

Mathematical Notation

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1999, 2000, 2015-19

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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).

Mathematical Notation

See Dupré, 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 gets it right.)

$\log 2^x$

$\log 2^x$

A term is something added, a factor something multiplied

The a^2 ~~term~~ ^{factor} in $3a^2(b + c)$

Have Conventions for Variables

scalar values: a, b, c

n-tuples: t, u, v, w

relations: q, r, s

relation schemes: **Q, R, S**

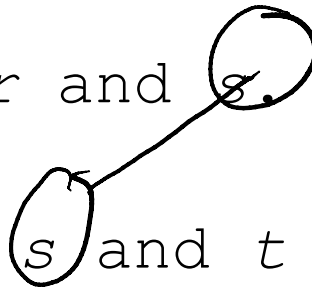
Observe the culture in your area.

Avoid “puns”.

Consider relations r and s .

...

Take any two tuples s and t in r .



More on Variables

Don't start a sentence with a lowercase variable

Let r ~~is~~^{be} the ratio of reads to writes. ~~Select~~
 Including Greek: ~~Operator~~ σ denotes ~~select~~
 ~~σ~~ is the select operator. ~~is~~ denoted σ .

Name things for later use.

Suppose we want to find all matches to a pattern P in a sequence. ...

After finding the first match of P the pattern, we reset the cursor.

Abbreviations, If and Only If

Avoid abbreviations.

- iff, s.t., wlog
- Moduli m and n are relatively prime ~~\Rightarrow~~ ^{implies} the sequence is maximal.
- The number of false positives is $>$ ^{greater than} ~~the~~ number of false negatives.

You don't need "if and only if" in a definition.

Definition: Group G is *Abelian* if ~~and only if~~ its operator is commutative.

Subscripts and Superscripts

Try to avoid subscripts and superscripts

Consider computing the greatest common divisor of $\frac{n_1}{m}$ and $\frac{n_2}{n}$.

Little of computer science is inherently deep enough to require double subscripts. Look for a clearer notation.

Plus, it takes effort to distinguish x_{n_i} from x_{n_j}

x_{n_i} x'_n x_{n_i} x_{n_j}

How to avoid subscripts?

- different letters
- turn into function application or array notation

Simplify Notation

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

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

$$\forall i. \quad t_i = r_{i-1} + \frac{s_{i-1}}{t_{i-1}}$$

$$t_{i+1} = r_i + s_i/t_i$$

$$\forall i. \quad t_{i+1} = r_i + \frac{s_i}{t_i}$$

Formulas

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

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

$$a^2 \underbrace{(a+1)^i (b+1)^{k-i} b^2}$$

$$r = (a+1)^i (b+1)^{k-i}$$

$$2^b + r + c^3$$

$$a^2 r b^2$$

In a summation, “constants” should go first

$$\sum_i x_i \cdot T \quad \rightarrow \quad \sum_i T \cdot x_i$$

Inline and Displayed Math

Math is set either *in-line*

... where $d = C_0 f$ is the drag coefficient ...

$$d = C_0 f$$

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.

Ellipses in Expressions

Use baseline ellipses for a list

2, 4, 6, ..., 28

(in LaTeX)

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

2, 4, 6, ..., 28

Use centered ellipses for a series of operations

2 + 4 + 6 + ... + 28

(in LaTeX)

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

2 + 4 + 6 + ... + 28

LaTeX gets the spacing right!

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

$p_1, p_2, \dots, p_i, f_1, f_2, \dots, f_j$

Numbering Equations

Use equation numbers when you, or someone else, will need to refer back to the equation further along in the paper.

Recalling the expression for μ in Equation (3),

is easier on the reader than

Recalling the expression for μ derived above,

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.

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 ...

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 to state them***, a generally good intellectual process.