CS5404 Advanced Compiler

by Prof. Jenq-Kuen Lee

Course Description

This course will introduce the aspect of embedded compiler techniques in ILP code optimizations, DSP Compilers, multi-core compilers for low power, and embedded and heterogeneous dual-core optimizations. This course now also covers basic prospect of AI compiler. This course will include LLVM software projects and use of embedded tools. This course is considered as an advanced course after basic compiler course and before the more advanced graduate compiler course. This can also be considered as the 1st course of compiler course in the graduate school. Following the experiences last year, we will also include special topic presentations from registered students. The main topics include

1. Data dependence analysis.
2. Loop parallelization theories.
3. Data flow analysis equations (Aho's book Chapter 8-10).
4. Pointer and Structure analysis
5. Parallel Languages and Parallel Programming Environments.
6. ILP compilers
7. DSP compilers
8. Superscalar and VLIW Compilations for modern single processor architectures.
9. DSP library and DSP compilation issues.
10. Compilers and OS for energy reductions.
11. Compilers for low-power.
12. Compilers for embedded systems.
13. Toolkits for DSP processors.
14. LLVM MLIR Study
15. OpenCL Compilers for HSA.
16. AI Compiler and Compiler Designs
17. OpenCL 2.2 and 3.0 specification discussions
18. NNEF Models and TVM Deep Learning Compilers

Languages and Software used

C, C++, Fortran 77, Fortran 90, PAC DSP Tools, LLVM, and GCC compilers

Text Books

Lecture Notes by the instructor

Reference Book

1. "Compilers, Principles, Techniques, and Tools", A. Aho, Monica Lam, R. Sethi, J. Ullman, Addison-Wesley, Second Edition, 2007.
2. "Optimizing Compilers for Modern Architectures", Randy Allen Ken Kennedy, Morgan Kaufmann, Academic Press 2002
3. "Embedded Computing: A VLIW Approach to Architecture, Compilers, and Tools", Chapter 7-8, J. Fisher, P. Faraboschi, C. Young, Morgan Kaufmann, 2005 (Elesvier).
4. "Encyclopedia of Parallel Computing", Padua, David (Ed.)
5. "Performance on Multi-Core programming using OpenMP and OpenCL", 2013(ASIAWORLD), ISBN: 9789868639867

Grading

1. Projects 40% (Totally three projects)
2. Final-exam 40%
3. Special topic presentations 20%