

# Notes on Technical Writing

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# Why bother to write well?

- Professional appearance
  - Like a well-prepared resume
- Well-written material is easier to read

Both of these affect the **impact** of your work.

- If you want your writing to have impact, make sure your message is clear and out in front.

# Common defects

## 1. Unnecessary wordiness:

- The purpose of this transistor is to lower the output impedance.
- This transistor lowers the output impedance.

## 2. Vagueness, obscurity:

- It has been argued [6] that the the benefit is ephemeral.
- Li [6] has argued that the benefit does not last, possibly due to an increasing tolerance for the drug.

## 3. Ultracompactness:

- Identical collinear segmented injectors
- Many small matched injectors in a line

# Rules

Technical writing should be

1. **Concise**, not wordy
2. **Concrete**, not vague
3. **Down-to-earth**, not esoteric or “ultracompact”

# Concise vs. Wordy

- The purpose of this transistor is to lower the output impedance.
  - This transistor lowers the output impedance.
- The reason he left college was that his health became impaired.
  - Failing health compelled him to leave college.
- One might rightly conclude that frequency compensation would be difficult.
  - Frequency compensation is difficult.

# Some enemies of conciseness

- Redundant phrases
  - “it should be noted that. . .”
- Long words
  - utilize vs. use
- Passivity
  - The following items have been recommended by the study group, vs. The study group recommends
- Negative form
  - They did not often arrive on time, vs. They usually arrived late

# Voices

- Passive voice:
  - $B$  is caused by  $A$
- Active voice:
  - $A$  causes  $B$
- Negative form:
  - $X$  is not untrue.
- Positive form:
  - $X$  is true.

# Examples

- Active voice:
  - Widrow has shown. . .
- Passive voice, with agency:
  - It has been shown by Widrow. . .
- Passive, no agency:
  - It has been shown. . .

Passivity encourages vagueness!

1. An investigation is presented. . .
2. Results are derived. . .
3. It has been said . . .



# Concrete vs. Vague

- An investigation into certain second-order effects suggest a revised model for resistive parasitics.
  - we have found that base and collector resistances are current–dependent.
- Certain authors dispute this [2,3].
  - Miller [2] recommends the use of more data, while Gonzales, in his famous study of yield statistics, rejects the while approach [3].

# Vague abstracts and summaries

- An advance in the definition of certain operators is made possible by the application of some recent results in complexity theory. Full details are supplied, and illustrative examples are included. Data on related findings are presented in the final section along with implications for further research.
  - Note the mystery and suspense

# The deadly acknowledgement

- The assistance of my associates Ralph Feinster and Paula Hibbin has been invaluable.
  - I would like to thank Ralph Feinster for telling me about the work of the Stanford group and Paula Hibbin for thorough readings of the manuscript, which resulted in many improvements and corrections.

# Down-to-earth vs. esoteric

- Antipodal diodic phase demodulator
  - Two diodes back-to-back, one to sense positive polarity and one to sense negative.
- Identical collinear segmented injectors
  - Many small matched injectors side-by-side
- Performed with an objective. . .
  - Done with a purpose. . .

# Down-to-earth vs. esoteric

- It is interesting to note that the numerical instability which plagues these algorithms is caused by coefficient roundoff; the problem is summarized in [5].
  - Coefficient roundoff causes the numerical instability that plagues these algorithms; Chen [5] summarizes the problem.

# Down-to-earth vs. esoteric

Without the slightest change in meaning, the second sentence

1. is more concise
2. is streamlined (two passive statements become active)
3. uses citation [5] correctly
4. embeds information in citation, so less obscure
5. avoids misuse of “which”
6. lets the reader decide if it’s “interesting”

# Hyperqualification

- Many of the members of the sample population showed some tendency in the direction of not being very stable.
  - The sample tended toward instability.
- It is almost certain that the greater number of the semiconductors will prove to be of almost no commercial value, but for many the strong possibility remains that they will seem rather interesting to the theoretician and continue for some time to attract a great deal of attention in many laboratories.
  - Most exotic semiconductors may be useless, but they are fascinating.

# What are you really saying?

- “Our proposal follows the sequential itemization of points occurring elsewhere in your RFP, wherever possible, to facilitate your review...”
  - We will follow your outline.
- “Evaluation and Parameterization of Stability and Safety Performance Characteristics of Two and Three Wheeled Vehicular Toys for Riding”
  - Why Children Fall Off Bicycles



# Self-reference

Scholarly authors often get into trouble by trying very hard not to call themselves anything.

This leads to:

- The presumptuous “we”, with single author
  - We have assumed a cardinality no more than  $n$  to the set
- Excessive and awkward use of the passive voice
  - It is then observed that the injected carriers can be found to be mainly absorbed by the junction, and by the use of standard techniques a heavy current can be established to be present.

# Self-reference

- The dangling modifier
  - By applying a forward bias  $V$ , the junction potential is reduced to  $\psi_0 - V$ .
- The use of “author”, sometimes confusingly
  - In his earlier paper, Sturgess advocated Gaussian elimination. The author is now inclined to favor iterative methods.
- Overuse of “one” to mean “I”

# Self-reference

In some cases, uses of “I, me, my, mine” will neatly resolve the problem.

- In his earlier paper, Sturges advocated the use of Gaussian elimination. I am now inclined to favor iterative methods.
- It is thus the considered position of the present author in relation to his previous work [9] as well as to that of others [3,17] that too hasty and perhaps too general assertions may in the past have been made by the aforementioned.
  - I now think that in my review of MOS models [9] I overstated the importance of analytical simplicity, as Bainton and Morrow do also [3,17].

# Self-reference

More often, you need to remove yourself from the picture entirely, and simply describe the situation.

1. We have assumed a cardinality no more than  $n$  to the set.
2. I have assumed a cardinality no more than  $n$  to the set.
3. The proof works only if the set has a cardinality no more than  $n$ .

From Examples (2) and (3):

- Then the junction absorbs the carriers it injected, and a heavy current flows.
- When a forward bias  $V$  is applied, the junction potential falls to  $\psi_0 - V$ .

# Conclusions:

- When you are not an essential part of the story, **leave yourself out!**
  - describe the situation in narrative fashion
- When you are part of the story, bring yourself in directly, not obliquely.

# Word problems

- Plain words often misused:
  - which vs. that (...a date which will live in infamy...)
  - like vs. as (...as a cigarette should!)
  - less vs. fewer (six items or less)
  - was vs. were (if I was the king...)

# Word problems

- Plural words, often misused as singular:
  - data (well, maybe...)
  - strata
  - phenomena
  - criteria
  - media

# Word problems

- Words that are fancy, or easily confused:
  - affect vs. effect
  - allude vs. elude
  - allusion vs. illusion
  - alternately vs. alternatively
  - approve vs. appraise
  - averse vs. adverse
  - capital vs. capitol
  - complement vs. compliment
  - comprise vs. compose
  - continual vs. continuous
  - discreet vs. discrete
  - farther vs. further
  - imply vs. infer
  - principal vs. principle
  - regretful vs. regrettable

Use a dictionary!



# Word problems

- Words that don't exist, or shouldn't:
  - accessorize
  - customize
  - finalize
  - moisturize
  - prioritize
  - importantly
  - irregardless
  - piecewise
  - taxwise

# Word problems

- Words that are frequently misspelled by engineers
  - implement not impliment
  - complement not compliment
  - occurrence not occurence
  - dependent not dependant
  - auxiliary not auxillary
  - preceding not preceeding
  - referring not refering
  - category not catagory
  - consistent not consistant
  - descendant (noun) not descendent
  - its (belonging to it) not it's (it is)

# Punctuation problems

- Apostrophe (its vs. it's, etc.)
  - if letters or numbers are omitted, an apostrophe is always used (there is → there's, 1978 → '78)
- to indicate possession, an apostrophe is usually used (Mary's dog)
  - but not with most possessive pronouns (its, hers, his, theirs, yours, ours, whose)
- Therefore:
  - It's not easy to put the apostrophe in its place.
  - I assume you're satisfied with your purchase.
  - Who's the person whose coat is missing?

# Comma

- Parenthetical expressions are enclosed between commas:
  - Marjorie's husband, Colonel Nelson paid us a visit yesterday.
  - My brother, you will be pleased to hear, is now in perfect health.
  - The best way to see a country, unless you are pressed for time, is to travel on foot.
  - ...unless you agree, that is, and you are willing to sign.

# Comma

- Use commas between the elements of a series with three or more terms:
  - gold, silver, or copper
  - eat, drink, and be leery. — O. Henry
- do not put a comma alone between two complete statements (independent clauses):
  - Stevenson's romances are entertaining, they are full of exciting adventures.
  - It is nearly half past five, we cannot reach town before dark.

# Comma Options

## 1. Option 1:

- Stevenson's romances are entertaining; they are full of exciting adventures.
- It is nearly half past five; we cannot reach town before dark.

## 2. Option 2:

- Stevenson's romances are entertaining. They are full of exciting adventures.
- It is nearly half past five. We cannot reach town before dark.

## 3. Option 3:

- Stevenson's romances are entertaining, for they are full of exciting adventures.
- It is nearly half past five, and we cannot reach town before dark.

# Hyphenation

Used to group terms that form an adjective and precede the word they modify:

- A well-designed unit.
  - This unit is well designed.
- A field-effect transistor.
  - A device based on field effect.

# Mathematical writing

- Symbols in different formulas **must** be separated by words.
  - BAD: Consider  $S_q$ ,  $q < p$ .
  - GOOD: Consider  $S_q$ , where  $q < p$ .
- **Never** start a sentence with a symbol.
  - BAD:  $x^n - a$  has  $n$  distinct zeroes.
  - GOOD: The polynomial  $x^n - a$  has  $n$  distinct zeroes.



# Mathematical writing

- Avoid the use of the symbols  $\Rightarrow$ ,  $\forall$ ,  $\wedge$ ; replace them by the corresponding words. (Unless you are writing a paper on logic.)
- The statement just preceding a theorem, algorithm, etc., should be a complete sentence or should end with a colon.
  - BAD: We now have the following  
**Theorem.**  $H(x)$  is continuous.
  - GOOD: We can now prove the following result.  
**Theorem.** The function  $H(x)$  defined in (5) is continuous.

Even better: replace the first sentence by something more suggestive.

# Mathematical writing

- The statement of a theorem should be self-contained, and not depend on the preceding text.
- Display important formulas on a line by themselves.
- Don't get carried away by subscripts, especially when dealing with a set that doesn't need to be indexed; set element notation can be used to avoid subscripted subscripts.

# Mathematical writing

For example, it is often troublesome to start out with a definition like “Let  $X = \{x_1, x_2, \dots, x_n\}$ ” if you’re going to need subsets of  $X$ , since the subset will have to be defined as  $\{x_{i_1}, x_{i_2}, \dots, x_{i_m}\}$ , say. Also, you’ll need to refer to elements  $x_i$  and  $x_j$  all the time. Don’t name the elements of  $X$  unless necessary. Then you can refer to elements  $x$  and  $y$  of  $X$  in your subsequent discussion, without needing subscripts.

# Mathematical writing

- In general, don't use jargon unnecessarily. Even specialists in a field get more pleasure from papers that use a nonspecialist's vocabulary.
  - **BAD:** "If  $\mathbf{L}^+(P, N_0)$  is the set of functions  $f : P \rightarrow N_0$  with the property that  $\exists n_0 \in N_0 \forall p \in P p \geq n_0 \Rightarrow f(p) = 0$  then there exists a bijection  $N_1 \rightarrow \mathbf{L}^+(P, N_0)$  such that if  $n \rightarrow f$  then  $n = \prod_{p \in P} p^{f(p)}$ . Here  $P$  is the prime numbers and  $N_1 = N_0 \sim \{0\}$ ."
  - **GOOD:** "According to the 'fundamental theorem of arithmetic', (proved in ex. 1.2.4-21), each positive integer  $u$  can be expressed in the form  $u = 2^{u_2} 3^{u_3} 5^{u_5} 7^{u_7} 11^{u_{11}} \dots = \prod_p \text{prime } p^{u_p}$ , where the exponents  $u_2, u_3, \dots$  are uniquely determined nonnegative integers, and where all but a finite number of the exponents are zero."

# Mathematical writing

- Don't use the same notation for two different things. Conversely, use consistent notation for the same thing when it appears in several places. For example, don't say " $A_j$  for  $1 \leq j \leq n$ " in one place and " $A_i$  for  $1 \leq i \leq n$ " in another unless there is a good reason.
- The opening paragraph should be your best paragraph, and its first sentence should be your best sentence.
- Read what you have written and change the wording if it does not flow smoothly.

# Mathematical writing

- Vary the sentence structure and the choice of words, to avoid monotony. But use parallelism when parallel concepts are being discussed. Avoid words like “this” or “also” in consecutive sentences; such words, as well as unusual or polysyllabic utterances, tend to stick in a reader’s mind longer than other words.
- Motivate the reader for what follows. Keep the reader uppermost in mind: What does the reader know so far? What does the reader expect next?
- Don’t use the style of homework papers, in which a sequence of formulas is merely listed.

# Mathematical writing

- Many readers will skip over formulas on their first reading of your exposition. Therefore, your sentences should flow smoothly when all but the simplest formulas are replaced by “blah” or some other grunting noise.
- The word “we” is often useful to avoid the passive voice. This use of “we” should be used in contexts where it means “you and me together”, and not a formal equivalent of “I”. Think of a dialog between author and reader. In most technical writing, “I” should be avoided, unless the author’s persona is relevant.
- Don’t omit “that” when it helps the reader parse the sentence.
  - BAD: Assume  $A$  is a group.
  - GOOD: Assume that  $A$  is a group.

# Mathematical writing

- Don't say "which" when "that" sounds better. The general rule nowadays is to use "which" only when it is preceded by a comma or by a preposition, or when it is used interrogatively. Experiment to find out which is better, "which" or "that", and you'll understand this rule.
- Resist the temptation to use long strings of nouns as adjectives: consider the packet switched data communication network protocol problem.
- The normal style rules for English say that commas and periods should be placed inside quotation marks, but other punctuation (like colons, semicolons, question marks, exclamation marks) stay outside the quotation marks, unless they are part of the quotation.



# Mathematical writing

- On the other hand, punctuation should always be strictly logical with respect to parentheses and brackets. Put a period inside a parentheses if and only if the sentence ending with that period is entirely within the parentheses. The punctuation within the parentheses should be correct, independently of the outside context, and the punctuation outside the parentheses should be correct if the parenthesized statement would be removed.

**Bad:** This is bad, (although intentionally so.)

- Small numbers should be spelled out when used as adjectives, but not when used as names.

# Mathematical writing

- Capitalize names like Theorem 1, Lemma 2, Algorithm 3, Table 4, Method 5, Figure 6.
- The Princeton University Press has dictated that the following words should not be hyphenated: nondeterminism, nonnegative, nonzero, etc.
- - GOOD: i.e., foo and e.g., foo
  - BAD: ie foo, i.e. foo, e.g. foo
- Initials
  - (1) D. O. Smith — CORRECT
  - (2) D.O. Smith — WRONG
  - (1) Ph.D. degree — CORRECT
  - (2) PhD degree — CORRECT (Adnan's choice)

# Mathematical writing

- Note the difference between an intra-word dash or hyphen, as in X-ray, a medium dash for number ranges, like 1–2, and a punctuation dash—like this.
- When using L<sup>A</sup>T<sub>E</sub>X, note that the separation between a sentence ending period and the next word is more than the separation between words. Consequently, look out for problems with Dr. Aziz, as opposed to Dr. Aziz. (Use a tilde to join the period.) Similarly, you don't want to ever have Figure 5 broken, or a citation like Li [5] broken; use tildes to join them.
- When in doubt read Don E. Knuth.
- L<sup>A</sup>T<sub>E</sub>X is vastly superior to those “what-you-see-is-all-you-get” tools.

# Sources

1. *EE290ls class*. R. K. Brayton. Berkeley, Spring 1991.
2. *Mathematical Writing*. Knuth, *et al.* MAA Press, 1989.