CSE110A: Introduction to Compiler Design

Extra Credit Ideas

Preliminaries

1. To maximize your extra credit, you can submit this assignment along with Homework 5, which also qualifies as an extra credit opportunity.

2. To receive full points for this extra credit assignment, you must write a minimum three-page summary on any of the videos or topics listed below.

   You are allowed to use ChatGPT or other AI tools; however, you must include the exact prompts you entered, along with a clear explanation of which parts of the AI-generated output you used to write your report.

   Please note: We use plagiarism detection software. If you choose to use AI tools, you must document your usage properly.

3. In addition to this extra credit assignment and Homework 5, you can earn more credit by giving a 5-minute presentation on your topic during the last day of class.

4. The grading details for the extra credit are still being finalized. For now, please think of this as an additional learning opportunity, but rest assured that you will be fairly compensated with appropriate points.

5. The topics below are suggestions. A great source of interesting compiler-related topics is the LLVM YouTube channel. In general, the farther back you go in their video archive, the less esoteric and more accessible the topics tend to be. Topics related to LLVM IR, MLIR, and the LLVM toolchain are all excellent choices. You may also consider topics related to tools like Flex, Lex, Yacc, Bison, and similar technologies.

6. Some possible topics could explore interesting aspects of the LLVM pipeline. For example, you might choose something cutting edge or thought-provoking that could inspire future research or projects for yourself or others. You are encouraged to propose a novel idea. You may work on this individually or in collaboration with one other person.

1 Possible things to cover

In your summary, include a critique of the video from a learning perspective. Discuss what was effective and what could be improved. Highlight any particularly interesting aspects you observed and provide a brief tutorial or explanation of the key concepts you learned. Reflect on the originality of the ideas presented and discuss their potential for future research or further exploration. Share

your personal recommendations and takeaways. Most importantly, aim to make your summary engaging and meaningful for both yourself and others who might read or listen to it.

2 Featured Video

LLVM in 100 seconds
https://www.youtube.com/watch?v=BT2Cv-Tjq7Q

3 Publications and Tutorials

A Gentle Introduction to LLVM IR
Website with a tutorial: https://mcyoung.xyz/2023/08/01/llvm-ir/

4 Video Resources

4.1 Topic: LLVM

- **Teaching MLIR Concepts to Undergraduate Students**
  https://www.youtube.com/watch?v=XnRZA1pz7iw
  Published: 11 months ago; Duration: 19:01; Views: 5.2K

- **LLVM IR Tutorial - Phis, GEPs, and Other Things Oh My**
  https://www.youtube.com/watch?v=m8G$_S$5$LwlTo$
  Published: 6 years ago; Duration: 50:46; Views: 29K

- **XLA: Accelerated Linear Algebra**
  https://www.youtube.com/watch?v=2IOPpyyuLkc
  Published: 8 years ago; Duration: 36:41; Views: 5.4K

- **MLIR Linalg Op Fusion - Theory & Practice**
  https://www.youtube.com/watch?v=7-xAzlda0F8
  Published: 11 months ago; Duration: 21:13; Views: 1.5K

- **Writing an LLVM Pass: 101**
  https://www.youtube.com/watch?v=ar7cJl2aBuU
  Published: 5 years ago; Duration: 1:09:15; Views: 16K

- **Welcome to the Back-End: The LLVM Machine Representation**
  https://www.youtube.com/watch?v=objxlZg01D0
  Published: 7 years ago; Duration: 53:56; Views: 9.8K

- **MLIR: An Agile Infrastructure for Building a Compiler Ecosystem**
  https://www.youtube.com/watch?v=0bxyZDGs-aA
  Published: 4 years ago; Duration: 1:04:43; Views: 9.6K

4.2 Topic: LLVM Social Bangalore

- **Deep Learning Based Compiler Optimizations**
  https://www.youtube.com/watch?v=pyXDgyQr1A0
  Published: 3 years ago; Duration: 1:42:38; Views: 1.9K

- **Introduction to Compilers and Stages of Compilation**
  https://www.youtube.com/watch?v=A7I0497Up0c
  Published: 2 years ago; Duration: 1:11:37; Views: 3.1K

- **Torch-MLIR 101**
  https://www.youtube.com/watch?v=ZpwlVxsD9$_U$
  Published: 2 years ago; Duration: 45:00; Views: 3K

4.3 Topic: Triton

- **Mosaic GPU: A DSL for Fast Hopper Kernels in Python**
  https://www.youtube.com/watch?v=tnADC2XuAr0
  Published: 8 months ago; Duration: 15:59; Views: 801

- **Compiler Tools: Writing an MLIR Pass**
  https://www.youtube.com/watch?v=etlFyqSsmL0
  Published: 8 months ago; Duration: 31:51; Views: 2K

4.4 Topic: TensorFlow

- **Inside TensorFlow: AutoGraph**
  https://www.youtube.com/watch?v=NIEgzljyDyI
  Published: 5 years ago; Duration: 53:55; Views: 10K

- **Inside TensorFlow: TF Model Optimization Toolkit (Quantization and Pruning)**
  https://www.youtube.com/watch?v=4iq-d2AmfRU
  Published: 5 years ago; Duration: 42:35; Views: 16K

- **Inside TensorFlow: MLIR for TF Developers**
  https://www.youtube.com/watch?v=R5LLIj8EMxw
  Published: 5 years ago; Duration: 43:41; Views: 10K

5 Topic: Sparse Tensors and Compilers

- **[CTSTA'23] Challenges and Opportunities for Sparse Compilers in LLM**
  https://www.youtube.com/watch?v=tTHmdekz7II
  Published: 11 months ago; Duration: 16:27; Views: 19

- **ICPP Keynote: Making Sparse Fast with the TACO Domain Specific Language for Sparse Tensor Algebra**
  https://www.youtube.com/watch?v=8S7srKxsLXk
  Published: 4.8 years ago; Duration: 30:12; Views: 194

- **Saman Amarasinghe AMD HIP Tutorial, 9-3, rocSPARSE**
  https://www.youtube.com/watch?v=3p3kzj4y3eM
  Published: 1 year ago; Duration: 13:54; Views: 117

- **[SPARSE24] Design DSLs with xDSL**
  https://www.youtube.com/watch?v=XJ5Mu-0foIA
  Published: 10 months ago; Duration: 21:33; Views: 240

6 Additional Video Resources

- **How to Build a Compiler with LLVM and MLIR - 09 IR (SLIR) Generation**
  https://www.youtube.com/watch?v=cIyVAivh65I
  Published: 3.7 years ago; Duration: 1:04:45; Views: 2.6K

- **Read a Paper: Multi-Level Intermediate Representation (MLIR)**
  https://www.youtube.com/watch?v=6BwqK6E8v3g
  Published: 3.2 years ago; Duration: 7:42; Views: 6.9K

- **Who Uses JAX?**
  https://www.youtube.com/watch?v=Vg5HCzHE0GA
  Published: 2 years ago; Duration: 3:31; Views: 10K

- **Building Domain-Specific Compilers Quickly with MLIR Compiler Infrastructure, Chris Lattner**
  https://www.youtube.com/watch?v=5OSP5DNAozU
  Published: 4.6 years ago; Duration: 4:30; Views: 16K

- **HC34-T2: Heterogeneous Compilation in MLIR**
  https://www.youtube.com/watch?v=VFexAjUoTZI
  Published: 2.5 years ago; Duration: 3:32:32; Views: 5.5K

- **Writing a Compiler with LLVM - Cailin Smith - NDC Oslo 2022**
  https://www.youtube.com/watch?v=vrRXIQDCCEk
  Published: 2.4 years ago; Duration: 47:58; Views: 48K

- **What's New in Compiler Explorer? by Matt Godbolt**
  https://www.youtube.com/watch?v=Ey0H79z$_p$co
  Published: 1.6 years ago; Duration: Not specified; Views: 2.3K

- **An Introduction to LLVM IR**
  https://www.youtube.com/watch?v=CDKuH7SIgdM
  Published: 3 months ago; Duration: 33:55; Views: 2.2K