 (9/11)

Serial ATA

Series 1000: but *the 1000 series*

servocontroller: *servo* by itself is not sufficient

servomechanism: an automatic feedback system that monitors an operation and makes necessary adjustments; *servo* is not sufficient

set-top box: an interactive television device that sits on top of the television

setup (*n*)*,* **set up** (*v*)

SGI: formerly Silicon Graphics Inc.

SGML: Standard Generalized Markup Language

SGMP: Simple Gateway-Monitoring Protocol

shar: shell archive; a file combination protocol

shrink-wrapped

SI: acronym for the French version of International System of Units, a scientific method of expressing the magnitude or quantity of seven specific natural phenomena

SIA: Semiconductor Industry Association

SIAM: Society for Industrial and Applied Mathematics

SID: Society for Information Display

SIG: special-interest group; see *ACM*

Siggraph; Sigmod

Sigma: a project to develop a software development workstation environment, staffed by a consortium of companies working under the direction of Japan's Ministry of International Trade and Industry (MITI) through the Information-Processing Technology Agency (IPA)

signs: see the *Numbers and Symbols* section

SIIA: Software Information Industry Assoc.

Sim: benchmark

SIMD: single instruction, multiple data—the simplest form of parallel architecture; pronounced "sim-dee" and takes *a* as its article. Spell out on first use if necessary for contextual clarity. Use hyphens when written out and used as a modifier/adjective.

 *   **SIMM**: single, in-line memory module

Simox: separation by implanted oxygen

single-sign-on

single-stuck-at fault model: see *stuck-at*

SIP: Session Initiation Protocol

SITA: Société Internationale de Télécommunications Aéronautiques

sizeable: *Webster's* also uses *sizable*

SkinnyDIP: trademark name for thin-packaged DIP chips (*DIP* stands for *dual in-line package*)

Slim: Software Life-Cycle Management, a project-estimation system developed by Lawrence Putnam

SLOC: source lines of code. Don't spell this out in *Software*.

SLP: Service Location Protocol

small-scale (*adj*)

smart card (*n*)

smart home (*n*), **smart-home** (*adj*)

smartphone (*n*)

SMD: surface-mount device

SME: Society of Manufacturing Engineers and small and medium enterprise

SMEs: small and medium enterprises

SMIL: Synchronized Multimedia Integration Language; use *a* before acronym—pronounced "smile"

S/MIME: secure MIME

SMS: short message service

SMT: surface-mount technology

SMTP: Simple Mail-Transfer Protocol

SNAP: scalable networks and platforms; phrase coined by Gordon Bell and Jim Gray at University of California, Berkeley

SNMP: Simple Network-Management Protocol

SNR: signal-to-noise ratio

SOA: service-oriented architecture; pronounced "soh-uh," as in a SOA

*   **SOAP**: a Web services messaging protocol; originally the acronym for Simple Object Access Protocol, the term is no longer defined in common use

SOC: service-oriented computing; service-oriented collaboration

SoC: system-on-chip (*adj*); system on chip (*n*); systems on chip (*n pl*); abbreviated plural noun form is SoCs.

social media (*n*, *adj*)

social network

soft copy (*n*), **soft-copy** (*adj*)

software engineering (*n*, *adj*)

software-hardware development *(n)*

Softwire

soho: small office/home office

SOJ: small-outline, J-lead

solid modeling (*n*), **solid-modeling** (*adj*): okay to omit hyphen in graphics or visualization publications

son: one of several family words used to describe relationships among nodes in databases; the term is legitimate—don't edit it out

Sonet: Synchronous Optical Network; a Bellcore standard

Sony PlayStation

source code: no hyphen for *n* or *adj*

SPA: Software Publishers Association, now part of SIIA (see entry above); also *scratchpad area* (from IEEE)

spam: junk email

Sparc: Sun Microsystems' *scalable processor architecture*; a RISC-based CPU used primarily in engineering workstations

Sparcstation: examples are Sparcstation IPX and Sparcstation 2

SPC: Software Productivity Consortium, a research group

SPEC: Standard Performance Evaluation Corporation (formerly System Performance Evaluation Cooperative); a vendor-sponsored source of the SPEC benchmarks; examples are the SPECint92 and SPECfp92

speedup (*n*)

Spice: simulation program with integrated circuit emphasis

*   **SPIE**: Society of Photo-Optical Instrumentation Engineers; the organization now styles itself "the international society for optical engineering"

spreadsheet (*n*)

Springer: book publisher; use in all references

*   **SQL**: Structured Query Language

squash-and-stretch (*n*): function that enlarges and reduces, not necessarily in proportion to all dimensions; also called *rubberbanding*

SRAM: static RAM

SRI: Stanford Research Institute

SSH: Secure Shell or Secure Socket Shell; a security protocol

SSI: small-scale integration, typically from one to four circuits

*   **SSL**: Secure Sockets Layer; a security protocol

stand-alone (*adj*)

Staran

Stars: Software Technology for Adaptable, Reliable Systems; a US Defense Dept. project

Star Tap

StartTLS

start-up (*n. adj)*

statechart: not state chart or state-chart

state of the art (*n*), **state-of-the-art** (*adj*): represents the highest level of available technology (as compared with "state of the practice," which is the highest level in general use). It is an overworked phrase; consider substituting "current technology.

state-transition (*adj*)

stereo pair (*n*): two pictures that produce a 3D image

stuck-at (*adj*), **stuck-at fault** (*n*): a type of circuit defect in which a gate can be stuck at either 1 or 0: *stuck-at-1 fault, stuck-at-0 fault*; can also be abbreviated as *SA1* and *SA0*

stuck-open fault (*n*): not synonymous with *stuck-at fault*

stylesheet (*n, adj*)

Styrofoam: use *foam* or *plastic foam* when referring to generic consumer or packaging products; capitalize when used as a trademark

subsystem (*n*)

Sun OS: Sun Microsystems' version of the Unix operating system

SunSoft: division of Sun Microsystems that provides system software

Sun workstation: initial capital on "Sun"; from Sun Microsystems

Sunmos: Sandia/University of New Mexico operating system; an OS for the Intel Paragon parallel supercomputer

super-: no hyphen when used to form a compound word (*supercomputer*)

supercomputer (*n*): no fixed processing speed definition; changes with advances in technology

supermini: short for *superminicomputer*, which is the preferred usage

surface: Do not use as a transitive verb in the sense of "bringing to the top." A whale *surfaces*, but a speaker does not *surface* an idea. If you must give buoyancy to ideas, *float* them. However, *surface* can be used as a transitive verb in the sense of "refining or smoothing a physical surface," as in *surfacing* lumber.

surface-mount device, **surface-mount technology**: board manufacturing method in which chips are "glued" to boards

SW: "southwest" in addresses

SWEBOK Guide: Preferred abbreviated format to use when referring to the *Guide to the Software Engineering Body of Knowledge*.

SWIG: simplified wrapper and interface generator

systemwide

T

* **2D**: two-dimensional, no hyphen
* **3D**: three-dimensional, no hyphen

3DES: (say: "triple DES")

T1: digital transmission at 1.544 Mbits per second; T3 is a faster line

tape out

tar: tape archive; file combination protocol

task ID: use the one-word form, *taskid*, only in program statements

task type: use the one-word form, *tasktype*, only in program statements

Tbyte: terabyte; one billion bytes

TC: technical committee; spell out on first use

Tcl/Tk: a computer language developed by John Ousterhout of UC Berkeley; can also be separate—Tcl and Tk

* **TCP**: Transmission Control Protocol

TCPA: Microsoft's Trusted Computing Platform Architecture, formerly known as Palladium

* **TCP/IP**

TDM: time-division multiplexing

TDMA: time division multiple access

telephone numbers: see the *Numbers and Symbols* section; also *CMS* 6.77

teletext: a noninteractive (broadcast) text/graphics communications system

Teletype: use only when describing Teletype Corp. equipment; generic word is *teletypewriter*

teletypewriter: see above; abbreviated TTY

television: okay to abbreviate as TV

telex: acronym for teletype exchange, a service that permits the transmission of data using commercial telecommunication facilities comprised of a network of teletypewriters

Tell-A-Graf: graphics software by Computer Associates International

Telenet (*n*): Terminal Emulation Protocol; US Sprint's switching network originally developed for Arpanet

testbed (*n*): an environment containing all the components necessary for testing a system

tests (statistical): F-test; t-test, chi-square test; P value; Wilcoxon rank sum test

TeX: see *LaTeX*; pronounced "tech"

Tflops: teraflops; one billion flops

TFT: thin-film transistor

the: When referring to an academic institution's name that starts with *the* (such as the University of Texas), lowercase "the" or delete it. Always delete "the" in a byline. This rule stands regardless of the format on university stationery, seals, and so forth. When referring to a corporate entity whose name begins with "the" (such as the Irvine Company), lowercase or delete "the."

ThinDIP: trademark name for thin-packaged DIP chips; "DIP" stands for *dual in-line package*

Thomas J. Watson Research Center, **T.J. Watson Research Center**: an IBM facility; refer to as *IBM T.J. Watson Research Center* on first use

Thomas J. Watson: when referring to the persons, distinguish between Jr. and Sr.

three-space, **three-dimensional space**: a mathematical term; also 3-space; can be written as S^3 or R^3

throughput

tif: an electronic file format

*   **TIFF**: tagged image-file format; graphics-file format; even though the filename extension is .tif, the acronym is TIFF

tiling: a nonoverlapping approach to window management

time-consuming

time frame

time line: description of events during a particular historical period; **timeline**: a schedule of events or procedures

time-multiplexed (*adj*)

time-out (*n*), **time out** (*v*)

time-shared (*adj*)

time-sharing (*n*): simultaneous use of a central computer by many users at remote locations

time sheet (*n*)

time stamp (*n*)

time step (*n*), **time-step** (*adj*)

time to market

TI OMAP: Texas Instruments Open Multimedia Applications Platform

TIP: terminal interface processor

TLB: translation look-aside buffer

TLS: Transport Layer Security

TMS32010, **TMS34010**: no space between letters and numbers; processors from Texas Instruments

toolbox (*n*), **toolkit** (*n*), **toolset** (*n*): one word when used in computer contexts

tonnes: use "metric tons" instead

TOP: Technical Office Protocol; see *MAP/TOP*

top-down design

touch pad (*n*): a touch-sensitive user interface

touchscreen (*n*): a touch-sensitive user interface

TP0-TP4: Transport Protocol Class 0 to 4; a set of transmission protocols in the ISO protocol suite

traceable; traceback; **traceroute**

trackball (*n*)

trademark: The *registered trademark* (®) symbol indicates that the trademark is registered in the US Patent and Trademark Office; (™) indicates that it is pending. Avoid using trademark symbols in text. However, oblige an author who owns a trademark and insists upon its use. In this case, use the company's name before the product on first reference to establish ownership, for example, Sun's Sbus; thereafter, use the product name by itself.

tradeoff (*n*)*;* **trade off** (*v*)

transition: Do not use as a verb.

transputer (*n*) (**trans**ister com**puter)**: a microprocessor with local memory and communication links. It's both an Inmos product and a generic term.

troff: text run-off; pronounce "tee-roff"; a Unix text-format front-end (coding) and output (printing) processor; variations include **nroff** and **ditroff** (device-independent troff)

Trojan horse

TRON: The Real-Time Operating-System Nucleus, a Japanese computer project to develop hardware and software technology to run household systems that are independent but communicate with each other for smart homes and the like; modules include **MTRON**, **BTRON**, **ITRON**, **CTRON**, and **ITRON**

TSR: terminate-and-stay-resident

TTL: transistor-transistor logic

TTS (*adj*): text-to-speech

t-**test**: a statistical test that deals with the problems associated with inference based on small samples

-tuple: suffix for a set <<of so many>> elements

turnaround

turnkey (*adj*): describes a system delivered ready to run without adding any hardware or software; synonym for *off the shelf*

* **TV**: abbreviation for television

TWAIN: technology without an interesting name—programming interface that lets a graphics application activate a scanner or other image-capturing device

U

UBE: unsolicited bulk e-mail

ubicomp: abbreviation for ubiquitous computing

ubiquitous computing: when it's an adjective, no hyphen in *Pervasive Computing* but hyphenated in other magazines

UCE: unsolicited commercial e-mail

UCS: universal character set

* **UDDI**: universal description, discovery, and integration

UDP: User Datagram Protocol

UI: unit interval; a measure of time

UIMS: user-interface management system; UIMSs (plural)

UIP: user-interface presentation

UIST: user-interface software and technology

UK: United Kingdom (no periods), comprising England, Scotland, Northern Ireland, and Wales; not synonymous with Britain. Do not use UK if the country name is sufficient.

ULSI: ultralarge-scale integration; can be used as a stand-alone noun when referring to the concept but not to physical objects, for example: *ULSI circuit*, *ULSI chip*

Ultracomputer: IBM and New York University's supercomputer

Ultranet

ultrawideband (*adj*.): See also UWB.

UML: Unified Modeling Language. Don't spell this out in *Software*.

UMTS: Universal Mobile Telecommunications System

UN: United Nations (no periods)

underway (*adv*.), **under way** (*adj*.)

uni-: not hyphenated as a prefix (*uniprocessor*)

unicode

UniForum

Univac: Universal Automatic Computer

University *X* at *Y*, or **University *X*, *Y*,** or **University *X-Y***: Follow the specific institution's usage. Although some universities capitalize *the* and consider it part of the university's name, Computer Society style either deletes or lowercases the word. Thus, it is *the Ohio State University* (not *The Ohio State University*) and *the University of Kansas* (not *The University of Kansas*). See also *the*. It's University of California at Santa Barbara, but all other UC campuses use this format: University of California, Berkeley.

Unix: a multilanguage operating system developed at AT&T Bell Laboratories; various versions are in existence

upgradable

UPnP: universal plug and play

uppercase

* **URI**: uniform resource identifier

*   **URL**: uniform resource locator

       URN: uniform resource name

*   **US** (*n*, *adj*): United States; no periods

*   **USB**: Universal Serial Bus

       USENIX

       user-friendly (*adj*): frequently overused; avoid unless appropriate to the context

       username

       USRA: Universities Space Research Association

       UTF-8: Unicode Transformation Format-8

       UUCPnet: Unix-to-Unix copy network

       UWB: ultrawideband, a wireless communication technology

V

V: volts. Examples: *45 V* (*n*); *45-V* (*adj*) *power supply*

v.: abbreviation for *versus* in a legal context (*Smith* v. *Jones*); see also *vs.*

Vac: volts of alternating current (*25 Vac*)

validation: testing a product or product specification to ensure that it meets the requirements (that it has the specified functions); compare with *verification*

Vanet: vehicular ad hoc network

VAR: value-added reseller

variable-length field

VAX: a mainframe made by Digital Equipment Corp.; plural is VAXs; *VAX* reportedly comes from *virtual address extension* (to the PDP-11)

VAX 11/725, **11/730**, **11/750**, **11/780**, **11/782**, **11/785**, **8600**: note slash, not hyphen

VAX/VMS: operating system for VAX computers; *VMS* stands for *VAX Management System*

VCCS: voltage-controlled current source

* **VCR**: videocassette recorder

Vdc: volts of direct current (*25 Vdc*)

VDT: video display terminal, a generic term; not interchangeable with *CRT*

verification: determining whether a product meets its requirements (whether it does what it is supposed to); compare with *validation*

Versabus

VersaDOS

version: capitalize only when used with the name of a product (*Microsoft Word Version 6.0*). An acceptable informal abbreviation (except at the beginning of a sentence) is lowercase *v*, closed up next to a number: "Macsyma v2.0." The word *version* or its abbreviation is not always necessary: "Word 6.0 is a major release."

versus: see *v.* and *vs.*

vertices: plural of *vertex*

* **VGA**: video graphics adapter (or array); an IBM color-display standard allowing 256 colors

VHDL: very high density logic; also VHSIC Hardware Description Language. Don't spell this out in *Pervasive Computing* when it means the latter.

VHSIC: very high speed integrated circuit

via: Use this word sparingly (It means "by way of," "through the medium or agency of," or "by means of.") Often, "through" works just as well and sounds less formal.

VIC: video interface chip

vice president: see *CMS* 8.21; capitalize when referring to the Vice President of the United States

videocassette, videocassette recorder

videoconference, **videoconferencing**

videodisk; **video game**

video on demand (*n*), **video-on-demand** (*adj*), **VoD** (abbreviation)

videotape (*n, v*)

videotex: interactive text/graphics communications system; also known as *viewdata*

video over IP

viewport

virtual memory

virtual reality (VR): In *Computer Graphics and Applications* don't hyphenate this when it's used as a compound adjective. Also, you normally don't need to spell this out in *Computer Graphics and Applications*.

VisiCalc: a financial spreadsheet program from now-defunct Software Arts Products

*   **VLSI**: very large-scale integration. *VLSI* can be used as a stand-alone noun when referring to the concept but not to physical objects—for example, *VLSI circuit*, *VLSI chip*; VLSI also is acceptable for VLSI Technology Inc.

VM: virtual machine; also JVM or Java virtual machine

VMEbus

VMS: VAX Management System, an operating system for DEC VAX computers

Vnet: an IBM internal network

VoD: video on demand (*n*)

voice over IP (*n*), **voice-over-IP** (*adj*), **VoIP** (abbreviation)

von Neumann (*adj*): refers to the concept of storing data and the instructions that apply to that data together; the stored-program concept (*von Neumann sort*; *non–von Neumann architecture*); note that the second example takes an en-dash, not a hyphen

voxel: loosely speaking, a 3D pixel

VPE: visual programming environment

VPL: visual programming language

VPN: virtual private network

VRAM: video random-access memory

Vrije Universiteit, Amsterdam: Free University, Amsterdam. Commonly used acronym (VU University Amsterdam) doesn't work—it's redundant.

VRML: Virtual Reality Modeling Language

vs.: normal abbreviation for *versus*, except in legal context, see *v.*; spell out in text; abbreviation is acceptable elsewhere

VT52, **VT100**, **VT101**, **VT102**, **VT131**, **VT220**: Digital Equipment Corp. video display terminals

W

W: watts (25-W *dissipation*)

W.: "west" in addresses

* **W3C**: World Wide Web Consortium

wafer-scale integration

WAN: wide area network. Don't spell this out in the optional magazines.

WAP: Wireless Application Protocol

Washington, DC

watts

waveform

wave front

wave function

WCGA: World Computer Graphics Association

WDM: wavelength-division multiplexing

WDP: World Data Processing

Web: short name for the **World Wide Web**; **Net** is the short name for the **Internet**

Web browser, Web services

webcam, **webcast, weblog, webmaster, webpage, webserver, website**

well: a well-defined concept; the concept is well defined (don't hyphenate "well" words following being verbs)

WG: see *working group*

Whetstone: benchmarks

whiteboard

white list, white pages

-wide (*suffix*): see *CMS* 7.85, Table 3

wideband (*adj*)

Wi-Fi: wireless products certified by the Wi-Alliance to be interoperable

Wii Remote

wiki: computer software for creating, editing, and linking web pages

Wikipedia: a multilingual, web-based encyclopedia project operated by the Wikimedia Foundation.

wild cards

John Wiley & Sons

WiMax

WIMP: windows, icons, menus, pointing devices

Windows 95/98/NT/2000/Me

WinZip: file compression program

wireframe (*adj*): refers to a line drawing of a 2D or 3D object (a wireframe image)

wire wrap (*n*): a method of making an electrical connection in a circuit by wrapping wires around terminals

wire-wrapping (*adj*): as in *wire-wrapping techniques*

WISC: writable-instruction-set computing

WLAN: wireless local area network

word: a sequence of bits that a processor can act on simultaneously. More bits per word let the processor work on more data simultaneously. A word can be defined in terms of bytes (a two-byte word equals a 16-bit word), but bits are the more common unit; also *Mword*, *Kword*.

word-slice processor

workaround

working group: initial capitals if in a title, for example, "Working Group on Posix Definitions"; lowercase if generic

workflow, workload, workplace, worksheet

workspace: the amount of memory a program requires, over and above the amount necessary to store the program itself

workstation

worldwide

World Wide Web: abbreviated WWW; see *Web, WWW*

WORM: write-once, read-many (times)

WoZ

wrap-up (*n*), **wrap up** (*v*)

WSCI: Web service choreography interface

WSDL: Web Services Description Language; pronounced "whizdle"

WSN: wireless sensor network

WVGA: wide VGA

WWW: see *World Wide Web; Web;* depending on context, abbreviated form acceptable on first reference

WYSIWYG: stands for *what you see is what you get*; acceptable on first reference in departments, but spell out on first reference in feature articles

X

9/07 Xen: open source virtualization software

X.25: the network layer protocol in the ISO protocol suite

X.400: an ISO mail protocol

x-**axis** (*n*, *adj*)

Xbox

X client (*n*), **X-client** (*adj*): see also *X Window System*

XDR: External Data Representation; a protocol

Xenix: an operating system similar to Unix from Microsoft for PCs based on the Intel 8088, 80286, and 80386 chips

Xerox PARC: now just PARC

XGA: extended graphics array; a high-resolution graphics standard introduced by IBM in 1990

XLANG

XLink: XML Linking Language

XMI: XML Metadata Interchange

Xmodem: abbreviated term for *cross-modem*, an error-free file-transfer protocol

*   **XML**: Extensible Markup Language

XMPP: Extensible Messaging and Presence Protocol

XMS: extended memory specification; used to address memory above 1 Mbyte in the 80286 and later CPUs

XMT: extensible MPEG-4 textual format

XNS: Xerox Network Services

XOR: exclusive-OR operation used in cryptography

XPath: XML Path Language

XPointer: XML Pointer Language

x-ray (*n, adj, v*)

XHTTP, XHTML, XML

XT: see *IBM PC*

XScale: an Intel processor

X Window System, **X Windows** (no hyphens): a graphics environment from MIT for Unix workstations

X11 Windows

xy-**plane**, also *yz*-, *xz*-planes

XSL: Extensible Style Sheet Language

XSLT: Extensible Style Sheet Language Transformation

Y

Y2K Problem: the crisis that didn't happen in 2000

YACC: a compiler compiler; a Unix tool

Yahoo

y-**axis**: (*n*, *adj*)

years: to form plural, add an "s": *1990s*; when referring to just the decade, spell out, for example, *nineties*

yellow pages

Ymodem: file transfer protocol

Z

0-day: refers to the timing of viruses released the same day as a patch

z-**axis**: (*n*, *adj*)

z-**buffer**: storage for *z*-axis values for 3D images, sometimes called the "depth buffer"

Z80: a microprocessor from Zenith Data Systems

Z80-A

Zadeh, Lotfi: a pioneer in fuzzy logic; note the first name, often misspelled

ZIP: zigzag in-line package; a file-compression technique; ZIP code

Zmodem: successor to Xmodem and Ymodem