# Goals

The goals of these lectures:

- describe the general research/development process
- discuss the specific requirements for a CSE thesis
- show how to go about achieving these effectively
- At the end, you should ...
- understand precisely what's required of you
- produce a better result (project/report/seminar)
- use your time more effectively

Week2-1

## Topics

- In these lectures, we'll talk about:
- goals/requirements of 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)

Week2-2

# Outline

In this lecture:

- structure and preparation of Thesis A seminar
- structure and preparation of Thesis A report
- carrying out the project
- structure and preparation of Thesis B thesis
- Some of this material is based on ideas from: Thesis Web Site, http://www.cse.unsw.edu.au/db/thesis/

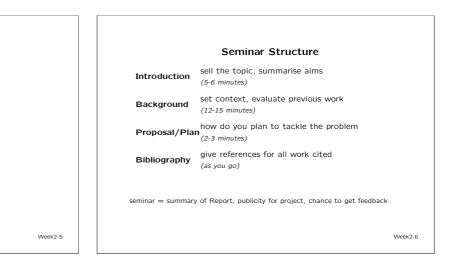
- Introduction to Thesis Writing Structures and Processes Pam Mort, The Learning Centre, UNSW How Theses Get Written: Some Cool Tips Steve Easterbrook, Dept. Computer Science, University of Toronto

Thesis A Seminar

Week2-3

#### Thesis A

- Thesis A aims for you to demonstrate that  $\ldots$
- you have a thorough understanding of the topic
- you have identified an area 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, ...)



## 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.

Week2-7

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).

Week2-8

#### Seminar (cont.)

Some rules for making slides:

- at least 20-point font, preferably sans serif font
- no more than 10 lines of text per slide
- no more than 2 main points per slide
- use pictures/diagrams to illustrate ideas
- strip the text down to the bare essentials
- The *content* is the most important thing.

**Nobody** cares about colours, background, fancy transitions. Presentation Tools: PowerPoint. S5 (HTML-based), LaTeX/PDF (e.g. Beamer)

Week2-9

#### The Seminar

Take it seriously ... you're being assessed.

Speak clearly ... tell a story ... practice.

Don't just read the slides ...

- if you can ad lib talk around the slides
- if you prefer, write a script and read from that

Week2-10

# The Seminar (cont.)

Question time is important (hopefully)

- you will get unexepected questions (this is where the assessor double-checks whether you know the material)
- you will get very useful feedback (others will notice things that you (and your supervisor) may have missed)

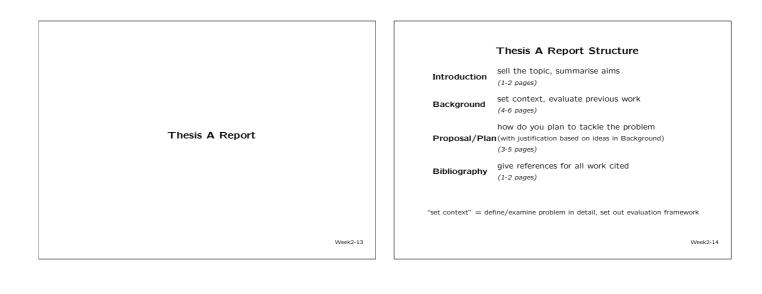
Attend seminars by others, especially on related topics (you may get a whole lot of useful ideas by seeing a different viewpoint)

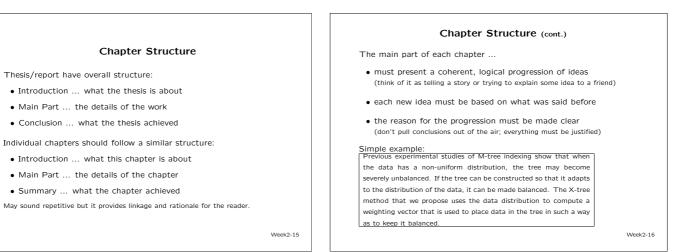
Week2-11

## The Seminar (cont.)

Suggested timetable for seminar preparation:

Weeks	Task
1-5	Work out precisely what your project is
2-12	Prepare your Thesis A report
10-11	Prepare the presentation
11	Show the slides to your supervisor
12	Revise the slides and practice





# Introduction

Write a draft of the introduction  $\mathit{now},$  containing  $\ldots$ 

• what are you trying to achieve? why is it important?

Leave it while you write the rest.

After you finish the rest, come back and re-write it ...

- significance/importance of the general topic area
- brief review of current state-of-the-art in the area
- $\ensuremath{\bullet}$  the aim of your study and what are its implications
- summary of the main results and implications
- structure of rest of thesis; what does each chapter give

Week2-17

#### Background

This chapter aims to show:

- that you understand what the problem is
- that you are aware of the current state-of-the-art
- that you can analyse and critique others' work

• that there is an unsolved problem to be investigated

The chapter structure follows roughly these goals

- ${\ensuremath{\bullet}}$  describe the problem in detail, all issues/aspects
- develop an approach for determining a "good" solution
- describe and analyse previous work (using this approach)
- conclude that some aspect of the problem is not yet solved
  Week2-18

#### Background (cont.)

For DEV thesis, you might conclude that previous systems ...

- did not exist (nobody has ever built a system to do this)
- were too inefficient
- had usability problems

For RES thesis, you might conclude that previous methods ...

- · did not work for a certain class of data
- · were inefficient for a certain class of data

#### • were not elegant

Ultimately, you must show that your approach effectively addresses the problem.

Week2-19

## Doing the Literature Review

# Goals:

- collect a comprehensive set of publications on the topic
- build a picture of the nature and scope of the problem
- develop a framework for evaluating possible solutions
- analyse the specific work described in the publications

How comprehensive? (a.k.a. how many references is enough?)

- until you are convinced that you have all relevant material
- some topics may require: one main ref + one general ref
- other topics may have dozens of relevant publications
- use your judgement when to stop (and ask supervisor)

Week2-20

# Doing the Literature Review (cont.)

How to find references?

- your supervisor may give you some papers/references
- if not, try using Google with terms from the topic title
- once you have an initial set of references ...
  - use their bibliographies to find prior work
  - use Citation Index to find *subsequent* work (e.g. citeseer)
- try to identify seminal papers on the topic

Week2-21

#### Doing the Literature Review (cont.)

Maintaining your bibliography:

- maintain a database using a bibliography tool (e.g. BibTeX)
- keep all printed copies of papers in a labelled folder
- keep all electronic copies under your "thesis" directory\*
- make electronic notes on all papers, as you read them

- For word processing, I strongly recommend LaTeX, because it ... produces better looking output, especially mathematical formulae has good facilities for bibliography, cross-referencing, table of contents encourages you to concentrate on *content*, not *appearance*

Week2-22

# Doing the Literature Review (cont.)

How to "get a handle" on the topic?

- read and think about the references
- determine how they relate to each other
- work out common themes and differences
- note what assumptions they make (are they reasonable?)
- think about you might assess the "goodness" of each

Keep (electronic) notes:

- write a description of the topic, in your own words
- keep a list of important issues and unresolved problems

Week2-23

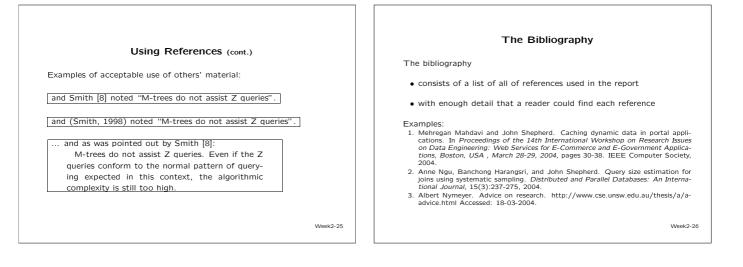


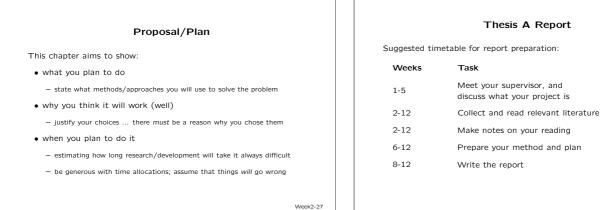
What you should  $\ensuremath{\text{NOT}}$  do with references:

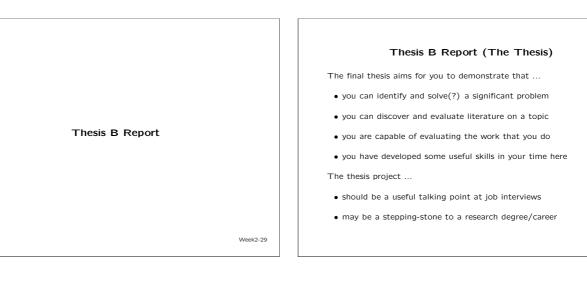
- copy/paste large pieces of text from them into your report\*\*
- if you do this, it's plagiarism and you fail

Every statement in your thesis which is based on others' work

- must be attributed to them (via a reference)
- even if you make the statement entirely in your own words
- but especially if you are "quoting" them (minimise this)
- \*\* One exception is where the quote is an indented paragraph and well-attributed







	Thesis Structure
Introduction	sell the topic, summarise aims (2-5 pages)
Background	set context, evaluate previous work (15-30 pages)
Own Work	what have you done, exactly (10-20 pages)
Evaluation	convince us that it's good (10-20 pages)
Conclusion	summarise achievments (and failures) (2-5 pages)
Bibliography	give references for all work cited
Appendices	present tedious details of data/programs

Week2-31

Chapter Titles		
Introduction	no choice	
Background	or "Literature Review", or name it after the gen- eral topic area (e.g. "Database Indexing", "e-Learning Systems",)	
Own Work	should be named after your approach or system (e.g. "X-Trees", "WebCMS",)	
Evaluation	or "Experimental Results"	
Conclusion	no choice	
Bibliography	or "References"	
Appendices	no choice	
	Week2-32	

#### Doing the Work

Each thesis is different, so no specific advice on how to do it.

- Some general advice, to ensure that you keep on track ...
- ${\ensuremath{\bullet}}$  try to stick to the plan that you made in Thesis A
- always work towards a specific short-term goal/milestone
- meet your supervisor regularly (force them to meet)

If you leave the implementation too late  $\ldots$ 

- you will be busy with assignments, marking, etc.
- you won't have time to properly evaluate your work

Week2-33

# Doing the Work (cont.)

To plan milestones, work backwards:

- thesis must be completed by week 14
- will take 1 week to write up evaluation alone, so ...
- evaluation must be completed by week 13
- will take 4 weeks to do the evaluation, so ...
- system must be completed by week 9
- will take 8 weeks to implement the system, so ...
- must start implementing system in week 1
- etc. etc.

Week2-34

# Doing the Work (cont.)

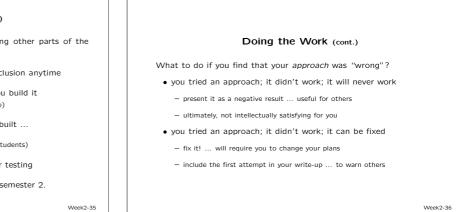
The above planning assumes that you are writing other parts of the thesis as you go:

- you can write Introduction/Background/Conclusion anytime
- you can write description of system before you build it (but will most likely need minor adjustments as you go)

If you're doing usability testing on a system you built  $\ldots$ 

- you need usability testers (typically other thesis students)
- you will probably need to modify system after testing

Comclusion: you need a working system early in semester 2.



#### Doing the Work (cont.)

What to do if you find that your *plan* was "wrong"?

- the most likely cause: you tried to do too much
- reduce the scope of the work; discuss with supervisor
  e.g. build a system with less functionality (omit some functions)
  - e.g. devise a method that solves a subset of cases
- do not reduce the evaluation of your work

Week2-37

## Introduction and Background

Use material from these chapters in Thesis A report.

#### Introduction:

- will definitely need to change if scope/methods change
- ${\ensuremath{\bullet}}$  re-write to better reflect the final outcomes of project

Background:

- change description of problem if necessary
- add any additional material discovered since thesis A
- elaborate framework and literature review in more detail
- add any missing material on how to evaluate your work

Week2-38

#### Your Own Work

Contents of this chapter depend on whether RES or DEV thesis. Either way, should still follow Intro/MainPart/Summary chapter structure.

If you have solved several distinct problems:

- use several chapters of the form (Problem<sub>i</sub>, Evaluation<sub>i</sub>)
- if this leads to too much repetition, try:
  (Common Material) (Problem<sub>1</sub>,Eval<sub>1</sub>) (Problem<sub>2</sub>,Eval<sub>2</sub>) ...

Week2-39

#### Your Own Work (cont.)

For a RES thesis:

- state the precise research question (including assumptions/limits)
- describe the approach (what exactly did you do?)
- justify your choice of methods (why did you do it this way?)
- $\ensuremath{\,\bullet\,}$  outline alternatives that were rejected

Week2-40

#### Your Own Work (cont.)

For a DEV thesis:

- summarize the system requirements (cf. Background)
- describe the design/implementation (what exactly did you do?)
- justify your choice of methods (why did you do it this way?)
  - platform, architecture, algorithms, data structures, ...
- outline alternatives that were rejected
- In all of the above, follow an established software engineering methodology.

For an interactive system, adding a tour of the interface is very useful to give readers a feeling for what you've done.

Week2-41

## Evaluation

Aim of evaluation:

- ${\ensuremath{\,\bullet\,}}$  to convince the reader that you have a good solution
- to show that you can analyse and interpret results

To conduct the evaluation:

- refer back to evaluation framework in Background
- for each evaluation dimension, develop an instrument to measure/assess it
  - must explain how instrument assesses dimension
- apply the instrument and present and *analyse* the results

#### Evaluation (cont.)

Examples of dimensions and instruments:

Satisfies functionality

apply a standard software engineering testing strategy

Usability of interactive system ...

• conduct task-based usability analysis on range of people

Efficiency of database indexing ...

- measure performance over a wide range of query types
- measure over a large range of database sizes

Will typically need to apply tests across several dimensions.

## Evaluation (cont.)

Presentation of results:

- summarise results in Eval chapter; give full details in appendix
- learn a graphing program (e.g. gnuplot)

Analysis/interpretation of results

• essential that you say precisely what the results mean

Week2-44

#### Conclusion

The conclusion should ...

- re-state the goal from the introduction
- summarize what parts of it you have achieved
- $\bullet$  summarize what you have  ${\boldsymbol{not}}$  acheived
- for any limitations/deficiencies,...

outline how you might approach them (don't need solution)

Typical structure for this chapter:

• main conclusions, subsection on Future Work

Future work is aimed at students who might do this thesis in the future.

Week2-45

Week2-43

## Other Resources

Most online resources talk about PhD theses, but many of the basic ideas are also relevant here.

"Writing and Presenting your Thesis or Dissertation", S. Joseph Levine, Michigan State University http://www.learnerassociates.net/dissthes/

"How to write a PhD Thesis", Joe Wolfe, Physics, UNSW http://www.phys.unsw.edu.au/ jw/thesis.html

"How to Write a Dissertation", Douglas Comer, Computer Science, Purdue University http://www.cs.purdue.edu/homes/dec/essay.dissertation.html

"How to Write a Master's Thesis in Computer Science", William D. Shoaf, Computer Science, Florida Inst. Technology http://www.cs.fit.edu/wds/guides/howto/howto.html

Week2-46

# Other Resources (cont.)

Pages with collections of other resources: http://www-2.cs.cmu.edu/afs/cs.cmu.edu/user/mleone/web/how-to.html

http://www.cs.iastate.edu/ honavar/research-methods-workshop.html