

3.4 Abbreviations and acronyms

In British use, as a rule of thumb, a full stop is placed after an abbreviation only when the abbreviation does not end on the same letter as the word being abbreviated. For example, “Dr” does not get a full stop, but “Prof.” does; note that both are capitalised. Also remember that line breaks between a title and a surname should be prevented by the ~ character. In American use, this rule of thumb seems not to apply, and all titles are followed by a full stop.

The use of upper- or lowercase forms of abbreviations and acronyms are determined by usage rather than logic [1, ¶15.7]. Therefore, consult a dictionary if you are uncertain. As a rule of thumb, abbreviations that function as nouns are usually written in uppercase (HTML, HIV), but those that function as adverbial phrases are usually written in lowercase (rpm, mph). Acronyms tend to become lowercase the more they are used (Aids, laser).

The abbreviations “i.e.” for *id est* (“that is”) and “e.g.” for *exempli gratia* (“for example”) are always followed by commas. Also, do not leave out the full stops. Unless space comes at a premium, rather use English (or Afrikaans) equivalents in prose.

References

- [1] *The Chicago Manual of Style*. The University of Chicago Press, Chicago and London, fifteenth edition, 2003.
- [2] Will Fitzgerald. As simple as possible, but no simpler. <http://www.entish.org/wordpress/?p=638>, September 2007.
- [3] Donald E. Knuth. *The T_EXbook*. Addison-Wesley, Reading, Massachusetts, 1986.
- [4] Donald E. Knuth, Tracy Larrabee, and Paul M. Roberts. Mathematical writing. Report based on a course of the same name given at Stanford University, 1987.
- [5] Leslie Lamport. *L^AT_EX: A Document Preparation System: User’s Guide and Reference Manual*. Addison-Wesley, Reading, Massachusetts, second edition, 1994.
- [6] John Ralston Saul. *The Unconscious Civilization*. Penguin, London, 1997.
- [7] Robin Zahir. the open space between form and formlessness: radical typography in the poetry of e.e.cummings. http://a.parsons.edu/~robin/2004/fall/major_studio_i/type/exp/typography.pdf, 2004.

Style and common L^AT_EX mistakes

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Note: L^AT_EX is a set of macros on top of T_EX. Macros are simple, high-level commands that “expand” to complex, low-level commands. So, L^AT_EX commands expand to T_EX commands. In the sequel, I mostly write “L^AT_EX”, but when discussing features handled directly by T_EX, without help or interference from L^AT_EX, I write “T_EX”.

1 Text

1.1 Quotation marks

Quotation marks often confuse L^AT_EX beginners. Plain-text documents, for historical reasons, typically use one symbol (') for both opening and closing single quotes (and apostrophes), and another symbol (") for both opening and closing double quotes. Professionally typeset documents, however, use different symbols for opening and closing quotes.

In L^AT_EX, left and right single quotes are produced by the keyboard characters ` and ', respectively. For left and right double quotes, these must be repeated so that they become the sequences `` and '' , respectively.

Consider the following sentence, formatted as plain-text:

```
"Yes," she said, "that is my father's car."
```

Given as L^AT_EX input, it produces the following output:

```
"Yes," she said, "that is my father's car."
```

Note that the double quote input characters were all typeset as *right* double quotes—the " character does not distinguish between left and right quotes in L^AT_EX. Instead, the sentence should be entered thus:

```
``Yes,'' she said, ``that is my father's car.``
```

This yields:

```
“Yes,” she said, “that is my father’s car.”
```

And we are happy at having produced typographically correct left and right quotes.

Double quote characters in plain-text Don't be tempted to use " for right double quotes in the input. Some L^AT_EX packages redefine this character to mean something else, leading to unexpected consequences should it be used to input a quote. Use " only if you have imported such a package, and (especially) then, never to input a right double quote.

Spacing with repeated quotes Be careful when quotations are nested. L^AT_EX scans the input from left to right, so that

```
He said, ``I am `T-Rex'`---he smiled---``really!``
```

is typeset as

```
He said, “I am ‘T-Rex’”—he smiled—“really!”
```

quotation marks, unless they are part of the quotation. Here I distance myself from the Americans and prefer what I was taught when writing for courses in the humanities: Only punctuation marks that are part of the quotation appear inside the quotation marks.

Keeping unnecessary punctuation outside of the quotation marks minimises the possibility for confusion. For example, consider the following sentence:

```
Every program must end on the string “end.”
```

It is not clear at all whether the full stop is part of the direction on how to end a program. Keeping the full stop outside the quotation makes it clear that “end” is the keyword and that a program must end, without full stop, on the word “end”.

3.2 Dashes

In addition to the hyphen—which should never be used as a dash—T_EX offers two dashes, the en-dash “–” and the em-dash “—”, entered as -- and ---, respectively. The en-dash is mainly used to connect two numbers and then means “up to and including”. However, never use an en-dash when the first of the numbers is preceded by “from”. The following examples show correct usage:

```
In the years the problem was first studied, 1979–81, the scientists  
were thought mad.
```

```
Dr Drofstats ran the laboratory from 1997 to 2003.
```

In running text, the en-dash could be used as a minus sign. However, in L^AT_EX such use would not give the correct spacing around the dash; therefore, rather use math mode.

The em-dash is very versatile, but I point out only one important use: Like commas, parentheses, or a colon, an em-dash or a pair of em-dashes may set off an amplifying or explanatory statement. For an example, refer to the first sentence of this subsection.

3.3 The empty set

I most emphatically do not like the default T_EX symbol for an empty set, \emptyset . Maybe it has to do with reading too many ugly dot-matrix computer printouts when I was younger: In those printouts, to distinguish between the capital letter “O” and the zero “0”, zeros⁸ typically had a strike-through line from the bottom left to the top right. Therefore, for the empty set, I prefer the symbol \emptyset , produced by the `\varnothing` command, and made available by the $\mathcal{A}\mathcal{M}\mathcal{S}$ -L^AT_EX packages.

⁸Please note the spelling of the plural of the cardinal zero.

since feeling is first

e. e. cummings

since feeling is first
who pays any attention
to the syntax of things
will never wholly kiss you;
wholly to be a fool
while Spring is in the world
my blood approves,
and kisses are a better fate
than wisdom
lady i swear by all flowers. Don't cry
—the best gesture of my brain is less than
your eyelids' flutter which says
we are for each other: then
laugh, leaning back in my arms
for life's not a paragraph
And death i think is no parenthesis

In scientific publishing, I dare say, you will rarely have the opportunity to worry about the finer points of quoting—you will probably be paraphrasing. You will, however, sometimes use what is called “scare quotes”—here you should be flexing the index and middle fingers of both hands and lifting your eyebrows in the style of Dr Evil—quotes that signal the enclosed words should be interpreted in an approximating, “non-standard, ironic, or other special sense” [1, ¶7.58].⁶ For example, would you describe a Riemann sum as approximating the ‘total area’ underneath a curve, or rather, the “total area”? Then, the two most important things are (1) to follow the guidelines of the publication you are writing for, and (2) whatever practice you follow, follow it consistently. When there are no prescriptions, you must decide which looks better, and most importantly, which is more legible for your purposes.⁷

A more relevant question may be the one of whether punctuation comes inside or outside of the quote. In North American use, commas and full stops are placed inside the quotation marks, but other punctuation stay outside the

⁶Note how I use quotes here, both for quoting from a source and for *scare quotes*. Note also that if the words you surround with scare quotes are actually part of the canon, you would be better off by using some other way of emphasising, for example, italicisation.

⁷Though, I dare once again say, to the uninitiated, we could just as well surround all mathematical texts with scare quotes, and go about our infernal business in obscurity.

The quotes after the word “T-Rex” are incorrect. Because \LaTeX scans the input from left to right, it recognises the first two ' characters as a double right quote before recognising the next ' as a single right quote. Use the thin space command $\,$, to tell \LaTeX how to separate the single from the double quote. Enter

```
He said, ``I am `T-Rex'\, ' '---he smiled---`really!''
```

to get

```
He said, “I am ‘T-Rex’”—he smiled—“really!”
```

As a rule of thumb, always use the thin space command to separate quotes, even though \LaTeX handles some cases correctly.

1.2 Spacing after end-of-sentence characters

\TeX has one of the most sophisticated—some say *the* most sophisticated—text-flow and hyphenation algorithms around. Whereas a typical word processor hyphenates words as they appear from earlier to later in the text and provides very coarse control over widows¹ and orphans², \TeX embraces a larger view of the Force: It considers each paragraph in its entirety and chooses the breakpoints in such a way that the spacing between words is as uniform as possible.

\TeX automatically puts extra space at the end of a sentence.³ Used without qualification, full stops, question marks, and exclamation marks are interpreted as end-of-sentence punctuation. When the spacing between words are stretched to fill a line, the spaces after punctuation characters stretch more than those after non-punctuation characters; those after end-of-sentence punctuation stretch even more than those after other punctuation.

\TeX does need a bit of help, though. When a full stop, question mark, or exclamation mark does not mark the end of a sentence—for example, when a full stop is used to end an abbreviation—then a normal interword space should be forced. This is typically done either by a tilde (\sim) or the $_$ command. The former inserts a normal interword space and prevents line-breaking, whereas the latter inserts a normal interword space and allows line-breaking. Consider the following example:

¹The first line(s) of a paragraph at the bottom of a page.

²The last line(s) of a paragraph at the top of a page.

³There is an ongoing debate about whether one or two spaces must follow a full stop. In the days of typewriters with monospaced fonts (every character has the same width), it was customary to put two spaces after end-of-sentence punctuation. When using typefaces with variable-width characters, putting two spaces after the end of a sentence is frowned upon. However, unless it has stretched spacing to fill a line, \TeX by default uses only 1 $\frac{1}{3}$ times a normal space after a sentence.

“Oh, no!” she cried. Prof. Knuth grinned.
“Oh, no!”\ she cried. Prof.~Knuth grinned.

The above is typeset as follows—note where the spacing differs.

“Oh, no!” she cried. Prof. Knuth grinned.
“Oh, no!” she cried. Prof. Knuth grinned.

As a rule of thumb, use the tilde to connect an abbreviated title and a name, and also to connect abbreviations that belong together, such as “cf.~Fig.~7”; otherwise use `_`.

1.3 Automatic references

The example of cross-referencing in the last sentence of §1.2 is not how we should handle numbering. Unless referring to a numbered entity in a separate document, always use L^AT_EX’s automatic numbering and referencing. For example, the “§1.2” reference was entered as “`\S\ref{sect:eol}`”. The label command simply followed the sectioning command.

```
\subsection{Spacing after end-of-sentence characters}
\label{sect:eol}
```

Note that we tend to add categorising prefixes to the label keys. This allows us to give related concepts nearly the same key, distinguishing them only by prefix, for example:

```
Figure~\ref{fig:zeta} illustrates Eq.~\eqref{eq:zeta} of
Definition~\ref{def:zeta}.
```

The `\eqref` command is from the `amsmath` package and automatically parenthesises its reference. Regardless of whether it follows an abbreviation or not, we should preface a `\ref` by a tilde so that there can be no page break between a number and the entity it numbers. There is also a `\pageref` command that allows us to refer to the page number of a label.

1.4 Ellipses

At the very least, use the `\ldots` command to make ellipses. Most emphatically, do not simply type three full stops as the spacing will be wrong.

```
This ... is wrong, but this \ldots\ is better.
```

This is typeset as follows.

```
This ... is wrong, but this ... is better.
```

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 set of prime numbers and $N_1 = N_0 \sim \{0\}$.

Reformatted verbally, as it were, this can be restated as:

According to the Fundamental Theorem of Arithmetic, 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 exponents are zero.

3 General typography and style

The following is a loose collection of my own musings on typographical issues. This is to say that, in a surprising turn, I do not pretend to lay down the law. I do try to motivate what I am saying, but in the end, unless qualified by a reference, what follows is my opinion. And here is also probably the only opportunity to quote one of my favourite poems, given on the following page, about the typography and style of life.⁵

3.1 Quotation marks

In North American use—and in Afrikaans—“top-level” quotes are delimited by double quotation marks, and nested quotes alternately use single and double quotes. In British, and hence, South African English, practice is the other way around, that is, single quotes, double quotes, single quotes, and so on. For a change, I side with the Americans: I think that double quotes more visibly sets off dialogue or quotes, which is helpful when you are speed-reading.

⁵Oh, the poem was typeset in the `verse` environment, contained in a customised float; refer to the documentation of the `float` package. Also, the words following “given” in the sentence marked by this footnote were inserted with the `\pageref` command; refer to the documentation for the `varioref` package. Incidentally, if this were a course in some discipline other than one from the pure sciences, think of all the fun you could have had doing radical “research” (refer to the use of “scare quotes” in §3.1) on the use of typography in the poems of e. e. cummings. An example is available [7], and note that the author has a degree in computer science. . . . And if you are interested in my general disdain of all things scholastic, and I use the term very specifically here, refer to Saul [6].

We use Theorem 37 in the correctness proof of Algorithm 7. Note that the first three parameters must be nonnegative; similarly the loop invariant guarantees that the i th element can never be negative. Figure 31 illustrates the algorithm for 147 elements, with the execution tree given for the evaluation of the 131st element.

Note that when a letter is used as an ordinal, it is still italicised as if it were a cardinal, but the suffix remains in roman type, for example, *i*th or *n*th. Also, names like Algorithm, Corollary, Lemma, and Theorem are capitalised.

The rule for small numbers do not apply to physical quantities and units of time, when used in a scientific context. Such quantities are almost always written as a sequence of digits, followed by an abbreviated form of the unit; the last digit and the unit abbreviated should be separated by a thin space. So, we would write 2 ℓ, 220 V, and 12 m/s. However, in some contexts, tradition and common sense dictate the use of numerals, for example, an 8-bit register or a 40-watt bulb. [1, ¶9.14, ¶9.17, ¶15.55–66].

Finally, for numbers of more than three digits (on either side of the fractional separator, for example, the decimal point), the digits are written as groups of three. *Chicago* [1, ¶9.22, ¶9.69–70] gives the following practices:

10 000,001 (European style)
 10 000.001 (Canadian style)
 10,000.001 (U.S. and British style)

In South Africa, we use the European system, although at Stellenbosch, we tend to use the Canadian system, that is, with a fractional point and the groups separated by a thin space. There are numerous L^AT_EX packages available for working with numbers and units; refer to the documentation for `numprint`, `Sistyle`, `SIunits`, `units`, and `unitsdef`.

2.12 Jargon

Try not to get carried away by your own erudition when writing mathematical text. That is to say, strive to compose clear prose, and formulate your work as simply as possible. A quote attributed to Einstein advises: “Make things as simple as possible, but no simpler.” [2].

Knuth et al. [4, p. 5] give a rather amusing example of the misuse of jargon. Consider the following mathematical fact, stated in the specialist’s vocabulary.

If $\mathbf{L}^+(P, N_0)$ is the set of functions $f : P \rightarrow N_0$ with the property that

$$\exists_{n_0 \in N_0} \forall_{p \in P} p \geq n_0 \implies f(p) = 0$$

Unfortunately, the `\ldots` command noticeably forces an additional space after the last dot that is the same as between the dots. So, if we force a normal interword space with `_` as above, the space between the last dot and the following word is too big. However, having the automatic “ellipsis space” after the last dot is appropriate if we end a sentence with an ellipsis—where there must properly be four dots—the last of which may actually be the dot of a question or exclamation mark. For example,

Thus, the light faded\ldots.

produces (correctly)

Thus, the light faded...

One quick hack is to use the `\ldots` command in math mode. Another, probably better, solution is to use the `ellipsis` package, which changes the existing `\dots` command—defined by L^AT_EX to be the same as `\ldots`—to look one character ahead before deciding whether to force an additional space or not.

This ... is wrong, but this $\$ \dots \$$ is better.

This ... is wrong, but this `\dots\` is probably best.

The sheer acting of Meryl Streep\dots!

As is clear from the last line, `\dots` as “corrected” by `ellipsis` even handles an end-of-sentence ellipsis correctly.⁴

This ... is wrong, but this ... is better.

This ... is wrong, but this ... is probably best.

The sheer acting of Meryl Streep...!

2 Mathematics

2.1 Failure to use math mode

When we typeset mathematics, L^AT_EX must be in math mode. Beginners often forget that this also applies to mathematics set in running text. Consider the following two sentences:

1. Solve $f(x) = 3x + 5$ for $x = 7$.

2. Solve $f(x) = 3x + 5$ for $x = 7$.

The first sentence was entered (correctly) as

⁴To appreciate the last sentence, refer to the French & Saunders re-imagining of the motion picture *Mamma Mia!* All hail to the BBC.

Solve $f(x) = 3x + 5$ for $x = 7$.

The second sentence was entered (incorrectly) as

Solve $f(x) = 3x + 5$ for $x = 7$.

Note the italicised formatting of the f and the x in the first sentence and also the spacing around the equals sign and the plus. An in-text formula starts and ends with a dollar character. This forces L^AT_EX into math mode, so that symbols such as variables are set in math italics, and also so that correct math spacing is applied.

Math mode is not simply the same as using the `\emph` command. Compare the following formula

$f(x) = 3x + 5$,

which was entered as

`\emph{f(x) = 3x + 5}`,

with the first sentence. In this last example, everything—parentheses, digits, the plus operator, and even the equals sign (note that the two parallel lines are not aligned vertically)—was italicised; in the first sentence, only the letters were italicised. Setting mathematics all in italics is just as uncivilised as not using math mode at all.

In closing, note that an in-text formula could also be entered in the `math` environment, or with the short form `\(...\)`. However, common practice is to use the dollar short form, `$. . .$`, as above.

2.2 Function names

L^AT_EX provides commands for typesetting common function names such as `sin`, `cos`, `log`, `max`, and so on, in math mode. Like any other command, commands for these functions start with a backslash. For example, the `\ln` command keeps “ln” from looking like the product of l and n :

$\ln e^x = x$.

This was entered as

`\[\ln e^{x} = x. \]`

Compare this to

$lne^x = x$,

which was typeset as

`\[ln e^{x} = x, \]`

Symbols instead of words If there is no possibility of ambiguity, words are preferable to an equivalent mathematical symbol or symbols in most cases. For example, unless you are writing a piece on formal logic, do not use the quantifiers \exists (“there exist(s)”) and \forall (“for all”) in your text. The following is poor style.

Let R be a binary relation on the set X . Now, define transitivity as $\forall x, y, z \in X, x R y \wedge y R z \implies x R z$.

Although the definition is mathematically and logically correct, it is difficult to follow at first glance.

For a binary relation R on a set X , we define transitivity thus: For all $x, y, z \in X$, if $x R y$ and $y R z$, then $x R z$.

Note that the implication was reformulated as an if–then statement, which is probably easier to follow. Incidentally, entering `$x R y$` yields xRy , with insufficient spacing around the R . The `\mathbin` command sets its argument as a binary operator with appropriate spacing. So, if we write `$x\mathbin{R}y$`, we get $x R y$.

Always remember that mathematics should read like prose, not minimalist verse. In particular, any symbols should fit into the text so that the symbol groups form discreet pieces of information. For example, either write “let $x \in X$ ” or “ x is an element of X ”, but do not write “ x is an element $\in X$ ”.

2.11 Numbers

When small numbers are used as adjectives—that is, if we do not talk about numbers as numbers—they should be spelt out, that is, written as words.

If there are no references in the input, L^AT_EX requires only 1 pass through the input. If there are references or bibliographic citations, a 2nd or 3rd pass might be necessary.

The paragraph above is extremely poor style. Rewrite it as follows.

If there are no references in the input, L^AT_EX requires only one pass through the input. If there are references or bibliographic citations, a second or third pass might be necessary.

What constitutes a small number in this context is open to some debate. *Chicago* [1, ¶9.3] has a general rule of spelling out whole numbers from one to one hundred, round numbers, and any number beginning a sentence. However, many scientific publications only spell out single-digit numbers [1, ¶9.6]; others spell out whole numbers between one and twenty. When you write for a specific publication, let yourself be led by its style; otherwise, whatever you do, do it consistently. The following is an example of good number style.

Symbol definitions Make sure that you define all the symbols you use properly. Consider the following example.

For a string $s = \sigma_0\sigma_1 \cdots \sigma_{n-1}$ of length n , where every σ_i for $i = 0, 1, \dots, n-1$ is a symbol in the alphabet Σ , a suffix of length m is a string $s' = \sigma_{n-m}\sigma_{n-m+1} \cdots \sigma_{n-1}$, where $0 \leq m \leq n$. For example, the string “stop” has the suffixes “stop”, “top”, “op”, “p”, and ϵ , the empty string.

The preceding example is from a footnote in a computer science tutorial to explain the term “suffix of a string”; in a longer text, the exposition should be more leisurely. Note that lowercase sigma symbols (σ) are used for elements in the set indicated by the uppercase sigma symbol (Σ). The relationship between a string and a suffix of the string is indicated by the re-use of the symbol s .

Consistency Be consistent in your use of symbols. For example, do not say “the sequence (x_i) for $1 \leq i \leq n$ ” in one place, and then “the sequence (x_k) for $1 \leq k \leq n$ ” in another, unless there is a good reason. Knuth et al. [4, p. 3] recommend choosing indices so that i ranges from 1 to m and j from 1 to n , and then to stick with this use consistently.

Start of sentences Do not start a sentence with a symbol. The following is poor style.

$f(x)$ is continuous.

Rather write:

The function $f(x)$ is continuous.

If the sentence does not scan well after adding words before a symbol, consider reordering the sentence completely.

This guideline also applies to technical writing involving programming languages, where a method, function, or variable name starts with a lowercase letter, as in the sentence that follows. `toString()` returns the string representation of an object. This looks jarring to the eye and should be rewritten, for example as: The parameterless method `toString()` returns the string representation of an object.

Set-builder notation For set-builder notation, use the `\mid` command instead of the `|` symbol. The latter has the wrong spacing:

Define the equivalence class $[a]$ as $\{x \in X | x \sim a\}$.

Rather enter the set as “ $\{x \in X \mid x \sim a\}$ ”, yielding the correct spacing around the bar:

Define the equivalence class $[a]$ as $\{x \in X \mid x \sim a\}$.

and note both that the “ln” is set upright in the first example, and also that the spacing after “ln” is wrong in the second example.

This is not merely being picky. Forgetting to write function names properly can be downright confusing. The double angle identity

$$\sin 2u = 2 \sin u \cos u$$

looks like some obscure Japanese incantation if we forget the backslashes before the function names:

$$\sin 2u = 2\sin u \cos u.$$

If a function or operator name is not provided by L^AT_EX, we can define our own operators with the `\DeclareMathOperator` command from the `amsmath` package. For example, if we want to express the Dimension Theorem for Matrices, that is, if A is a matrix with n columns, then

$$\text{rank}(A) + \text{nullity}(A) = n, \tag{1}$$

we define “rank” and “nullity” as new mathematical operators thus:

```
\DeclareMathOperator{\rank}{rank}
\DeclareMathOperator{\nullity}{nullity}
```

The `\DeclareMathOperator` can only be used in the document preamble. Also, `\usepackage{amsmath}` must be used to include the `amsmath` package, otherwise `\DeclareMathOperator` will not be available. Having defined “rank” and “nullity” as operators, we can render Eq. (1) as follows:

```
\begin{equation}
\label{eq:dimth}
\rank(A) + \nullity(A) = n,
\end{equation}
```

As operators, `\rank` and `\nullity` will have the appropriate spacing in math mode.

2.3 Differentials

Differentials should be treated as a unit, and should therefore have a little space separating them from other symbols in an equation. Considering the following two integrals:

1. $\int_0^1 f(x) dx$
2. $\int_0^1 f(x)dx$

They were entered, respectively, as

```

$$\int_0^1 f(x) \, dx$$

```

and

```

$$\int_0^1 f(x) dx$$

```

Note the use of the thin space `\`, in the first integral to separate the differential dx from $f(x)$ so that the integrand does not look like the product of $f(x)$, d , and x . (The command `\displaystyle` forces L^AT_EX to use large operators in an in-text formula; this is not significant here.) Simply leaving space between $f(x)$ and dx , as in the second integral, does not help as math mode has different rules than text mode for treating spaces.

Differentials for multiple integrals better illustrate the wisdom of using thin spaces for separation:

1. $dx dy = r dr d\theta$
2. $dx dy = r dr d\theta$

The first was entered as

```

$$dx \, dy = r \, dr \, d\theta$$

```

and the second as

```

$$dx dy = r dr d\theta$$

```

The first is preferable to the second as it clearly separates the differentials from one another.

2.4 Blank lines after displayed elements

Do not use blank lines blindly after displayed mathematics. Consider the following example, where we assume that the word “We” is *not* the start of a paragraph.

We relate energy E and mass m by the equation

$$E = mc^2,$$

where c is the speed of light in a vacuum.

This should be entered as follows.

```
We relate energy  $E$  and mass  $m$  by the equation

$$E = mc^2,$$

where  $c$  is the speed of light in a vacuum.
```

Note that, for binary operators, we do not leave out the operator on either side of the ellipsis.

There is one exception. When, for some reason, we do not omit the multiplication dot, the ellipsis points must be aligned on the baseline:

$$a_1 \cdot a_2 \cdot \dots \cdot a_n.$$

That is, we input:

```

$$[ a_1 \cdot a_2 \cdot \dots \cdot a_n ]$$

```

2.10 Mathematical symbols

Mathematical symbols should make your arguments and results clear. (Also refer to §2.12.) If, instead, they obfuscate your writing, consider using different symbols or leaving them out entirely.

When you do use symbols, use them in such a way that their meaning is intuitively clear to anyone with mathematical training.

- Use uppercase letters A, B, C, \dots for sets.
- Use a and b for arbitrary elements from such sets.
- Use c for a constant value.
- Use $f, g,$ and h for functions.
- Use $i, j, k,$ and ℓ (`\ell`) for indices.
- Use m and n for the number of elements in a set or sequence.
- Use p and q for predicates.
- Use $x, y,$ and z for variables or elements of sets.

That said, however, every mathematical discipline has particular symbol conventions that you must follow. For example, in algebraic arguments, when we want to show that arbitrary elements from a set are related in some specific way, we commonly use x and x' (read as “ x prime”) for the elements under consideration. This is not to be confused with a prime symbol indicating the derivative of a function, that is, when we write $f'(x)$ is the derivative of $f(x)$.

Within paragraphs, \TeX 's spacing rules can do its magic best when the punctuation is not part of formulae. Similarly, don't mix in punctuation when it is not part of the equation. The following is wrong—note the placement of the first comma.

for $x = a, b$, or bc .

It should be

for $x = a$, b , or c .

2.9 Elided elements, lists, and relations

Instead of `\ldots` and `\cdots`, use the following semantically oriented dots commands from the `amsmath` package:

- `\dotsc` for “dots with commas”,
- `\dotsb` for “dots with binary operators or relations”,
- `\dotsm` for “multiplication dots”,
- `\dotsi` for “dots with integrals”, and
- `\dotso` for “other dots” (none of the above).

Different journals have different rules and conventions, and using these commands makes it easier to adapt your document on-the-fly to the editor's whim. Now, consider the following examples:

$$\begin{aligned} i &= 0, 1, 2, \dots \\ x_1, x_2, \dots, x_n \\ x_1 + x_2 + \dots + x_n \\ a_1 < a_2 < \dots < a_n \\ a_1 a_2 \dots a_n \\ \int_{A_1} \int_{A_2} \dots \end{aligned}$$

These were entered as:

```
\begin{gather*}
i = 0, 1, 2, \dotsc \\\
x_{1}, x_{2}, \dotsc, x_{n} \\\
x_{1} + x_{2} + \dotsb + x_{n} \\\
a_{1} < a_{2} < \dotsb < a_{n} \\\
a_{1} a_{2} \dotsm a_{n} \\\
\int_{A_{1}} \int_{A_{2}} \dotsi.
\end{gather*}
```

Were we to have a blank line between the end of the displayed equation and the word “where”, we get the following:

We relate energy E and mass m by the equation

$$E = mc^2,$$

where c is the speed of light in a vacuum.

Only insert blank lines between the end of a displayed equation and the following text if the text starts a new paragraph.

2.5 Parenthesising “tall” equations

Use the `\left` and `\right` commands when parenthesising tall factors in equations, for example, those containing fractions. For example, the input

```
\[ \left(\ln\left\lfloor\frac{n(n+1)}{a}\right\rfloor\right)^k
\right\rfloor^m\right)^k , \]
```

produces the output

$$\left(\ln\left[\frac{n(n+1)}{a}\right]^{m^b}\right)^k,$$

and note how the “big” parenthetic delimiters are of just exactly the right height. Leaving out the `\left` and `\right` commands yields the following,

$$(\ln\lfloor\frac{n(n+1)}{a}\rfloor^{m^b})^k,$$

which both looks amateurish and is difficult to read.

Although there must a `\left` for every `\right`, and vice versa, it is still possible to insert a “ghost” left or right parenthetic delimiter using a full stop. Consider the following example.

```
\[ \left.\frac{dy}{dx}\right|_{x=1} . \]
```

This produces

$$\frac{dy}{dx}\Big|_{x=1}.$$

Be careful, however: In \LaTeX , `\left` and `\right` delimits a box, the height of which is the maximum height of the elements between the two delimiters. Consider the following example where we wish to denote the evaluation of a formula at a particular value of one of its variables:

```
\[ \int_0^{\pi/2} \sin x \, dx =
\left.-\cos x\right|_{x=0}^{x=\pi/2} = 1. \]
```

This produces

$$\int_0^{\pi/2} \sin x \, dx = -\cos x \Big|_{x=0}^{x=\pi/2} = 1.$$

The output, though correct—nothing is taller than the x between the two delimiters—is probably not what we wanted. We could move the `\left.` command before the `\int` symbol, but doing so results in a vertical line that is too tall. In this case, it is better to use one of the predefined sizes from the `amsmath` package:

```
\[ \int_0^{\pi/2} \sin x \, dx =
-\cos x \Big|_{x=0}^{x=\pi/2} = 1. \]
```

This yields

$$\int_0^{\pi/2} \sin x \, dx = -\cos x \Big|_{x=0}^{x=\pi/2} = 1.$$

2.6 Use align instead of eqnarray

The `eqnarray` command of L^AT_EX is a blunt tool. In the absence of anything else it is good enough, but there are better environments available in the `amsmath` package. One aspect where `eqnarray` is particularly lacking is in its use of space:

$$\begin{aligned} v &= v_0 + at, \\ v^2 &= v_0^2 + 2a\Delta s. \end{aligned}$$

This was entered as:

```
\begin{eqnarray*}
v & & = & & v_{0} + at, \\
v^2 & & = & & v_{0}^2 + 2a\Delta s.
\end{eqnarray*}
```

Note that the spaces around the equals signs are too much; it is out of joint with what we get in, say, the `equation` environment. We should rather use the `align` environment from `amsmath`: It produces the same spacing as if we had used `equation`. Note that the ampersand comes *before* the equals sign.

```
\begin{align*}
v & & = & & v_{0} + at, \\
v^2 & & = & & v_{0}^2 + 2a\Delta s.
\end{align*}
```

This produces

$$\begin{aligned} v &= v_0 + at, \\ v^2 &= v_0^2 + 2a\Delta s. \end{aligned}$$

2.7 Extra carriage-returns in displayed math

Do not end the last line of a displayed math environment with the `\` command. Doing so inserts a superfluous empty line. Consider the last example in the previous section. Had we inserted `\` after the full stop on the second line, we get the following:

$$\begin{aligned} v &= v_0 + at, \\ v^2 &= v_0^2 + 2a\Delta s. \end{aligned}$$

Note that the space between this sentence and the end of the displayed math environment is now too large.

2.8 Punctuation

The *Chicago Manual of Style* instructs [1, ¶14.22]: “Mathematical expressions are sentences or parts of sentences, and they should be punctuated accordingly.” The *Manual* gives the following example of separating several expressions in a single display with commas (or semicolons), ending the last expression with a full stop:

$$\begin{aligned} x_1 + x_2 + x_3 &= 3, \\ x_1x_2 + x_2x_3 + x_3 + x_1 &= 6, \\ x_1x_2x_3 &= -1. \end{aligned}$$

However, we do not punctuate consecutive lines of multiline expressions:

$$\begin{aligned} (|a + b|)^2 &= (a + b)^2 = a^2 + 2ab + b^2 \\ &\leq a^2 + 2|a||b| + b^2 \\ &= |a|^2 + 2|a||b| + |b|^2 \\ &= (|a| + |b|)^2. \end{aligned}$$

As a rule of thumb, put the punctuation for an in-text formula outside the math environment, but put the punctuation for a displayed expression inside the math environment. Knuth [3, p. 161] gives the following example:

If $x < 0$, we have shown that $y = f(x)$.

This is rendered as:

If $x < 0$, we have shown that

$$y = f(x).$$