

Course Goals

Understand two big picture problems

- program optimization
- security or program analysis for debugging

In depth knowledge of program analysis ranging

- from entirely at compile-time, to run-time, to post run-time, to barely any analysis at all.

How these program analyses are applied to program optimization and security

Various Analysis Issues

- Representing and analyzing programs
- Efficiency versus precision tradeoff
- Precision when analyzing array usage in loops

Approach

- read and critique recent and influential papers
- implement a program analysis idea

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Other Important Course Goals

Research Exam Preparation

- paper reviewing skills will be critical for the research exam
- presenting the crucial points in a paper
- synthesizing ideas between papers
- suggesting future research questions

Thesis Project Preparation

- how to break projects into manageable pieces
- how to leverage existing research tools
- presenting research in a succinct fashion

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Compile-time Program Analysis

Discover properties of programs by looking at its source

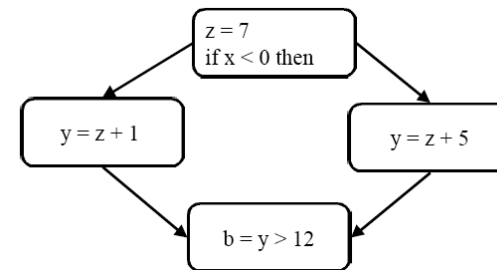
- local (a few lines of straight-line code)
- global or intraprocedural (full procedure)
- interprocedural (several procedures)
 - special case: whole program analysis

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Example of Compile-time Program Analysis



What are the possible values of y ?

Does answering this question require local, global, or interprocedural analysis?

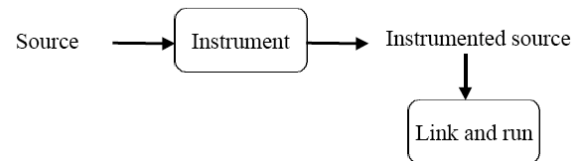
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Run-time Program Analysis

Discovers properties of programs by examining its runs

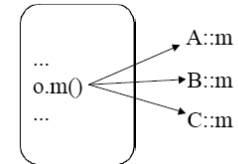


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Example of Run-time Program Analysis



What is the most common target of `o.m()`?
What can we do with that information?

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Tips for Reading a Research Paper (by Tia Newhall)

Read the paper three times

- First read the abstract, introduction, related work, and conclusion
- Next read the entire paper writing down questions and vocabulary words you need to look up
- Finally re-read the paper critically, answer the paper review questions

Questions to answer in a paper review

- What problem did the paper address?
- Is it important/interesting? What was the context for the paper?
- What is the approach used to solve the problem?
- How does the paper support or otherwise justify the conclusions it reaches?
How does it evaluate the approach?
- What problems are explicitly or implicitly left as future research questions?

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Selecting a Paper to Present

Read the abstract, introduction, and conclusion for all papers you are seriously considering

Consider selecting a paper related to your course project

Schedule around your deadlines in this course and other courses

Paper selection will be first-come-first-serve

- I will start posting assignments as soon as they are sent
- You must indicate which paper you would like to present by January 31

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Project

Five deliverables

- proposed tool example with preliminary project proposal
- proposal and tool example
- verbal status report (15 minutes)
- intermediate report
- final report and elevator speech

Possible projects accessible from colostate.edu

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Tool Example

C-breeze

- in CS553 Fall 2005 wrote a walker that counted operations in the program

LLVM compiler infrastructure

- <http://lvm.cs.uiuc.edu/docs/Projects.html>, describes how to create a project that uses LLVM
- could count operations or memory references or if statements or ...

TAU: Tuning and Analysis Utilities

- <http://www.cs.uoregon.edu/research/tau/home.php>
- could profile a benchmark program from last semester

OpenAnalysis

- could count the different types of memory reference expressions

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