FOSE1025 — Scientific Computing

Week 10 Lecture 1: Ethics and Reproducibility

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Abstract

In this lecture we will focus on ethical aspects of science, with special emphasis on those related to the gathering, storage, and manipulation of data. We will also touch aspects related to reproducibility issues in science and computing. We will pay particular attention to how to report errors and ask for help in online discussion and Q/A forums.

Update May 4, 2023

Contents

Reading

- These notes
- Readings listed in iLearn — Week 10

1 Ethics

1.1 Ethics in Science

Ethics in Life

https://www.scu.edu/mobi/resources–tools/blog-posts/ethics-in-life-and-business/ethics-in-life-and-business.html

But What is Ethics?

https://www.dictionary.com

ethical [eth-i-k*uh*l] SHOW IPA

SEE SYNONYMS FOR *ethical* ON THESAURUS.COM

adjective

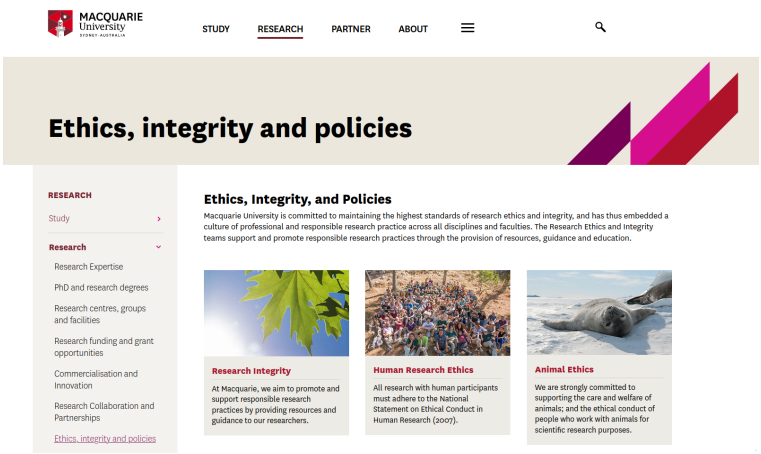
1. pertaining to or dealing with morals or the principles of morality; pertaining to right and wrong in conduct.
2. being in accordance with the rules or standards for right conduct or practice, especially the standards of a profession:
   It was not considered ethical for physicians to advertise.
3. (of drugs) sold only upon medical prescription.

In this unit, we are focusing on definition 2 "being in accordance with the rules or standards for right conduct or practice, especially the standards of a profession."

Academic Integrity at Macquarie University

iLearn's Academic Integrity Module: `https://ilearn.mq.edu.au/course/view.php?id=11590`

Ethics, integrity and policies at Macquarie University
https://www.mq.edu.au/research/ethics-integrity-and-policies



Key Ethical issues related to Scientific Research

Data Fabrication: Create or manipulate data to fit someone's purpose.

Plagiarism: Pretend that someone else's ideas are ours. Not acknowledging the source.

Impact in Society: Fail to consider the possibly negative impact of one's research.

Data Fabrication: The Case of Diederik Stapel (2004-2011)
https://en.wikipedia.org/wiki/Diederik_Stapel, *accessed 4 May 2023*

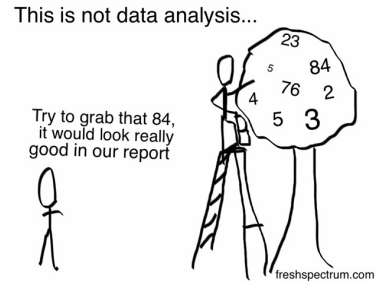
- Diederik Stapel is a Dutch former professor of social psychology at Tilburg University.
- During 2004-2011, he was involved in multiple cases of data fabrication.
- He manipulated data and fabricated entire experiments.
- It took several years to uncover the fraud because of several reasons:
  - The prestige of the researcher.
  - Insufficient clarity in the manuscripts as to how the data were collected.
  - Data used in the experiments were not made available.
    - As was usually the case in the field.

Different Forms of Fabricating Data

Besides the obvious fraud of creating data that does not exist, sometimes there is a fine line between fraud and poor research practice. For example:

- Manipulate the data so that it fits our expectations.
- *Cherrypicking* samples from our data.

https://freshspectrum.com/toon-cherry-picking-data/



Cherry picking is an idiom that generally means "to select the best or more desirable" (`https://www.merriam-webster.com/dictionary/cherry-pick`). Within many areas, including debating and argumentation, and in our case, research, cherry picking is associated with the idea of selecting the data that best suits our purpose. This usually also means to suppress data or evidence that is inconvenient to the researcher, and is an example of fabricating data (by selectively removing data to suit the researcher's purpose).

Plagiarism

- An essential part of science is to advance work made by others.

"If I have seen further than others, it is by standing upon the shoulders of giants" (Isaac Newton)

- . . . but the work by others needs to be acknowledged.
- *Failing to acknowledge others' work can be plagiarism.*
- Self-plagiarism is also plagiarism.

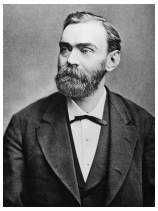
Impact in Society

- A common ethical problem with research and development in science and technology is not to stop and consider its possible (negative) impact in society.
- This is easier said than done. Often the implications of research in society are only known after the damage is done.
- Not everything is black and white: the impact can be both positive and negative.
- But stopping and thinking about these impacts can help improve the positive impact and diminish the negative impact.
- Several researchers have expressed regret for the research they undertook in their past.

The Case of Alfred Nobel
https://www.britannica.com/biography/Alfred-Nobel

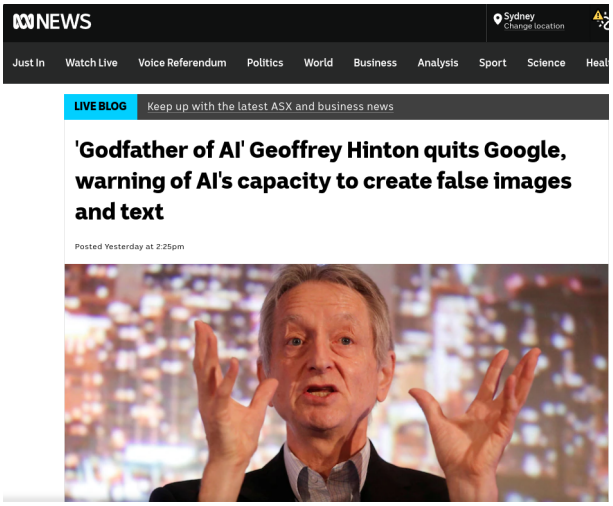
- Alfred Nobel invented the Dynamite.
- Dynamite was used for civilian use, e.g. mining . . .

- ... But it also had military uses.
- It has been said that Alfred Nobel funded the Nobel prize as a means to prevent negative reputation because of his invention of dynamite.



(Alfred Nobel)

More Recently, in May 2023 ...
https://www.abc.net.au/news/2023-05-03/geoffrey-hinton-godfather-of-ai-quits-google-with-danger-warning/102297868, *viewed 4 May 2023*



Geoffrey Hinton is one of the founders of modern Artificial Intelligence (AI) and his contribution to deep learning has been invaluable. In May 2023 he quit Google and expressed remorsement for his contribution to the development of AI.

1.2 Ethical Concerns with Data

Key Ethical Issues with Data
https://www.linkedin.com/learning/people-analytics/ethical-considerations

Privacy: Make sure that private data keeps private.

Security: Protect your data, avoid unauthorised access.

Fairness: Avoid bias in data, avoid promoting bias when using the data.

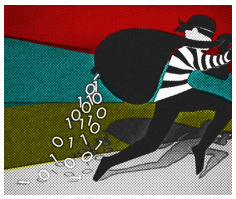
Disclosure and Consent: The users who provided the data need to know what you are using the data for, and give consent.

Privacy

- When data are collected from people, it needs to be *anonymised*.
- In anonymised data, references to private information are deleted or modified.
  - Names
  - Addresses
  - Passport numbers
  - ...
- Anonymisation is not easy: Currently there's so much data publicly available that sometimes it becomes possible to identify users and their habits even after the data have been anonymised.
  - Read, for example, this discussion about de-anonymisation of data from the Netflix prize: *https://www.wired.com/2 anonymous-data-sometimes-isnt/*

Security

- When gathering data with personal information, keep it secure.
  - Do not make it publicly available.
  - You may need to add password protection.
- Some organisations legislate *where* you can save the data.
  - When saving private data in the cloud, check the data policies of the provider of your cloud services.



https://www.flickr.com/photos/111692634@N04/15855653380

Fairness

- When data are collected, the data might be *biased*.
- That means that the data does not represent the real situation.
- E.g. collecting data from Twitter and assuming that Twitter users represent the entire population.
  - Only some kind of people use Twitter.
- Use of biased data might lead to:
  - Wrong business decisions (and lose money).
  - Being accused of bias or racism (and face a lawsuit). *https://www.independent.co.uk/life-style/gadgets-and-tech/news/bing-image-search-microsoft-jews-racist-hitler-nazis-a8579596.html*

Consent of Data

https://www.linkedin.com/learning/data-fluency-exploring-and-describing-data/data-ethics

Regulations like GDPR (Europe — General Data Protection Regulation) and APP (Australian Privacy Principles) establish the need for consent when gathering data.

- *Consent:* When collecting data from people, consent from these people is needed.
- *Informed consent:* People need to know how the data will be used before they give consent.
  - Data collected for one purpuse cannot be re-purposed.
- *Voluntary consent:* People have the choice to give consent or not.

2 Reproducibility

2.1 About Reproducibility

Why Reproducibility?

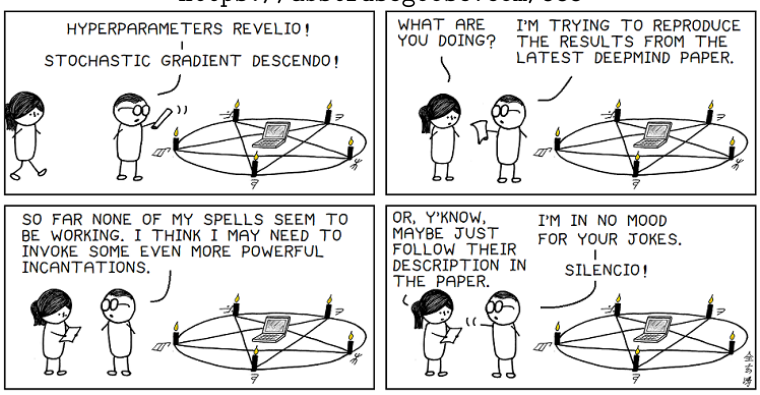
- When you conduct science, you need to make sure that others can reproduce what you did.
  - If others can reproduce what you did, then your claims are more likely to be taken as valid.
- When you report a problem, you need to make sure that others can reproduce your problem.
  - Otherwise they may not be able to help you.
  - It is said that the first step to solve the problem is to be able to formulate the question.

But What is Reproducibility?

- Basically, reproducibility means that someone else should be able to do the same as you did by following your instructions.
- When the experiments are performed with computers, there is some discussion/disagreement about what does "following your instructions" means:
  1. I can re-implement what you did after I read your report.
  2. I can run the code you wrote.
- The employability modules ("Achiever" and "Communicator") touch item 1.
- In the lectures of this unit, we have focused on the use of scripts (MATLAB) to cover item 2.

Writing for Reproducibility

https://abstrusegoose.com/588



Failure to Replicate
https://www.sciencedirect.com/science/article/pii/S026240792200625X?via%3Dihub

https://www.newscientist.com/article/
mg25433810-400-the-replication-crisis-has-spread-through-science-can-it-be-fixed/

This is the introductory text of the above link:

> *I HAVE a confession to make: some of the articles that have appeared in New Scientist, including ones I have written, are wrong. Not because we deliberately misled you. No, our reports were based on research by respected scientists at top universities, published in peer-reviewed journals. Yet, despite meeting all the normal standards of credibility, some findings turned out to be false.*

Read rest at `https://www.sciencedirect.com/science/article/pii/S026240792200625X?via%3Dihub`.

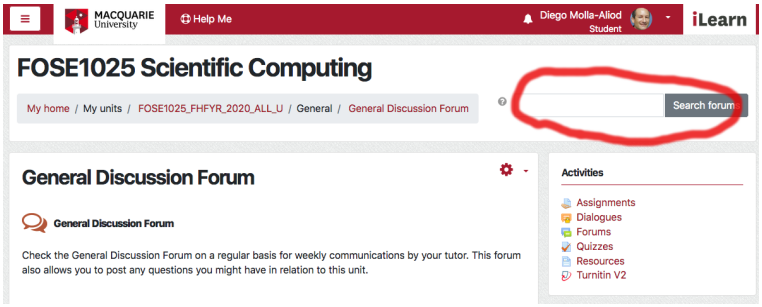
2.2 Asking Questions for Help

When do I Ask?

- Before asking a question, check if someone has asked it before!
- Know the most popular Q/A forums in your field.
  - For example, *https://stackoverflow.com/* is a very popular forum for asking questions related to programming.
- Know how to search the web for solutions to your problem.
  - For example, if you have a computer error, do a web search using the error message.

Is the Answer Somewhere in iLearn?
Follow these steps, in this order:

1. Look at the Announcement sections.
2. Look at the FAQ (if available).
3. Search the Discussion Forums (e.g. use the search box).



How do I Ask?

From *https://stackoverflow.com/help/how-to-ask*

1. Choose the right title.
2. Describe your problem.
3. Help others reproduce your problem.
4. Proof-read before posting.

Choose the Right Title and Description

1. Choose the right title

- Pretend that you're talking to a busy colleague.
- Try to sum up your entire question in one sentence.
- Spelling, grammar, and punctuation are important.

2. Describe your problem

- Don't just say "it doesn't work".
- Explain how you encountered your problem.
- Explain what you did to try to solve the problem.
  - Otherwise people may give a solution that you have tried already.

3. Help Others Reproduce your Problem

- *https://stackoverflow.com/help/minimal-reproducible-example*
- Do not just post your entire program.
- Do specify the specific version of your program (and sometimes also the version of your operating system).
- Write *minimal code/instructions* that reproduces your problem.
  - Sometimes, when you are writing this minimal code, you may find the answer by yourself.
  - *Minimal*: Must be the smallest code possible that reproduces the problem.
    - But must be readable!
  - *Complete*: Must be detailed enough to reproduce the problem.
  - *Reproducible*: Test your code/instructions yourself to make sure that it reproduces the problem.

Take-home Messages

- Have a general awareness of ethical issues when conducting scientific research.
  - Data fabrication
  - Plagiarism
  - Impact in society
- Explain the key ethical issues related to data.
  - Privacy
  - Security
  - Fairness
  - Disclosure and Consent
- Write instructions that can be reproducible.
- Write error messages and reports that can be reproducible.
- Document your work so that someone else can reproduce it.

What's Next

- No lectures on Weeks 11-13.
  - There will be activities related to employability skills.
  - These will be listed in iLearn.
- There are SGTAs until week 12.
- *In-class test 3 at the time of your scheduled SGTA of week 12.*
  - 30% unit assessment weight.
- Wed 17 May: Submit the project.
  - 30% unit assessment weight.
- Reproducibility project:
  - 10% unit assessment weight.
  - Week 12: Submit phase 1 (reproducibility document, 7%).
  - Week 13: Submit phase 2 (peer assessment, 3%).