

# Comments on drafts of final paper

## 1 References

Everone's paper should have a list of references, both to attribute where material came from and to point the reader to places where omitted details can be found. There are two issues with references: how they should be listed and how they should be cited.

First the list of references. This should appear at the end of the paper in its own section. Each item on the list should begin with a key which is used in the main paper to refer to the reference, something like [1] or [Ha]. Following this should be the complete information (author, title, publisher, year of publication, etc.) I don't really care exactly how you format this, so long as it's reasonable, includes all the relevant information and you're consistent with how you do it.

Latex has an environment for building this list of references, which I recommend you use. There's an environment called "thebibliography" (environment means that you use `\begin` and `\end`). Within the environment you use the `\bibitem` command to add a reference. I'm sure you can find documentation for this on the internet.

Now how to cite references. This is done by simply putting the key within the text together with the relevant spot in the source. For example, if [Ha] is the key to Hatcher's book, write something like [Ha, Ch. 2] to reference chapter 2 of the book. You should always include the relevant spot so the reader can find it in the source, especially when the source is a book. **Do not** just say "As in Hatcher, ..." or "We follow the proof in Hatcher." Also, don't cite references like (Hatcher, 2002) — that's the format they use in the sciences (I think), but it's not used in math.

Latex has a command for making citations, compatible with thebibliography. The command is `\cite`. There's an optional parameter for putting in the location within the source.

## 2 Correct use of language

I get quite annoyed at incorrect use of language; perhaps this is a bit of an overreaction, since the kind of misuse I'm about to talk about often doesn't really interfere with understanding, but I know many mathematicians who share the sentiment. The general rule here is: say things correctly! Here are some examples, slightly modified from your drafts:

**Wrong:** The notation  $+$  is used because it makes the group commutative. **Why:** Notation doesn't make the group commutative. **Possible fix:** The notation  $+$  is used because the group is commutative.

**Wrong:** We describe how the function is constant. **Why:** You're not about to describe the manner in which the function is constant, you're just going to say that it is so. **Possible fix:** The function is constant.

**Wrong:**  $\mathbf{R}/\mathbf{Z}$  is another way to define  $S^1$ . **Why:**  $\mathbf{R}/\mathbf{Z}$  is a space, not a way to define something. **Possible fix:**  $\mathbf{R}/\mathbf{Z}$  provides an alternate model of  $S^1$ .

**Wrong:** Homology groups are functors. **Why:** Groups are groups, not functors. Perhaps this is a bit too pedantic, but I don't think a mathematician would say that sentence. **Possible fix:** Homology is a functor. Or,  $H_n$  is a functor.

### 3 Definitions

Make important definitions very clear and explicit; do not leave them implicit in a discussion. For very important definitions, use a definition environment. (Like how you make theorems.) Also, italicize (or make bold) the term being defined in a definition. Here are some examples from your drafts where definitions are made poorly:

**Bad:**  $X \times \mathbf{R}^n$  is a bundle. These are the trivial ones. **Better:** A *trivial bundle* is one isomorphic to  $X \times \mathbf{R}^n$ .

**Bad:** If the transition maps are  $C^k$  then we have a  $C^k$  atlas. **Better:** An atlas is defined to be  $C^k$  if its transition maps are  $C^k$ .

**Bad:** We have just defined singular chain groups and boundary maps, so we have a singular chain complex. **Better:** The *singular chain complex* is the complex formed from the above singular chain groups and boundary maps.

### 4 Weak language

Don't say things like "we can do this" or "it's possible to do that." Just do it. For example, don't say "A point in  $S^1$  can be determined by a point in  $\mathbf{R}^2$ ." Say "We identify  $S^1$  with the unit circle in  $\mathbf{R}^2$ ." If it is not clear how  $S^1$  is identified with a subset of  $\mathbf{R}^2$  you have two options: say how or give a reference and tell the reader to see it for details. Just saying you "can" do something doesn't help though. Another example: don't say "We can define this as that." Just say "We define this as that."

### 5 Formatting

There are a number of small formatting issues that came up repeatedly. Here are some:

**Double quotes:** These are done in a special way in Latex: the opening double quote is made of two of the kind of quotes that are found on the key that also has the tilde (the one next to the 1 key), while the end quotes are made of two of the single quotes that are found on the key that also has the double quote.

**Paragraphs:** You begin a paragraph by putting an empty line after the previous paragraph in your Latex source. Do not use double backslash.

**Dashes:** Dashes and hyphens are different: hyphens break up words or names, while dashes behave similarly to colons. On the keyboard there's only a hyphen character. This is used for a hyphen in Latex. To get a dash in Latex, put three hyphens next to each other. There's also a shorter dash, used, for instance to indicate a page range, made with two hyphens. You can see the differences here: non-degenerate (hyphen), pages 35–55 (short dash) and "this is obvious — at least it should be!" (long dash).

**Parentheses:** Make sure your parentheses have the right size. There are various ways to do this. The command `\big(` will make a bigger parenthesis. There are variants that will make different sized ones. You can also use `\left(` and `\right)` and Latex will size them automatically.

**Real and complex numbers:** Make these either bold or blackboard bold. (Which you choose determines how refined your tastes are! But not your grade.) Thus, write  $\mathbf{R}$  or  $\mathbb{C}$  and not  $R$  or  $C$ .

## 6 Math next to math

Don't do this, it's visually confusing. So, don't write "Given a point  $x$ ,  $f(x)$  is a real number." Put a filler word (or words) to separate the  $x$  and  $f(x)$ . Possible fix: "Given a point  $x$ , we have a real number  $f(x)$ ."

Similarly, do not begin sentences (or really, even phrases) with math. So, don't write "Let  $M$  be a manifold.  $M$  has a fundamental class." Instead, say something like "Let  $M$  be a manifold. Then  $M$  has a fundamental class."

## 7 Abbreviations

Do not use abbreviations like iff and WLOG in writing. Also, avoid use of the symbols  $\forall$  and  $\exists$  as much as possible (unless you're writing a paper in logic).

## 8 Abstracts and conclusions

They're not needed. Math papers almost never have conclusions — just say what you're going to do in the paper in the introduction and do it. Research papers almost always have abstracts, but I don't think your papers need them.

## 9 Don't name things you don't use

Consider the following: "We introduce the notion of a *special function* on a manifold  $M$ . These are functions with special properties. Our main theorem is that every manifold has a special function." There's no reason to introduce the symbol  $M$  in the first sentence, as it is not used afterwards. So don't do it!

## 10 Formal language

In this paper, as with any math paper, the language should be fairly formal. Don't use pronouns like I and you. Also, go easy on opinions, such as calling things "beautiful" or "neat." It's ok to do this a little, especially when praising a particular person's ideas, but if you do it too often the paper begins to sound weird.

## 11 Plurals and articles

This seems mostly to be an issue with non-native speakers, and I think all of you in this category made mistakes like this. The kind of mistake I have in mind involves improper use of articles or plurals. This mostly seems to be a problem when you want to talk about something general, such as when you want to make a section title. I doubt I can give a general rule, so I'll give some examples.

- Don't title a section "Manifold" or "Bundle" Call it "Manifolds" or "Bundles."

- Don't say "Adams spectral sequence gives a way to compute homotopy groups," but "*The* Adams spectral sequence gives a way to compute homotopy groups."
- (This is a mistake native speakers made as well.) Don't say "the homology groups" to speak of homology groups in general; the phrase "the homology groups" should always be followed by "of —." To speak of these groups in general, drop the "the." For example, don't say "The homology groups are a powerful invariant," but "Homology groups are powerful invariants."

## 12 Theorems about isomorphisms

When you're giving a theorem that says that two things are isomorphic, it's almost always better to first write down what the map between the two things is, and then phrase the theorem to say that that map is an isomorphism. Sometimes this is not possible, because you want to state the theorem now and defining the map would take too long. In such cases, it's often best to say "Below we will construct a map  $f : X \rightarrow Y$ ," give a little bit of an idea of how this map is constructed and then state the theorem as "The map  $f$  is an isomorphism."

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18.904 Seminar in Topology  
Spring 2011

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