CSC3031 - Research and Project Skills

What is Research?
Knowledge, Originality and Contribution

John Fitzgerald

Welcome to CSC3031

Overview of this session:

1. What “Research” means: knowledge, originality, contribution
2. A brief overview of the research process: investigation, discovery, communication
3. What does this mean for your project?

1. What Research Means …

"Systematic investigation or inquiry aimed at contributing to knowledge of a theory, topic, etc., by careful consideration, observation, or study of a subject. In later use also: original critical or scientific investigation carried out under the auspices of an academic or other institution."

Oxford English Dictionary online

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Four key elements to this:

- *Knowledge*
- *Contribution*
- *Originality*
- *Systematic*

1.1 Knowledge

- We tend to think of a “body of knowledge” in a given topic. Research is about extending this body of knowledge.
- Knowledge tends to refer to a higher-level understanding than just data.
  - Knowledge often connected to other concepts, e.g. by explanation or causality.
- Wisdom sometimes seen as the capacity to apply knowledge in novel situations.

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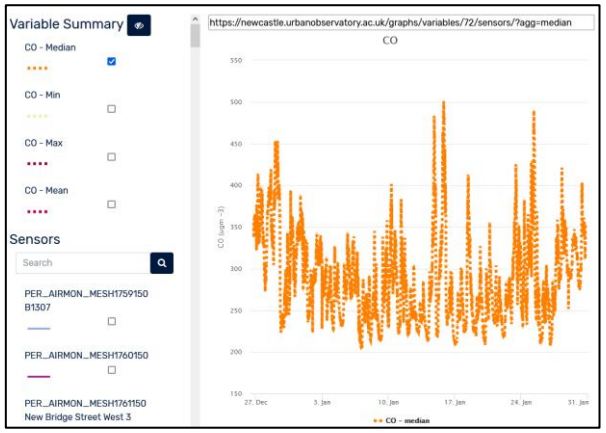


Data presented as information for analysis yielding insights.

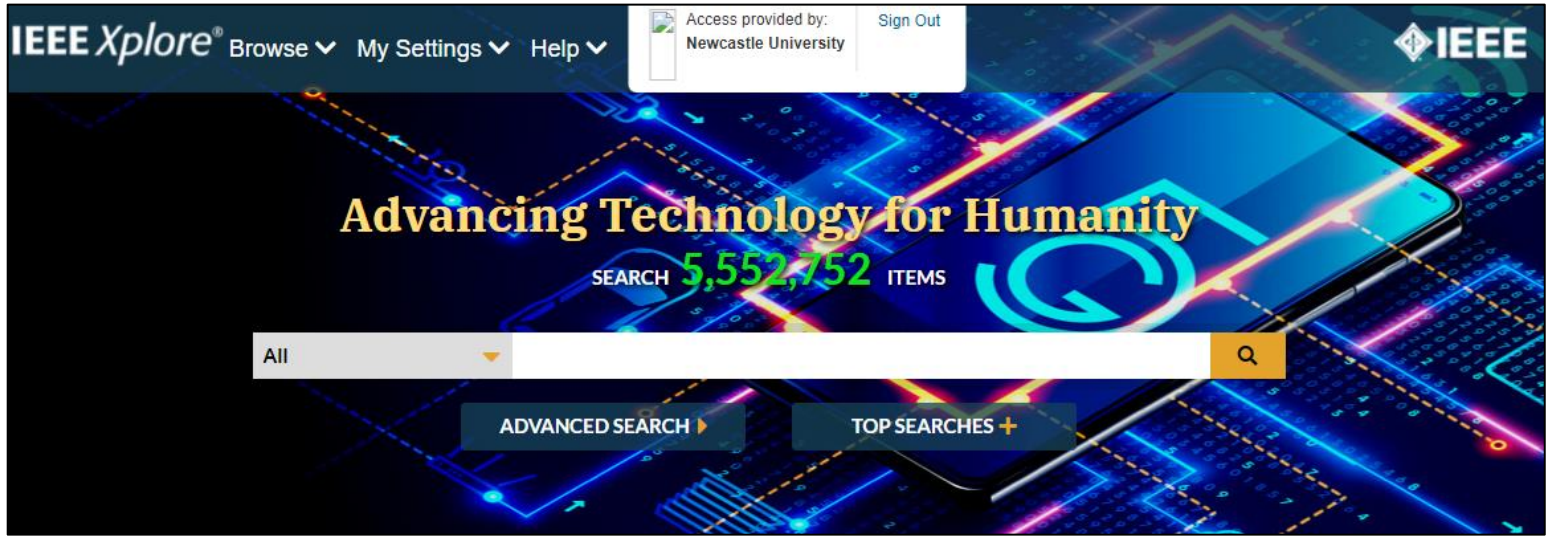
New knowledge in the literature

1.1 Knowledge

- Lots of variety in the CS knowledge base
- Take a look at some …

ACM Digital Library

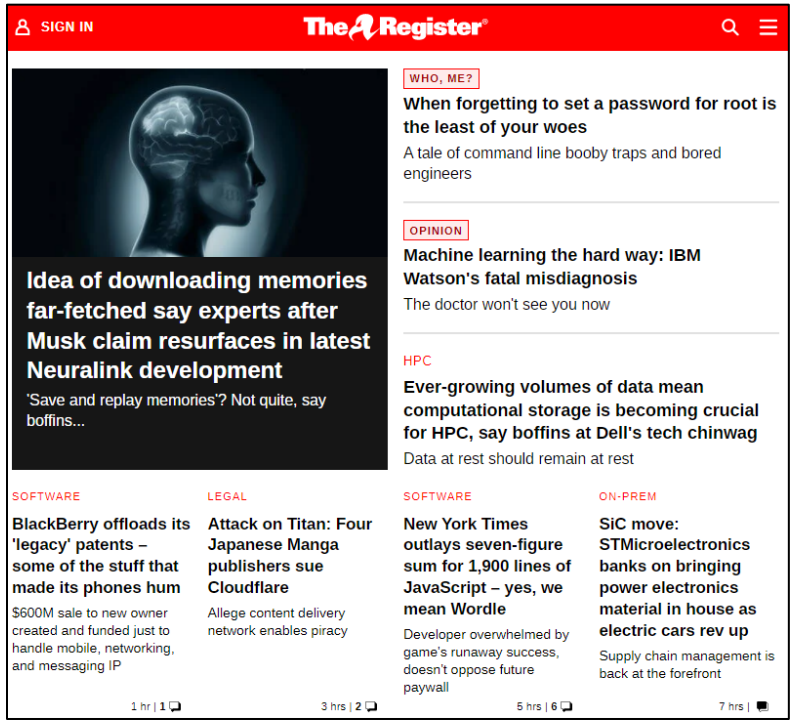
dl.acm.org



IEEE xplore

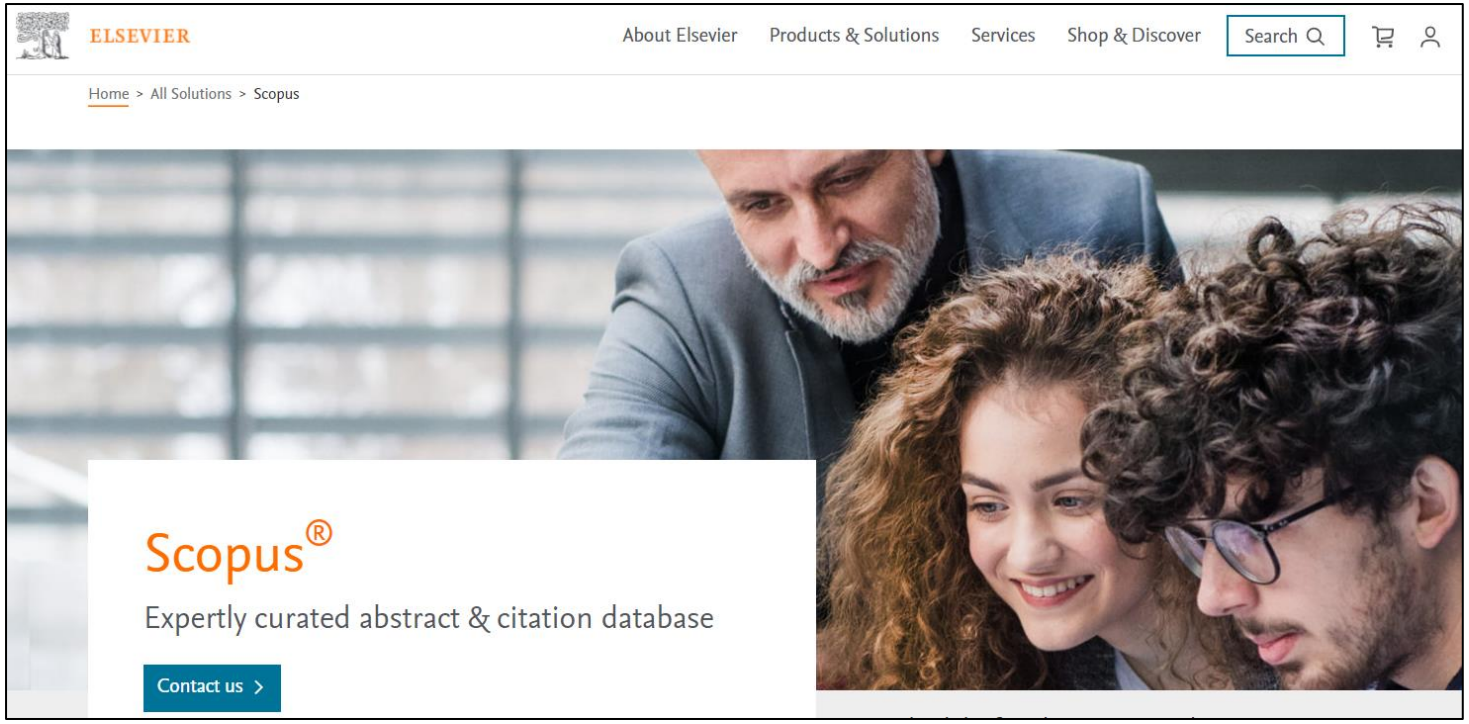
ieeexplore.ieee.org

1.1 Knowledge



The Register

www.theregister.com

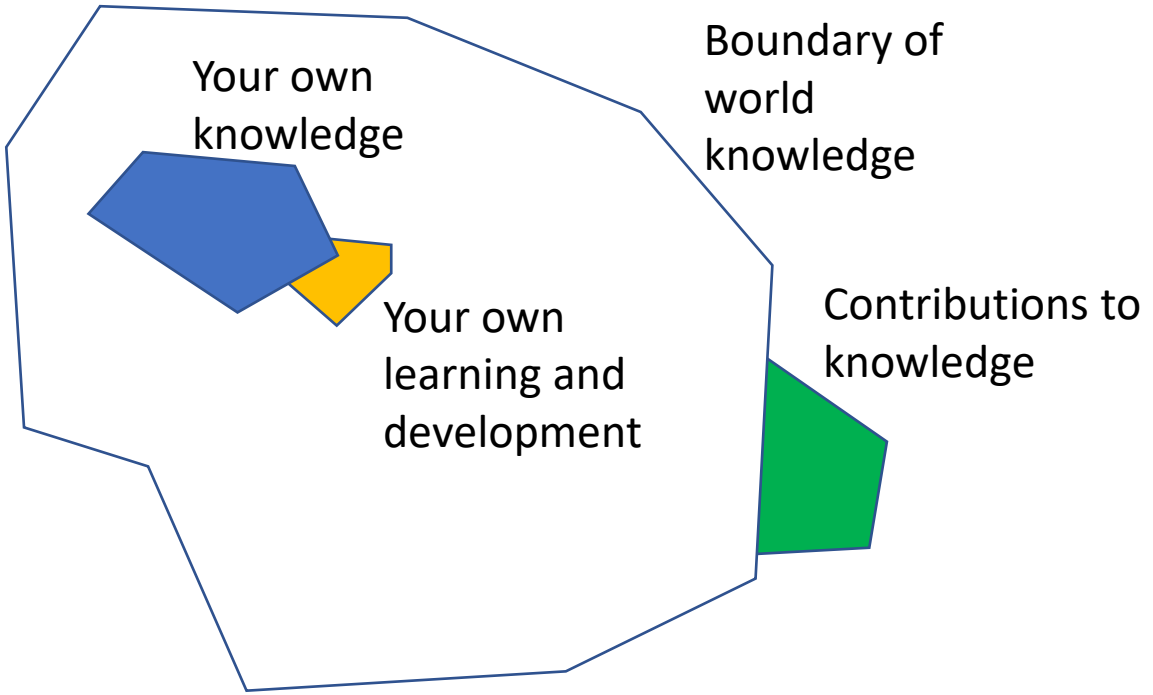


Scopus

https://www.elsevier.com/en-gb/solutions/scopus

1.2 Contribution (or gain)

- Research is about making a contribution to knowledge.
- Recorded in minds, books, papers, the internet, art, …
- We extend our individual knowledge by learning what is already known by others.
- A contribution to knowledge is a sharing of new ideas, theories, results



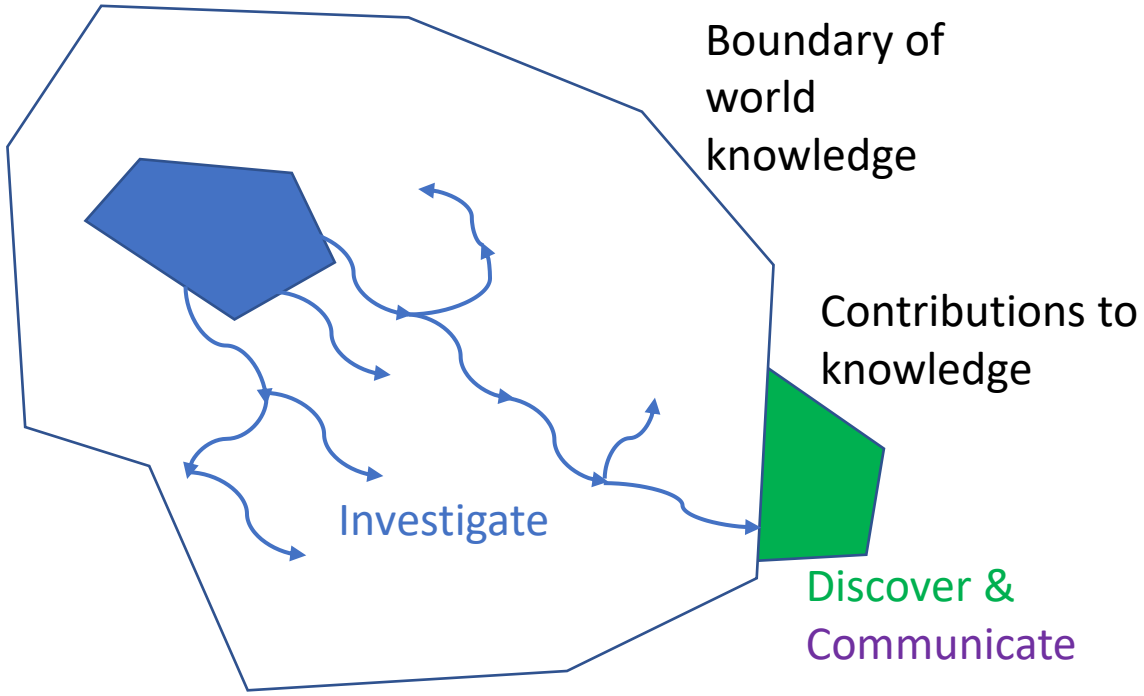
after Dawson

1.3 Originality

- We don’t extend the knowledge base by repeating work already done.
- Researchers place a lot of value on “originality” – the extent to which we are contributing previously unknown knowledge.
- You might do original work in your project, e.g.
  - Applying new tools, methods, procedures
  - Using existing data or methods in a new way
  - Even new knowledge that some methods or tools fail!
- Don’t worry! Your BSc project doesn’t have to make an original contribution to knowledge ☺ … but it might!

2. The Research Process

- Remember research is "Systematic investigation …"
- It's not done in an ad hoc manner
  - Investigation: review the field to understand the limits of current knowledge base.
  - Discovery: gather and interpret new information
  - Communication: present results and subject them to review
  - Integration: if accepted, the new results join the knowledge base.
- There are techniques and tools to help with each of these.



after Dawson

2. The Research Process: investigation

- Literature Surveys
  - The literature **search**: uncovering the published material on a topic and identifying its findings.
  - The literature **review**: adding value to the search by providing a critical evaluation, structuring the findings.
- Lots of systematic techniques for searching the literature in a thorough and fair way.

- In your project, the lit survey will:
  - Justify your project: help explain why it is worth doing
  - Put your project in context – contribution to wider efforts.
  - Provide others with a starting point for their own future work.
- We'll discuss how to access and review the CS literature in a later lecture.

2. The Research Process: investigation

- Good literature surveys are often outstandingly helpful.
- There are some great sources of survey papers. One of the best is the journal *ACM Computing Surveys (available in dl.acm.org)*
- Take a look at a recent issue of ACM Computing Surveys and select a paper. See where the authors …
  - identified the research questions that they wanted to answer
  - explained how they searched for papers on the topic
  - structured and analysed their findings
  - Identified “open questions” – topics as yet unresolved?

2. The Research Process: investigation

- You won't have time to undertake a full survey in your project, but in case you are interested, there are guidelines for conducting surveys in areas such as software engineering:
  - Barbara A. Kitchenham and Stuart Charters. 2007. Guidelines for Performing Systematic Literature Reviews in Software Engineering. Technical Report EBSE-2007-01. Keele University and University of Durham
- … and these people take their own medicine!
  - Barbara Kitchenham and Pearl Brereton. 2013. A systematic review of systematic review process research in software engineering. Information and Software Technology 55, 12 (2013), 2049–2075.

2. The Research Process: discovery

- There's a wide range of research methods in CS, e.g.,
  - Action research
  - Experiment
  - Case Study
  - Survey
- Time frame is important (a snapshot or a "longitudinal study")

- In your project, you may use some of these methods. You might:
  - "just build something" – but you must observe and evaluate the process.
  - You might run tests on code or a system that you've built to prove it has specific features.
  - You might use interviews, questionnaires or observations to, e.g., evaluate a product.

2. The Research Process: discovery

How might we tackle these kinds of question?

- Do AI-based search techniques reduce the effort required to find the best design for a robot?
- Has device driver software become less buggy in the last decade?
- Do smart homes impact human behaviour?
- What attacks could compromise a new communications protocol?

- Action research
- Experiment
- Case Study
- Survey

2. The Research Process: communication

- We typically publish new results. There's a plethora of ways to publish:
  - Peer reviewed or not?
  - Workshops, Conferences and Journals
  - Books
  - Technical Reports & Manuals
  - Any old web page
- Peer review is really the gold standard for most CS research publications.
- Take a look at IEEE Xplore, ACM Digital Library for many leading journals and conferences, including in your field.

- In your project, you'll write your final dissertation in the form of a technical paper.
  - Clear definition of the context
  - Background lit review
  - Description of the technical contribution
  - Discussion of the results and identifying how others could build on your work.

3. Review: what does all this mean for your project?

- Whether or not you are doing research yourself, you'll rely on the products of others' research.
- Research is less "rocket science" than you think:
  - Mostly quite systematic: investigate the state of knowledge; select appropriate methods; evaluate and communicate your findings.
  - There are quite well-defined methods for those tasks: the cleverness comes in using the right methods to justify the conclusions that you draw.
  - It's quite a social process: other scientists help to determine the scope of a subject, the norms of methods and tools, and the standards of results.
- Don't be afraid of the scientific literature … go ahead and explore.

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