Welcome!

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Prerequisites

Source code (e.g., C++)

Front-end

IR

Middle-end

IR

Back-end

Machine code

**EECS 323: Code analysis and transformation**

\[
\text{myVarX} = 40 \\
\text{myVarY} = \text{myVarX} + 2
\]

**EECS 322: Compiler Construction**

\[
\text{int main} \ldots
\]

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Outline

• Structure of the course

• This year’s topics

• Software framework
ATC

• You learned the internals of modern production-quality compilers
  • E.g., Data-flow analysis, constant propagation, memory alias analysis (CS 323)
  • E.g., Instruction selection, register allocation (CS 322)
• Research labs include advance techniques not yet included in production-quality compilers
  • They aren’t as robust as production-quality compilers need to be
• ATC:
  • You will learn some of these advanced techniques
    • They are organized in topics
    • Each year we look at techniques of two topics
    • Each year ATC is different
ATC assignments

• You will learn some advanced compilation techniques
  • You need to read and learn two research papers per week (you will have these two papers the week before they are due)
  • You will present a few of them and you will need to defend them (as they are your papers)
• You will do a project you choose from a set
  • The set of projects are related to the topics of the current year
  • You can work in a team (maximum 3 people per team)
  • You will develop your project during the quarter
  • Each team will meet me weekly to discuss progress and roadblocks
  • You will present your project to the rest of the class during the last 2 weeks
The ATC structure

Before the first lecture of this week, you need to choose the project to work on and your team

Basics for project

Topic & project

You develop your project
You present your improvements (description, empirical evaluation, code walk)

Today:

Week

Tuesday Tutorial
Thursday Tutorial

• We’ll do a hands-on tutorial about the codebase you’ll modify for your project
• Please install the software before class on your laptop

Before the first lecture of this week, you need to choose the project to work on and your team

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At the end of a week, you’ll have the 2 papers to read (and the presenters) for the next week when we will discuss them.
Before the first lecture of this week, you need to choose the project to work on and your team.

- Basics for project
- Topic & project
- You develop your project
- You present your improvements (description, empirical evaluation, code walk)

Today

Week

- Tuesday: Project
- Thursday: Project

- You describe the current state of your project and/or preliminary results
- What you are going to do next
Materials

• Software:
  • NOELLE: it can be downloaded from [here](#)
  • VIRGIL: it can be downloaded from [here](#)
  • Not ours: from the web

• Documentation:
  • Papers: either from the web (when available) or from Canvas
  • Software docs: from the web (if they exist)
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Topics

• Every year ATC covers two different topics

• Topics we will cover this year:
  • Parallelizing compilers
  • Dependences
Papers

• Distributed via Canvas every Friday

• Papers shared before a Friday are due the week after (one per class)

• Each paper will be presented by one of you
  • Everyone needs to read all papers before the class and participate in the discussion

• Roles:
  • Presenter: brief description of the paper focusing on the novelty of the work
  • Everyone altogether: paper discussion
  • A name wheel will be used to answer unanswered-questions
Mindset to use

• In this class: you will read 1 paper per lecture
  • Not 2-4

• Expectation: you need to read the single paper very careful
  • You need to understand it in depth
    Simple test: can you implement what is described?
      • Yes: you understood it
      • No: please re-read it again
  • You need to be ready to discuss it with the rest of the class
    (even if you are not the presenter 😊)

• Each paper will be presented by one of you
  • I will select the presenter the day before class
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Your project

• This class requires paper reading and a project (397/497)
  • Can be done in a team or not

• You will work at the frontier of compiler research
  • Edges at the frontier are sharp
  • I’ll guide you through your project to avoid getting cut

• You will provide weekly update on your progress
  • Where: Zoom
  • When: please use the doodle link at my website to find a 30-minutes time slot
Software framework

• You will need to use/extend one of our software framework
  Which one depends on the project you will choose to do

• NOELLE: our set of abstractions/transformations/analyses
  that can be used by an LLVM middle-end pass
  A collection of
  state-of-the-art parallelization techniques,
  program analyses and transformations

• VIRGIL: our simple runtime used by the parallelization techniques
  included in NOELLE
Projects
Removed for public release
Papers to read
Papers to read for next class

• Paper:
  “NOELLE Offers Empowering LLVM Extensions”
  • Please first watch the video 🎬
  • The paper can be downloaded from here
  • Presenter: no one for this paper

• After a brief Q&A about the paper,
  I will run a sequence of tutorials about NOELLE during next week
  • Tutorials will be used to help you start using NOELLE (for your project)