Mini-Project 1: Tool or Analysis Practicum

17-654/17-754: Analysis of Software Artifacts
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Proposal due Monday, April 17, 2005 at 5pm
MSE presentations and reports due April 24 or 27 at 5pm
Ph.D. presentations due May 1 or 4 at 5pm
Ph.D. reports due May 8 at 5pm
MSE: 200 points total
Ph.D.: 400 points total

The goals of this mini-project, for MSE students, are to gain an in-depth practical experience with an analysis tool or technique and reflect on the experience. For Ph.D. students, the goal is to gain a deeper understanding of the analysis research literature.

The expected scope of effort for this project is around 18 hours per MSE student (36 hours per Ph.D. student); plan your project accordingly.

Groups. 654 students may work on this programming project in groups of 4-6 (smaller groups are permitted, with scaled expectations, but should discuss this with the instructor). Group projects will be given a single grade. You are free to choose your own groups, subject to the constraint that the instructors reserve the right to assign groups in the case that some students are unable to find partners. Expectations for the project will be scaled (within reason) to the size of the group.

754 students may work on the project individually or in pairs (if not doing the literature review). Pair projects will be held to a higher standard.

Collaboration Policy. Since different groups will be working on different projects, the only collaboration policy is that your work must be your own (as always).

Hand-in Instructions. A 1-page overview with the proposed project and current status is due Monday, April 17 at 5:00pm (groups are encouraged to contact the instructor beforehand to discuss project choice). This should be emailed to the instructor (jonathan.aldrich@cs.cmu.edu).

You will present your project in class during the week of April 24-27.

The instructor will assign groups to days by Tuesday, April 18. You should turn in a project report via Blackboard by 5pm on the day you do NOT present (i.e. if you present on April 24 your report is due April 27, and vice versa). You may use late days on the report only; for each day the report is turned in late, each member of the group must use a late day (group members can pool late days if one person has none left).

1 Project Proposal

Your project proposal (Due April 17) should be about 1 page and contain:

1. The title of your proposed project
2. The names of the members of your group
3. Choose ONE of the project types below (from Section 4,5, or 6)
4. Describe what you intend to do (1/2-3/4 page). For tool evaluations and analysis applications, describe which tool or analysis you intend to use, what you intend to apply it to, and what qualitative and quantitative data you intend to collect. For development of new analysis techniques, briefly describe the technique you plan to investigate and how you will evaluate whether the new technique is useful. For Ph.D. literature reviews, describe the topic, list 2-3 papers from which you will begin the literature review, and how you will limit the scope.
5. Describe what you have done so far on the project. For MSE tool projects, a general guideline is that you should have at least run the tool successfully on a small example. For other MSE projects, you should have at least prototype-sized portion of the work done.

Grading for the project proposal will be worth 20 points; you will get full credit as long as you turn in a proposal that demonstrates careful thought about the project, and as long as you have done a reasonable amount of initial work towards the project.

The instructor will provide feedback on the proposal by April 18; some proposals may need to be scoped down or up, or adjusted to ensure they will fulfil the pedagogical goals of the project. Groups are encouraged to meet with the instructor before the proposal is due, and/or to turn in a proposal early so as to agree on a project topic as early as possible.

2 Presentations

Each MSE group will prepare a presentation approximately 15 minutes long, for presentation the week of April 24-27. For tool or analysis projects, the presentation should describe the tool or analysis technique if it was not presented in class; describe how the tool or technique was applied, describe qualitative and quantitative data gathered, give a summary of lessons learned, including the benefits, drawbacks, and scope of applicability of the tool or technique. For development of new analysis techniques, describe the new technique in technical detail, and describe your evaluation of the technique.

Presentations will be worth 60 points. You will be graded both on content (what you did) and clarity of presentation.

3 Project Reports

The final 120 points will be based on the project report. Grading will be based both on content and clarity of communication. The paper should be around 12-15 pages (single-spaced 12 point) for literature reviews, or 5-6 pages of text (diagrams, screenshots, examples will likely take extra space) for other project types, but these are general guidelines only; clarity is more important than length. The contents of the report are discussed in each section, below.

4 Tool or Analysis Application and Evaluation

Choose an analysis tool from the list available on the course website, or an alternative tool or relevant manual analysis technique by agreement with the course instructor. Apply the tool to one or more realistic software artifacts with the intent of developing an assessment of the strengths and weaknesses of the tool or technique, both in quantitative and qualitative terms.

The assessment must be written with other members of the class as the intended audience. The writeup should briefly describe the tool or technique, describe the experimental setup (for example, how was the tool or technique applied and to what subject), and describe both qualitative and quantitative data gathered in the experiment. Based on your experience, discuss the lessons you learned, including the benefits, drawbacks, and scope of applicability of the tool or technique.

The course website includes examples of model tool evaluations done in the past, to give you an idea of what is expected (the time budget is slightly

less than in 2005, so the length and detail of reports will be somewhat less). MSE students are encouraged, but not required, to apply an analysis tool or technique with relevance to their studio project.

Ph.D. (754) student projects will have a relaxed expectation for the practical evaluation of the tool or technique, since there will be fewer people involved in each project. However, Ph.D. project reports are expected to place practical experience with the tool or analysis into a research context: describe the strengths and weaknesses of the analysis compared to other similar results in the research literature, and describe open research problems that are illustrated by your experience with the tool.

5 New Analysis Techniques

With prior permission from the instructor, apply your knowledge of analysis to develop a new analysis technique or an application of an existing technique to a new problem domain. Examples might include defining a new bug-finding analysis, implementing an existing analysis in a new platform, experimenting with a new testing technique, or exploring an idea you have that might lead to more precise alias analysis. You may build your analysis on top of Crystal or any other analysis toolkit, such as Soot from McGill University or SUIF from Stanford University.

You should find some way of evaluating your new technique, typically by applying it to some software artifact. However, the weight given to evaluation is considerably less than the tool evaluation projects because of the analysis development component of the project.

Your writeup should introduce the problem, explaining why your analysis technique is needed from a software engineer's perspective, and why existing analysis tools are inadequate for your purposes. Then describe your new analysis technique in sufficient technical detail that it could be independently reproduced from the description. If your analysis technique is automated, briefly describe the implementation. Describe your evaluation of the technique in the same terms described above, and finally describe what you learned from the experience.

As with tool evaluations, Ph.D. project reports are expected to place practical experience with the tool or analysis into a research context: describe the strengths and weaknesses of the analysis compared to other similar results in the research literature. Ph.D. project presentations will be given the week of May 1-4, and project reports will be due finals week (Ph.D. students do a bigger project in liu of the test plan assignment).

While Ph.D. analysis projects are expected to use advanced techniques from the research literature, MSE projects are focused on practical utility. For example, a domain-specific tree-walker analysis that checks an important property for an MSE studio project would be appropriate for an MSE project. For example, in 2005 one team worked with the instructor to define the semantics of a domain-specific language that was relevant to their project.

6 Literature Review (Ph.D. or MSE with instructor's permission; individual projects)

Choose a subtopic of the analysis literature and analyze the research in this area in depth. Your report should cover the most important recent results in the sub-area, and put them into a comparative framework that shows their similarities, differences, strengths, and weaknesses. Your report should also describe the major open research questions in the area.

Ph.D. students who choose the literature review option will give a presentation in class on May 1 or May 4. The length is to be determined, but initially plan on 60-80 minutes. In the presentation, briefly introduce the class to the surveyed area, the technical details, benefits and costs of various proposed analysis techniques, and highlight important open issues that you identified.