CISC 879 Research Proposal Learning Experience

Learning Objectives: Graduate students completing this project should be able to independently and successfully:

(1) Perform a thorough bibliographical search (literature survey) of a particular topic in computer science.

(2) Compare, contrast and summarize a set of papers/research contributions on a particular topic.

(3) Write an informative, but concise and technical survey of the state-of-the-art in a particular subfield of computer science.

(4) Critically analyze the state-of-the-art in a particular problem, and brainstorm new ideas and directions on a particular research topic. Write a clear description of the new research idea.

(5) Develop an evaluation plan which would successfully determine the effectiveness of new ideas.

(6) Write a well-developed, concise research proposal.

(7) Learn to work together as a research team in gathering information, discussing existing approaches to gain understanding, critical thinking, and formulating new ideas.

(8) Critique a research proposal.

The Divided Project: The following description lays out the various subtasks and the timeline of minideadlines to ensure that each student makes the best use of the entire semester to hit every aspect of the first stages of research up through a written research proposal. Some deliverables are done as a group effort while others are to be done individually.

Potential Topics: You may choose a topic from our syllabus to expand upon, or choose a topic based on current proceedings (ICSE, ISSTA, ICST, ISSRE, FSE, ICSM, PASTE, ASE, or OOPSLA) over the past year, and have your topic approved by Lori.

If you are currently doing research in one of these areas, and are already past the stage of creating a literature survey, then you should choose another topic. If you have just started research in one of these topics, but have not done a literature survey, you may choose a topic somewhat closely related to your topic or a completely unrelated topic. If you are not sure which category you belong in here, you should talk to me.

The rest of this document explains each deliverable in detail. For each deliverable, please submit a printed copy or email the pdf as an attachment.

9-18: Deadline 0 Topic and group: The goal of this deadline is to identify a research topic that has open problems relevant to this course, as well as identify the group you want to work with. You may work on your own or with a partner.

9-30: Deadline 1 Bibliography Search Results: The goal for this deadline is to identify the world for your topic; that is, search for all papers relevant to your topic; not reading the papers,

but determining relevance based on title and abstract. You should search in digital libraries (ACM, IEEE,...), recent conferences and workshops that cover your topic, and then use the bibliographies of recent papers to identify earlier relevant papers. There are also various helpful tools to use for this, including citeseer and Google Scholar search. The deliverable is (a) one sentence describing the overall topic/research problem you are investigating, (b) a paragraph explaining how you performed your search (as precisely stated as possible), (c) a nicely formatted reference list, created by using bibtex and latex, and (d) a paragraph or enumerated list that cites the papers in your list and describes the classification of those papers in some way. For example, some of the papers are earlier foundation papers on the topic, some are solving subproblem X, some solve subproblem Y, some are all by the same research group Z, … The bibtex file should have the entries categorized in some way for ease in relating entries to each other, and ease in writing the survey. **This is a group effort, with one deliverable for the whole group.** The goal is to have an organized view of the world, not just a long list of papers on the topic.

Before starting the next step, meet with Lori during office hours (as a group) to discuss this bibliography and how you can focus your research proposal on a particular subproblem of the overall world in this area. Come with your preferences/thoughts.

10-14: Deadline 2 Outline of Literature Review: The goal for this deliverable is to understand the timeline, overall contributions, relative merits and limitations of the work embodied in the state-of-the-art in your topic. You need to read only the abstract, introduction, related work, and conclusions sections of each paper. Do this reading in chronological order (or reverse chronological order) of paper publication dates to obtain some sense of how the research has evolved over the years. Then, develop a pseudo outline where you have grouped the papers focusing on very similar problems, and then have 2 sentences for each paper. For each paper, be sure to include the problem addressed, contribution or key insight to solving that problem, findings of any evaluation of the contribution, and limitations. Thus, your outline should look like:

    I. Subtopic 1
        A. Paper 1: title and authors
            a. One sentence on the specific problem addressed, Contribution.
            b. One sentence on the findings of any evaluation and the limitations
        B. Paper 2: title and authors
        C. …
    II. Subtopic 2…

This outline should be in plain text so it is easy to insert into a latex file to start writing. **This is a group effort and has only one deliverable per group.**

10-30: Deadline 3 First Draft of background and literature survey: The goal for this deadline is what would typically be found in the Background and Related Work sections of a paper or proposal. You should read some Background and Related Work sections of papers to see how they are written. That is, a good literature survey does not just write a separate paragraph on every paper written in the field in any order you want.

* A good literature survey starts with a background section that familiarizes a computer science reader to the basic topic area, such as testing web applications – what constitutes a web

application, how are they characterized, examples from real life, how does the domain create unique problems...

*A good literature survey tries to group papers addressing similar problems and discuss and compare them together.

*A good literature survey also presents the papers typically in some chronological order within each problem identified.

*The most relevant papers to what you want to focus on are presented first, and then other papers that deal with problems related, but not so relevant, are discussed very briefly and sometimes only cited as a group with a single sentence. So, paragraphs are ordered from most relevant work to least relevant work to your chosen problem of interest.

* A good literature survey will do the following for the most relevant papers:
describe the overall goals/contributions of the paper, general approach and unique characteristics of their approach, then end with restrictions/limitations of that research. What didn't they address? Did they implement it and evaluate it?

A related work section should be no more than 1 1/2 pages in the double column format you are given in the latex file. Most are more like 1 page maximum. **Each person in the group should write their own background and related work sections.** Again, you can discuss what you think are the most relevant and least relevant papers and agree on them as a group, but each member needs to learn how to write these surveys by writing them on their own. It takes time and sometimes rewriting to put it together as above. The deliverable is a nicely formatted document with your Introduction (overall topic area and why it is important), Background section and your Related Work section (done individually), and reference list. You should use latex for formatting.

11-11:Deadline 4 Writeup of brainstorming session: The goal for this deadline is to get the group to:

   * review and discuss the key restrictions and limitations of existing research in the topic area as a whole
* write a few paragraphs summarizing those limitations

* discuss the key open issues/problems left unaddressed by existing work

* write a few paragraphs summarizing those key open issues

* brainstorm about possible approaches to attempt to address some subset of those key issues: applying some technique used in solving other problems in other domains, trying to develop new algorithms or alternate program representations,...

* write a few paragraphs outlining the possible approaches you could propose for addressing these problems

* think about how would you would evaluate the success of your proposed approach: what are the appropriate questions to ask for evaluating the approach, what could be implemented, what metrics could be measured and experiments could be performed to judge whether your approach indeed addresses the problems or improves on previous approaches in some way (space, execution time, program analysis time,...)

The deliverable for this deadline is a nicely formatted document that includes:
* your proposal title
* a section called Current Limitations and Key Open Issues
* a section called Proposed Research, which consists of two subsections:
    * Proposed Novel Approach(es)
    * Evaluation Plans

This is a group deliverable. You need only hand in one deliverable per group. These will be incorporated into each member's own individual proposal file for the next deadline.

11-25: Deadline 5 Complete Draft of proposal: The goal for this deadline is a complete first draft of a research proposal, created by merging, integrating, and smoothing out your previous writings. This proposal should include the following components:
* Proposal Title
* abstract (probably rewritten now to reflect what you are addressing and your overall approach) (300 words or less)
* introduction (motivate the general topic and why it is worth studying, present overview of what goals your research has) (1 page)
* background and state-of-the-art (give the computer science reader some background on your general topic area, as if they knew nothing about embedded systems or security,... and include your related work section as part of this background now (getting rid of the related work section title); end with a subsection called Limitations/unaddressed problems if appropriate.) (2-3 pages). So, this section includes your literature review (background and related work) and your current limitations writeup from your brainstorming session. Be sure to incorporate suggestions from the instructor on the background and related work first draft.
* challenges and goals (enumerate the challenges and goals that you are focusing on (1 page). this can include the open issues that you wrote up for the brainstorming session.
* proposed research (present your proposed approach(es), subsectioning as appropriate., including some steps you would follow to do your research (1 page)
* evaluation plan (enumerate the steps you will follow to do your research)(no more than 1/2 page)
* summary of foreseen contributions - how will your work help society, summarize the contributions it would make if you indeed followed through with this research (1 paragraph)
* reference list

This draft is written individually by each member of the group, separately. The deliverable is a nicely formatted first draft of a research proposal, one per group member.

12-9: Deadline 6 Final version of proposal: The goal for this deadline is a rewritten, complete version of your research proposal, focusing on the suggestions for improvement by me and your own observed potential improvements. It has the same format as the previous deadline. **Now, this is a single proposal by the research group to be reviewed at the Research Panel Review.**

Each proposal will be reviewed by a set of students and discussed in the research proposal panel session. Please submit the final research proposal as a pdf file with the name of your project as the name of the file, without any identification of the researchers in the text or filename. Please email this final proposal to Lori directly. She will place them in one share directory for all students in the class to see anonymous proposals. This ensures a blind review process.

You can use figures to help in your proposal – either taken from others (and cited properly) or drawn by your group. Figures often help in understanding. Also, please limit your proposal including bibliography to 8 pages, in the style format given in the directory /usa/pollock/public/latex.templates on stimpy.

Final Exam Week: Deadline 7 Proposal Reviews: The goal for this deadline is to learn how to review research proposals, from the perspective of a funding agency. Each person should sign up to review 3 proposals, making sure we have at least 3 reviews per proposal. You should sign up by editing the signup list in the shared proposal directory. You should read 3 proposals, fill out a review sheet found on the course website, and bring 2 copies (one with your name and one anonymous) to the panel review session ready to discuss the proposals. We will have a mock NSF proposal review session, where we will each become expert famous researchers and conduct a proposal review, using our reviews and the NSF proposal rating/ranking system. Wonder which proposal will be funded? Funding in this class will be through baked goods or gift certificates rather than grant money.