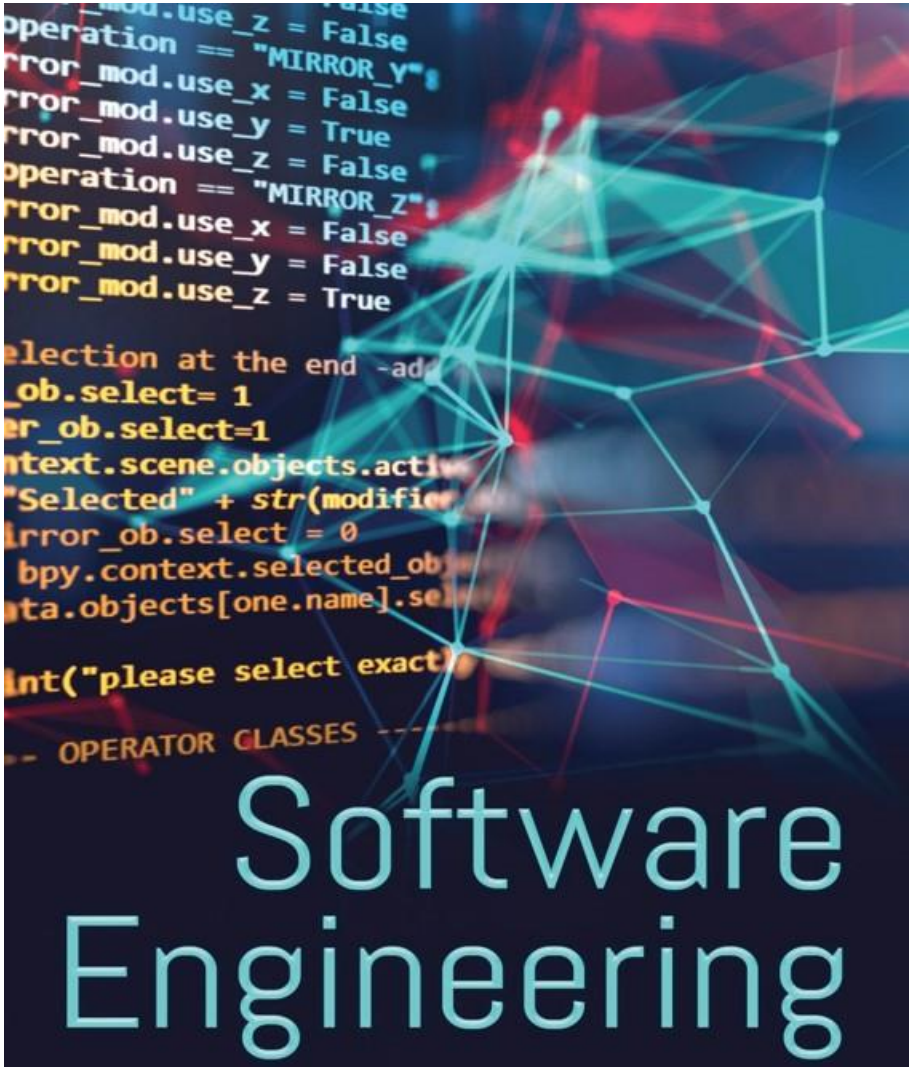
Object-Oriented Software Engineering: An Agile Unified Methodology
by David Kung

Lec.01 Introduction

Jackeycheung@HKMU

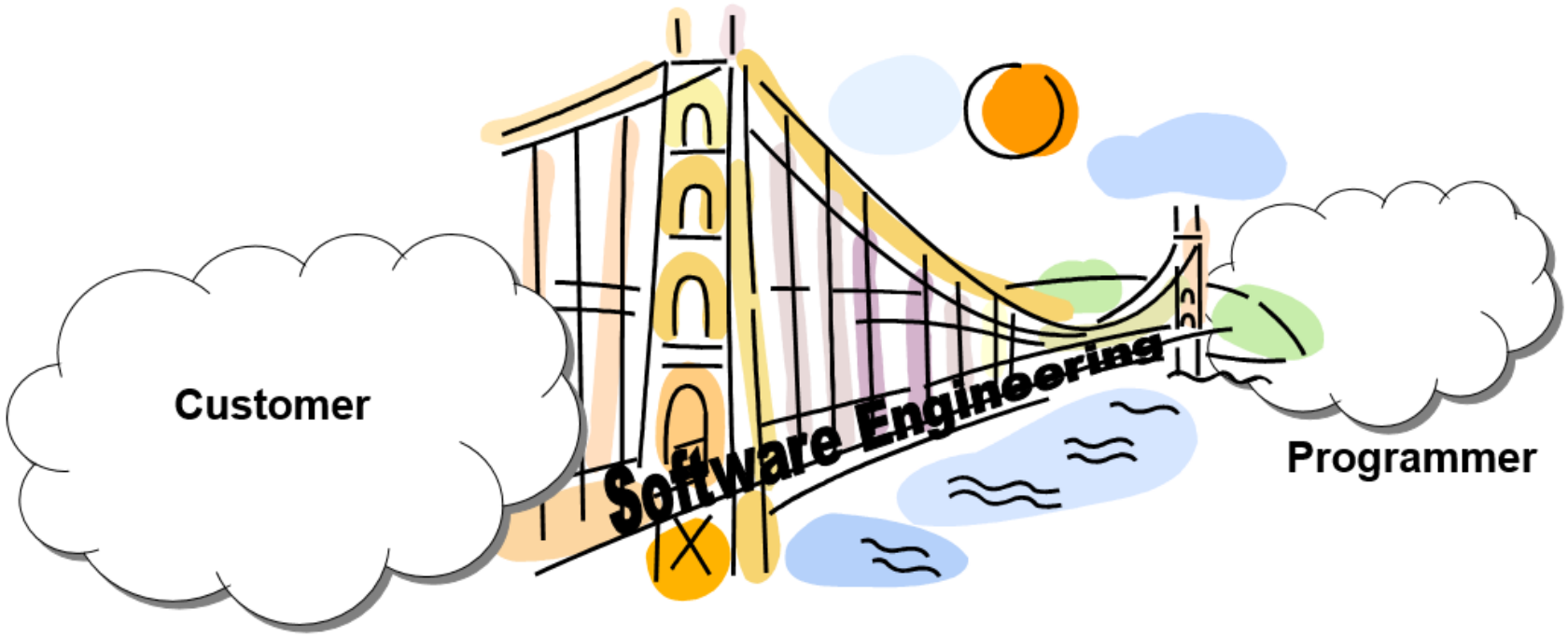
What Is Software Engineering?

Software engineering concept



What Is Software Engineering?

Software engineering concept



Key Takeaway Points

- Software engineering aims to significantly improve software productivity and software quality while reducing software costs and time to market.
- Software engineering consists of three tracks of interacting life cycle activities:
  - software development process
  - software quality assurance, and
  - software project management
- Object-oriented (OO) software engineering is a specialization of software engineering. It views the world and systems as consisting of objects that interact with each other.

Course instructor

- Jackey Cheung (Lecturer)
  - 20-year experience in IT industry/University
    - 5+ year in HKUST
    - 10+ year in CUHK
    - Some UK-Universities, etc.
  - My expertise: Computer Vision, Image Processing, Machine Learning, Cyber Security, Block Chain, Software Engineering, etc.
  - My excellent students
    - One graduate created an AR/XR company
    - One graduate ranked as an associate director
  - These experiences can help you (Career, FYP, etc.)

Course instructor

- Jackey Cheung (Lecturer)
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  - Phone: 852-2768-6898
  - Office hours: TBC, MC, A919 or by appointment (just e-mail or phone me)

- Angel Ng (Tutor)
  - E-mail: okng@hkmu.edu.hk
  - Phone: TBC

What Is Software Engineering?

Software engineering is focused on

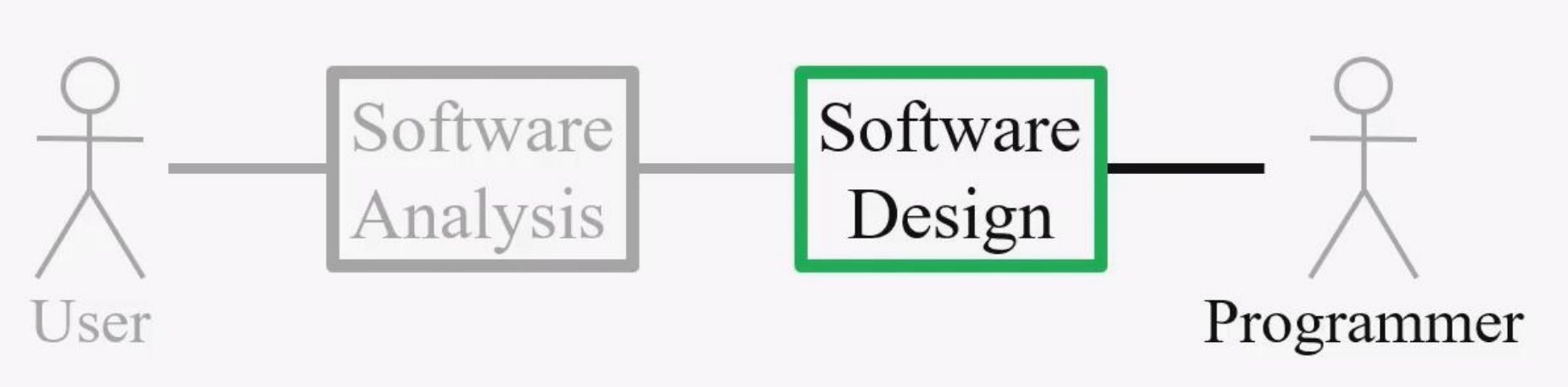
- research, education, and application of engineering processes and methods
- to significantly increase
  - *software productivity (P) and software quality (Q)*

– while reducing
  - *software costs (C)* and *time to market (T)*

– software PQCT.
  - What is the focus of data base systems?
  - What is the focus of operating systems?

What Is Software Engineering?

Software engineering concept



What Is Software Engineering?

Software engineering area

Why Software Engineering?

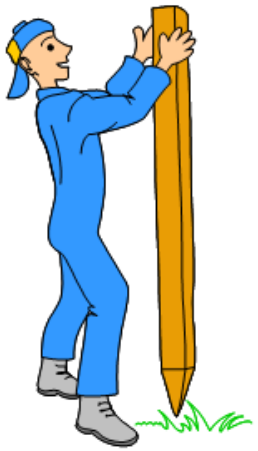
1. Software is expanding into all our society:

- Companies rely on software to run for businesses.
- Software systems - larger and more complex.
- Software costs: 90 – 95% of total system costs
  - Only 5 – 10% of total system costs two decades ago

- Embedded systems
  - Application specific integrated circuits (ASIC)
  - Are costly to replace – software quality is critical.

We need an engineering approach to software development.

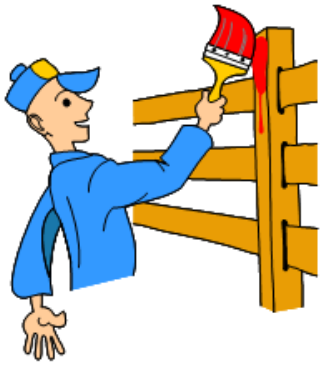
Why Software Engineering ?



Setting posts
[3 time units]

Cutting wood
[2 time units]

Nailing
[2 time units for unpainted;
3 time units otherwise]



Painting
[5 time units for uncut wood;
4 time units otherwise]

Why Software Engineering?

2. Large software systems development requires teamwork and software engineering supports it

   - A software engineer => 50–100 lines of code per day.
   - A small-system (10,000 lines) => 100-200 days/engineer
   - A medium-system (500,000 lines)=>20-40 years/engineer

Real software systems

$\Rightarrow$ Need many software engineers to work together

$\Rightarrow$ Need a protocol/system/UML to communicate

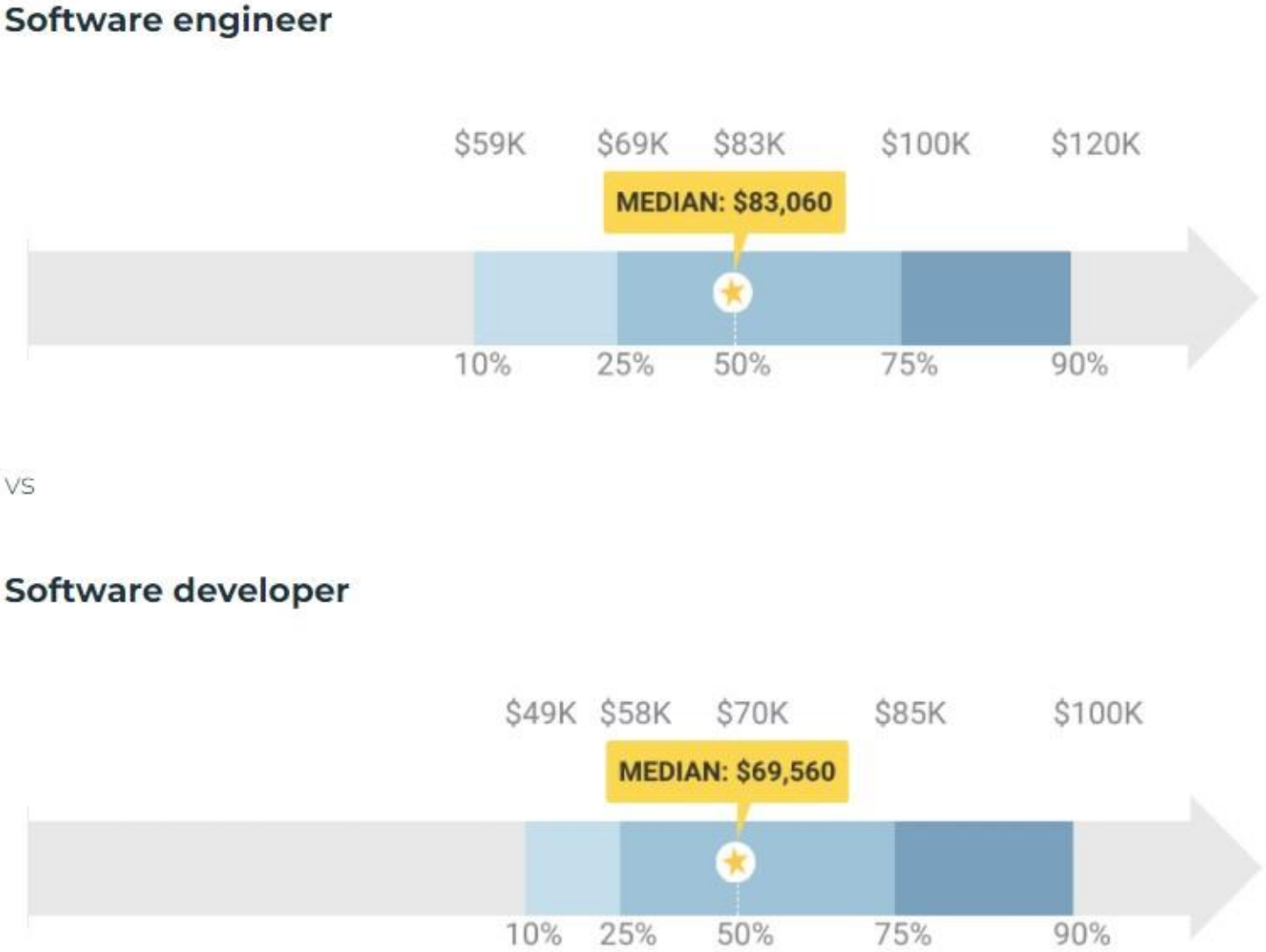
$\Rightarrow$ Software Engineering

Software Engineering

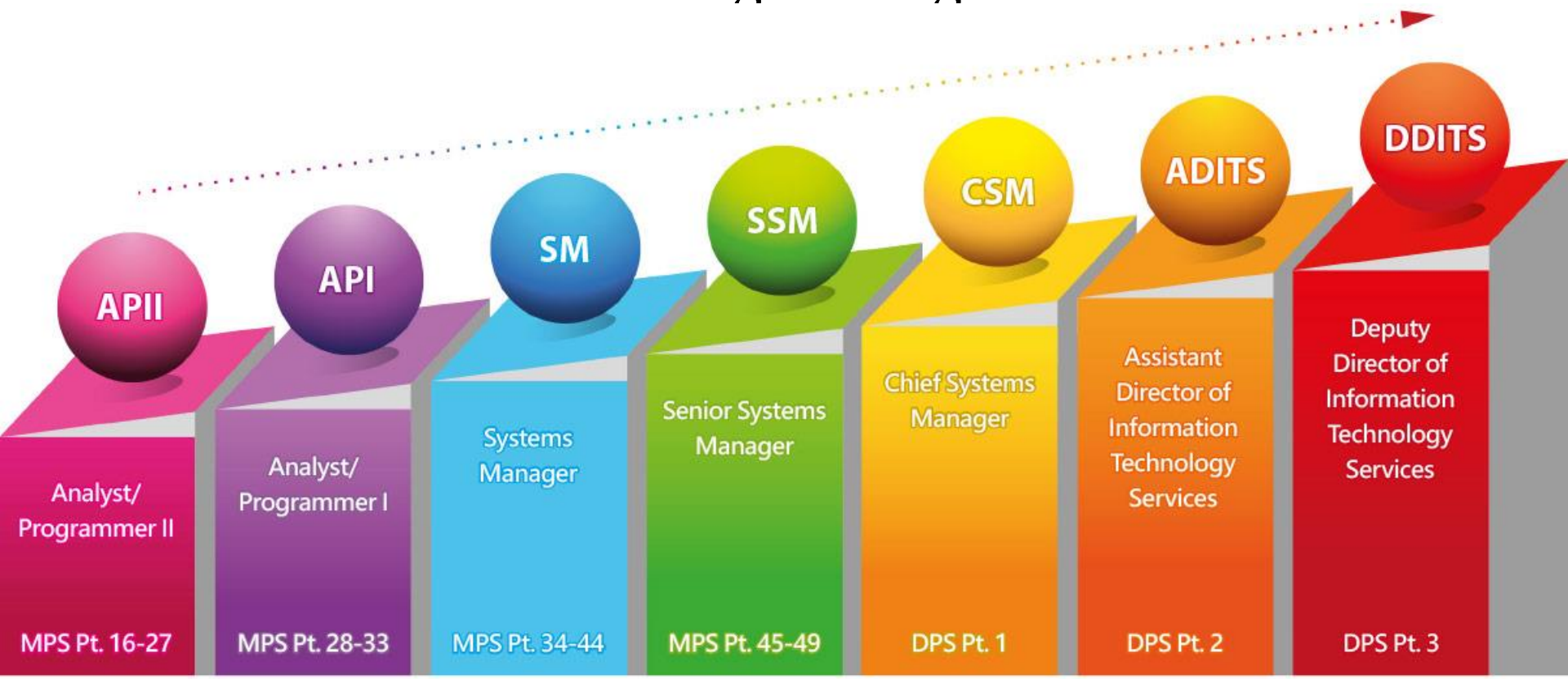
Software engineering characteristics

- *Software analysis is user driven*
- *Software design is a creative process*
- *Software engineering is experience-based*

Software Engineering Career



Software Engineering Career



MPS Pt.49 = HK$135,470 / month (2021)

MPS Pt.28 = HK$46,550 / month (2021)

MPS Pt.16 = HK$32,830 / month (2021)

Why Software Engineering?

To work together, the software engineers must overcome three challenges, among others:

Conceptualization

Communication

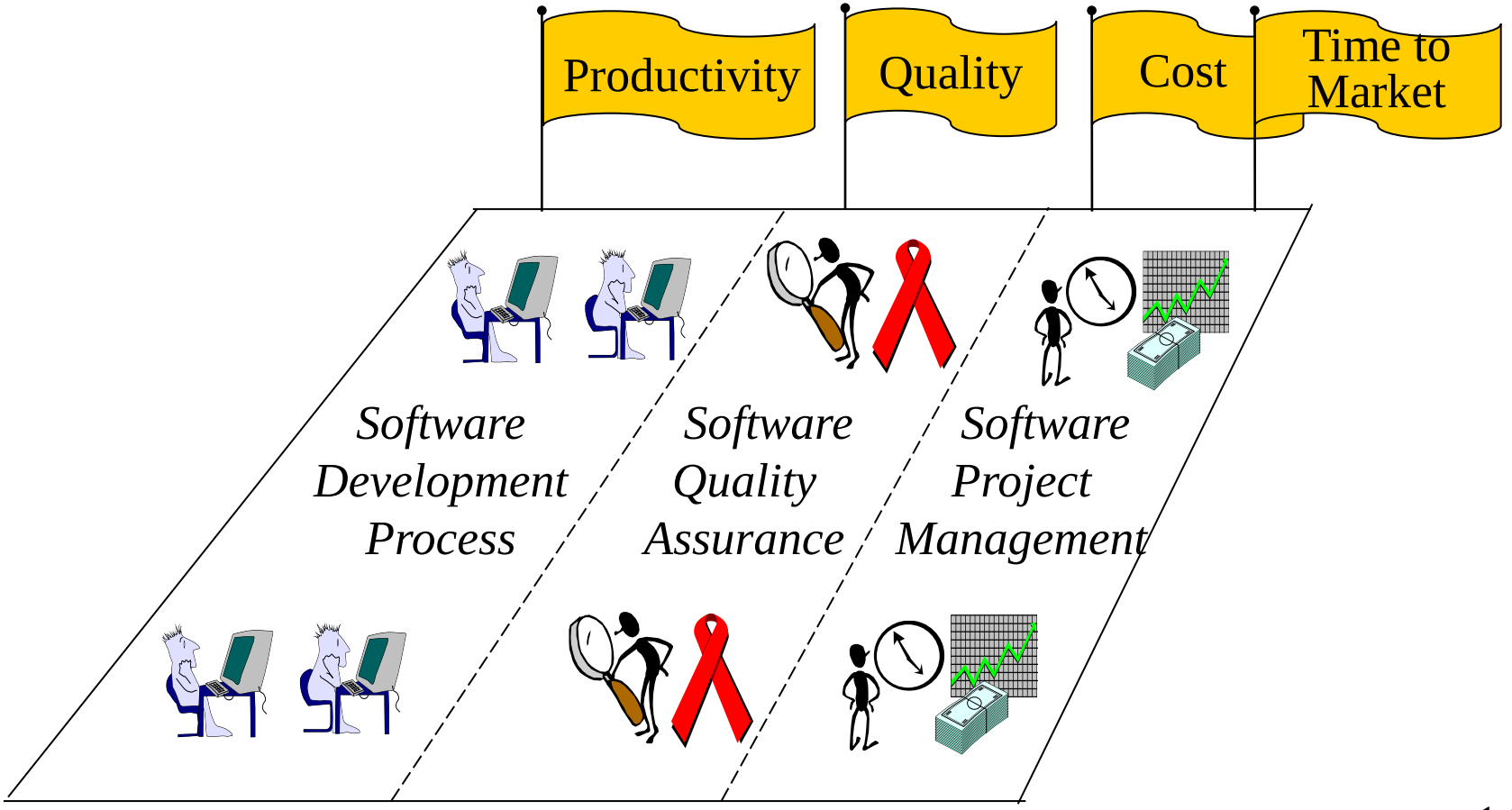
Coordination

Solution:

- Processes and methodologies for analysis and design
- UML for communication and coordination
- Tools that automate or support methodology steps.

Software Life Cycle Activities

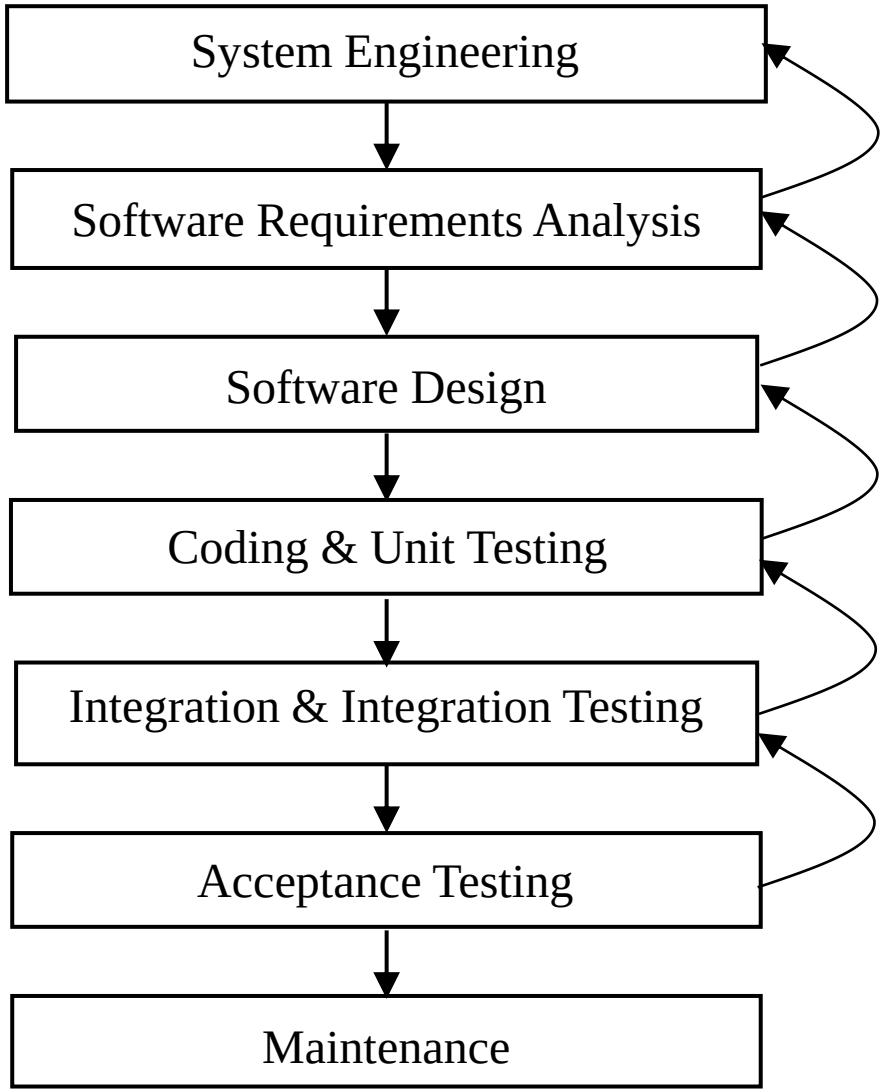
- Software processes and methodologies consist of life cycle activities:



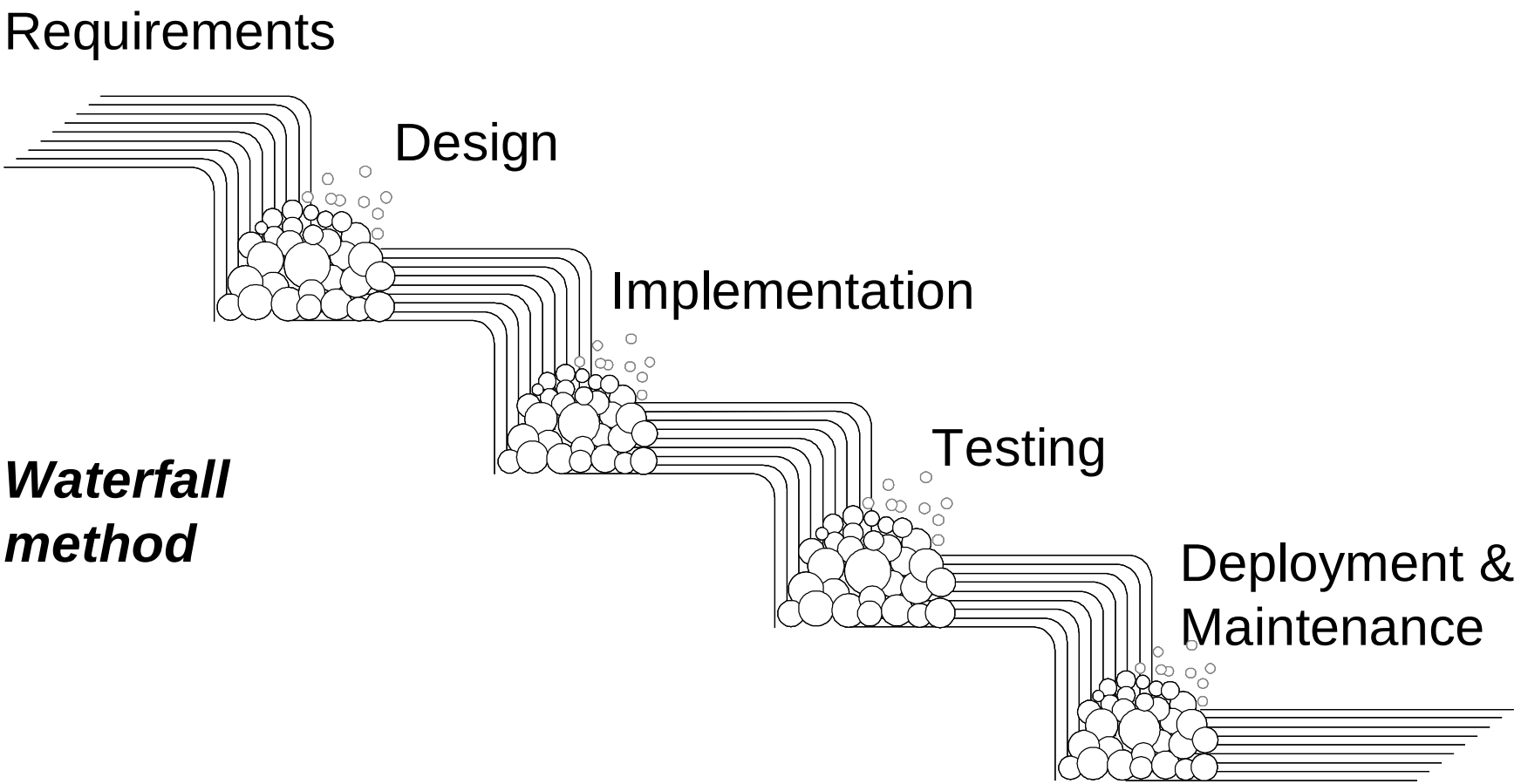
Software Development Process

- A software development process transforms the initial system concept into the operational system running in the target environment.
- It identifies the business needs, conducts a feasibility study, and formulates the requirements or capabilities that the system must deliver.
- It also designs, implements, tests, and deploys the system to the target environment.

The Waterfall Process

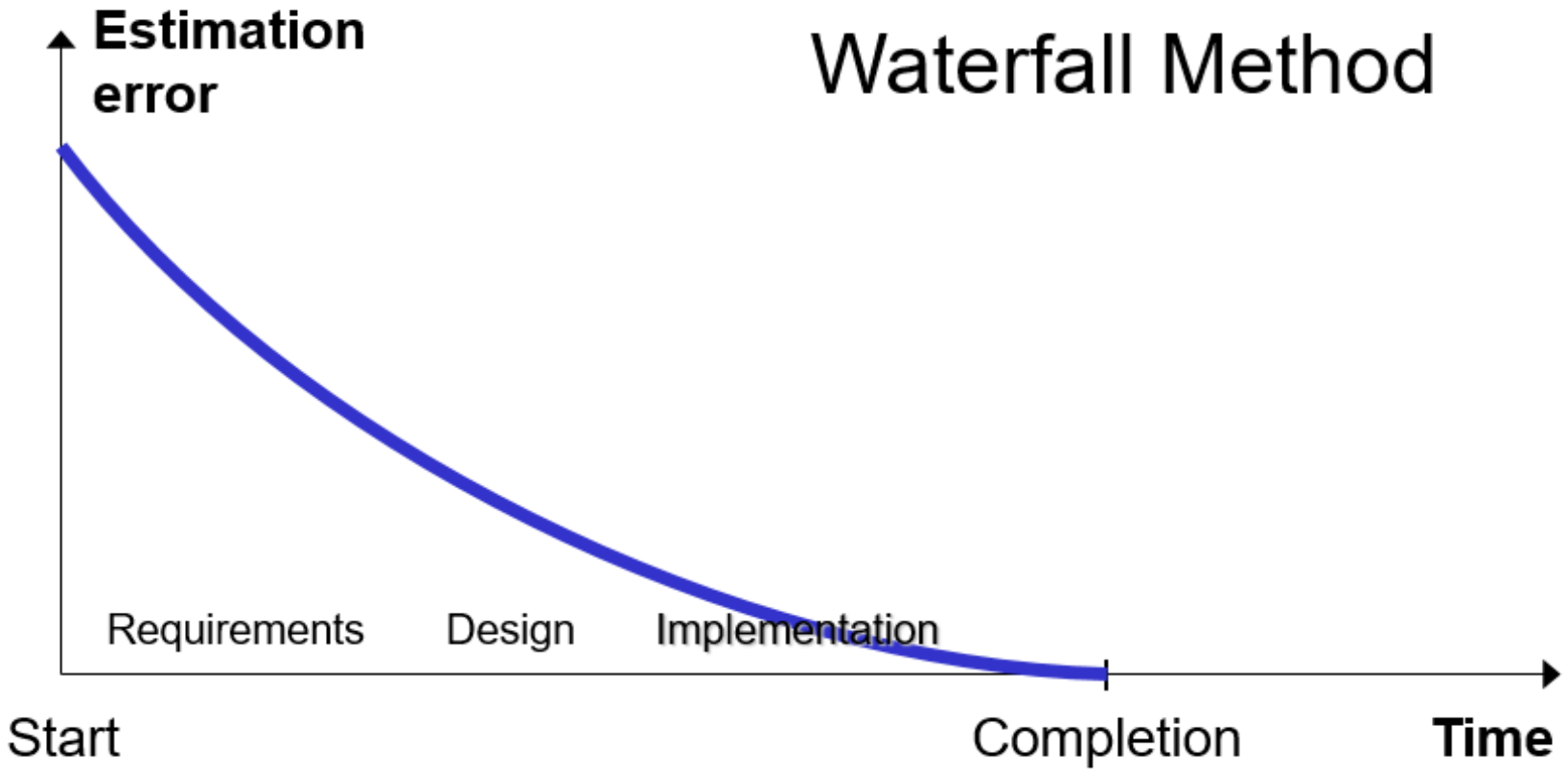


The Waterfall Process

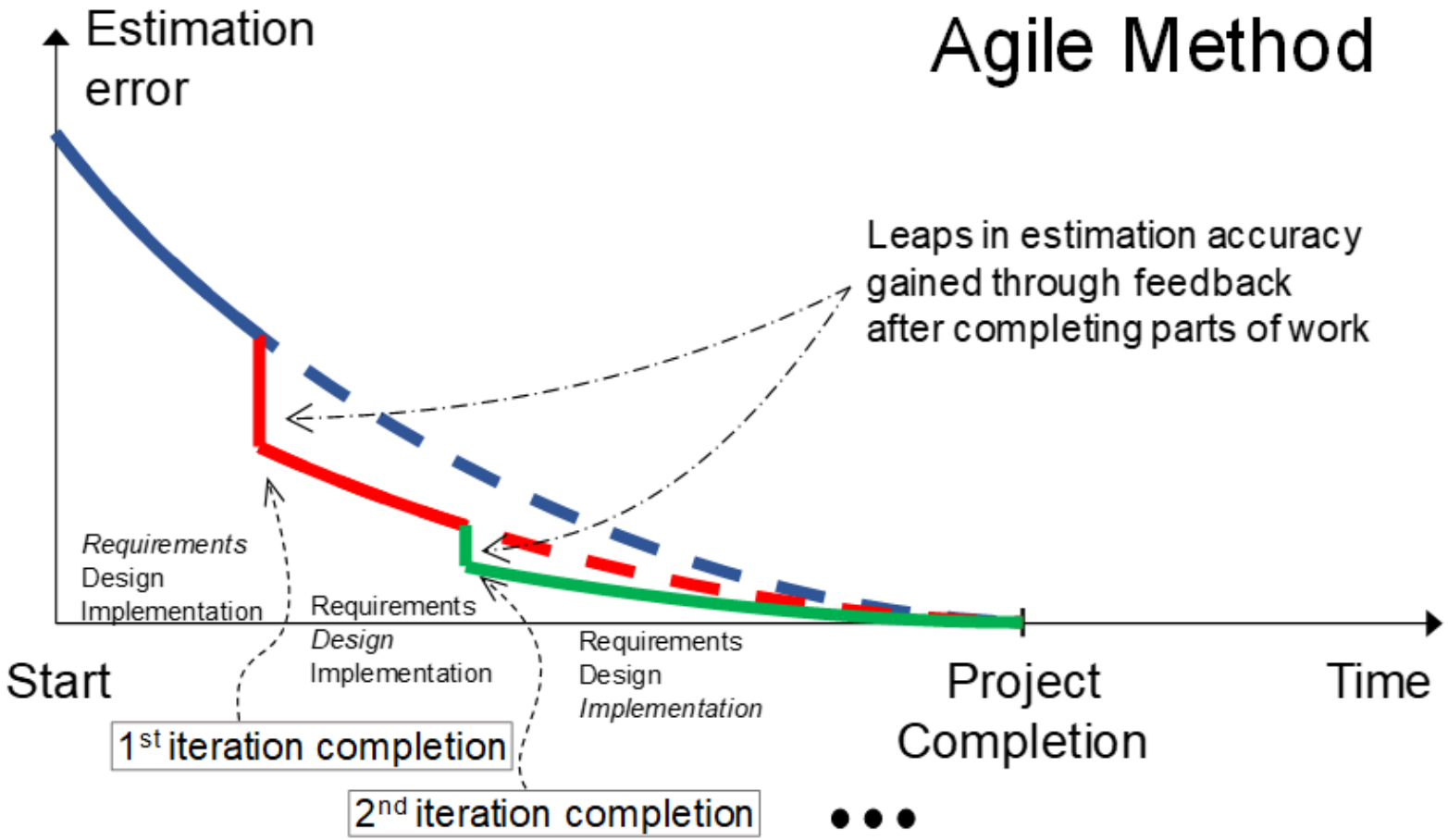


Waterfall method

The Waterfall Process



Can we make it better ?



Software Quality Assurance

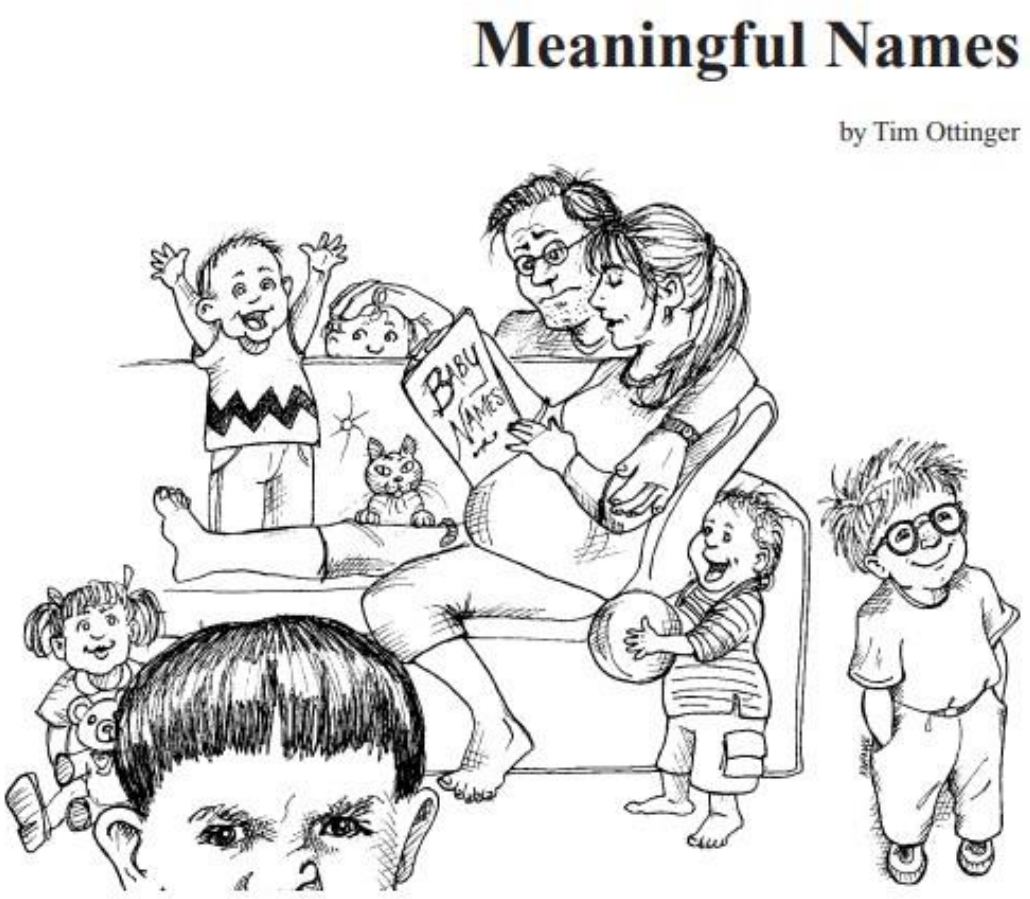
How to make your customer trust you ?

Software quality assurance (SQA) ensures that

- the development activities are performed properly, and
- the software artifacts produced by the development activities meet the software requirements and desired quality standards.

Some software coding tips

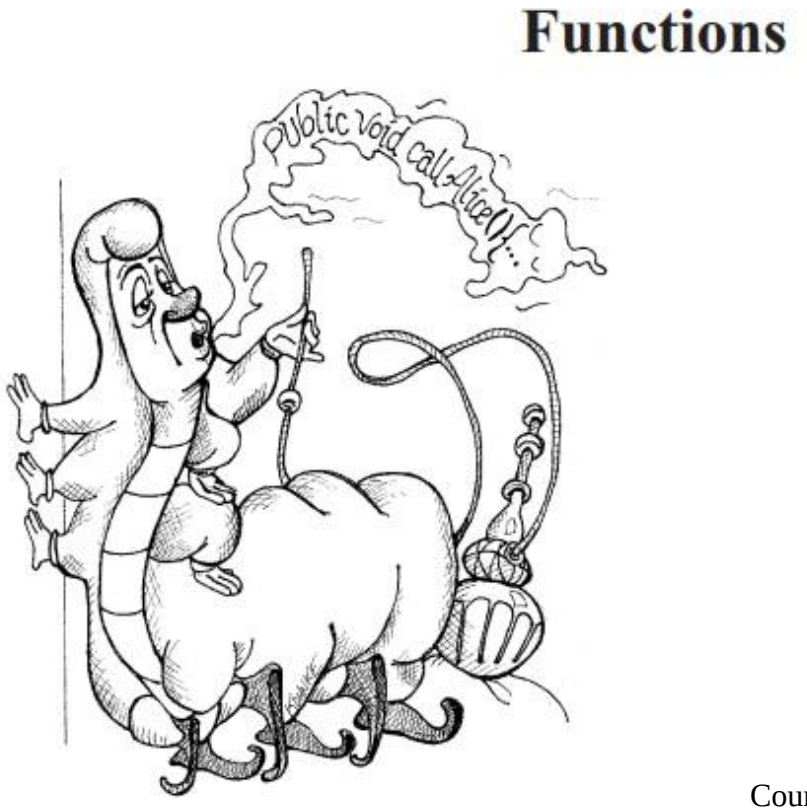
Unique name ? Global name ? Local name ?



Courtesy RC Martin

Some software coding tips

Procedure ? Sub-routine ? Function ?



Courtesy RC Martin

Software Quality Assurance

How to make your customer trust you ?

=>Follow software engineering standards

- **ISO/IEC/IEEE 90003:2018**
  - **Software engineering — Guidelines for the application of ISO 9001:2015 to computer software**

- **ISO/IEC JTC 1/SC 7**
  - **Software and systems engineering**
  - 200 **PUBLISHED ISO STANDARDS**
  - 34 **ISO STANDARDS UNDER DEVELOPMENT**

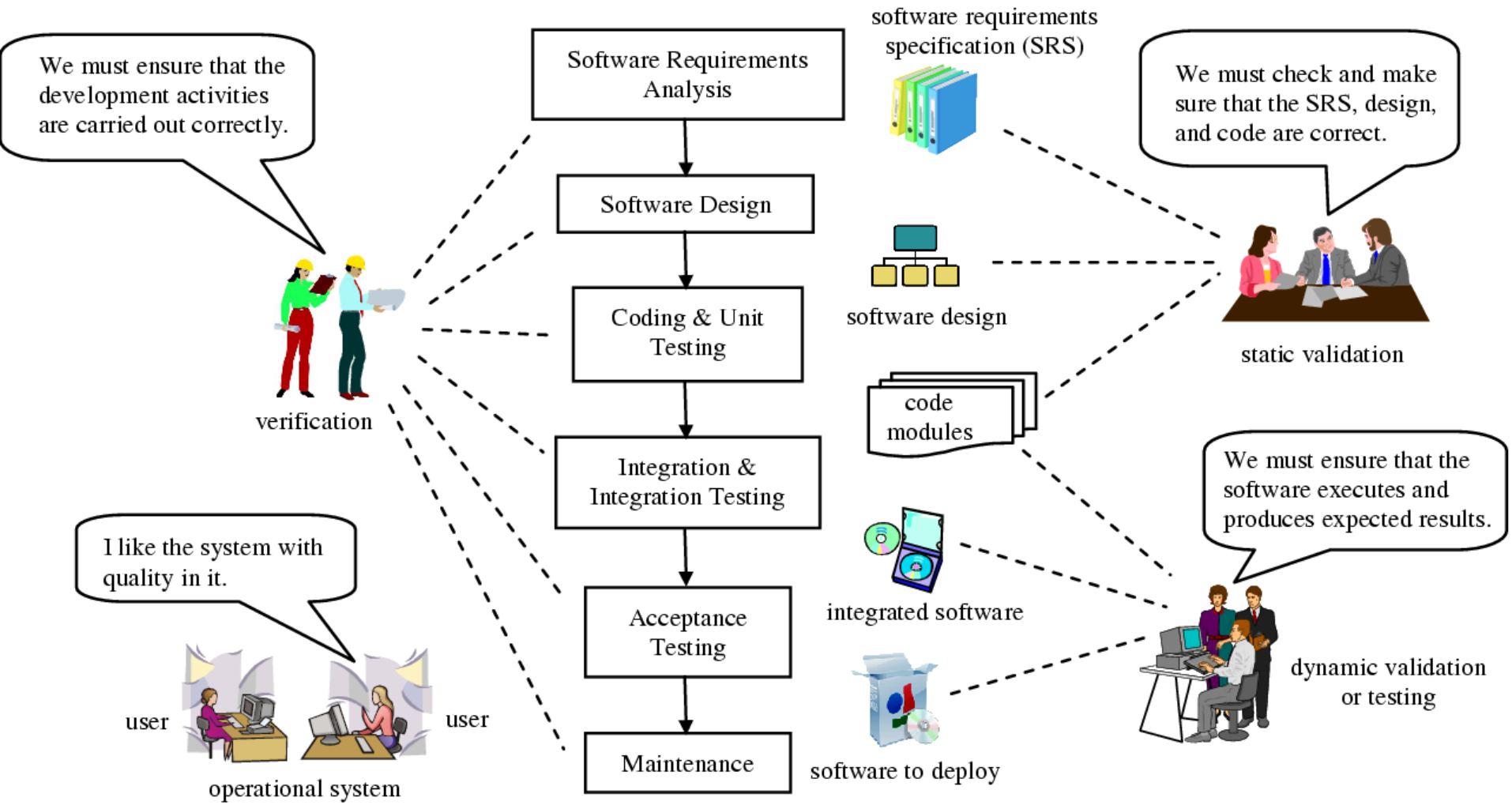
Software Quality Assurance

How to make your customer trust you ?

=>Follow software engineering standards

- ISO/IEC 12207
  - Software lifecycle processes
- ISO/IEC 15504 / ISO/IEC 33001
  - **Software Process Improvement and Capability Determination** (**SPICE**)
  - ISO/IEC 15504 superseded by *ISO/IEC 33001 Information technology – Process assessment – Concepts and terminology* in 2015
- ISO/IEC JTC 1/SC 7
  - Engineering of software products and systems

SQA Activities



Software Quality Assurance

How to make your customer trust you ?

=>Follow software engineering standards

- Many companies go for these standards
- Many companies hire professionals for it
- My student got the job in a big international company before graduation
- You can also do it

Software Project Management

- Software project management oversees the control and administration of the development and SQA activities.
- Project management activities include
  - effort estimation
  - project planning and scheduling
  - risk management
  - project administration, and
  - others.

These activities ensure that the software system is delivered on time and within budget.

Object-Oriented Software Engineering

- Object-oriented software engineering (OOSE) is a specialization of software engineering.
- The object-oriented paradigm views the world and systems as consisting of objects that relate and interact with each other.
- OOSE encompasses:
  - OO processes
  - OO methodologies
  - OO modeling languages
  - OO tools

Software Engineering and Computer Science

Computer Science

- Pursue optimal solutions
- $$$ is not an important consideration
- Programming in the small
- Technical issues
- Dealing with tame problems
- Foundations of software engineering

Software Engineering

- Good enough is enough
- $$$ is an important factor (PQCT)
- Programming in the large
- All issues and aspects
- Dealing with wicked problems
- Building on top of computer science and other disciplines

Software Engineering

The prime concepts

- Object oriented

The prime methods

- Unified process

The prime techniques

- UML diagrams

The prime tools

- LucidChart, etc.

Course syllabus

- Refer to the syllabus
  - The group project

Group construction

- The group project
  - Research for successful companies / cases
  - Let your software system fit international standards (ISO)
  - Details will be confirmed later
- Now construct your group first
- 4+-1 is ok

Class Discussion

- What are the focuses of computer science and software engineering, respectively?

- What are the educational objectives of computer science and software engineering, respectively?

Class Discussion

- Some authors say that software engineering is "programming in the large." What does this mean?

- What is the relationship between software engineering and computer science? Can you have one without the other?

Class Discussion

- What are the benefits of OOSE?

- Will OOSE replace the conventional approaches, and why?