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Course Objectives

To learn the basics of static analysis and transformation techniques, to explore in depth one aspect of compilation and optimization, and to prepare students to do research in compilers or related fields. Students will learn this material by building new pieces of an existing compiler, reading papers, and proposing and completing a course project.

Prerequisites

Facility with C++. Reasonable programming skills. Good English communication skills. Time and motivation.

Reading Material

- Assorted technical papers. (There is no textbook.)

Lecture Topics

Part 1: Basics

- Control flow analysis
- Dataflow analysis
- Reuse optimizations
- Static Single Assignment

Part 2: Interprocedural Analysis

- Motivation
- Pointer analysis
- Dimensions of the analysis space
- Flow-Sensitive analysis
- Flow-Insensitive analysis
 - * Subset-based
 - * Equality-based
- Context-Sensitive analysis

Part 3: Modern Uses

- Modern goals
- Correctness and security
- Dynamic optimization

- Object-oriented languages
- Binary translation

Part 4: Classical Uses

- Register allocation
- Instruction scheduling
- Locality and parallelism
- Dependence analysis

Programming Assignments

There will be roughly three modest programming assignments that will build upon the *LLVM* compiler. LLVM is written in C++, makes heavy use of the Standard Template Library, and runs on the CS Department's Linux boxes. The following is a tentative list of programming assignments, although the list is likely to change.

- Assignment 1: Syntactic transformation.
- Assignment 2: Iterative dataflow analysis.
- Assignment 3: Interprocedural optimization.

Homework

There will be some basic homework assignments to reinforce material that is covered in lecture. These will be lightly graded.

Course Projects

The course project allows students to explore one area of compilation in much more depth. These projects can take on many flavors—including a careful survey, an implementation, or an experiment—and they can be done individually or in groups. However, all course projects must be approved by the instructor, and students who do not propose a suitable project will be assigned one. An important part of these projects, even the assigned ones, is a definition of the project. Ideas for course projects will be circulated shortly.

Reading Assignments

There will be roughly one assigned reading per week. These will be research papers that either explore some lecture topic in depth or expose students to new ideas. All reading assignments are fair game on the exam.

Exams

There will be a final exam.

Communication Skills

Good communication skills, and in particular good English writing skills, will be important to succeed in this course. For each programming assignment, students will write a report, and the assignments will be graded on clarity and presentation as well as program correctness. In addition, good communication will be needed skills to propose, narrow, and define the course projects.

Grading

Assignments and Homework:	25%
Project:	45%
Final exam:	35%

The Administrative Assistant

Please see Lindy Aleshire to pickup any handouts that you may have missed.

Getting an Account

If you do not have a UTCS account, you can request one online at the following URL:

<https://udb.cs.utexas.edu/amut/acut/>

Read the usage policies, and then apply for an account by following the link labeled “Request a new account.” The first programming assignment will be handed out on Monday August 29th, so you’re encouraged to get your account right away.

Assignment 0

Due: August 29.

Part 1: Send a brief email message to both the professor and TA. This will primarily be used to create a class mailing list, but if you have any particular interests or motivations in taking this course, please let us know. Please include three bits of information: your department (eg, ECE or CS), your degree program (BS, MS, or PhD), and your advisor, if you have one.

Part 2: Join our Piazza group so that you can participate in offline discussions about the course and the assignments. You should receive an email message inviting you to join; if not, you can join by visiting the following page: <http://www.piazza.com>.

Open/Closed Door Policy

Feel free to stop by any time my door is open, which will be most of the time. If my door is closed, *please* don’t knock unless it’s truly urgent or unless you have a scheduled appointment.

Scientific Ethics

We’ll apply the usual standards of the scientific community: collaboration is encouraged, but you must give credit to your collaborators. *Academic dishonesty will lead to failure of the course.*