Top 10 Mistakes Made in Masters & Bachelors Thesis Reports and Papers (and even in PhD theses I examine!)

Zero-th rule (that is often broken) – follow good practice.

Scientific writing is itself a skill worth learning, and worth learning well:
- A good set of on-line materials for good scientific writing is available here:
  http://homepages.inf.ed.ac.uk/imurray2/teaching/writing/

  A good guided course is also available here:
  https://www.nature.com/scitable/ebooks/english-communication-for-scientists-14053993/writing-scientific-papers-14239285

  (~30+ minutes spent digesting at least some of this material could save hours of corrections, redrafting and help maximize your marks – a worthwhile investment!)

- A good overview of a literature review and how to write one is available here:
  https://www.youtube.com/watch?v=2WSIkNJ1rJU

Often we see a number of common mistakes (that become more frustrating with every instance). As result, I have taken the time to note them here, and their corrections, to help you avoid such errors (and hence curtail my future frustrations).

<begin THESIS RANT>

1. **Conjunctions**: In formal writing in the English language we ***do not*** start sentences with conjunctions (But … Then … Thus …. Because – *no, no, **no***). Use "Subsequently, ...", "As a result ...", "This meant that...", "However, …."or other alternatives.

2. **Figures:**

   - If it came from somewhere else it needs a reference in the caption:
     e.g. *Figure 4: an example of real-time face detection from Viola / Jones [23]*

   - Each figure should have a purpose and contribute something to the thesis story.

   - Figures (with a given caption) must not wrap over multiple pages. Split into 2 figures.

   - Each (and every!) figure should be explained to the reader in 3-4 sentences detailed what the reader is seeing: e.g.

     In Figure 4 we see an example of real-time face detection using this approach under varying illumination conditions. It is evident that performance under bright conditions is lesser than uniform illumination (Figure 4A). By contrast we can see good performance in low light conditions (Figure 4 C/D) where the facial features are correctly isolated despite poor illumination. These results are further supported by those of Figure 5 ....

     Overall from Figure 4-8 we can conclude that the approach .....

   - capital "F" when saying *"... as can be seen in Figure 3..."* - same for references to Tables, Sections and Chapters).

   - All figures should have a caption. Ideally the caption should be short with detail being discussed/given in the text. The caption *should no*t be a paragraph in itself developing its own argument and providing additional detail – *this should be in the main text.*

3. **Abstract:**

    - Firstly **know what an abstract is.**

    - Secondly **know how important it is for any piece of work.**

    - Thirdly**, do not write it last thing, late at night and by copying and pasting sentences randomly from the rest of document (yes, this has been done!)**

    See: http://www.ece.cmu.edu/~koopman/essays/abstract.html
    Also: http://www.durham.ac.uk/toby.breckon/tmp/feedback/abstract_20090820_190732.mp3

4. **Writing style:**

    - Write in the **third person narrative style** - "we" - **using the passive voice**

    - In general theses are written in the present tense
      e.g. We use the …. to achieve …. (*not* - We used the …. and achieved ….)
      This rule is not strict – see the discusssion at
      https://www.nature.com/scitable/topicpage/effective-writing-13815989 for more detail on this.

    - Do not use "isn't" / "wasn't" / "they're" / "didn't" or similar contractions.
      Use "is not" / "was not" / "they are" / "did not".

    - Know the apostrophe rule. Use it. *e.g. The cat's house. The cats' house.*
      http://www.eng-lang.co.uk/apostrophe_rules.htm

      Generally we try to avoid the use of the apostrophe in formal writing – this is a matter of good formal writing style and not a hard and fast full.
      (e.g. *The house belonging to the cat. The house of the cats.)*

      NOT - "… estimation of the robot's position is provided by ….."
      Instead try: "… estimation of robot position is provided by ….."

    - Know the difference between "effect" and "affect". Use them correctly.
      http://grammar.yourdictionary.com/style-and-usage/affect-effect-grammar.html

    - Each section, chapter and the overall thesis shown have a beginning, middle and an end. This thesis should tell a story in which the relevance of each section and the links between this and the previous section are clear to the reader. Introduce each topic, outline techniques/approaches at a high level then present the details and finally use linking text/phrases/sentences to move from one section/topic/chapter to the next.

    - *Avoid* having one heading "banging up against" another (i.e. heading after heading) e.g. **NOT**

            2.3 Evaluation
            2.3.1 Qualitative Results
            2.3.1.2 Durham Environment Test Set

      Instead try:

            2.3 Evaluation

We present our evaluation of .... using a methodology based on both quantitative and qualitative results using a range of test imagery.

2.3.1 Qualitative Results

Firstly we present a qualitative evaluation over test set XXXX and YYYY. This is based on considering the criteria of ......

2.3.1.2 Durham Environment Test Set

This dataset was gathered ....

It flows much better for the reader to have 1 or 2 introductory sentences in each section/chapter.

- The thesis is not a company report, it is not a chronological story (or log) book of what you did for your project – it is a scientific report (for a science and engineering degree). It should report:
    - What is the problem you are addressing ?
    - Why is it important ?
    - What work has been done on this topic before in the literature ?

    - What techniques/approaches are you going to use to address this problem?((how does your overall approach differ from work has been done on this topic before ?)
    - What is the methodology you used ? (i.e. approach/design/algorithm/pipeline)

    - What are the results you achieved ?
    - How are you evaluating those results ? (e.g. present statistics for machine learning / performance type results)
    - What conclusions can you draw from these results based on your evaluations ?

    - What work remains to be done in solving this problem or what other techniques could be tried in the future based on the results obtained here ? (i.e. future work – for someone else, not you!)

- *Assuming the level of knowledge of reader / audience*: assume they are at the same level as yourself (one of your peers). If you do (or did not know) the details of this technique before the project and they are not fully explained in a basic textbook then you should be detailing them in full in your thesis.

    e.g. *".... for which we use the HSV colourspace [Solomon, 2010]."* is fine.

    For more complex concepts such as machine learning classifiers, specific feature types and alike a brief paragraph summary may be good if they are quite key to your thesis. If a basic concept is absolutely central to your thesis – provide a full explanation in any case (e.g. if your thesis is about RGB colour, explain briefly what it is to make sure the reader has the same understanding as you).

- Avoid lists of things with bullet points unless each bullet point is itself a small paragraph of several sentences. Write the list instead as a full English prose paragraph.

- Use "Chapter 6" and "data set 6" etc. – not 6th Chapter or 6th data set.

- Capitalise:
    - all headings consistently – e.g. **2.3 Sobel Edge Detector** not **2.3 Sobel edge**

detector (or even worse **2.3 Sobel edge Detector**)

- all acronyms when they are introduced – e.g. *Computed Tomography (CT)* not *computed tomography (CT)*

5. References to OpenCV or Matlab or Java or C++ or similar …. code / functions:

- Do not use these. Reference the original scientific work instead.
  e.g. **WRONG:** To achieve …..tracking…. we use the meanshift() OpenCV function.
  RIGHT: To achieve ….. we used the mean shift tracking approach of [23]

where reference [23] in the document is:

[23] Comaniciu, E.; Meer, P., Mean Shift: A Robust Approach Toward Feature Space Analysis. *IEEE Transactions on Pattern Analysis and Machine Intelligence* 24 (5): pp. 603–619, 2002.

Same for Matlab functions / libraries etc. For standard approaches (e.g. Sobel / Adaptive Thresholding) reference a textbook – e.g. Solomon/Breckon, 2010:

Solomon, C.J., Breckon, T.P. *Fundamentals of Digital Image Processing: A Practical Approach with Examples in Matlab,* Wiley-Blackwell, 2010.

- Use a referencing tool. I recommend Mendeley (www.mendeley.com). Its free and has plugins for MS Word / libreoffice / bibtex etc.

6. Testing:

○ **problem #1** lack of testing in thesis

Is it *really* convincing if you have the results from 3 images or one dataset ? Have you only got one dataset to test with – how difficult is it to find or create another (even artificially or in the lab) ?

In this day and age we can even get multiple different image data sets of the Martian surface!

○ Think about **quantitative and qualitative evaluation.** If possible, have both.

7. Conclusions:

○ make sure they follow from the results and any discussion of the evaluation.

○ *"I worked {at this company | on this project} had a nice time and really enjoyed myself"* is not a conclusion to a scientific report.

8. Thesis structure:

○ a logical thesis structure should tell a clear story of what you did, how you did it, what was achieved, why this is important and how it compares to other work on the same problem/topic/field. Every Chapter should have a summary that clearly reiterates the key points of that section and sign-posts the reader into the next.

9. References:

○ In general we refer to published papers in the style of:

  ▪ "The work of [REF]"

- ▪ "Work by [REF] ..."
- ▪ "In [REF] we see that ...."
- ▪ "Within the work of"
  .or many variants on this theme..

i.e. we refer to the research work as the object we are discussing rather than actually referring to "the paper" itself as an object (e.g. **NOT using** "In the paper by" / "In the final paper" / "In another paper by" / "As stated in the IEEE International Conference on Poor Technical Writing ...". This is scientific writing style convention.

○ We must use references to support all major claims, generalizations and statements in our work. For example:

> *"The phenomenon of human visual completion has been of interest to psychologists for a considerable period, ranging from the early Gestalt principles to more modern interpretations. Much of the early work centres around the study of various, now famous illusory examples and the cues and process that cause certain perceptions for these cases. This work concentrates on the visual perception of 2D structures— to date an on-going aspect of psychological research."*

makes many sweeping statements and generalizations (here: on the topic of human vision) without any references to back up such claims! It would be much better presented in the following more scholarly style:

> *"The phenomenon of human visual completion has been of interest to psychologists for a considerable period, ranging from the early Gestalt principles [41] to more modern interpretations [37,72]. Much of the early work centres around the study of various, now famous illusory examples (Figure 2) and the cues and process that cause certain perceptions for these cases [34–36]. This work concentrates on the visual perception of 2D structures— to date an on-going aspect of psychological research (e.g. [88,23,54,87])."*

[from: <u>Amodal Volume Completion: 3D Visual Completion</u> (T.P. Breckon, R.B. Fisher), In Computer Vision and Image Understanding, Elsevier, Volume 99, No. 3, pp. 499-526, 2005.]

○ Ensure all references have the author names the right way around and contain page numbers for papers, publisher for books all issue/number information for journal papers:

Sokalski, J. Breckon, T.P., Cowling, I. *Automatic Salient Object Detection in UAV Imagery* In Proc. 25th Int. Conf. on Unmanned Air Vehicle Systems, pp. 11.1-11.12, 2010

○ Ensure references are *tidy*. For example a copy and paste from google scholar that appears like this:

Tomasi, Carlo, and Roberto Manduchi. "Bilateral filtering for gray and color images." In Computer Vision, 1998. Sixth International Conference on, pp. 839-846. IEEE, 1998.

contains a lot of redundant and unimportant information. Reformat it like this:

Tomasi, C., and Manduchi, R.. "Bilateral filtering for gray and color images." In Proc. Int. Conf. Computer Vision, pp. 839-846, 1998.

where "Proc. Int. Conf." is an abbreviation for "Proceedings of the International Conference on". The abbreviation takes up a lot less room. Also we have listed the authors correctly as surname, initial (Surname, I.) although I. Surname is also acceptable here. There should *not* be a mixture of "I. Surname" and "Firstname

Surname" references in the bibliography. It should be consistent.

Unnecessary CAPITALIZATION of names and or titles must be avoided.

WRONG: TOMASI, C., AND MANDUCHI, R.. "BILATERAL FILTERING FOR GRAY AND COLOR IMAGES." In Proc. Int. Conf. Computer Vision, pp. 839-846, 1998.

- ○ Please know the correct way for reference URLs (i.e. with a page title and accessed date)

- ○ If within your report you are quoting whole sentences or paragraphs from a paper or references – use both **quotation marks and italics** – e.g. As was claimed within [12] *"the combustion based design was ....."*.

10. Including irrelevant material:

- do not include source code listings in the thesis (anywhere); pseudo-code is acceptable but only where the specifics of an algorithm need to be detailed

- consider what is relevant to the thesis story, also what is interesting to the reader

- any discussion on a large topic (e.g. literature review on face recognition) can be curtailed by saying "For further detail the reader is directed to the work of [17]." where reference [17] happens to be a survey paper or recent textbook

- If you are referencing any paper > 5 years old, please consider – is there a more recent reference that better shows the current state of the art ? (this is not true for all topics or for fundamental principles, but please do make sure).

<end THESIS RANT> :o)

Post thesis perhaps we could even publish your work (looks very good on the CV and for future things like CEng / CSci applications):

General advice on writing paper(s) with a specific aim to publishing your work:

- See:
  https://www.nature.com/scitable/ebooks/english-communication-for-scientists-14053993/writing-scientific-papers-14239285

- All aspects: http://www.gris.tu-darmstadt.de/~akuijper/coaching.html

- Writing a research paper:
  http://www.gris.tu-darmstadt.de/~akuijper/researchcoaching/writing-a-paper-slides.pdf