

# Scholarship Skills, Lecture 6

Scholarship Skills

**Scholarship Skills**

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**Lecture 6: Mathematical notation, footnotes, figures and tables and lots of other text elements**

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Todd Leen – 2001, 2006

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**Mathematics**

Core rules apply here, too

- Organize to help the reader
- Be simple
- Use a consistent lexical set (variable names and symbols).

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## Mathematical Notation

See Dupre, Segments 94, 118

Italicize variables in the text

The loop exits when  $n$  exceeds  $m$ .

(If you use Latex, set variables in text in math mode)

The loop exits when  $n$  exceeds  $m$ .

But abbreviations (log, max, sin) and numerals should be roman

$\log 2^x$

(Latex does this for you!)

```
$ \log 2^x $
```

Be careful of similar symbols

$A$   $\mathcal{A}$

$\$A\$$  vs  $\{\cal A\}$  in Latex

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## Subscripts and Superscripts

A term is something added, a factor something multiplied

The  $a^2$  factor in  $3a^2(b + c)$

Try to avoid subscripts and superscripts in computer science

Consider computing the greatest common divisor of  $n_1$  and  $n_2$ .

but engineering and physics writing relies on them to indicate vector, matrix, and tensor components, as well as items in a sequence

$$G_{\mu\nu} = 8\pi T_{\mu\nu}$$

$$V_i = \sum_{j=1}^M A_{ij} x_j$$

$$a_i, i = 1, 2, \dots, N$$

Little of computer science, engineering, or even physics is inherently deep enough to require double subscripts. Find a clearer notation.

How to avoid subscripts?

- different letters
- turn into function application

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### Simplify Notation

If you find  $i-1$  is a subscript more often than  $i$ , consider using  $i$  and  $i+1$

$$t_i = r_{i-1} + s_{i-1}/t_{i-1}$$

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### Formulas

If a big messy formula occurs more than once, factor it out, especially if you want the reader to see the repetition

$$2^b + (a+1)^i(b+1)^{k-i} + c^3$$
$$a^2(a+1)^i(b+1)^{k-i}b^2$$

In a summation, "constants" should go first

$$\sum_{i=1}^N T x_i$$

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## Inline and Displayed Math

Math is set either in-line

... where  $d=C_0f$  is the drag coefficient ...

or as a display object (in its own indented paragraph)

the maximum likelihood estimator for the noise variance is

$$\sigma_{ML}^2 = \frac{1}{d-q} \sum_{j=q+1}^d \lambda_j \quad (3.13)$$

Anything longer than about a dozen characters should be typeset as a display object.

Everything that you refer back to should be set as a display object and numbered!

If the formatting forces a line break in a math expression, typeset it as a display object.

What about page breaks?

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## Ellipses in Expressions

Use baseline ellipses for a list

2, 4, 6, ... , 28

(in Latex)

\$ 2, 4, 6, \ldots , 28 \$

Use centered ellipses for a series of operations

2 + 4 + 6 + ... + 28

(in Latex)

\$ 2 + 4 + 6 + \cdots + 28 \$

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### Make Sure Ellipses Can Be Filled in

Ask yourself if it's obvious how to fill in the sequence

$x, y, z, \dots$

$p_1, p_2, \dots, q_j$

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### Numbering Equations

Displayed equations can be set with or without numbers

Following simplification we obtain

$$\mu = (a + b)^5 \exp(-\lambda) .$$

This equality shows that ...

OR

Following simplification we obtain

$$\mu = (a + b)^5 \exp(-\lambda) . \quad (5)$$

Equation (5) shows that ...

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## Numbered vs. Un-Numbered Equations

I (Todd) rarely use un-numbered equations. It's not taboo, but I reserve it for items that definitely won't need to be referred to

- later in the text
- by a reviewer
- by someone leading a reading group

## Numbering Equations 2

Use numbers when you will need to refer back to the equation further along in the paper. Use numbers when the equation is a primary definition or result.

Recalling the expression for  $m$  in Equation (3),

is easier on the reader than

Recalling the expression for  $\mu$  derived above,

## Numbering Equations 3

Numbering equations also facilitates the review process and discussion among readers.

"In Equation (3), the author ..."

is easier than

"In the second equation following the first full paragraph in Section 2, the author ..."

*Core Rule: Organize to Help the Reader*

## When to Include Mathematical Detail

Guideline: You should include enough detail so that someone well versed in the area can reproduce the results of the paper.

You can put lengthy derivations or proofs that break up the flow of the text into an appendix (but not when the technique used is part of the creative contribution of the paper).

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### When to Include Mathematical Detail

In conference papers or letters, space limitations preclude giving much detail.

But tell the reader in a few words how you arrived at the result. (Again, a reader well versed in the area should be able to reproduce the results.)

Instead of

We approximate equation (43) as ...

use

Using the Green function for the operator in equation (27), expanding about  $C=0$  and retaining terms through second order, we can approximate equation (43) as ...

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### Latex vs. WYSIWYG Editors

If you're going to write anything mathematically extensive (e.g. more involved than your zip code), learn Latex. (Todd speaking)

- Latex is easier to use than Equation Editor, MathType, or the equivalent (lame) tool in FrameMaker.

Markup languages make it easy to do global changes to variable names, operator symbols, and formatting (such as changing spacing between operators and arguments).

Markup languages let you define macros for complex formulae or frequently used operators.

Markup languages frequently have well-designed specialized type elements like operators (e.g. integrals, summations), subscripts and superscripts. In Equation Editor, you have to fiddle with the spacings, font sizes, and offsets to get something attractive. This is a big waste of time, unless you consider yourself a Font Designer.

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### Latex vs WYSIWYG Editors

- LaTeX is SAFER than Equation Editor, MathType, or the equivalent (lame) tool in FrameMaker.

Equation Editor is mouse-intensive and so more likely to cause repetitive motion injuries.

- Unless you memorize the obscure hot-keys for Equation Editor or MathType, Latex is faster.

Latex commands are intuitive and quick to memorize.

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### Latex vs. WYSIWYG Editors

- Latex source is the standard for many engineering and physics journal final submissions (and at least one computer science journal). (Conferences usually specify camera-ready copy and offer formatting guides for several typesetting tools.)

- Latex math typesetting often looks a bit better than the default settings on Equation Editor, and it seems to scale better with overall size changes.

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## Final Thoughts on Math

Use some words following equations. You should tell the readers the important conclusion they should draw from the equation. Don't assume that they'll get the thrust without making it clear.

This addition also forces you to interpret results, rather than just state them, a generally good intellectual process. It forces you to think about the results.

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## Moving On

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## Footnotes and Parenthetical Comments

Use them sparingly.

If the main text is unclear or incomplete without the footnote or comment, it should probably be rewritten.

Don't use a footnote to rewrite something already stated in the main text. Instead, regard footnotes as *parenthetical remarks*; that is, something the reader can skip the first time through without losing vital information.

```
A hash table (which is a frequent database
access method) gives good performance on single-
item lookups. Other common access methods are
...
```

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## Figures and Tables

Put meaningful and *informative* captions on figures and tables

```
Table 3. Performance characteristics.
```

```
Table 3. Comparative performance of simulated annealing and
Monte Carlo methods on join planning.
```

Use distinct captions on different figures

Use the same name formats between text and figure.

(Core Rule: Use a consistent lexical set.)

```
Buf1 Buf_1
```

You should have no tables or figures that are not pointed to explicitly in the main text. Call out (or cite) every figure, table and graph in the text.

```
Tells the reader when to look at the figure or table
```

Tell the reader what to notice in figures and tables. Don't assume they'll know what to attend to without telling them.

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## Captions

Include a figure or table number.

Captions should be informative and describe all frames in the figure

Figure 2 (a) Plot of the posterior mean for each point in the latent space. (b) Plot of the 12-dimensional data projected onto the 2-dimensional subspace that maximizes the negentropy. (c) Plot of 12-dimensional data projected onto 2-dimensional principal subspace.

## Captions

Include a credit for material from another source -- copied or adapted.

Fig. 3 Univariate factor analysis of IQ test data. (Adapted from *The Mismeasure of Man*, Stephen J. Gould, W.W. Norton & Co., 1996. Used with permission.)

Make sure that you do get permission before using such material!

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### Callouts

"Call out all figures, tables, programs ..."  
(Dupré, Segment 62)

Figure 3(a) shows the results using a nonlinear GTM mapping under the conditions reported by Bishop et al. [4].

Use single numbers (as above) for articles, double numbers such as "Figure 4.3(a) shows ..."  
for the third figure in the fourth chapter of a book or thesis.

The order of appearance of figures or tables should match the order that they are called out in the text.

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### Callouts

Capitalize the words "Figure" and "Table" when used with a number.

The results with this modified algorithm are shown in Figure 3.

Don't use a buried callout the first time you refer to a figure or table.

After the modification, the results are improved (see Figure 3).

However, you can use this format for subsequent references to the figure or table.

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### Callouts

If the figure or table uses information from another source, give the credit in the figure caption, not the text. (Puts credit line close to information.)

As part of the callout, make sure to tell the readers what they should notice about the figure (or table, or code block). Don't assume that they will get the major point themselves. They might see something entirely different in the figure!

Make sure elements in the figure match the elements in the text

### Tables

Number tables and call them out in the text and tell the reader what to pay attention to in the table.

Give only information that you're going to discuss. (Avoid clutter, be concise ...)

Write a title or caption for each table.

Set off headers with a horizontal line.

Set off row labels with a vertical line.

## Tables

Indicate units in the column header.  
Keep style consistent between tables.  
Don't use too many vertical and horizontal rule lines in the body of a table -- they add visual clutter. (They do help if tables have many lines.)  
Align columns of numbers on the decimal point, and use leading zeros (e.g. 0.5).

## Code

Use a different font for typesetting a code block, and indent the code block.  
Dupré (Segment 94) suggests using a monospace font such as `Courier`.  
Monospace fonts use the same amount of horizontal space for each character, like a typewriter does.  
(Does anyone remember typewriters?)

### Code

Some folks claim that you should distinguish code blocks further by using a sans-serif font for them if your text is set in a serif font -- or vice versa.

Serif Fonts -- Times Roman, Garamond, Palatino

Sans Serif Fonts -- Arial, Helvetica, Lucida

Set large blocks of code as a numbered figure or box.

### Graphs

Keep graphs and charts uncluttered.

- Work as hard to make figures clear as you do to make your text clear.
- Only include information that you're going to refer to in the text.

*Core Rules: Be Concise, Be Simple*

Label axes!

Use REALLY BIG fonts for axis labels and tick mark numbers. Your figure will be reduced in size when typeset.

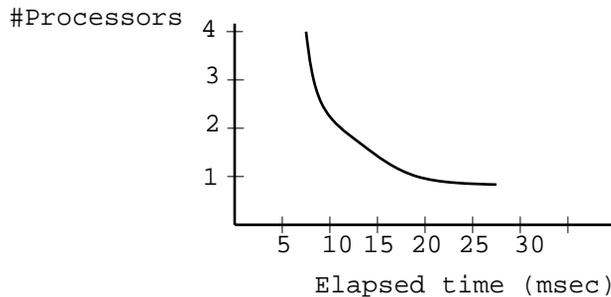
(If you use MatLab to generate figures, use 16 point fonts or larger for the figure axes.)

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### Graphs

Independent axis generally goes along the bottom.



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### Graphs

Where several curves or data point classes are given, use different line types or marking symbols and provide a legend. Keep fonts in the legend large so they're legible.

Look at Tufte's beautiful book *The Visual Display of Quantitative Information*.  
Graphics Press, Cheshire, CT, 1983.

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## Lists

Keep lists and references to them in the same order

We cover three basic tree-traversal methods: in order, pre-order, and post-order. With pre-order, the parent node is visited ...

Consider setting off lists typographically

Keep lists pure—readers assume that elements will be of like kind

### **Stony Brook Travel**

Cruises  
Airline Tickets  
Trains  
Golf Buffs

## Lists 2

Watch for list splices

With a cache size of  $M$ ,  $P_1, P_2, \dots, P_n$  are accessed one-by-one.

Don't use etc. when the reader of the list is unlikely to fill in the rest of it.

The stable marriage problem has been explored by Floyd [21], Sedgewick [34], etc.

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### List Structure

From Dupré, Segment 26

In-text Lists -- short lists, together the entries are a sentence. Separate entries are not sentences. Separate entries should be separated by commas or semicolons.

We discuss three types of models: (1) parametric, (2) nonparametric, and (3) semi-parametric.

We discuss several types of models: parametric, nonparametric, and semiparametric.

Please do the following: Rewrite the exercise, paying close attention to the *core rules* for writing; read the assigned sections in the text; and complete the new exercise.

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### Lists

If at least one entry needs to be a complete sentence (with a period), then don't use a list format but instead use running text.

Our marketing strategy will include several actions. First, we will organize a kickoff meeting. Second, we will write to all the magazines in the field, and get them to review our product. Third, we will rent booths at several conferences. Finally, we will purchase two mailing lists, and send out brochures.

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## Lists

### Displayed lists

We tried several alternatives:

1. Unimodal density estimates
2. Mixture model density estimates
3. Parzen window density estimates

## Personal Pronoun: I or We

"I" is not used much in technical writing, though not unheard of

"We" is okay for a single author as long as it means you're taking the reading by the hand and leading them along

We next come to the case where  $n$  is prime.

or if you're describing what you did

We then tried reducing the number of queues.

Pick a personal pronoun and use it. Avoiding using any personal pronouns can lead to sentences in passive voice.

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### Tense

Try to use the present tense as much as possible. Reserve past tense for referring to previous parts of the text.

A theorem stays true over time.

Recall that in Chapter 2 we proved that every integer had a unique prime factorization.

Look again if you find yourself changing tense in the middle of a paragraph.

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### Subjunctive, Idioms

Avoid the use of “would” if you actually did something.

Doubling the cache size would result in a third as many cache misses.

Be careful with idioms—will all your readers know them or be able to infer them from context?

The language LIKON is just a strawman.

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### Clarity

Don't intentionally try to baffle the reader.  
A reader (or listener) is most impressed when he or she learns something without a big struggle

Make sure material stands by itself  
Don't rely on section headings

**Section 3.2 Simulated Annealing**  
This randomized method ...

Make sure tables have labels on columns and give units. Make sure graph axes are labeled.

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### Extra Information Can Confuse

[Core Rule: *Be concise.*]

Don't say "A or B" if  $A = B$ , unless

If duplicates are allowed, the algorithm will be  $O(n^2)$  or quadratic.

Don't repeat information immediately

This class of applications requires multimodal interfaces with interactive response. These multimodal interfaces with interactive response can reduce ...

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### Ambiguity

[Core Rule: *Be clear.*]

Can your text be misread, or could it require backtracking.

The interface points to the database schema

Singular form in descriptions can eliminate some ambiguity.

The databases have table definitions and constraints.

The -ing form of a verb — might modify verb phrase or noun.

Kim transformed nested queries into flat queries using join.

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### Terminology

If you appropriate a term for a new concept, make sure it won't conflict with the common usage and that it has the right connotation.

We will call an algorithm *big* if its space complexity is quadratic or greater.

We will call a time series with sudden changes in direction *goofy*.

In creating and explaining terms, figure out what they are the "unit of"

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### Help for the Reader [Core Rule: *Be simple*]

- Break up long noun phrases (beware of 5 words or more)

This value is compared to the latency feedback policy packet rate adjustment range limit.

- Give names to specific objects.

The root node is guaranteed to have a left child and a right child.

...

The right child of the root must have a larger value ...

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### More Help for the Reader

- Don't change technical terms unnecessarily. [Core rule: *Use a consistent lexical set.*]

Each table contains multiple rows, each with one or more fields. The records are the unit of insertion and deletion.

- Don't assume programming language code is self-describing.

Understanding may hinge on style or naming conventions the reader doesn't know.

```
(IMPLIES (NOT (LISTP A))  
         (EQUAL (APPEND (APPEND A B) C))  
         (APPEND A (APPEND B C))))
```

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### Brevity

[Core Rule: *Be concise.*]

Wordiness hampers understanding.

Learn to filter out “filler words” from your writing.

Try to remove words that are not specific to the domain of discourse.

This change would create a situation where a query could give two answers.

The purpose of this attempt is to be able to measure the effect of double buffering.

The user needs an understanding of the underlying ...

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### Brevity 2

Seek words that advance the sentence. Do your words add new information?

We investigate the process of data flow analysis.

If you are using a “perform” verb with a noun, look for a verb form of the noun.

The designer must make a judgement whether ...

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### You Try It

During the course of this investigation ...  
In order to explore the ramifications of ...  
Two potential problems that can occur when  
trying to combine a hash table with a B-  
tree ...  
This observation provides an explanation of  
the difference ...  
We added a module for the management of  
exceptions ...  
An explanation facility that would provide  
users with help in selecting the  
appropriate ...  
We conducted interviews with four groups ...  
In the face of this exciting opportunity,  
however, there are several changes that  
need to be made to existing query engines  
to make them applicable for the task of  
querying the Internet.

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### Repetition

Okay when used to clarify, or to keep  
sentences or clauses *parallel*.

The search process proceeds from  
parent to child. Each child is  
visited after its parent.

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