

EECS 22L: Software Engineering Project in C Language

Lecture 1

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Lecture 1: Overview

- Introduction
 - Programming Courses in EECS
 - EECS 22L course outline and overview
- Course Administration
 - Projects and deliverables
 - Grading policy and exams
 - Team work!
 - Web page and programming setup
- Introduction to Software Engineering
 - General software engineering
 - Software development process in EECS 22L

Programming Courses in EECS

- Introductory Programming
 - EECS 10: uses C programming language (for EE)
 - EECS 12: uses Python programming language (for CpE)
- Programming from the Ground Up
 - EECS 20: starts with Assembly language (on bare CPU), then introduces C programming language
- Advanced Programming Courses
 - EECS 22: “Advanced C Programming” (in ANSI C)
 - EECS 22L: “Software Engineering Project in C” (ANSI C/C++)
- Object-Oriented Programming
 - EECS 40: introduces objects and classes, hierarchy, and higher object-oriented programming concepts using Java

EECS 22L: Software Eng. Project in C

- “Developing real C Programs in a Team”
 - Hands-on experience with larger software projects
 - Introduction to software engineering
 - Specification, documentation, implementation, testing
 - Team work
- Features
 - Design efficient data structures, APIs
 - Utilize programming modules, build libraries, GUIs
 - Develop and optimize contemporary software applications
- Tools
 - Software development, version control: `ssh`, `gcc`, `cvs`, `chmod`
 - Compilation, scripting, packaging: `make`, `bash`, `groff`, `gtar`
 - Testing and debugging with `gdb`, `ddd`, `gprof`, `gcov`, ...

EECS 22L: Software Eng. Project in C

- Catalogue Data
 - **EECS 22L Software Engineering Project in C Language (Credit Units: 3) W.**
 - Hands-on experience with the ANSI-C programming language.
 - Medium-sized programming projects, team work.
 - Software specification, documentation, implementation, testing.
 - Definition of data structures and application programming interface.
 - Creation of program modules, linking with external libraries.
 - Rule-based compilation, version control.
 - Prerequisites: EECS 22
 - (Design Units: 3)

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EECS 22L: Software Eng. Project in C

- Course Outline
 - Software engineering topics, including specification, documentation, implementation, testing, debugging, project planning, organization, maintenance, version control, organization of source files, header files, modules
 - Compilation flow, Makefile, shell scripting
 - Definition of data structures and application programming interface
 - External libraries, system programming, POSIX API, interrupts
 - Introduction to C++ language, syntax and semantics, references, inline functions, default arguments, classes, members, and methods, object creation and deletion (constructors, destructors)

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Course Overview

Week	Lecture topics	Project tasks	
1	Introduction to software engineering	Project 1	Application specification
2	Software architecture, design flow, documentation		Software architecture specification
3	Introduction to version control, GUI programming		Documentation, implementation
4	Software development, testing, documentation		Implementation, testing, debugging
5	Software packaging, installation, deployment		Delivery, installation, deployment
6	Project planning, organization, maintenance	Project 2	Application specification
7	Data structure and API design		Software architecture specification
8	System programming, shell scripting, Linux tools		Documentation, implementation
9	Outlook to object-oriented programming in C++		Implementation, testing, debugging
10	Course wrap up		Delivery, installation, deployment

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Course Overview

- Class Schedule
 - Quote from EECS 22L course outline:
EECS 22L *“Meets for 1 hour of lecture, 1 hour of discussion and 3 hours of laboratory each week for 10 weeks”*
 - However, current schedule of classes lists 3 hours of lecture, 1 hour of discussion and 3 hours of laboratory
 - Use lecture slots for actual lectures, as needed
 - Use remaining lecture slots for team meetings and team presentations
- Detailed Class Schedule
 - Online at course web site:
<https://eee.uci.edu/15w/18020/schedule.html>

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Course Administration

- Projects and Deliverables

Project	Task	Points	Deliverable	Due
Project 1: Chess Game	Application specification	100	Chess_UserManual.pdf	Jan 12, 12pm (noon)
	Software specification	100	Chess_SoftwareSpec.pdf	Jan 19, 12pm (noon)
	Software alpha version	100	Chess_Alpha.tar.gz Chess_Alpha_src.tar.gz	Jan 26, 12pm (noon)
	Software release	100 (+X)	Chess_V1.0.tar.gz Chess_V1.0_src.tar.gz	Feb 2, 12pm (noon)
Project 2: TBD	Application specification	100	TBD	Feb 16, 12pm (noon)

	Software release	100 (+X)		Mar 16, 12pm (noon)

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Course Administration

- Effort Assessment

- Team: Project deliverables
- Individual student: Exams, plus feedback from peers, TAs

- Grading Policy

- Programming projects 50% (team effort)
- Participation 5% (individual effort)
- Midterm examination 15% (individual effort)
- Final examination 30% (individual effort)

- Exams

- Midterm exam Project 1 contribution (week 5)
- Final exam Project 2 contribution (final week)
 - Short oral exams by individual students at the computer
 - Explain original contribution to the team, and answer few ad-hoc questions

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Course Administration

- Team Work
 - Projects will be performed by student teams
 - Project 1: 10 teams of 7-8 students
 - Project 2: TBD
 - EEE Survey on team preferences open until 1pm today!
 - *Team work* is an essential aspect of this class!
 - Every student needs to contribute to the team effort!
 - Tasks may be assigned to individual team members, but all members share the responsibility for deliverables
 - Collaboration
 - Team meeting at least once a week
 - Dedicated team account on the server
 - Share code, data, and documents (within your team only!)
 - Competition
 - Teams compete for extra credit!

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Course Administration

- Course web pages online at <http://eee.uci.edu/15w/18020/>
 - Instructor information
 - Course description and contents
 - Course policies and resources
 - Course and project schedule
 - Course communication
 - Message board (announcements, class discussion)
 - Email (administrative issues)
 - Office hours (instructor and TAs)
- Linux system environment
 - Same as for EECS 22
 - EECS Linux servers **crystalcove** and **zuma**
 - New: shared team accounts: **team1**, **team2**, ...

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Introduction to Software Engineering

- What is Software Engineering?
 - Software engineering is the application of *engineering to software*
 - Software engineering can be defined as:
 - *The application of, or*
 - *the study of a systematic, disciplined, quantifiable approach to the development, operation and maintenance of software.*
- EECS 22L ...
 - ... is *not* a complete course on software engineering!
 - ... consists of projects that demonstrate the essential tasks and tools of software development in ANSI C

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Introduction to Software Engineering

- General Software Engineering Process
 - Project feasibility and planning
 - Requirements analysis, definition, and specification
 - Design and documentation of the system and software
 - E.g. using UML (Unified Modeling Language)
 - Implementation
 - Programming (modules, system)
 - Testing against the specification (units, system)
 - Delivery, operation, maintenance
- EECS 22L Software Development Process
 1. Application specification and documentation
 2. Software architecture design and specification
 3. Implementation, testing, and debugging
 4. Software release

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Introduction to Software Engineering

- EECS 22L *does not* cover
General Software Engineering Topics
 - General processes of software engineering
 - General feasibility study and requirements engineering
 - General design strategy and documentation
 - E.g. UML
 - Usability and reliability studies
 - Legacy systems and evolution of software
 - General project or personnel management
 - Consideration of economic, legal, social and other factors
 - Verification of software
 - ...

Software Development Process

- EECS 22L *does* cover
the essential tasks and tools of software development
 - Using ANSI-C programming language
 - With an outlook into object-oriented design, i.e. C++
 - In Linux environment
 - With typical Linux tools chain,
e.g. `gcc`, `make`, `gdb`, `ssh`, `cvs`, `gtar`, `bash`, `gprof`, ...
 - With focus on practical aspects
 - Medium-size projects
 - Programming practice
 - Communication
 - Team work!

Software Development Process

- EECS 22L Software Development Process
 1. Application specification
 - User's perspective (aka. client, customer, consumer)
 - Documentation
 2. Software architecture design and specification
 - Developer's perspective (aka. producer)
 - Software layers and modules
 - Documentation
 3. Implementation, testing, and debugging
 - Unit testing
 - System testing
 4. Software release
 - Binary program and documentation
 - Source code and documentation

Software Development Process

1. Application Specification
 - Goal: Specify the user experience!
 - What does the user (customer, client, consumer) want?
 - What does he need to provide? What does he get?
 - What does the software do? What features does it have?
 - Deliverable: Software User Manual (as anticipated)
 - Input data including options and parameters
 - What? In which format? In which order? From which device? ...
 - Processing
 - What? (*not* how!) What happens? What is presented?
 - Output
 - What? In which format? In which order? To which device? ...
 - Some features may be intentionally left “undefined”
 - Specification document is typically an early version of the final documentation: *User Manual!*

Software User Manual

- Contents of a User Manual for a Software Product (1/2)
 - Title page
 - Software title, version
 - Author/producer, affiliation
 - Front matter
 - Table of contents
 - Glossary
 - Overview (or Tutorial)
 - Introduction, goals, usage scenario
 - Typical screenshot
 - Main features
 - Installation
 - System requirements
 - Setup and configuration
 - Uninstalling

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Software User Manual

- Contents of a User Manual for a Software Product (2/2)
 - Documentation of functionality
 - Detailed description of functions, menu options
 - User input, program output
 - Screen shots
 - Back matter
 - Trouble shooting, error messages
 - Copyright, contact information
 - Legal, license, disclaimer of warranty
 - Index
 - References
 - Appendix

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Software Development Process

2. Software Architecture Design and Specification

- Goal: Specify the developer's perspective!
 - What data structures are used? What algorithms?
 - What modules is the program composed of? Dependencies?
 - How do the modules interact? What functions and parameters?
- Deliverable: Software Architecture Document
 - *Detailed description of the software components and structures!*
 - Data structures and algorithms
 - How is data organized?
 - How is data processed?
 - Software layers and modules
 - Software architecture with layers of modules and libraries
 - Application Procedural Interface (API) of modules (header files!)
 - Implementation plan
 - Project timeline
 - Tasks and team member responsibilities

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Software Development Process

3. Implementation, Testing, and Debugging

- Goal: Develop and build the software!
 - Implement the modules and integrate them
 - Perform unit testing
 - Perform system testing
- Deliverables: Early version of the software packages
 - *Alpha version: Demonstrate feasibility to the user*
 - *Beta version: Preview software to the user*
- 1. Software program package (for users)
 - Executable program
 - User manual (with known limitations)
- 2. Source code package (for developers)
 - Source code file hierarchy
 - Software architecture document

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Software Development Process

4. Software Release

- Goal: Release, install, operate and maintain the software!
 - Complete the implementation and testing
 - Complete the documentation
- Deliverables: Final version of the software packages
 - *Everything needed for users (client, customer, consumer) to install, learn and operate the software!*
 - *Everything needed for developers to install, maintain and upgrade the software!*
- 1. Software program package (for users)
 - Executable program
 - User manual
- 2. Source code package (for developers)
 - Source code file hierarchy
 - Software architecture document