

# Research Methods

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# What is research?

What is 'research  
methods'?

The process of  
research

References

'Research is how we create knowledge.'

'The art of asking questions that have useful answers that can be methodologically determined.'

*The Merriam-Webster online dictionary*: 'a studious inquiry or examination; especially: investigation or experimentation aimed at the discovery and interpretation of facts, revision of accepted theories or laws in the light of new facts, or practical application of such new or revised theories or laws'.

*The Gale Encyclopedia of Education*: the purposes of research 'include exploring, describing, predicting, explaining, or evaluating some phenomenon or set of phenomena'.

*Wikipedia* (July 2011): 'research ... is creative work undertaken systematically to increase the stock of knowledge, including knowledge of humanity, culture and society, and the use of this stock of knowledge to devise new applications'.

# Research methods

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'This subject is an introduction to the processes of science as they apply to computing and related disciplines, including designing experiments, locating relevant literature, writing theses, giving presentations, and refereeing. Underlying all of these, the subject will foster the development of critical thinking, a skeptical, scientific perspective, and scientific ethics.'

- ▶ Introduction to the skills & tasks involved in doing research.
- ▶ Overview of what is expected of a research student; and of a researcher.
- ▶ Guidance on the steps towards completion of a substantial research project.

# Introduction to skills ...

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In particular, how to produce a strong thesis! Specifically,

- ▶ How to read and understand research papers; and what to say about them.
- ▶ How to write about your own research, and how to present it to others.
- ▶ Library skills for researchers.
- ▶ Planning and scheduling.
- ▶ Experiments, human studies, data, and study design.
- ▶ Statistical methods for research data.
- ▶ Ethics and research conduct.

# Research projects, research students

- ▶ Minor theses: half-semester to two or sometimes three semesters;  
Typically tightly defined and scoped, with limited aims.
- ▶ MPhil: eighteen months (but can stretch to two years);  
Typically a thorough exploration of a narrow question, often a stage  
on the path to a PhD.
- ▶ PhD: three years (but can stretch to four years);  
Typically a thorough exploration of a substantial question.  
Identification and clarification of the question may be a significant  
part of the the project.

# Research projects, research students

## Multiple cohorts of student:

- ▶ IS (Information systems) vs CE (computing or engineering)
- ▶ MBC (M.Sc or MIT or MIS) vs RHD (MPhil or PhD)

Make sure you are in the right stream! See the subject guide in the LMS.



## Research projects

Despite the differences between different kinds of thesis, and regardless of the scale of projects, the processes of doing the research & achieving the outcomes are much the same.

- ▶ Identification of research questions & hypotheses.
- ▶ Reading and assessing literature.
- ▶ Development of methods.
- ▶ Data collection, experimentation, mathematical proof.
- ▶ Analysis, interpretation, and critical evaluation.
- ▶ Write-up & presentation.

# Project outcomes

## A thesis ...

- ▶ Minor thesis – usually examined within the department.
- ▶ MPhil or PhD – examined by internationally recognized experts.

## New knowledge ...

- ▶ Student projects are research training – but most do lead to publishable research outcomes.
- ▶ Refereed journal or conference papers.

New skills: communication, critical thinking, independence.



# UoM PhD examination guidelines (2010)

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- ▶ Does the candidate show sufficient familiarity with, and critical understanding of, the relevant literature?
- ▶ Does the thesis provide a sufficiently comprehensive investigation of the topic?
- ▶ Are the methods and techniques adopted appropriate to the subject matter and are they properly justified and applied?
- ▶ Are the results suitably set out and accompanied by adequate exposition and interpretation?
- ▶ Are conclusions and implications appropriately developed and clearly linked to the nature and content of the research framework and findings?
- ▶ Have the research questions in fact been tested?
- ▶ Is the literary quality and general presentation of the thesis of a suitably high standard?
- ▶ Does the thesis constitute a substantive original contribution to knowledge in the subject area with which it deals?

## Analysis of examiners' reports

(Extracted from work by John McDonald of the University of Ballarat, reported in detail in Evans, Gruba, and Zobel, *How To Write A Better Thesis*, third edition.)

- ▶ A significant and substantial problem has been investigated.
- ▶ The thesis demonstrates a systematic pursuit of a line of inquiry.
- ▶ It is well-planned and executed, with each section clearly building on the last (that is, there is a coherent macro-level structure).
- ▶ The literature review is critical and evaluative, and sets forth an argument for why and how the study should be conducted.
- ▶ The research design is appropriate and allows the questions to be answered.
- ▶ Advanced analytical skills are used; a clear chain of evidence is laid down.
- ▶ The discussion is disciplined and not excessively speculative.
- ▶ Conclusions are well drawn and convincing; clear claims are made about the exact contributions of the thesis.
- ▶ Elegant, precise, and economical written expression.
- ▶ There is evidence of systematic proof-reading and error correction.

# Aims of research

To have impact.

To create knowledge.

To create wealth.

To change practice.

To be part of something important.

To have fun; to learn.

# The process of research

**Speculate** – develop a concept, follow a train of thought, have a hunch that an idea is worthwhile.

**Encapsulate** – form a specific research question.

**Observe** – gather preliminary data, make an initial implementation, sketch out some proofs.

**Hypothesise** – make testable predictions based on a strong understanding of the research question.

**Test** – design instruments, undertake mathematical analysis, systematically gather data, perform robust experiments.

**Analyse** – use critical argument to link the results to the hypothesis, thus demonstrating whether it is supported or contradicted.

**Write-up** – use the results and analysis to convince skeptical examiners that your conclusions are interesting and correct.

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# Perspectives on research

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The traditional sciences were, historically, *observational* and concerned with quantifying and explaining the properties of the natural universe.

Much technical research today is applied and concerns *utility*, that is, solution of problems in a practical context.

But it is not sufficient to just build or define something that seems to solve a problem – research typically involves understanding the properties of the solution:

- ▶ How far short of the ideal?
- ▶ Scope, limitations?
- ▶ Measurable properties?
- ▶ Lessons for other problems?

# Assessment in COMP90044

Literature review (all), statement of research question (RHD)

Paper reviews (RHD), paper summaries (MBC)

Research presentation

Experimental or study design



**Justin Zobel, *Writing for Computer Science*, Third ed., Springer, 2015.**

Available through the library as a free e-print.

*Please:* do not share by email; download it yourself.

• **David Evans, Paul Gruba, and Justin Zobel, *How to Write a Better Thesis*, Third ed., Springer, 2014.**

Available through the library as a free e-print.

*Please:* do not share by email; download it yourself.

• **Paul Gruba and Justin Zobel, *How to Write a Better Minor Thesis*, Melbourne University Publishing, 2014**

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