

Goals

The goals of these lectures:

- review the process/requirements for a CSE thesis
- describe the general research/development process
- show how to go about achieving a good result

At the end, you should ...

- understand precisely what's required of you
- produce a better project/report/seminar/demo
- use your time more effectively

Week1-1

Topics

In these lectures, we'll talk about:

- goals/requirements/process for 4th-year thesis
- the process of doing research/development
- getting started on a project
- preparing/delivering the seminar
- *writing the literature review (Thesis A Report)*
- *doing and evaluating the work*
- *writing the final thesis (Thesis B Report)*

Week1-2

Overview of 4th-year Thesis

Aims of the 4th-year thesis:

- allow you to "put together" what you've learned
- give you exposure to research/implementation topics
- give you experience in tackling a sizeable project
- require you to practice planning/time-management
- give you experience in report writing and presentation

Week1-3

Overview of 4th-year Thesis (cont.)

Overview of thesis process

- find a topic (do this now)
- do background research, make plan (07s1, weeks 1-10)
- *report* (literature review + plan) (due 07s1, week 11) (5%)
- *seminar* (project overview + plan) (in 07s1, week 12) (5%)
- *thesis* (project + evaluation) (due 07s2, week 14) (90%)
- *demonstration* (07s2, week 14)

Week1-4

Overview of 4th-year Thesis (cont.)

Assessment:

- Thesis A is graded (SY/UN)
- Thesis A mark is held over for inclusion in Thesis B
- overall Thesis mark is computed as:

$$\text{ThesisAMark} = \text{ReportMark} + \text{SeminarMark}$$
$$\text{ThesisMark} = (\text{SupervisorMark} + \text{AssessorMark}) / 2$$
$$\text{FinalMark} = 0.9 * \text{ThesisMark} + \text{ThesisAMark}$$
$$\text{FinalGrade} = \text{HD|DN|CR|PS|FL, determined by FinalMark}$$
$$\text{FinalGrade} = \text{UF, if SupervisorMark} < 50 \text{ and AssessorMark} < 50$$

Week1-5

Overview of 4th-year Thesis (cont.)

Changes for 2007:

- 07s1: on-line submission (PDF)
- 07s2: assessment criteria for thesis B
- 07s?: sorting out Week 12 seminar time-slots
- 07s?: Thesis web site

All are currently being worked on ... details to follow.

Week1-6

Overview of 4th-year Thesis (cont.)

For definitive description of Thesis:

- UG Thesis 2007 (Course Outline)¹
- CSE Thesis web site²
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The Course Outline document is definitive.

4th-year Thesis Coordinator ... John Shepherd ³

- academic co-ordination: nominations, guidance, staff liaison

Student Office Manager ... Cassandra Nock ⁴

- administration: extensions, late penalties, reassessment

Week1-7

FAQ

Q: How long should X be? ($X \in$ chapter, Report, Seminar, Thesis)

A: As long as is necessary to make it convincing.

Q: When is Y due? ($Y \in$ Report, Seminar, Thesis)

A: Check www.cse.unsw.edu.au/thesis

Q: What happens if I can't finish?

A: You get less marks than you would if you finished.

Q: Can I get an extension?

A: No ... if Thesis A is late/missing, you get AF.
If Thesis B is late, you suffer heavy *late penalties*.

Week1-8

FAQ (cont.)

Q: What must I do to get good marks?

A: Depends on who you're asking ...

Supervisor:

- knows everything you did (or ought to)
- can assess based on continuous performance

Assessor:

- (most likely) sees only Seminar, Demo, Thesis
- can assess based on what she/he observes in S/D/T

To be safe: ask what they're looking for.

Week1-9

Why a Thesis is not an Assignment

A thesis is significantly different from an assignment:

- it is, typically, *open-ended*
 - there is not an obvious single "correct" answer
 - you have more say in the direction the work takes
- it has a much longer time-frame
 - you need more *self-discipline* to get things done
 - you have more responsibility to *plan* your progress

If you're still in "assignment mode", break the task into 2-week-long steps and treat each one as an assignment (but, alas, no late penalty).

Week1-10

Different Types of Theses

Theses have been classified into:

RES	carry out a small focussed piece of research
DEV	build a software and/or hardware system
R&D	combination of the above two ... build a system, but needs research to get it done

Expectations for each type are slightly different (see later)

Week1-11

What is Research?

Activity that advances the store of human knowledge, e.g.

- explaining a previously unexplained phenomenon
- developing techniques to do things better
- proposing a new viewpoint on a cultural system
- proving a theorem

Sci/Eng research follows the "scientific method":

- Observe ... Hypothesize ... Test ... (repeat)

Week1-12

What is Research? (cont.)

Example: biologist discovering new frog species

Observation:

- notices some yellow frogs behave differently to others

Hypothesis:

- maybe there are two species of yellow frogs

Test:

- systematically observe behaviour of two populations
- capture frogs and examine them in more detail
- nowadays, use genetic analysis to define new species

Week1-13

Computing Research

Writing a piece of software, no matter how complex, isn't generally regarded as research in itself.

However, it would be considered research if

- it uses a new method/algorithm/data structure
(the new method must be *demonstrably* better than earlier approaches)
- it solves a problem not previously solved by computer
(will typically involve development of new methods, anyway)

Week1-14

Computing Research (cont.)

Example: devising a new database indexing method

Observation:

- queries of type Y are not efficient with existing methods

Hypothesis:

- my new method (X-trees) will handle Y queries *better*

Test:

- analyse computational complexity of X-trees for Y queries
- build X-trees indexing library, test on a variety of data

Week1-15

Computing Research (cont.)

Evaluation of computing research:

- solves existing problem more effectively than before
- solves a wider range of problems than before (generalises)

Demonstrations of effectiveness follow two tracks ...

Theoretical, e.g.

- analyse complexity, prove upper/lower bounds, ...

Experimental, e.g.

- build prototype; measure performance on range of data

Week1-16

What is Development?

Construction of artefacts/systems to solve problems.

Implicit notion that new systems are *better* than existing.

There is still a (minor) research aspect:

- you must demonstrate effectiveness
- you must analyse and describe limitations

A very important requirement for a DEV project:

- follow a well-defined project development methodology
- document the development process in the thesis

(cf. research projects: the result is paramount, method matters less)

Week1-17

Computing Development

Aim: build a system to meet a demand or solve a problem.

May involve developing software, hardware, or a combination.

The goal is clearly to build the system, but you must also:

- follow a (software) engineering methodology (+ document it)
- provide a demonstration that the system *works effectively*
- note any unsolved problems and limitations

Week1-18

Computing Development (cont.)

Characteristics of effectiveness are problem-dependent, e.g.

- time and space, for most computing projects
- bandwidth utilisation, for networks
- usability, if there's a user interface
- accuracy (precision/recall), for web search engines

Must use *appropriate* evaluation instrument for project.

Must be honest about effectiveness (even negative results are useful).

Week1-19

Doing Research

The process is an elaboration of "observe/hypothesis/test":

- understand the broad topic area
- establish an evaluation framework (issues, metrics)
- look at what others have done and evaluate
- find an area of "weakness" in existing work
- devise a (better) solution
- evaluate the effectiveness of the solution

Hint: document all parts of this process **as they are done**.

Week1-20

Reporting Research

Reporting follows, more or less, the steps in the process:

- Introduction** sell the topic, summarise aims
- Background** set the context, review literature
- Own Work** what have you done, exactly
- Evaluation** convince us that it's good
- Conclusion** summarise achievements (and failures)

Week1-21

Reporting Research (cont.)

Introduction:

- outline the topic area, significance, originality, ...
- give overall aims of your work, summarise contribution

Background:

- describe the problem you are trying to solve in detail
- establish evaluation framework (what makes a *good* solution?)
- describe *and analyse* what others have done already

Week1-22

Reporting Research (cont.)

Own Work:

- describe your proposed method/approach in detail

Evaluation: (experimental)

- describe evaluation process (what are you measuring, how, why)
- report *and discuss* results of evaluation

Conclusion:

- summarise what you achieved
- *and* what you didn't achieve ... and suggest how to fix it

Week1-23

Doing Development

Has similarities to research ... but like "observe/build/test":

- understand/refine the requirements
- establish an evaluation framework
- look at what others have done and evaluate
- look at what methods are available, and choose
- devise a solution (implement system)
- evaluate the effectiveness of the solution

Hint: document all parts of this process **as they are done**.

Week1-24

Reporting Development

Reporting follows, more or less, the steps in the process:

- Introduction** sell the topic, summarise aims
- Background** set context, evaluate approaches
- Own Work** what have you done, exactly
- Evaluation** convince us that it's good
- Conclusion** summarise achievements (and failures)

Week1-25

Reporting Development (cont.)

Introduction:

- outline the topic area, significance, benefits ...
- give overall aims of the project

Background:

- describe the problem you are trying to solve in detail
- establish evaluation framework (how to recognise a good solution)
- describe *and analyse* what others have done already (maybe no-one has attempted this before?)
- evaluate possible implementation methods/approaches

Week1-26

Reporting Development (cont.)

Own Work:

- describe implementation process (SE) and final product
- if it has a user interface, give a tour of this

Evaluation:

- describe evaluation process (what are you measuring, how, why)
- report *and discuss* results of evaluation

Conclusion:

- summarise what you achieved
- *and* what you didn't achieve ... and suggest how to fix it

Week1-27

Getting Started

Week1-28

Getting Started

What you should be doing as soon as you have a topic:

- *think* about the topic ... understand all aspects, etc.
- find out what others have done before (reading required)
(Google⁵ Scholar⁶ ... Citeseer⁷ ... DBLP⁸ ... Wikipedia(?)⁹)
- consider what's need to evaluate your work
(don't bother considering evaluation-by-bluff ... it doesn't work)
- make notes on everything that you look at/think about
- set up a thesis web site? (for holding the notes)
- meet your supervisor and find out what they expect
- establish a consistent Thesis working pattern (weekly meeting?)

Do all of this before week 6 and assignments get heavy.

Week1-29

Getting Started (cont.)

Things you should do **today** ...

- create a directory called *thesis* (or *4910* or ...)
 - create subdirectories: *report*, *seminar*, *thesis*
 - if doing implementation, create a directory called *system*
 - create subdirectories:
 - *notes*: where you type up ideas as you think of them
 - *papers*: to keep electronic copies of reference material
 - if keen, set up a web site (e.g. Wiki) for your thesis work
- You should do this *today* because you have no assignments to do yet.

Week1-30

Thesis A

Thesis A aims for you to demonstrate that ...

- you have a thorough understanding of the topic
- you have identified an aspect that requires work
- you have an approach for solving the problem
(and you can argue the likely effectiveness of this approach)
- you have a plan for carrying out the work
(including time-frames for tasks, knowing how to evaluate, ...)

Week1-31

Thesis A Seminar

Week1-32

Seminar Structure

Introduction	sell the topic, summarise aims (5-6 minutes)
Background	set context, evaluate previous work (12-15 minutes)
Proposal/Plan	how do you plan to tackle the problem (2-3 minutes)
Bibliography	give references for all work cited (as you go)

Seminar = summary of Report, publicity for project, chance for feedback

Week1-33

Seminar

The seminar aims to:

- give you a chance to practice your presentation skills
- let you show that you have met the goals of Thesis A
 - convince others that you're studying an important/interesting problem
 - demonstrate that you've done some research/thinking about it already
 - have a plan for the rest of the year to solve the problem

If you already have some results to show, that's a bonus.

Target your seminar at fellow thesis students *except* target the hard-core technical stuff at your supervisor and assessor.

Week1-34

Seminar (cont.)

Suggested structure for presentation:

1. Title slide (name of project, your name, ...)
2. Example to illustrate the problem (1-3 slides)
3. Introduction to problem; statement of goal (1 slide)
4. More detailed problem description (3-4 slides)
5. Survey/critique of existing approaches (3-4 slides)
6. Outline your approach to solve it (1-3 slides)
7. Plan for your work for the rest of the year (1 slide)

Use max 15 slides; you cannot cover more in 25 mins.

(The most difficult part of preparing a presentation is deciding what to leave out)

Practice the talk to a friend (for timing and explanation clarity).

Week1-35

URLS

1. www.cse.unsw.edu.au/thesis/2007ThesisOutline.pdf
2. www.cse.unsw.edu.au/thesis/
3. www.cse.unsw.edu.au/info/jas.html
4. www.cse.unsw.edu.au/info/chu.html
5. www.google.com.au/
6. scholar.google.com.au/
7. citeseer.csail.mit.edu/
8. www.informatik.uni-trier.de/~ley/db/
9. http://en.wikipedia.org/wiki/Main_Page

Week1-36