CSE 2311

Software Development Project

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YORK UNIVERSITÉ UNIVERSITY

Reading

- Author: Ian Sommerville
- Title: Software Engineering
- Chapters 1-4

Software Engineering

- Software Engineering is the science and art of building significant software systems that are:
  1. on time
  2. on budget
  3. with acceptable performance
  4. with correct operation

Software Engineering

- The economies of all developed nations are dependent on software.
- More and more systems are software controlled.
- Software engineering is concerned with theories, methods and tools for professional software development.
- Software engineering expenditure represents a significant fraction of the GNP of developed countries.

Software Costs

- Software costs often dominate system costs. The costs of software on a PC are often greater than the hardware cost.
- Software costs more to maintain than it does to develop.
- Software engineering is concerned with cost-effective software development.

Software Products

- Generic products
  - Stand-alone systems which are produced by a development organization and sold on the open market to any customer.
- Customized products
  - Systems which are commissioned by a specific customer and developed specially by some contractor.

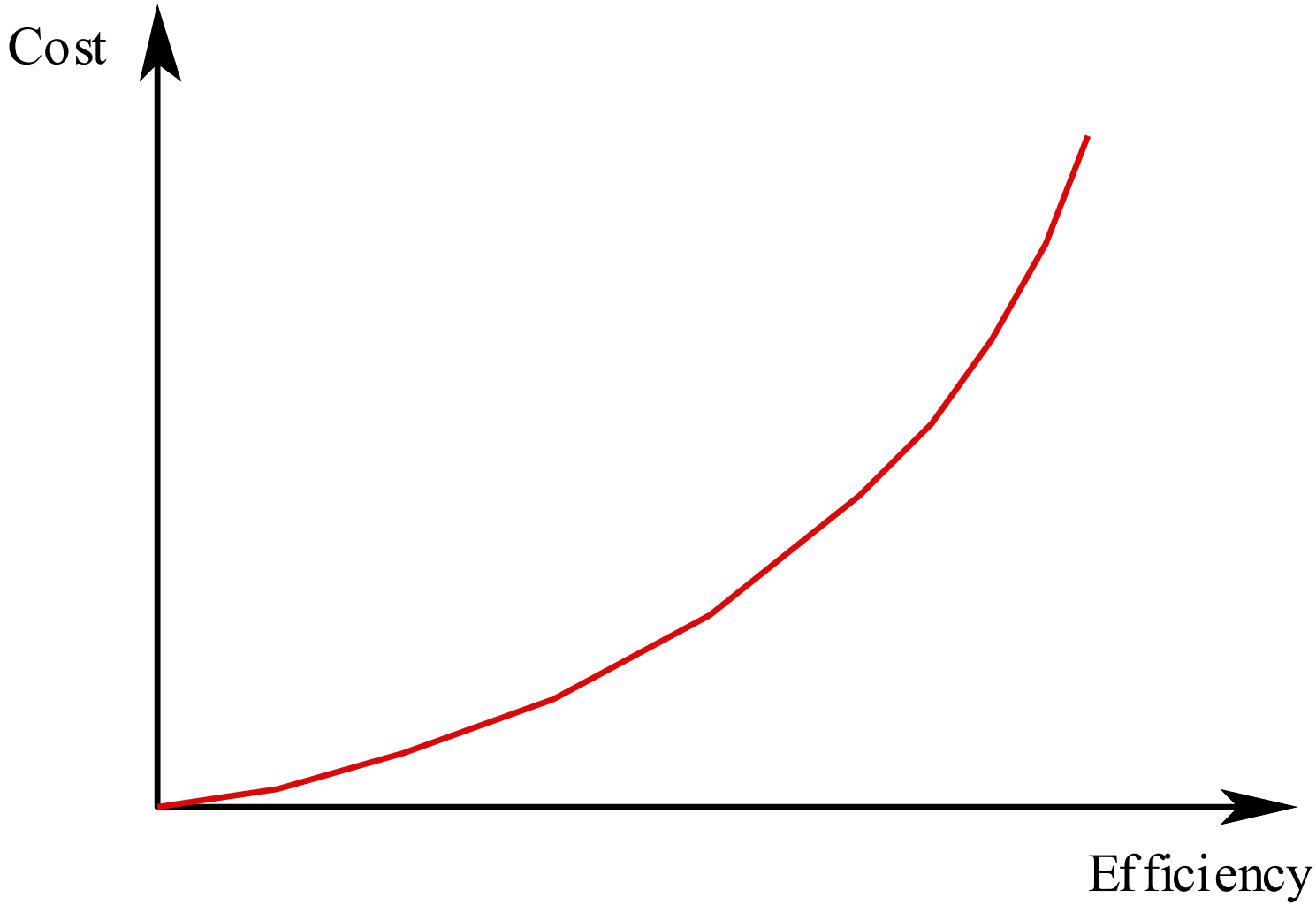
Software Product Attributes

- Maintainability
- Dependability
- Efficiency
- Usability

Importance of Product Characteristics

- The relative importance of these characteristics depends on the product and the environment in which it is to be used.
- In some cases, some attributes may dominate
  - In safety-critical real-time systems, key attributes may be dependability and efficiency.
- Costs tend to rise exponentially if very high levels of any one attribute are required.

Efficiency Costs



The Software Process

- Structured set of activities required to develop a software system
  - Specification
  - Design
  - Validation
  - Evolution
- Activities vary depending on the organization and the type of system being developed.
- Must be explicitly modeled if it is to be managed.

Engineering Process Model

- **Specify**: Set out the requirements and constraints on the system.
- **Design**: Produce a model of the system.
- **Manufacture**: Build the system.
- **Test**: Check the system meets the required specifications.
- **Install**: Deliver the system to the customer and ensure it is operational.
- **Maintain**: Repair faults in the system as they are discovered.

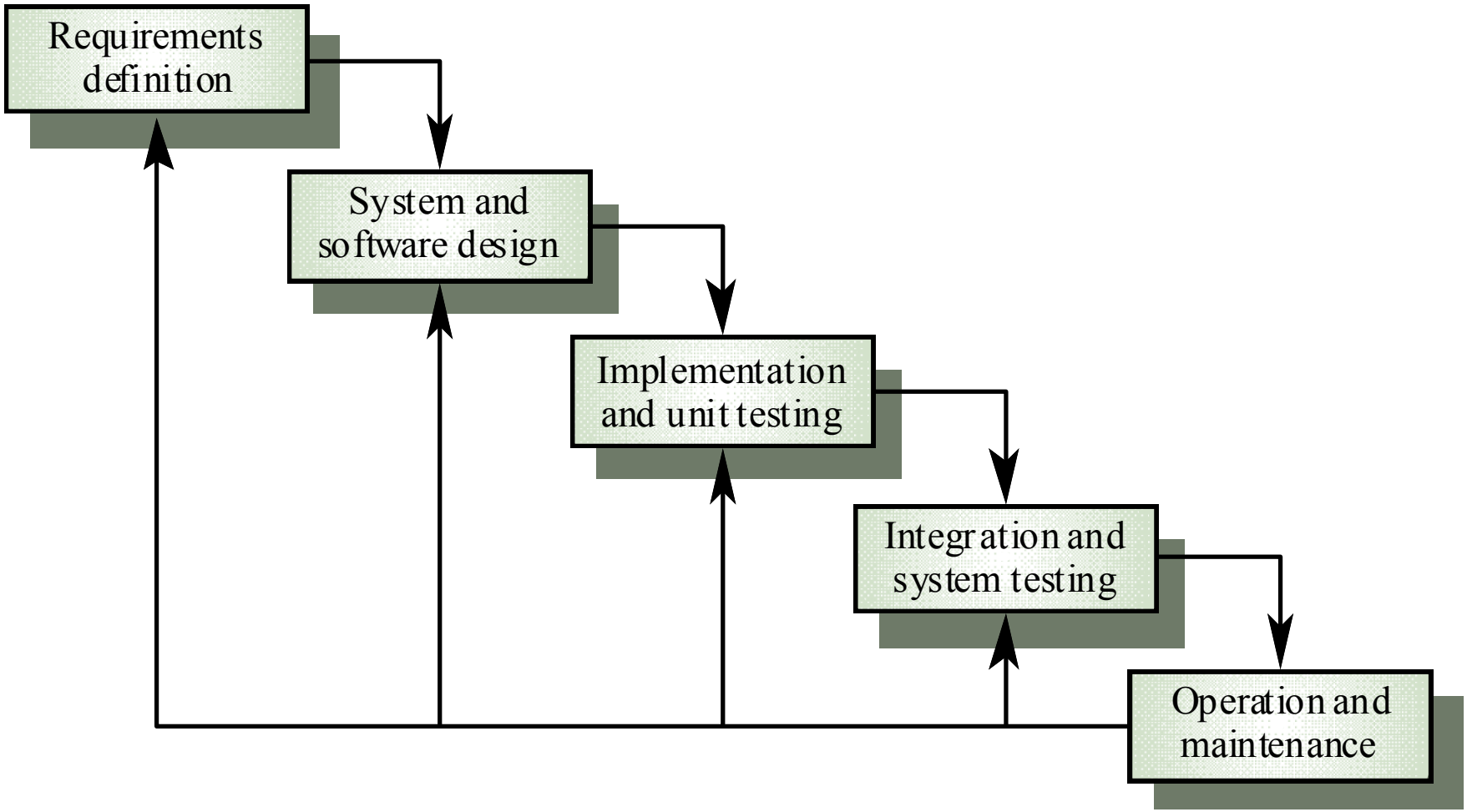
Software Engineering is Different

- Normally, specifications are incomplete.
- Very blurred distinction between specification, design and manufacture.
- No physical realization of the system for testing.
- Software does not wear out - maintenance does not mean component replacement.

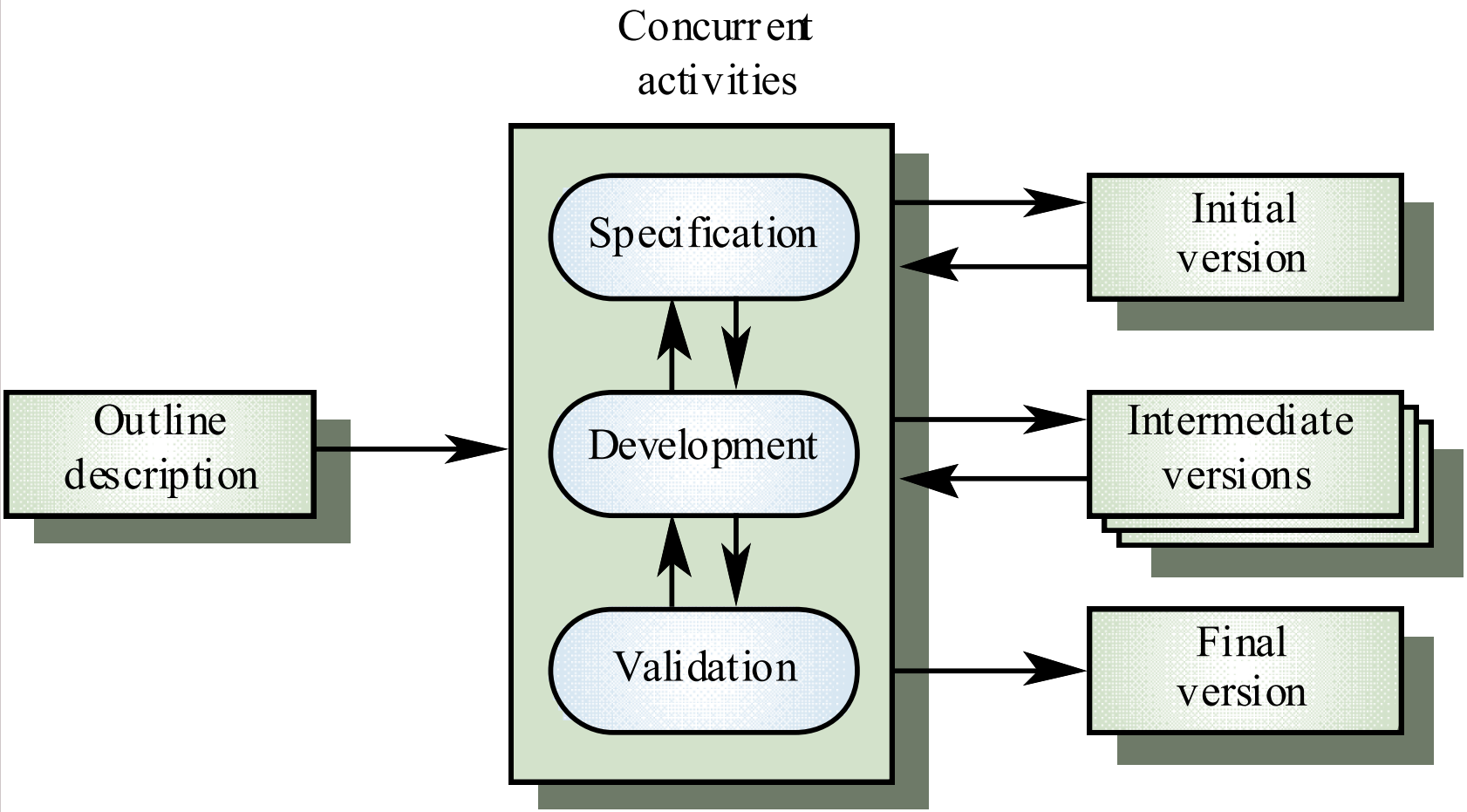
Generic Software Process Models

- **Waterfall**
  - Separate and distinct phases of specification and development
- **Evolutionary**
  - Specification and development are interleaved
- **Formal Transformation**
  - A mathematical system model is formally transformed to an implementation
- **Reuse-based**
  - The system is assembled from existing components

Waterfall Process Model



Evolutionary Process Model



Process Model Problems

- Waterfall
  - High risk for new systems because of specification and design problems.
  - Low risk for well-understood developments using familiar technology.
- Prototyping
  - Low risk for new applications because specification and program stay in step.
  - High risk because of lack of process visibility.
- Transformational
  - High risk because of need for advanced technology and staff skills

Hybrid Process Models

- Large systems are usually made up of several sub-systems.
- The same process model need not be used for all subsystems.
- Prototyping for high-risk specifications.
- Waterfall model for well-understood developments.

Agile methods

- Dissatisfaction with the overheads involved in design methods led to the creation of agile methods. These methods:
  - Focus on the code rather than the design;
  - Are based on an iterative approach to software development;
  - Are intended to deliver working software quickly and evolve this quickly to meet changing requirements.
- Agile methods are probably best suited to small/ medium-sized business systems or PC products.

Principles of agile methods

Principle	Description
Customer involvement	The customer should be closely involved throughout the development process. Their role is provide and prioritise new system requirements and to evaluate the iterations of the system.
Incremental delivery	The software is developed in increments with the customer specifying the requirements to be included in each increment.
People not process	The skills of the development team should be recognised and exploited. The team should be left to develop their own ways of working without prescriptive processes.
Embrace change	Expect the system requirements to change and design the system so that it can accommodate these changes.
Maintain simplicity	Focus on simplicity in both the software being developed and in the development process used. Wherever possible, actively work to eliminate complexity from the system.

Problems with agile methods

- It can be difficult to keep the interest of customers who are involved in the process.
- Team members may be unsuited to the intense involvement that characterizes agile methods.
- Prioritizing changes can be difficult where there are multiple stakeholders.
- Maintaining simplicity requires extra work.
- Contracts may be a problem as with other approaches to iterative development.

Extreme Programming

- An agile development methodology
- Created by Kent Beck in the mid-90s
- A set of 12 key practices taken to their "extremes"
- We will try to use some in this course

The XP slides are based on a slide set by Daniel Baranowski

Small Releases

- Small in terms of functionality
- Less functionality means releases happen more frequently
- Support the planning game

Small Releases – Advantages

- Frequent feedback
- Tracking
- Reduce chance of overall project slippage

Small Releases – Disadvantages

- Not easy for all projects
- Not needed for all projects
- Versioning issues

Testing

- Unit testing
- Test-first design
- All automated

Testing – Advantages

- Unit testing promote testing completeness
- Test-first gives developers a goal
- Automation gives a suite of regression test

Testing – Disadvantages

- Automated unit testing isn't for everything
- Reliance on unit testing isn't a good idea
- A test result is only as good as the test itself

Refactoring

- Changing how the system does something but not what is done
- Improves the quality of the system in some way

Refactoring – Advantages

- Prompts developers to proactively improve the product as a whole
- Increases developer knowledge of the system

Refactoring – Disadvantages

- Not everyone is capable of refactoring
- Refactoring may not always be appropriate
- Would upfront design eliminate refactoring?

Pair Programming

- Two Developers, One monitor, One Keyboard
- One “drives” and the other thinks
- Switch roles as needed

Pair Programming – Advantages

- Two heads are better than one
- Focus
- Two people are more likely to answer the following questions:
  - Is this whole approach going to work?
  - What are some test cases that may not work yet?
  - Is there a way to simplify this?

Pair Programming – Disadvantages

- http://www.cenqua.com/pairon/
- Many tasks really don't require two programmers
- A hard sell to the customers
- Not for everyone

Collective Ownership

- The idea that all developers own all of the code
- Enables refactoring

Collective Ownership – Advantages

- Helps mitigate the loss of a team member leaving
- Promotes developers to take responsibility for the system as a whole rather than parts of the system

Collective Ownership - Disadvantages

- Loss of accountability
- Limitation to how much of a large system that an individual can practically “own”

Continuous Integration

- New features and changes are worked into the system immediately
- Code is not worked on without being integrated for more than a day

Continuous Integration - Advantages

- Reduces to lengthy process
- Enables the Small Releases practice

Continuous Integration – Disadvantages

- The one day limit is not always practical
- Reduces the importance of a well-thought-out architecture

Web resources

- www.junit.org
- www.xprogramming.com
- www.extremeprogramming.org
- www.refactoring.com
- www.pairprogramming.com

Our project

- Fully develop a system that translates guitar tablature from ASCII to PDF
- We will call it TAB2PDF
- We will use an extreme programming approach whenever possible

ASCII Tablature

```
TITLE=Moonlight Sonata
SUBTITLE=Ludwig van Beethoven
SPACING=5

|--------------------------|--------------------------|
|-----1-----1-----1-----1-|-----1-----1-----1-----1-|
|---2-----2-----2-----2---|---2-----2-----2-----2---|
|-2-----2-----2-----2-----|-2-----2-----2-----2-----|
|-0-----------------------|--------------------------|
|--------------------------|-3-----------------------|

|--------------------------|--------------------------|
|-----1-----1-----3-----3-|-----3-----1-----0-----0-|
|---2-----2-----3-----3---|---1-----2-----2-----1---|
|-3-----3-----3-----3-----|-2-----2-----2-----0-----|
|-------------5------------|--------------------------|
|-1-----------------------|-0-----------0------------|
```

PDF Tablature

To get started

- Look at the sample input and output files posted on the course website
- Download the iText library for dynamically creating PDF files
  - http://itextpdf.com
- Attempt to create a Hello World PDF file
- Lots of examples at the site above

Intentionally vague requirements

- In a real software development project, requirements are vague and ever-changing
- The exact requirements will be refined iteratively by meeting with the “customer” on a weekly basis

Teams

- Teams are assigned randomly by the “manager”
- As enrollment in the course changes in the first few weeks, the “manager” will rearrange the teams
- Same as a real software project!

Team 1

- Aolaritei, Alexander Viorel
- Bahri, Jonathan Renatius
- Hinh, Ronald
- Layne, Skyler Christopher
- Naji, Saad

Team 2

- Bassakyros, Tom
- Kresling, Artem
- Patel, Deep
- Pimentel, Ante Jeremias
- Said, Adem

Team 3

- Kuffour, Jason Eugene
- Nasar, Mohamed
- Rauff, Siraj Muhammed
- Shah, Muhammad
- Tran, Calvin

Workload

- This course requires 8-10 hours per week per student
- Have to start working immediately
- In the second hour of each lecture, each team will present their progress to the instructor and receive feedback
  - “Customer” on site!

Evaluation

- 20% - Midterm prototype + Presentation (due Feb 26)
- 80% - Final project + Presentation (due Apr 4)

- Each team submission will receive a grade based on its merit. Individual grades may be less if full participation has not been demonstrated.