COS700 RM – Research Methods 2015

Lecture 4
Writing a research proposal
The Research Proposal

• The overall idea:
  – Expresses in formal writing what you are going to do, why you are going to do it, and how you are going to do it.
• If done properly, it constitutes a significant amount of the work of the overall research project.
• Is it really necessary to write a proposal?
  – A weak proposal is a waste of time.
  – A strong proposal will save you time.
• Advantages:
  – An agreement between you and your supervisor
  – Forces you to think clearly and precisely about the research before you do too much of the work.
  – Forces you to start writing early (many of the paragraphs should end up in the final report, so not wasted effort).
Typical structure of the research proposal

- Page 1: Cover page with essential information
- Page 2: Title repeated with abstract and keywords.
  1. Introduction
  2. Problem statement
  3. Methodology
  4. Literature survey
  5. Planning
  6. References

- Slight deviations fine, but basic elements must be there.
The cover page

• The words “University of Pretoria”, “Computer Science Department”, “COS700 Research Proposal”
• The date (at least the month and year)
• Title of research project
• Student name, number, email address
• Name of supervisor(s)
The Title

• Must capture the essence of the research project, i.e. the topic of the research.
• Must be specific (enough detail), but concise (no unnecessary words).
• Must not contain abbreviations or acronyms.
Real examples of CS research project titles

Video Rewrite

SIP / H.323 / AIX telephone customization

Molecular Communication: Modeling and Simulations

Collision Detection for Interactive Environments and Simulations

Implementing a Genetic Algorithm to Optimize Database Queries Involving Numerous Joins

Virtual Reality Meets Computer Vision
The abstract of the proposal

• Why do you think it is called an abstract?
• Length: 100 – 200 words
• Content:
  – Brief background to the research (no citations) & problem statement
  – Method(s) to be used
  – Expected results
• Usually easier to write last.
• Do not just cut and paste from the proposal: write in a more condensed form.
Example project abstracts

Abstract

Thesis statement: The *Time-varying Reeb Graph* provides a topological framework to perform visualization of a time-varying volumetric dataset. It assists us to compute the number and genus of level-set components for all (function value, time) pairs, compute seed-cells for fast level-set extraction, and perform temporal simplification of level-set topology.

Abstract: We propose a new collision detection algorithm for polygonal models in interactive environments and simulations based on incremental computations. The algorithm will be implemented as a system that will provide collision detection for large-scale geometric data sets modeled from primitives such as polygons and polytopes. The overall goal is to develop a demonstrable system that can be used with present-day animation and simulation environments.

This proposal explores the merging of computer vision and interactive computer graphics. Computer vision techniques seek to construct models from sequences of images. Computer graphics techniques create sequences of images from models. Combining these two disciplines yields a powerful, interactive, image-oriented system. A prototype system is described which senses a head-mounted display user’s environment from the head-mounted display see-through video stream and correctly composites real-world and synthetic head-mounted display images. Such a system is feasible and will provide improved perception for see-through virtual environment applications.

Are they any good?
Another example abstract

The task of making controlled surface modifications with a Scanning Tunnelling Microscope (STM) is sufficiently complicated that it requires an effective and powerful user interface to the microscope. The processes of making changes are not well understood and will require extensive experimentation to understand.

The goal of this system is to approach the ideal interface for the scientist - presence on the surface itself. The system will make use of a Head-Mounted Display (HMD) and Force-Feedback Arm (ARM) to present an immersive virtual environment in which the user is projected onto the surface and given the ability to act at the atomic scale. It will give the user the power to modify the real world from within a virtual world. This will require that the virtual world be carefully registered with the real world at all times and that the model presented to the user be consistent with the external environment. The purpose of this system is to transport the user into a nanoworld and to provide a means for the user to make changes in this environment. It seeks to create teleoperation at the atomic scale.
The introduction of the proposal

• Introduce the background against which your research will be conducted.
• Aim is to convince the reader:
  – That the research is relevant, necessary and timely.
  – That the research has not been done.
• What to put in the introduction:
  – Start with the broad field into which your research falls.
  – Become more specific.
  – Lead into the problem statement.
  – Use references throughout (but it is not the full literature survey).
• Example project: Multicasting of multimedia via a metropolitan area network
  – Could start with a statement about how the use of multimedia data has increased.
  – Then move onto the high bandwidth requirements of multimedia data and some ways multimedia data is communicated.
  – Outline the shortcomings of existing approaches.
  – Introduce multicasting & metropolitan area networks
  – Summarize some of the relevant existing work.
The problem statement

• Describe the problem that your research will address in as much detail as possible.
• Stating your title as a question sometimes helps in naming the problem.

Collision Detection for Interactive Environments and Simulations

• Specify and describe your main objectives and sub-objectives.
  – to demonstrate ..., to evaluate..., to determine..., to establish..., to argue..., to prove ..., etc.
• Define the scope and limitations of the research.
  – What your work deals with and what it does not deal with.
  – “This work does not consider...”
• State any assumptions that you are aware of.
The Methodology

• Identify the methods that you plan to use to address your objectives.
  – Which paradigms and tools?
  – What code do you expect to write?
  – What experiments will you need to conduct? (briefly outline)
  – Refer back to Lecture 3 handout.

• Must tie back to your research objectives.

• Should be clear that methods are appropriate (explain why alternative methods not proposed).
Bad example

6. Approach to the Study

Reading will have to be done on how the voice network in the Computer Science department works, how the phone connects and makes calls via the VoIP gateways and also how the protocols the phone uses work. Reading will also have to be done about embedded systems and how to update the flash memory in the phone. Should encryption be added reading will be have to be done on that subject.
The Literature Survey

• Give an overview of research that has been conducted on the problem you are investigating.

• Only use published references.

• Work should be directly linked to your work (and you must point out the link).

• Objective: to show how your research relates to and differs from existing research.

• NB: Identify the main players in the field.

• See lecture 2.
Project planning

• Identify and describe the specific phases of your work
  – such as reading, writing, coding, experimentation, testing, writing, editing, writing.

• Provide a schedule of everything that needs to be done all the way up to the submission date (5 November) or presentation date (?? Nov).
  – Tasks that need to be done and the time allocated to them with deadlines.
  – Remember that your supervisor needs time to review your report/paper and you need time to incorporate changes before the submission date.

• Advantages of task timelines:
  – Forces you to break down the work into manageable chunks.
  – Lets you think about the logical sequence of tasks.
  – Planning helps you to not miss out important tasks.
  – Creates deadlines for yourself.
  – Clears you head (you don’t have to hold it all in your head, because it’s in the plan).
  – Can be used to map progress.
The schedule – some hints

• Be realistic, rather pad the time than set unrealistic deadlines.
• Don’t forget to factor in other things (other modules, your life, …)
• Some tasks can overlap in time – it’s good to have alternative tasks to work on.
• Give page estimates to your writing tasks.
• Start from the end and plan backwards.
• Commit to your plan: have your timeline visible somewhere.
• Update your plan if necessary as you progress with the work.
Example 1

<table>
<thead>
<tr>
<th>1 Week</th>
<th>Learn how the various VoIP protocols work.</th>
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<tbody>
<tr>
<td>3 Weeks</td>
<td>Learn more about embedded programming and understand the code provided with the phone.</td>
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<tr>
<td>1 Week</td>
<td>Find ways to improve the interface.</td>
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<tr>
<td>3 Weeks</td>
<td>Implement changes to the interface.</td>
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<tr>
<td>1 Week</td>
<td>Investigate the viability of adding encryption to the phone</td>
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<tr>
<td>2 Weeks</td>
<td>Possibly add encryption to the phone</td>
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<tr>
<td>3 Weeks</td>
<td>Investigate adding PPPoE and possibly implementing it.</td>
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</table>
## 6. Work schedule

<table>
<thead>
<tr>
<th>Task</th>
<th>Start Date</th>
<th>End Date</th>
<th>Days Completed</th>
<th>Days Remaining</th>
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<tbody>
<tr>
<td>1 Preliminary study</td>
<td>2009/09/20</td>
<td>2009/12/15</td>
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<td>2 Literature Review</td>
<td>2010/02/01</td>
<td>2012/09/30</td>
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<td>743</td>
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<tr>
<td>3 User requirements gathering</td>
<td>2010/03/01</td>
<td>2011/03/31</td>
<td>186</td>
<td>204</td>
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<td>4 Proposal writing</td>
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<td>2010/08/31</td>
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<td>5 First round design</td>
<td>2010/09/01</td>
<td>2010/12/15</td>
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<td>6 First user evaluation Testing</td>
<td>2010/10/01</td>
<td>2010/12/15</td>
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<td>7 Second round design</td>
<td>2011/01/15</td>
<td>2011/03/31</td>
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<td>8 Second User evaluation Testing</td>
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<td>9 Third round design</td>
<td>2011/04/01</td>
<td>2011/11/30</td>
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<td>10 Third user evaluation Testing</td>
<td>2011/05/01</td>
<td>2011/11/30</td>
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<td>11 Writing of papers</td>
<td>2012/01/15</td>
<td>2012/03/31</td>
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<td>12 Results analysis</td>
<td>2012/01/15</td>
<td>2012/03/31</td>
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<tr>
<td>13 Thesis write up</td>
<td>2012/04/01</td>
<td>2012/09/30</td>
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![Gantt Chart](chart.png)

Is this a good plan?
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<td>Decide on Specific Project Idea</td>
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<td>Write Proposal and Prepare Presentation</td>
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<td>Devise Query Plan Encoding for GA</td>
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<td>Set Up Programming Environment</td>
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<td>Create Initial Test Data</td>
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<td>Decipher PostgreSQL’s Cost Metric</td>
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<td>Use Cost Metric to Implement Fitness Function</td>
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<td>Create the Classes and Functions for GA</td>
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<td>Run GA Against Test Data and Fine Tune</td>
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<td>Perform Final Tests and Analysis</td>
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Is this a good plan?
The References

- Provide a list of references that you have cited in the proposal.
- See Lecture 2.
Academic writing

• Some resources:
  – Video: “Writing in the Sciences – Cut the Clutter”, Stanford School of Medicine, med.stanford.edu.
No, no, if you make the paper too easy to read, everyone will know how you got the results!
References (for this lecture)