

Introduction & Software Development Life Cycle

CMP9134: Software Engineering

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6 February 2026

Today's Agenda

- 1 Module Overview
- 2 What is Software Engineering?
- 3 Software Development Life Cycle
- 4 Project Management
- 5 SDLC Models

Module Learning Outcomes

- **LO1:** Critically apply software engineering principles and techniques to software engineering problems, taking into account recent advances in the field.
- **LO2:** Analyse, develop and evaluate a software artefact from inception to deployment employing professional engineering approaches.
- **LO3:** Apply social, ethical and professional practices and critically analyse their applicability.

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Module Delivery Team

Dr Francesco Del Duchetto

- Lecturer in Robotics and Autonomous Systems.
- Research: Human-robot interaction, AI & Robot learning, Robot vision and navigation.
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Interactions

- **Lectures:** Fridays, 9:00 - 10:00 AM in MB3401.
- **Workshops:** Fridays, 1:30 - 3:30 PM in INB2102.
- **BlackBoard:** Use the Discussion Board for questions regarding material or logistics.

Module Syllabus (Weeks 1-5)

W	Date	Lecture Topic	Workshop
1	06/02/25	Intro & Software Development Life Cycle	Versioning control (GitHub)
2	13/02/25	Agile Frameworks	Agile Setup
3	20/02/25	Software Requirements	Requirement Analysis
4	27/02/25	Software Modelling & OOP	System Architecture
5	06/03/25	Pattern & Reuse	Structural Design
6	13/03/25	HCI & Design Thinking	UI Prototyping
7	20/03/25	Containerisation	Docker & devcontainers
8	27/03/25	Software Testing	Unit Testing
<i>Break - No Lectures</i>			
12	24/04/25	DevOps & CI/CD	Test Driven Development
13	01/05/25	Continuous Deployment	Automatic Deployment
14	08/05/25	Evolution & Legacy	Refactoring
15	15/05/25	Legal, Ethical, Professional & Social Issues	Project support

Assessment

- **Assessment 1 (100%):** Design, develop, evaluate and document a comprehensive web application for searching open-license media.
- **Deliverables:**
 - 1 Public GitHub repository (source code, documentation).
 - 2 Detailed project report (PDF).
 - 3 5-minute video demonstration.
- **Note:** This is an individual assessment.

Module Pre-requisites

- Basic computer and IT skills (e.g., file management, using a web browser, installing software).
- Understanding of fundamental programming concepts (e.g., variables, control structures, functions).
- Proficiency in coding in any language (e.g., Python, Java, C++).
- Familiarity with basic software development tools (e.g., text editors, IDEs).
- Being proactive and independent in learning new languages and tools as needed.

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Definition

- **Scientific method:** Discovery and organisation of knowledge by means of observation and experimentation.
- **Engineering:** The application of scientific methods to solving real-world problems.
- **Software Engineering:** Applies empirical and scientific approaches to solve practical problems in software.

“A Bad System Will Beat a Good Person Every Time” - W. Edwards Deming.

Why is it Important?

- Society relies on advanced software systems.
- We need to produce reliable and trustworthy systems economically.
- It is cheaper in the long run to use SE methods than to write programs as personal projects.
- **Diversity:** There is no “Silver Bullet” (universal technique) for all systems (e.g., Stand-alone vs Embedded vs Data collection).

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The SDLC

The Software Development Life Cycle (SDLC) is the process of designing, building, and maintaining software applications.

- | | |
|-------------------------|---|
| 1 Planning | ■ Managing complexity in a structured way. |
| 2 Analysis | |
| 3 Design | ■ Provides specific deliverables at each stage. |
| 4 Implementation | |
| 5 Testing & Integration | ■ Frameworks (like Agile) emerge from best practices. |
| 6 Maintenance | |

Core Process Activities

All software processes involve these four activities:

- 1 **Software specification:** Defining the software to be produced and constraints.
- 2 **Software development:** Designing and programming the software.
- 3 **Software validation:** Checking that it is what the customer requires.
- 4 **Software evolution:** Modifying software to reflect changing requirements.

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Project Management in SDLC

Planning, organising, and controlling resources to achieve project goals.

- **Planning Phase:** Define goals, identify risks, estimate costs.
- **Analysis/Design:** Create Work Breakdown Structure (WBS) and schedules.
- **Implementation:** Monitor progress and manage stakeholders.
- **Maintenance:** Allocate resources for updates.

The Project Charter

A document outlining objectives, scope, stakeholders, and high-level requirements.

Components

- Project Background & Objectives
- Scope & Deliverables
- Stakeholders (Sponsors, Managers, Team)
- Assumptions, Constraints, and Risks

Work Breakdown Structure (WBS)

A hierarchical decomposition of project deliverables into smaller, manageable components.

- Level 1: Product Vision
- Level 2: Major Deliverables/Phases
- Lower Levels: Tangible results requiring decomposition.

Scheduling and Estimation

- **Project Schedule:** Timeline identifying tasks, dependencies, and resources.
- **Tools:** Microsoft Project, GanttPRO, Trello (Kanban), Jira.
- **Software Metrics:**
 - Lines of Code (LOC)
 - Function Points (FP)
 - Story Points (Agile complexity metric)

Risk Management

Identifying, assessing, and mitigating potential risks.

- **Monitoring:** Tracking progress vs planned performance.
- **Issue Tracking:** Using tools like Jira or GitHub Issues to track defects.
- **Burndown Charts:** Visualizing work completed vs work remaining.

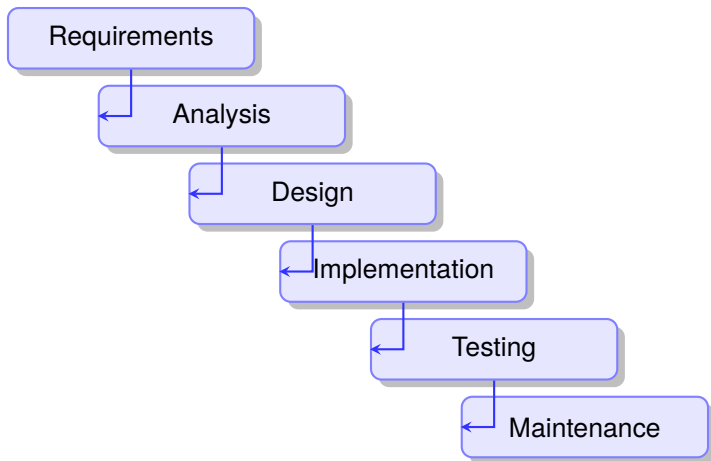
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SDLC Models Overview

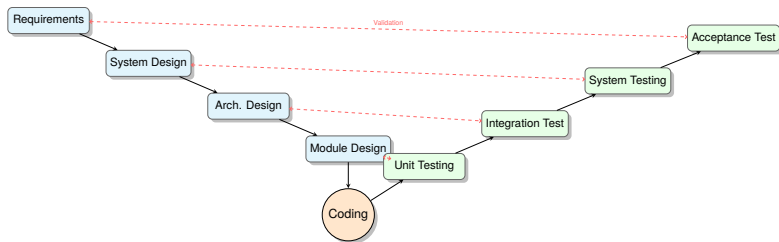
- Different projects require different approaches.
- Common models:
 - **Waterfall:** Linear, sequential.
 - **V-Model:** Emphasises verification and validation.
 - **Incremental:** Progressive development.
 - **Spiral:** Risk-driven.
 - **Agile:** Iterative, flexible (e.g., Scrum).

Waterfall Model

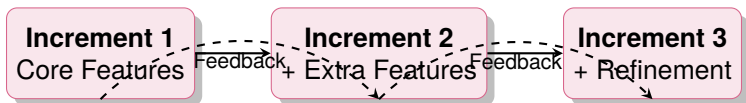


Sequential flow: Output of one phase is the input for the next.

The V-Model

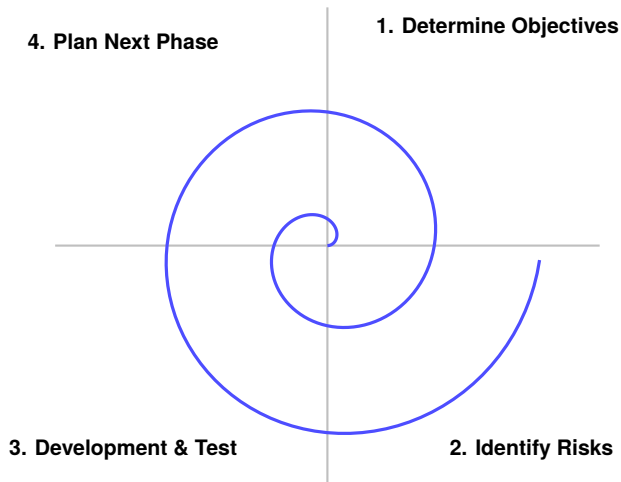


Incremental Model



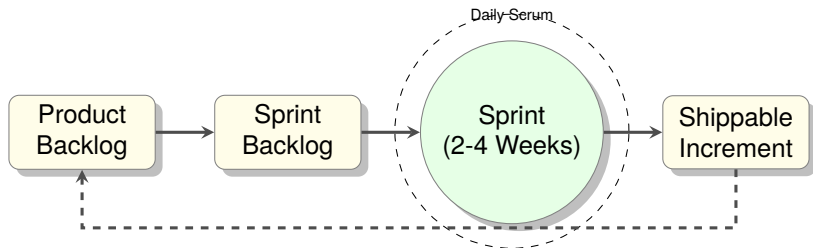
System is broken down into small, manageable portions. Functional software is produced early.

Spiral Model



Risk-driven process iteratively passing through phases.
Radius grows with cost/time.

Agile (Scrum) Process



Iterative development, constant feedback, flexible to change.

Next Steps

- **This Week's Workshop:** Learning Git (Version Control).
- **Reading:** Sommerville, *Software Engineering 9th Edition*, Chapter 1.
- **Next Week:** Software Process & Project Planning.

Any Questions?