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Computer Science

Notes on Conducting Master Thesis Research

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- Master Thesis Research
  - selecting topic
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  - reporting results

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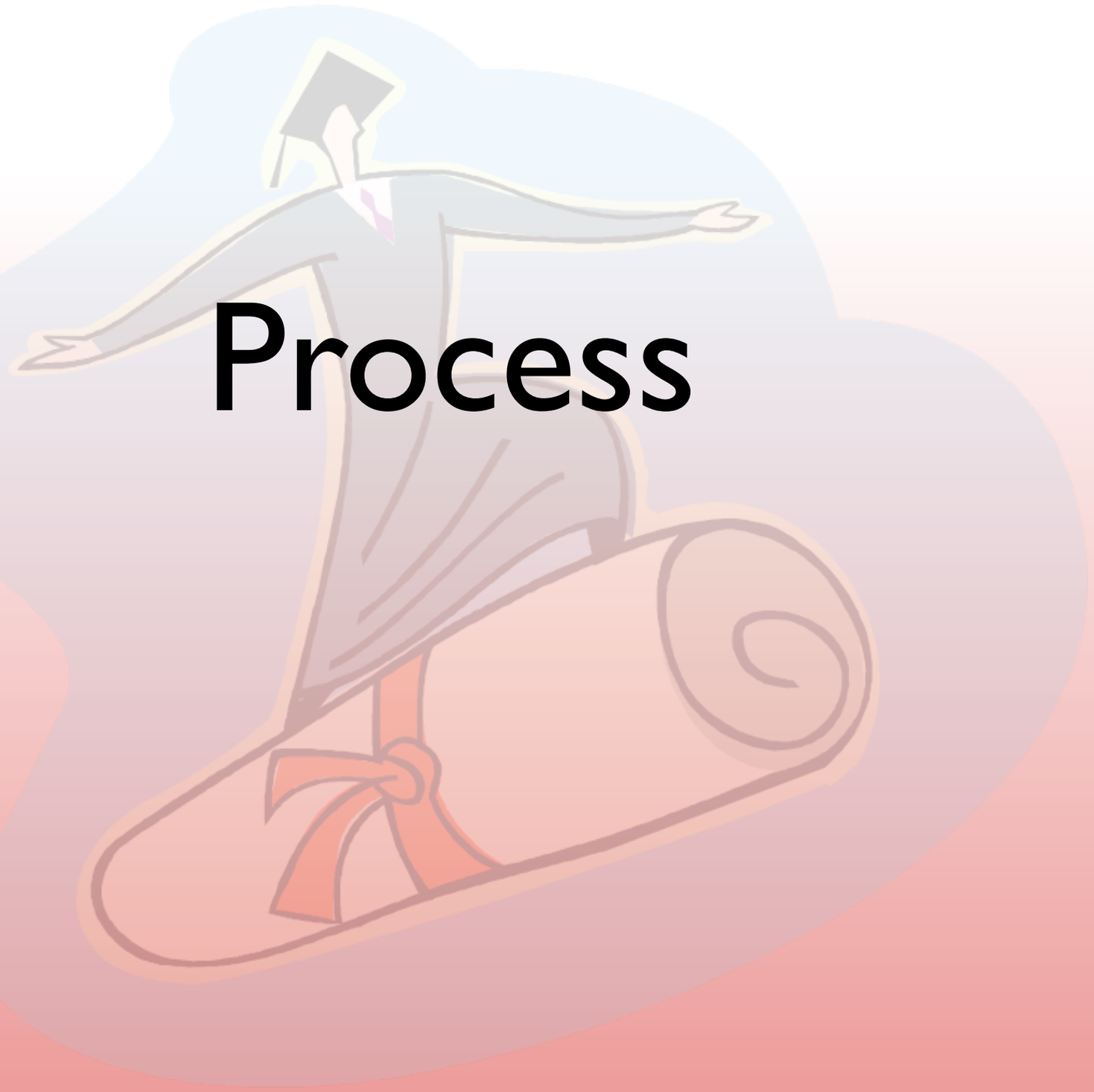

Process

Master Thesis Process

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- Select a research topic - as soon as possible
- Select a research advisor, who will become the chair of the committee.
- Write a proposal for the thesis and submit it to the advisor
- Invite two holders of doctorates in Computer Science or a field related to your topic to serve as the other two members of the committee:
  - One internal and one at large (internal or external)
- Conduct the research collecting experimental data
- Report the research in a document that includes data analysis and thesis evaluation
- Obtain supervisor's approval to distribute the thesis to the examination committee no later than one month before the defense
  - It usually takes weeks to get things right, so start early
    - Submitting chunks of the document progressively is the best approach

Candidacy

- Your research proposal needs to be accepted by the advisor (who is also the chair of the examination committee) before you are eligible to apply for the candidacy status
- To be granted the status, you will need to submit to the administration office a formal Candidacy Form
  - The form has to be signed by the thesis advisor and by the program director
  - Two names of the other committee members must be included too
    - No signatures are needed, but you should obtain from them a written consent to serve on your committee though (email is fine)

http://oak.cs.csuci.edu/cms/uploads/Forms/CandidacyForm.pdf

- As a candidate, you will be allowed to register in the Master Thesis course (COMP597)
- It is expected that you take all other required courses before you enroll in the Master Thesis class, so you can focus on the research
  - As usually, there are exceptions in response to necessities

Thesis Defense

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- After enrolling into COMP597 Master Thesis, you will work with your advisor until the advisor decides that your research and the report in the formal thesis document are ready for a defense before your thesis committee
  - You will go through numerous revisions of your work, as not only the core research, but also the presentation of the results is important
  - It is expected that your work will be publishable, so your advisor may ask you to write a summary of the work in a form of a conference or journal paper
    - A paper is desired but not a required element of your graduation requirements, however
- After your advisor instructs you to go ahead with the distribution of the thesis, you need to distribute the draft to all members of the committee
  - At this time, your advisor should schedule the defense giving the committee at least one month to read the document and analyze your work

Thesis Defense: Presentation

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- The defense consists of three parts:
  - Public presentation of your findings
  - Public Q&A session following the presentation
  - Confidential examination by the committee
- Prepare roughly a one-hour presentation that should consist of the following segment as applicable:
  - Introduction
  - Demonstration of your system if feasible
  - Analysis of the results
  - Conclusions
  - Ideas for the future

Thesis Defense: Examination

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- In the examination session that is closed to public, the committee will ask questions relevant to your thesis
  - You should be confident in explaining all aspects of your work, as one of the goals is to ensure that you have mastered all necessary knowledge and that you are the sole author of the work
- Next, you will be asked to leave the room, so the committee can confer behind the closed door the overall quality of your thesis. After that relatively short meeting you will be asked to come back and the outcome will be communicated to you by the chair of the committee.
- The possible outcomes of the defense are:
  - Accept with no changes
  - Accept with minor changes
  - Accept with major changes
  - Reject

Thesis Defense: Outcomes

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- If your work is accepted with no changes or with minor changes, and all other requirements for the graduation have been met, then you are granted the title of Master of Science in Computer Science
  - A request for minor changes will be handled between you and your advisor
  - Please note that a graduation letter from the Graduation Office is a formal proof of your graduation
- If you are asked to make major changes to your work, then you will have to re-submit a revised copy of the thesis to the committee for another review
  - In such case, you will have to wait for your degree until the committee accepts the changes
- If the committee rejects the thesis, the candidate will have to repeat the whole process: take additional six units of COMP597; select a new research topic, an advisor, and a committee; conduct new research; and then write a new report and defend it in front of the new committee

Thesis Publication

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- Master of Science in Computer Science theses are published by the CSUCI Library
  - Any recommend changes will have to be incorporated before your work is archived
- Archiving is in electronic format (PDF) in a repository at the CSUCI library
- The publication requires:
  - A copy of the defense sign-off pages
    - These are the first three pages of the document with room for signatures of the members of the examination committee, Director of the MSCS Program, and the Dean of Extended University
  - Student-signed Non-Exclusive Distribution License

- The publication process is described at:

http://www.library.csuci.edu/ThesisProcess/index.html

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Conducting Research

Master Thesis Objectives

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- The research that the students conduct in the process should be reasonably challenging.
- However, the main objective of the thesis component of the program is to teach the students the process of conducting studies in a systematic, structured way, collecting and analyzing results, drawing conclusions, and writing technically rigorous reports.
- All of that changes in a Ph.D. program where the research is the most important aspect of the studies.
- Students, who plan to continue their education at a doctorate level, may want to select a topic that allows them to showcase their abilities as researchers.

Picking Research Topic

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- A variety of ways
  - Some students start the program knowing what they want to do
  - Check if a professor has a list of topics listed (Web page, doors, etc.)
  - Check faculty publications
  - Check faculty achievement database
    - Do not overlook other disciplines!
  - Check what the peers are researching and with whom
  - If you have a particular field in mind, check the proceeding from primary conferences
    - Pay special attention to the "future" parts
  - Ask your employer for the needs
    - Find a professor with matching interests
- After picking a potential topic, make an appointment to discuss possibility of advising
  - Write a paragraph that is an abstract of your intentions
  - Iterate with the potential advisor until you are both satisfied

Thesis Document Content

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- Sign-off pages
  - CSUCI-wide standard

    http://www.library.csuci.edu/ThesisProcess/thesiscoverpages.pdf
- Table of Content
- Chapter 1: Introduction
- Chapter 2: Field Overview
- Chapter 3: Technical DetailsS
- Chapter 4: Experiments
- Chapter 5: Analysis of Results
- Chapter 6: Conclusions
- Chapter 7: Future Work
- References

Please note that this is just a sample content.
Your advisor may elect to follow a different format.

Introduction

- Statement of work
- The thesis that you are attempting to prove
- Why do you want to do it?
- Why is it a worthwhile topic?
- Any inspirational references?
- Any encompassing larger goals? (“save the world”)

- The thesis proposal is a good starting point

Field Overview

- This is a showcase for presenting the knowledge that you have gained while researching the topic for your thesis
  - You may benefit from preparing COMP599 Seminar presentations
- Theoretical foundations for your work
- Description of similar work
- May be used to set background for comparative studies in the Conclusions section
- Should include ample references to other publications
  - Basically, every claim should have a supporting reference
  - The publications must be included in the References section
    - Use easy to identify tags

Technical Details

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- You show here your skills as a software engineer
- Describe how did you implement or engineered the system with which you conducted the experiments that proved (or disproved) your thesis
  - Usually, it is implied that you wrote some code for your research
    - If you did, then you may inject illustrative snippets of code if you must, but in general including code is not a good idea
- Show architecture of the system
- Show the setup for the experiments
- Explained how the data were collected
- Explained what tools were used for data visualization and data analysis
- Explain any tricks of trade that you used in the implementation and during the experiments
- Present any hints that will help anybody to repeat, verify, and extend the experiments

Experiments

- This is a necessary part of your research
  - Designing, engineering, developing, and implementing a system, technique, methodology, architecture, etc., are necessary but not sufficient components of your research
- The experiments should follow the descriptions that you should have included in the technical part
  - See the previous slide
- Collect the experimental data meticulously
- Label the data carefully, so you can easily associate them with the experiments
- Select a format that will be convenient for analyzing your data
- Protect the data with special care
  - Back up, back up, back up…

Analysis of Results

- Data should support proving or disproving your thesis
  - You need to provide some illustrative ways to show that
  - Graphical visualization is not a required, but an extremely effective way of presenting data
    - You must design your visuals carefully, though
    - Always include ample commentary with good cross-referencing
    - Don't forget that 3D visualization might be better for a lot of data
  - You may want to look at presentation techniques done by others, so it is easier to put your results in perspective

- For Master-level research you can get away with a negative outcome
  - Basically, you could as well reverse your thesis (e.g., "this works" vs. "this does not work")
    - Please keep in mind however that if you are to pursue a doctorate, a negative outcome will not be acceptable for a Ph.D. dissertation
  - You may need to adjust your document to make it into a coherent whole

Conclusions

- This is an executive summary of your research
  - You may want to repeat your thesis statement (potentially rephrasing it)
- You should include remarks evaluating your work
  - Did you prove or disproved your thesis?
- Relate your results to other published work
  - Did you improve something done before?
  - Did you fail to improve?
    - The "why?" analysis is important in this case, as it is the basis for validating your work
      - The goal of this analysis is to guide any future research in the area
- Include any conditions for your concluding remarks

Future Work

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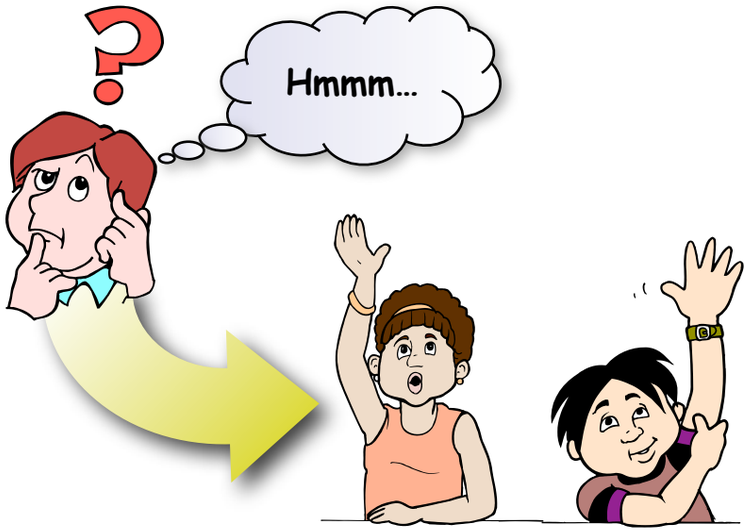
- This is a collection of thoughts for potential future expansion of your research
  - It can also guide other researchers
- While conducting research, collect any idea that pops up in your head
  - That will be the basis for the "future" section
- Think about things that you wanted, but have not done
  - Not only "features", but also techniques, methodologies, experiments, visualization ideas, concepts, etc.
- List things that you cannibalized due to the lack of time
- Include things that could be done differently from how you did them
- List tools, techniques, methodologies that could be used in addition or instead of the ones that you utilized

References

- Make this a substantial part of the report
- Any statement in the report should have a supporting reference
- All references should be easily identifiable
  - Include all details of the source like name, author, volume, publisher, year, page, etc.
- All references should have a tag by which you refer to them from the text
- Avoid URLs, as they commonly disappear with no warning
  - It's a serious problem, since a lot of information is on the Internet
  - Online journals, libraries, are usually fine if they have official formal repositories
- Try to provide scientific references rather than popular science
- Journals and conference proceedings are best to refer to



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