COMS W4115
Programming Languages and Translators
Spring 2013

Class meets 2:40-3:55pm on Mondays and Wednesdays, 535 Mudd.

Courseworks site: https://courseworks.columbia.edu

Piazza bulletin board: https://piazza.com/class#spring2013/comsw4115

On Wednesday, April 24, 2013, Maria Ayako Taku gave a lecture in class on "Functional Programming Languages." Maria discussed the influence of the lambda calculus on functional languages and showed how to implement an interpreter using the functional language OCaml.

Important Dates

- The final exam for COMS W4115 will be held Monday, May 6, 2013, 2:40-3:55pm, in 535 Mudd for people whose last names begin with A-L, and in 702 Hamilton for people whose last names begin with M-Z. It will be based on material covered in the lectures throughout the semester. See final exam information for the coverage of the final.
- Each team will be required to give a 20-minute presentation on their language and translator during May 14-16, 2013.
    - All presentations will be in the Computer Science Conference Room, room 453, Computer Science Building.
    - See Project Presentations and Reports for presentation and report requirements.
    - See language presentation suggestions for hints on how to give a good presentation.
    - Presentation Schedule: May 1 and 14-16, 2013.

Name	email	Office hours	Location
Prof. Al Aho	aho@cs.columbia.edu	Mon & Wed 1:00-2:00	513 CSB
Karan Bathla	kb2658@columbia.edu	Mon & Tue 4:00-5:00	TA Room, 122 Mudd
Melanie Kambadur	melanie@cs.columbia.edu	Thu 10:00-12:00	TA Room, 122 Mudd
Jared Pochtar	jrp2181@columbia.edu	Fri 4:30-6:30	TA Room, 122 Mudd
Maria Taku	mat2185@columbia.edu	Tue & Thu 12:30-2:30	TA Room, 122 Mudd

In PLT you will learn the syntactic and semantic elements and the computational models of the most important modern programming languages as well as the algorithms and techniques used by compilers to translate them into machine and other target languages. The course will cover imperative, object-oriented, functional, logic and scripting languages, as well as trends in the evolution of programming languages.

A highlight of this course is a semester-long programming project in which you will work in a small team to create and implement an innovative little language of your own design. This project will teach you computational thinking in language design as well as project management, teamwork, and communication skills that you can apply in all aspects of your career.

Examples of past languages created in PLT can be found at
  Fall 2012 PLT Languages
  Spring 2012 PLT Languages
  Fall 2011 PLT Languages
  Spring 2011 PLT Languages

The concepts, techniques, and tools that you will learn in this course have broad application to many areas of computer science outside of programming languages and compilers.

Fluency in C and Java

COMS W3137 Data Structures and Algorithms

COMS W3261 Computer Science Theory

Date	Lecture	Reading
Jan 23	Introduction to PLT	Chs 1 and 2
Jan 23	Introduction to PLT (powerpoint)	Chs 1 and 2
Jan 28	The Basic Elements of Languages and Compilers	Chs 1 and 2
Jan 30	Structure of a Compiler	3.1-3.3
Feb 4	Regular Expressions and Lexical Analysis	3.3, 3.5
Feb 4	Homework Assignment #1	Due Feb 13
Feb 6	Implementing a Lexical Analyzer	Ch 3
Feb 11	Context-Free Grammars	4.1, 4.2
Feb 13	Parsing Context-Free Grammars	4.3, 4.4, 4.9
Feb 18	Software Project Management	Robert L. Martin
Feb 20	Predictive Top-Down Parsers	4.4
Feb 25	Bottom-Up Parsing	4.5, 4.6
Feb 25	Homework Assignment #2	Due Mar 6
Feb 27	Parsing Action Conflicts	4.8, 4.9
Mar 4	Syntax-Directed Translation	5.1-5.5
Mar 6	Intermediate Representations	6.1-6.3
Mar 11	Midterm Review	
Mar 25	Intermediate Code Generation	6.1-6.3
Mar 27	Translation of Statements	6.4-6.8, 7.1
Apr 1	Procedures	7.1-7.2
Apr 1	Homework Assignment #3	Due Apr 10
Apr 3	Run-time Environments	7.1-7.2, 7.6.1
Apr 8	Code Generation	8.1-8.5
Apr 10	Code Generation Algorithms	8.2-8.4, 8.6, 8.8, 8.10
Apr 15	Code Optimization	8.5, 8.7, 9.1
Apr 15	Homework Assignment #4	Due Apr 24
Apr 17	Introduction to The Lambda Calculus	
Apr 22	The Lambda Calculus	
Apr 24	Functional Programming Languages	Maria Ayako Taku
Apr 29	Sample Final	
Apr 29	Sample Final Solutions	

Alfred V. Aho and Jeffrey D. Ullman
Foundations of Computer Science, C Edition
W. H. Freeman, 1995
An online version of this book is available here.

Andrew W. Appel
Modern Compiler Implementation in Java, Second Edition
Cambridge University Press, 2002

Keith D. Cooper and Linda Torczon
Engineering a Compiler, Second Edition
Morgan Kaufmann, 2012

Steven S. Muchnick
Advanced Compiler Design and Implementation
Morgan Kaufmann, 1997

Michael L. Scott
Programming Language Pragmatics, Third Edition
Morgan Kaufmann, 2009

Robert W. Sebesta
Concepts of Programming Languages, Tenth Edition
Pearson/Addison-Wesley, 2012

Stephen Edward's CS4115 Web Page

Grading   40 % Project
            10 % Homework
            20 % Midterm
            30 % Final