Introduction to
the Software Engineering Course

Outline

- Introduction to course
- What is software
- What is software engineering
- Why is software engineering needed
- Software engineering application and research

Teachers

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  - Ms. Lily Chengyan LIN
    - Office: T3-602-R25
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Teachers

- Section 1002
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  - Mr. Xubin WANG
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Teachers

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  - Mr. ZHANG Yindong
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Lecture Hours and Venues

Software Engineering (1001)	Dr. Tianhui MENG	T7-302	Wed 9:00-10:50
Software Engineering (1001)	Dr. Tianhui MENG	T7-302	Fri 9:00-9:50
Software Engineering (1002)	Dr. Judy Xin FENG	T7-303	Wed 9:00-10:50
Software Engineering (1002)	Dr. Judy Xin FENG	T7-303	Fri 9:00-9:50
Software Engineering (1003)	Dr. Jefferson FONG	T7-301	Wed 9:00-10:50
Software Engineering (1003)	Dr. Jefferson FONG	T7-301	Fri 9:00-9:50

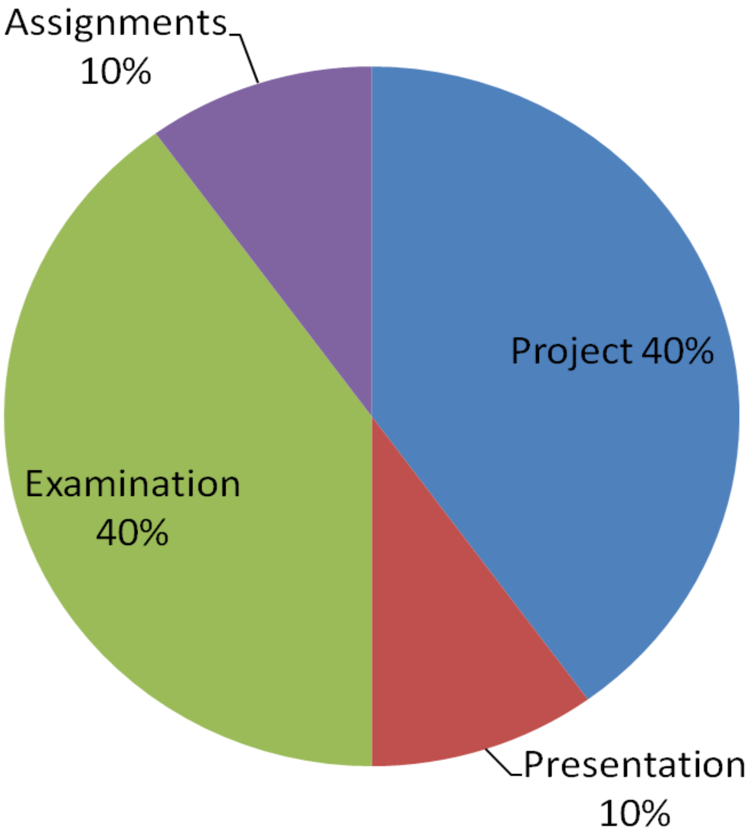
Attentions:

- All three sections have same lecture hours (SE) and workshop hours (SDW).
- After groups are formed, you will be notified later which section you should be physically located in. About the grouping, we will introduce it later in the third lecture hour today.
- Starting from Week 2, you might go to another section according to notification from teacher.

Contact Teachers

- Enterprise WeChat
  - An Enterprise WeCom group is set up for each physical section
  - Both SE and SDW classrooms will follow the physical section (starting from week 2)
- Office hours
  - Refer to the timetable on school’s website.

Evaluation



Software engineering and software development workshop III will share ONE project.

Final exam is very important!
It needs to reach at least a certain threshold mark in order to pass the course (otherwise you will receive a F grade, regardless of the marks for the other assessment components)

Syllabus and Rubrics

- Syllabus
  - Objectives of this course
  - Assessments
  - Contents covered

- Rubrics
  - How assignments, project, quizzes, exams are assessed.

Both syllabus and rubrics are available on iSpace

How to Fail Quickly

- Assignment
  - Copy others
    - BOTH (copied and copying) are given 0, and probably fail this course
  - No late submission is accepted
- Quiz and exam
  - Plagiarism
  - Do not show up
- Plagiarism in any assessment work including continuous assessment and final exam will be considered Academic misconduct and make you fail this course

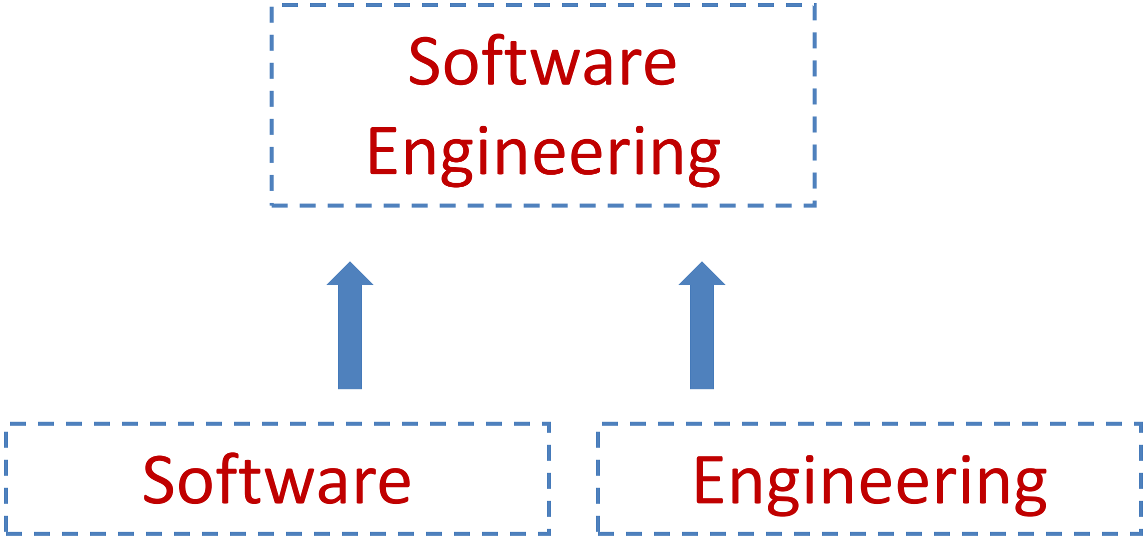
References

1. Ian Sommerville, Software Engineering (10th edition), 2016
2. Roger Pressman, Software Engineering, a Practitioner's Approach, (7th edition) 2010
3. Bernd Bruegge, Object-oriented software engineering : using UML, patterns, and Java (2nd edition), 2009
4. Mark Priestley, Practical object-oriented design with UML, (2nd edition), 2004
5. Curtis Tsang, Object-oriented technology : from diagram to code with visual paradigm for UML, 2004
6. David Kung, Object Oriented Software Engineering, 2013. (Chinese version)

Lectures 1 – 4 can refer to reference 1 - 2.
Lecture 5 – 13 can refer to reference 3 – 5.
References 6 is for the students are interested in more practical processes and examples.

What Is Software Engineering???

What Is Software Engineering



Software Engineering

Software

Engineering

What Is Software

What Is Software???

What Is Software

Software =?= Programs

What Is Software

- Software is
  - instructions that, when executed, provide desired function and performance,
  - data structures that enables the programs to adequately manipulate information, and
  - documents that describe the operations and use of the programs
- Software is [Sommerville]
  - computer programs and associated documentation.

What Is Software

Software = Programs + Documentation

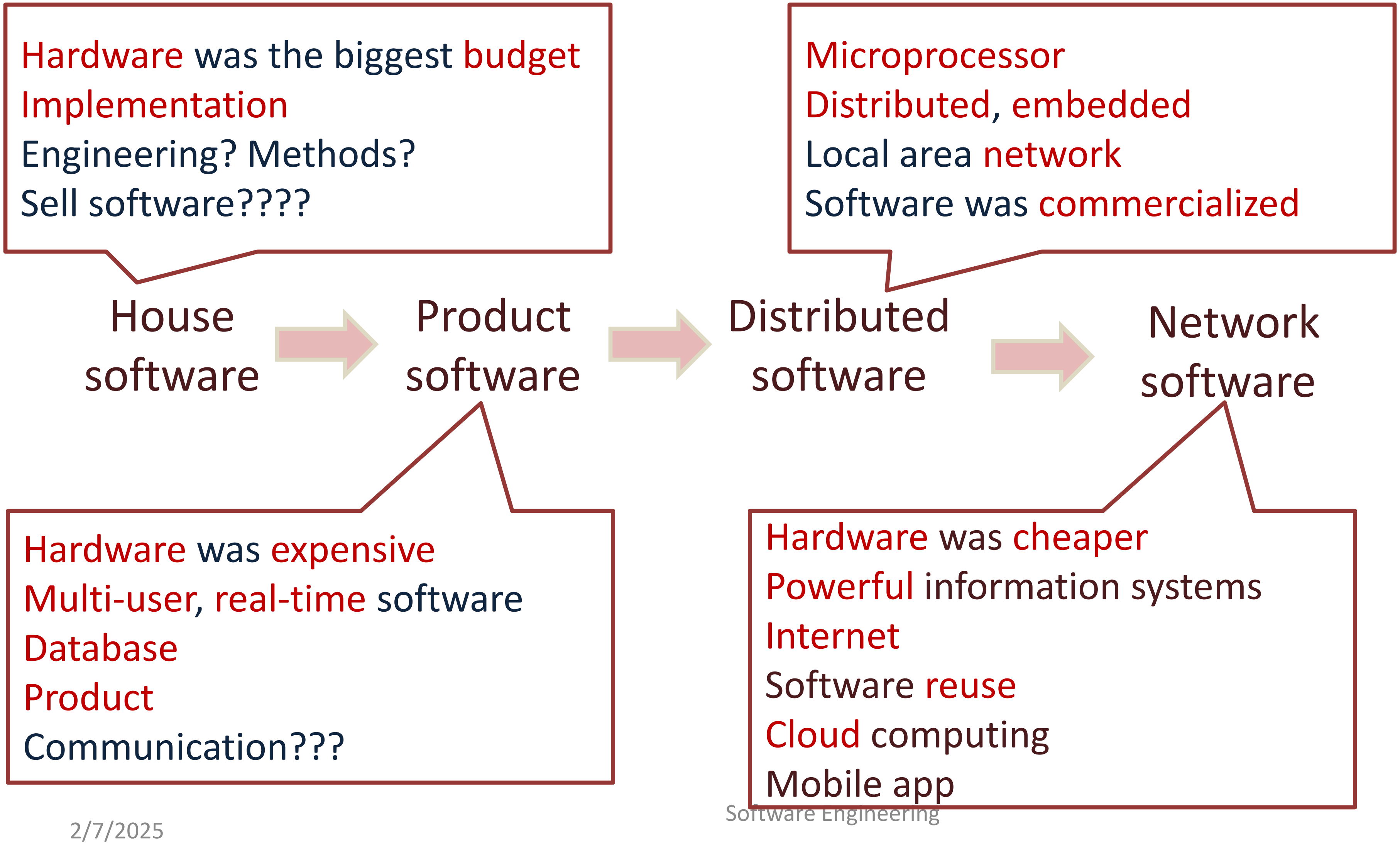
What Is Software

- Characteristics
  - Software has no mass
  - It is not rather manufactured in the classical sense.
  - Software does not “wear out”, but it does “deteriorate (衰退)”.
    - Can you give more characteristics about software?

Software

- Types of Software
  - Generic software
    - System software
    - IDE (Integrated Development Environment)
    - …
  - Customized software
    - Real-time software
    - Business software
    - Embedded software
    - …

Software Development History



House software

Hardware was the biggest budget
Implementation
Engineering? Methods?
Sell software????

Product software

Hardware was expensive
Multi-user, real-time software
Database
Product
Communication???

Distributed software

Microprocessor
Distributed, embedded
Local area network
Software was commercialized

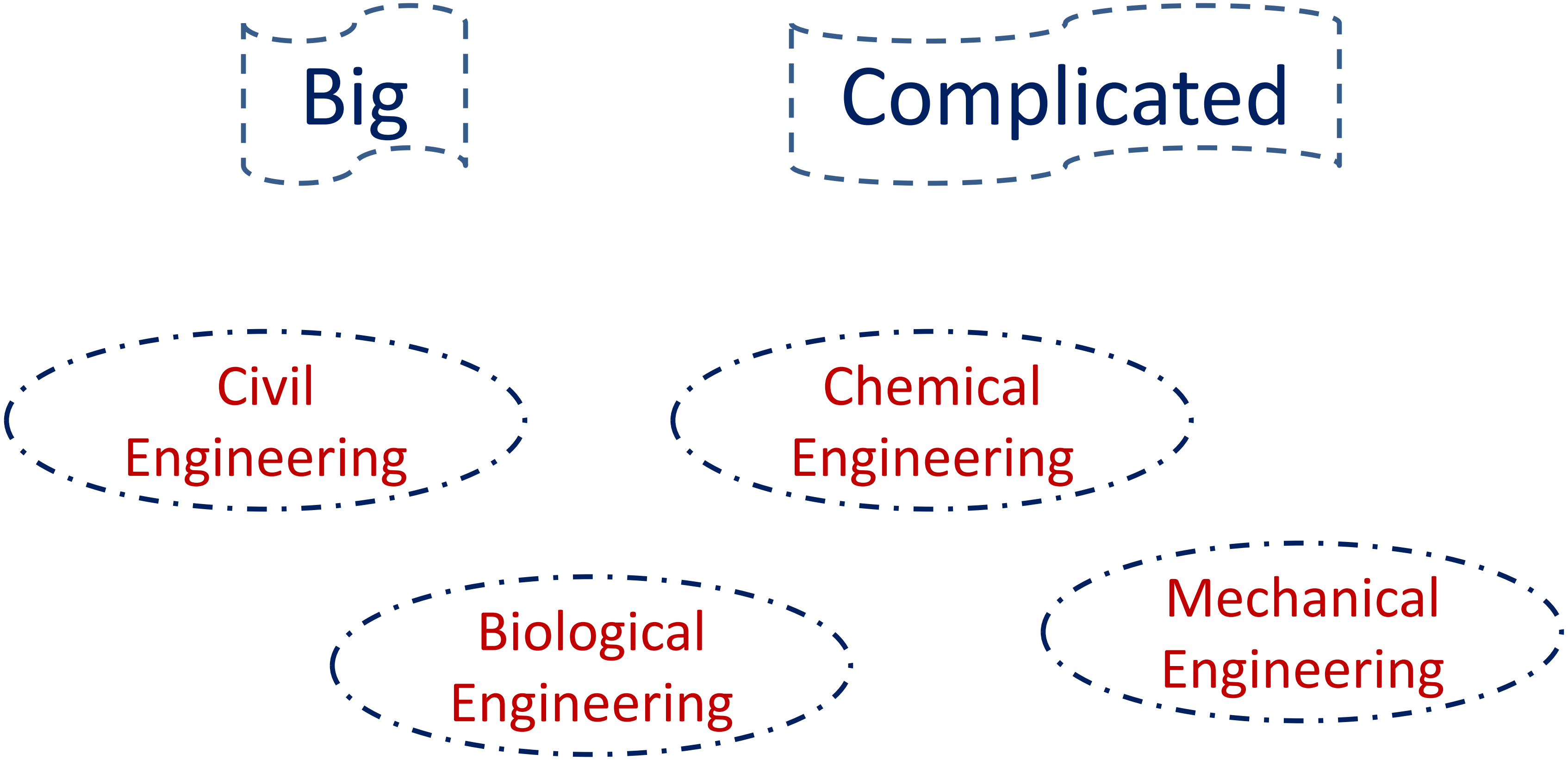
Network software

Hardware was cheaper
Powerful information systems
Internet
Software reuse
Cloud computing
Mobile app

What Is Engineering???

Any keywords can describe engineering?

What Is Engineering



Big

Complicated

Civil Engineering

Chemical Engineering

Biological Engineering

Mechanical Engineering

What Is Engineering

Civil Engineering

What is this about???

What will be done???

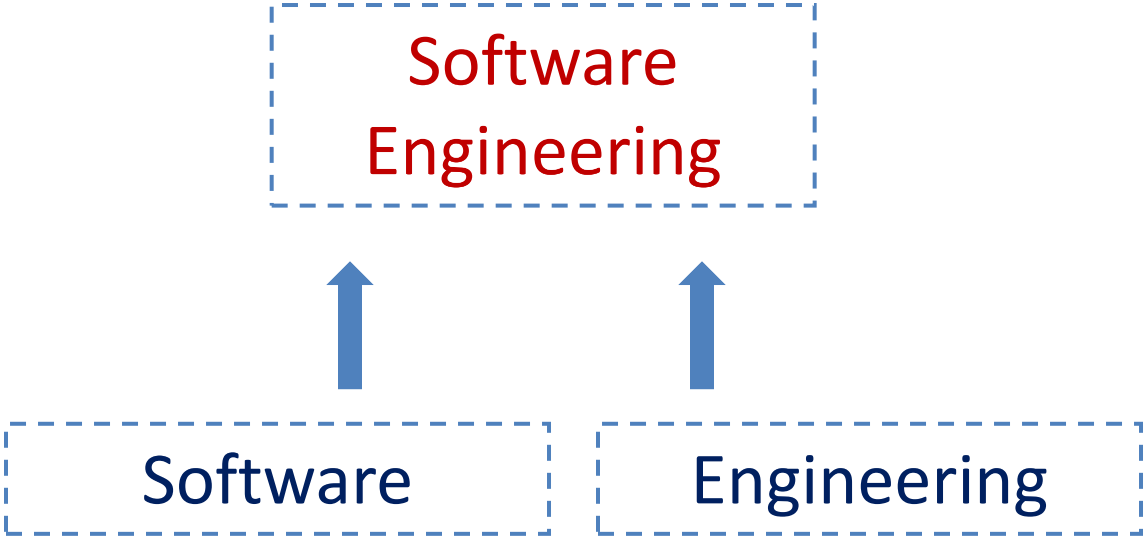
Questions to Answer on Engineering

- Questions to answer in engineering
  - What is the problem to be solved?
  - What are the characteristics of the entity to solve?
  - How will the entity be constructed?
  - What approach will be used to uncover errors that were made in the design and construction of the entity?
  - How will the entity be supported over the long term, when corrections, adaptations and enhancements are requested by users of the entity?

What Is Engineering

- Engineering
  - the application of scientific and mathematical principles to practical ends such as the design, manufacture, and operation of efficient and economical structures, machines, processes, and systems
  - the analysis, design, constructions, verifications, and management of technical entities

What Is Software Engineering



Software Engineering

Software

Engineering

Software Engineering

- The term “Software Engineering” was first used in 1968 NATO Conference on Software Engineering
- Software Engineering is [Sommerville]
  - an engineering discipline which is concerned with all aspects of software production
- Software Engineering is [IEEE 93]
  - (1) the application of a systematic, disciplined, quantifiable approach to the development, operation, and maintenance of software; that is, the application of engineering to software.
  - (2) the study of approaches as in (1).
- Refer to iSpace on software engineering history

Questions to Answer on Engineering

- Questions to answer in engineering
  - What is the problem to be solved?
  - What are the characteristics of the entity to solve?
  - How will the entity be constructed?
  - What approach will be used to uncover errors that were made in the design and construction of the entity?
  - How will the entity be supported over the long term, when corrections, adaptations and enhancements are requested by users of the entity?

Questions to Answer on Software Engineering

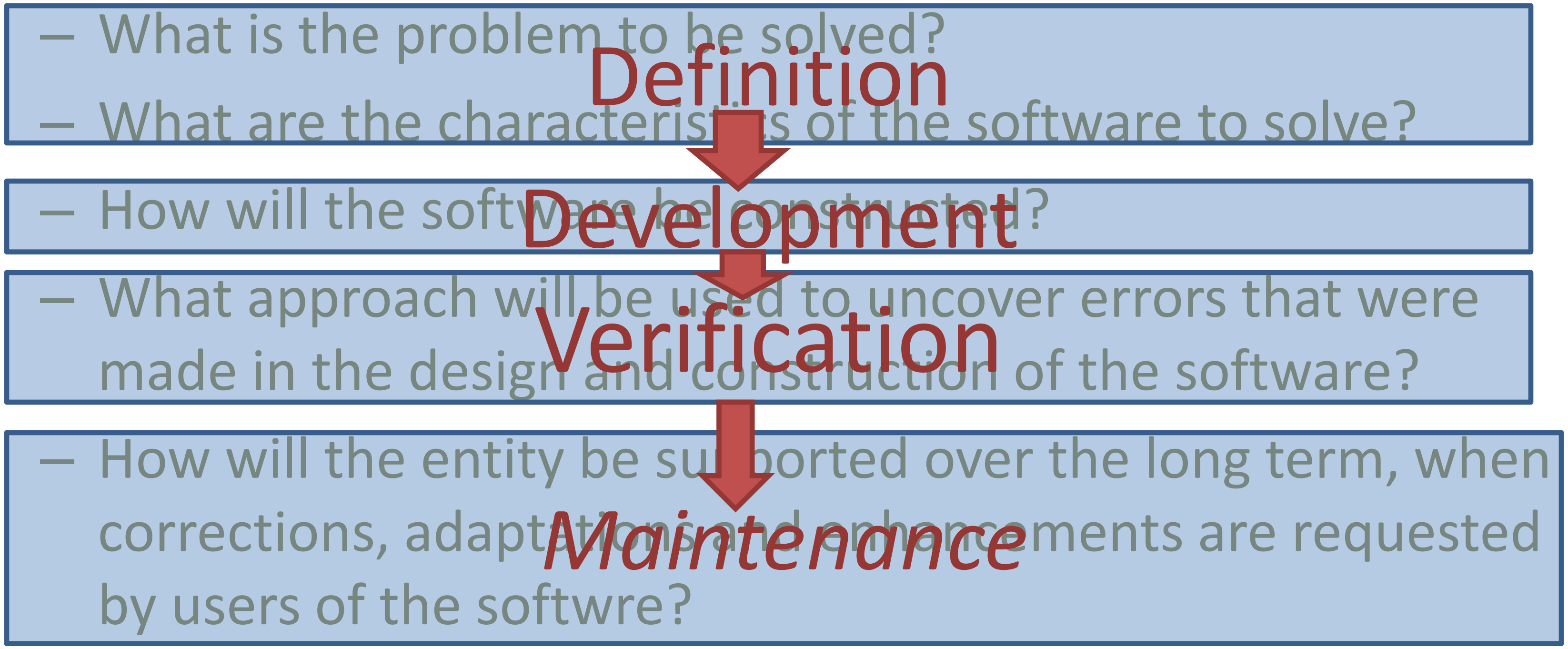
- Questions to answer in software engineering
  - What is the problem to be solved?
  - What are the characteristics of the software to solve?
  - How will the software be constructed?
  - How to uncover errors that were made in the design and construction of the software?
  - How will the software be supported over the long term, when corrections, adaptations and enhancements are requested by users of the software?

Questions to Answer on Software Engineering

- Questions to answer in software engineering
  - **What** is the problem to be solved?
  - **What** are the characteristics of the software to solve?
  - **How** will the software be constructed?
  - **How** to uncover errors that were made in the design and construction of the software?
  - **How** will the software be supported over the long term, when corrections, adaptations and enhancements are requested by users of the software?

Questions on Software Engineering?

- Questions to answer in software engineering



  - What is the problem to be solved?
  - What are the characteristics of the software to solve?

Definition

  - How will the software be constructed?

Development

  - What approach will be used to uncover errors that were made in the design and construction of the software?

Verification

  - How will the entity be supported over the long term, when corrections, adaptations and enhancements are requested by users of the softwre?

Maintenance

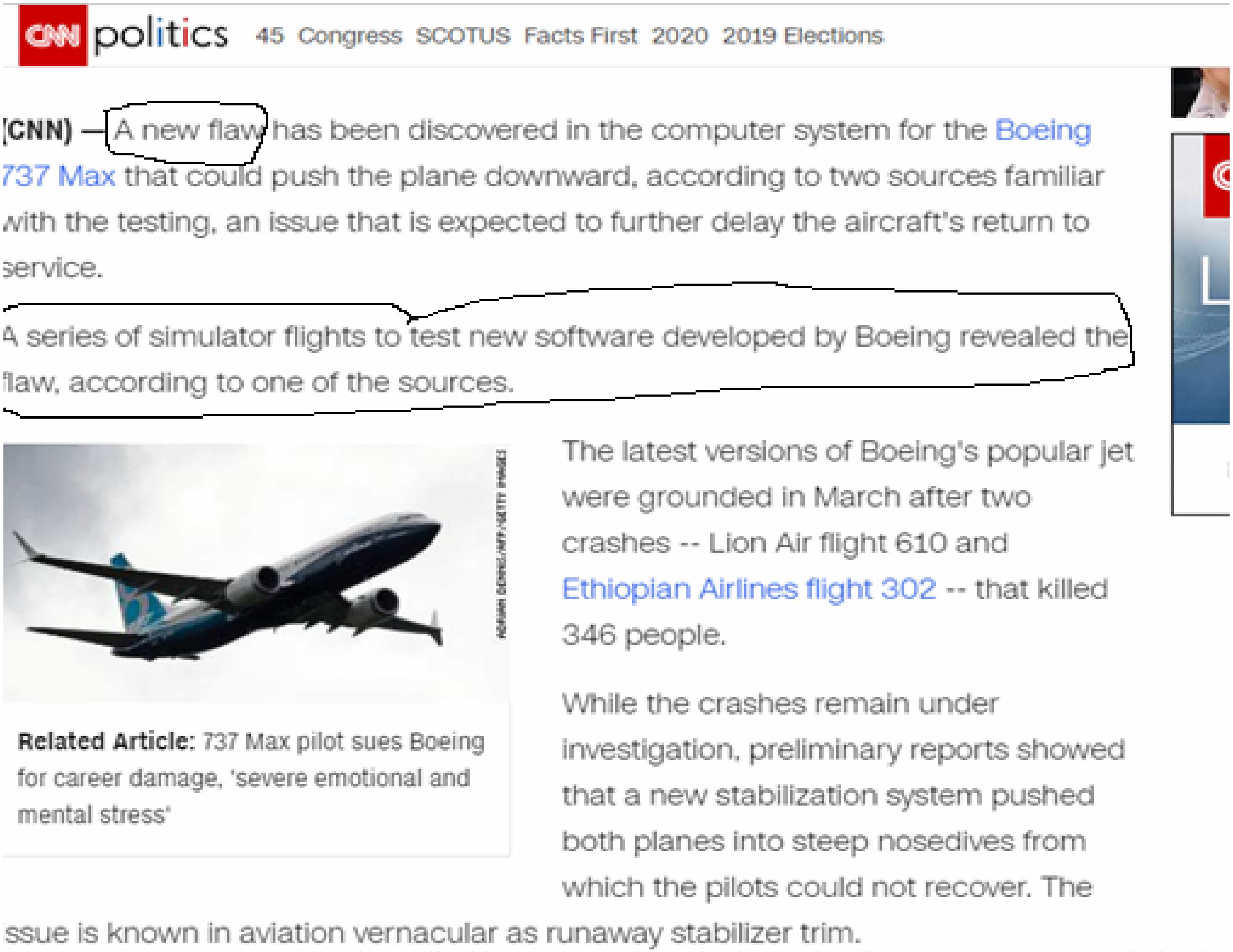
Why Software Engineering?

11 of the most costly software errors in history [2019 update]

- NASA’s Mars Climate Orbiter (1998, $125 million)
- Ariane 5 Flight 50 ($8 billion)
- EDS Child Support System (2004, US$1 billion)
- Soviet Gas Pipeline Explosion (1982, the largest non-nuclear explosion in the planet’s history)
- Bitcoin Hack, Mt. Gox (2011, half a billion US dollars)
- Heathrow Terminal 5 Opening (42,000 bags failed to travel with their owners, and over 500 flights were cancelled.)
- The Mariner 1 Spacecraft (1962, $18 million)
- The Morris Worm (1988, $100 Million)
- Patriot Missile Error (1991, failed to detect an attack on an Army barracks. The attack killed 28 American soldiers.)
- Pentium FDIV bug (1994, $475 million)
- Knight’s $440 Million Error (a $440 million loss in just 30 minutes, shares lost 75 percent in two days)

Source: https://raygun.com/blog/costly-software-errors-history/

Why Software Engineering?


CNN politics
45 Congress SCOTUS Facts First 2020 2019 Elections
ADRIAN DENNIS/AFP/GETTY IMAGES

(CNN) — A new flaw has been discovered in the computer system for the Boeing 737 Max that could push the plane downward, according to two sources familiar with the testing, an issue that is expected to further delay the aircraft's return to service.

A series of simulator flights to test new software developed by Boeing revealed the flaw, according to one of the sources.

Related Article: 737 Max pilot sues Boeing for career damage, 'severe emotional and mental stress'

The latest versions of Boeing's popular jet were grounded in March after two crashes -- Lion Air flight 610 and Ethiopian Airlines flight 302 -- that killed 346 people.

While the crashes remain under investigation, preliminary reports showed that a new stabilization system pushed both planes into steep nosedives from which the pilots could not recover. The issue is known in aviation vernacular as runaway stabilizer trim.

Source: https://edition.cnn.com/2019/06/26/politics/boeing-737-max-flaw/index.html

Updated:

Boeing

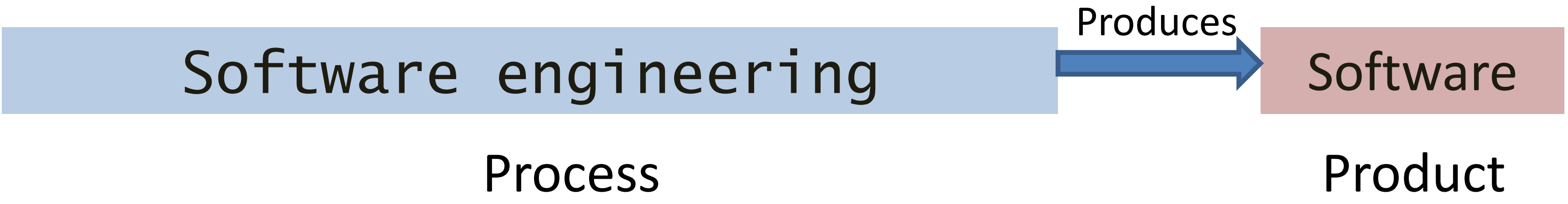
Why Software Engineering?

- Development of IBM OS/360 operating systems (1964)
  - led by Fred Brook
  - cost and budget overruns
  - over 10 years
  - over 1000 programmers
  - Fred Brook admitted in an interview: a multi-million dollar mistake

Purpose of Software Engineering

- Obtain high **quality** software
- Reduce development **cost**
- Meet the **deadline** of project

Relationship Between Software and Software Engineering



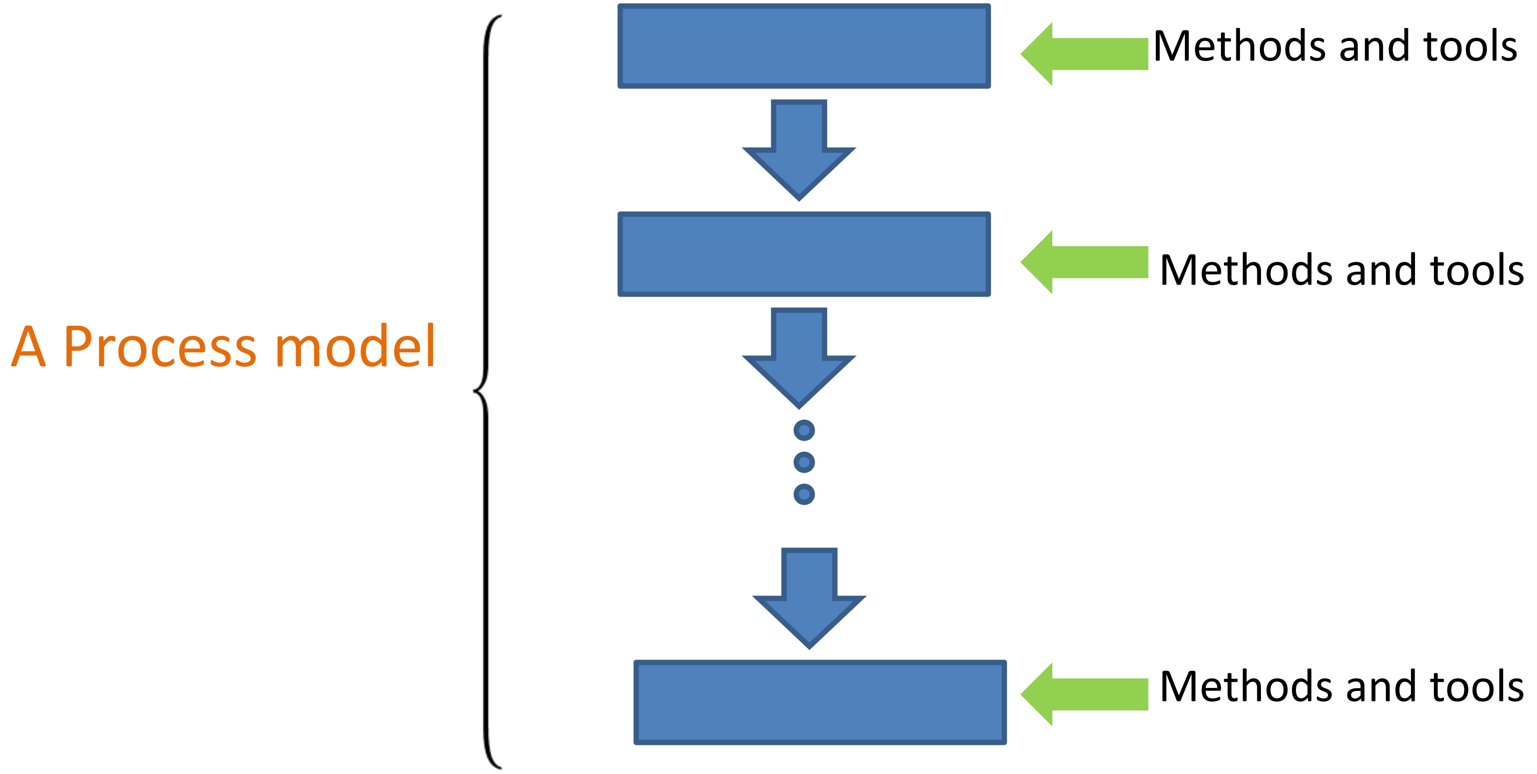
Difference Between Software Engineering and Computer Science

- Computer Science
  - Theories
  - Fundamentals
- Software Engineering
  - Practical problems
  - A subject in Department of Computer Science

Software Engineering – Sub-domains

- Computer-Aided Software Engineering (CASE)
  - Programs used to support software engineering
- Empirical Software Engineering
  - emphasizes the use of empirical studies
- Experimental Software Engineering
  - focusing on experiments on software systems
- Automated Software Engineering
  - Focus on automating the phases in software engineering
  - Knowledge-based Software Engineering

Software Engineering



A Process model

Methods and tools

Methods and tools

Methods and tools

Course Objectives

- Principles of software engineering
- Project development practices
- Market tools that support software project development

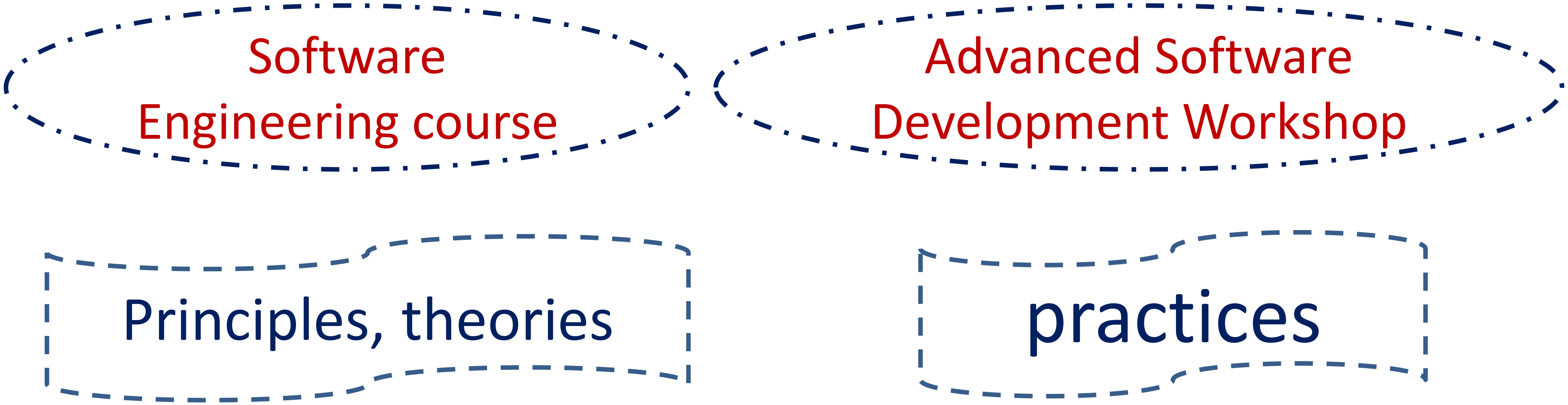
Practices

- Project development practices
  - Requirement **analysis**
  - Software **design**
  - Software **programming**
  - Software **verification** and **validation**
  - Software **maintenance**

Tools

- Market tools that support software project development
  - Models
  - Testing
  - Management

Software Engineering & Advanced Software Development Workshop



Software Engineering course

Advanced Software Development Workshop

Principles, theories

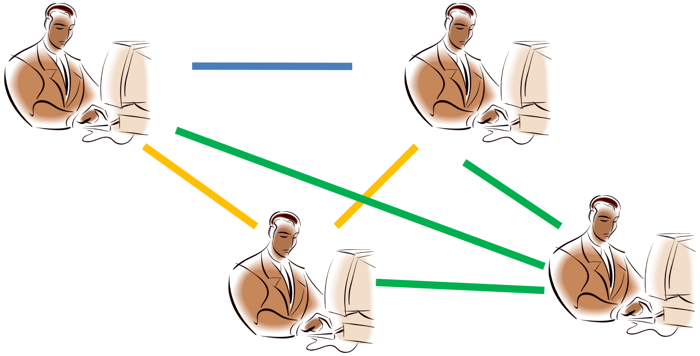
practices

Players in a Project

- Project leaders
  - plan, supervision, allocation of tasks
- Engineers
  - analysis, design, code, test
  - programmer, tester, analyst, architecture engineer, SQA engineer …
- Customers
  - requirement, validation.

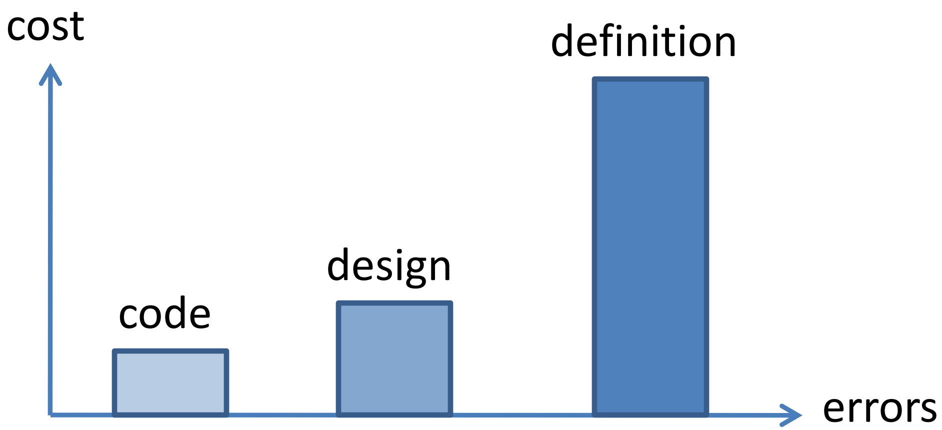
Myths and Realities

- Project leaders
  - Myth: “If we get behind schedule, we can add more programmers and catch up with the schedule”
  - Reality: “Add more programmers to a late software can make it later”.



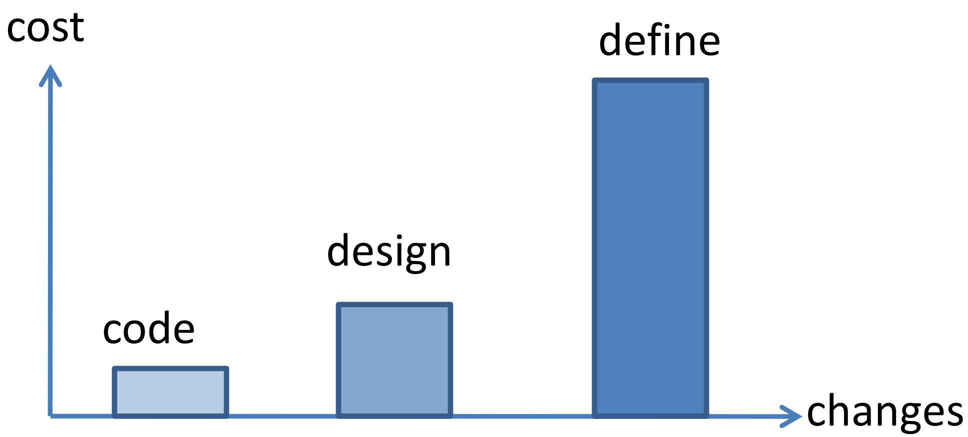
Myths and Realities

- Engineers
  - Myth: “Once we write the program and get it to work, our job is done”
  - Reality: “The sooner you start writing a program, the longer it will take you to get done”.



Myths and Realities

- Customers
  - Myth: “Project requirements continually change, but change can be easily accommodated because software is flexible”
  - Reality: “Changes to the product can be very difficult and the cost can be very high”

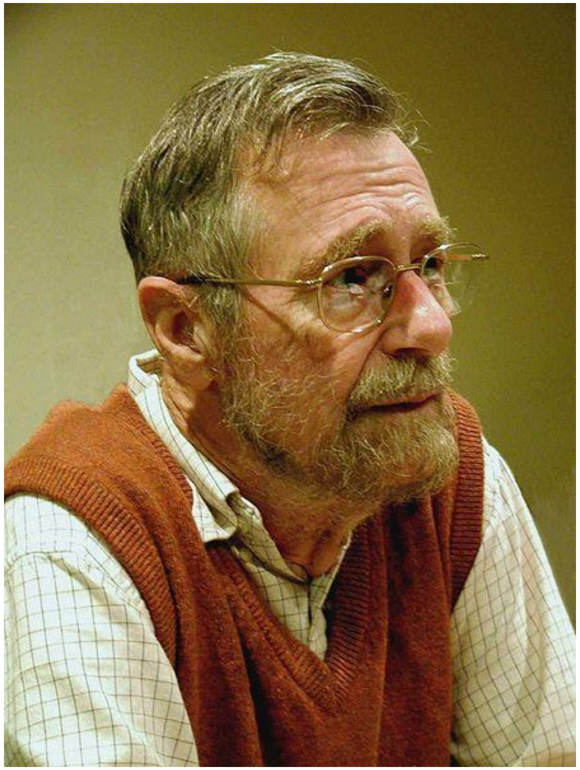


Pioneers in Software Engineering

- Barry Boehm (1935)
  - Constructive cost model (COCOMO)
  - Spiral Model of the software process

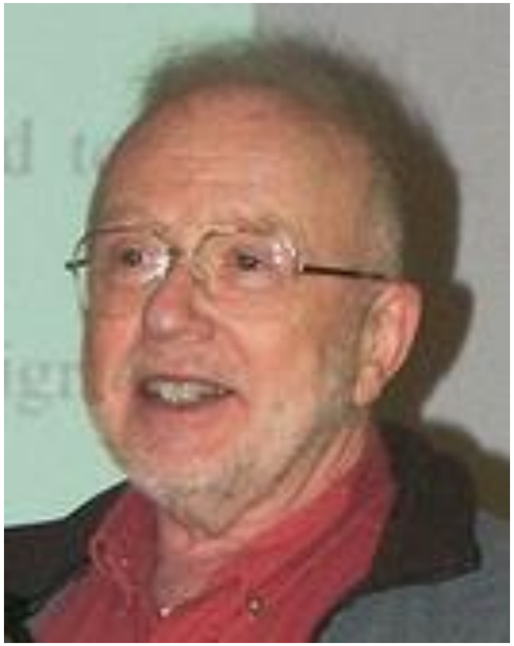
Pioneers in Software Engineering

- Edsger Dijkstra (1930)
  - Shortest path program
  - The multiprogramming system
  - Structured programming
    - “Goto” statements are harmful



Pioneers in Software Engineering

- David Parnas (1941)
  - Information hiding (Foundation of OO)
  - Modular design
  - Tabular specification
  - He visited UIC twice



Pioneers in Software Engineering

- Michael Jackson (1958)
  - Jackson system development

Pioneers in Software Engineering

- Peter Chen (Chinese: 陳品山)
  - Entity-Relationship Model (ERP)
  - Computer-Aided Software Engineering

Peter Chen (陳品山)

Comments on this Course

Boring…
Theoretical…

Exciting…
Practical…

Software Engineering at Microsoft

- Microsoft claims to be a BIG software engineering company
- Software engineering is, as a matter of fact, applied to all the companies, no matter
  - what service is provided
  - what scale is the company

Software Engineering Institutes/Schools/Programs around the World

- USA
  - Carnegie Mellon University
    - SEI: http://www.sei.cmu.edu/
  - Top 10 most popular software engineering colleges in US
    - http://www.campusexplorer.com/colleges/major/FCF8A86C/Engineering/DC71CFC1/Computer-Software-Engineering/
  - ……
- Canada
  - University of Waterloo
    - https://uwaterloo.ca/software-engineering/
  - University of Victoria
    - http://www.seng.uvic.ca/
  - ……

Software Engineering Institutes/Schools/Programs around the World

- Australia
  - The University of Western Austria
    - http://web.csse.uwa.edu.au/
  - Swinburne University
    - http://courses.swinburne.edu.au/courses/Bachelor-of-Engineering-(Software-Engineering)-I044/local
  - University of Wollongong
    - http://www.uow.edu.au/informatics/scsse/index.html
  - The University of Newcastle
    - http://www.newcastle.edu.au/program/10984.html
  - ……
- UK
  - Oxford University
    - https://www.cs.ox.ac.uk/softeng/
  - University of Salford Manchester
    - http://www.salford.ac.uk/courses/software-engineering
  - ……

Software Engineering Institutes/Schools/Programs around the World

- School of software, Tsinghua University
  - http://www.thss.tsinghua.edu.cn/publish/soft/3650/index.html
- Software Institute, Nanjing University
  - http://software.nju.edu.cn/index.php?option=com_content&view=article&id=3&catid=41&Itemid=2
- Software Institute, Sun Yat-sen University
  - http://ss.sysu.edu.cn/informationsystem/ArticleList.aspx?id=31

Software Engineering Companies/Organizations

- SEA (Software Engineering Australia)
  - http://www.business.gov.au/GBDirectory/S/Pages/SoftwareEngineeringAustralia(SEA).aspx
- Microsoft
  - http://careers.microsoft.com/careers/en/hk/professions.aspx
- SAP
  - http://www.sdn.sap.com/irj/sdn/index?rid=/webcontent/uuid/509d5d9a-e348-2a10-12b8-c6b9c2f2fc22
- ……

Software Engineering Research Centers

- IBM
  - http://www.research.ibm.com/softeng/
- Microsoft
  - http://research.microsoft.com/en-us/groups/rise/
  - http://research.microsoft.com/en-us/groups/ese/
- Focus-Inova
  - http://www.focus-inova.com/en/home
- ……
- Fraunhofer Institute of Empirical Software Engineering
  - http://www.iese.fraunhofer.de/en.html
- The Irish Software Engineering Research center
  - http://www.lero.ie/
- Security and Software Engineering Research center
  - http://www.serc.net/about
- ……

Software Engineering Conferences

- Top Software Engineering conferences
  - ICSE : International Conference on Software Engineering (IEEE)
    - SCORE: Student Contest on Software Engineering, biennially held with ICSE
  - FSE: International Symposium on Foundations of Software Engineering (ACM SIGSOFT)
  - EuroSys : ACM European Conference on Computer Systems (ACM)
  - Mobisys : Annual International Conference on Mobile Systems, Applications, and Services (ACM)
  - ASE: International Conference on Automated Software Engineering (IEEE/ACM)
  - International Conference on Tools and Algorithms for the Construction and Analysis of Systems (Springer)
  - Symposium on User Interface Software and Technology (ACM)

Software Engineer

Software Engineer=?= Programmer

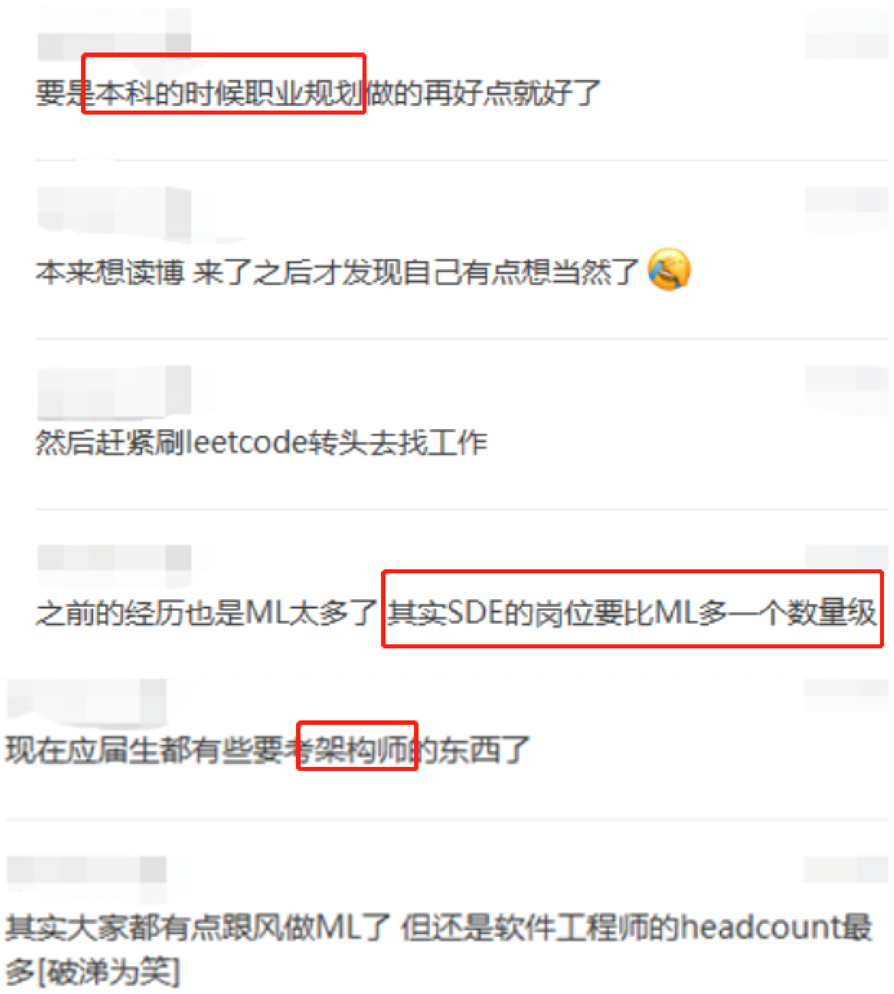
Career Tracks

- Programmer
- Architect
- Analyst
- Tester
- Software quality assurance engineer
- Project leader
- Manager
- Researcher

Feedbacks from Employers and Our Graduates

- 88% need to write documentation at work
- 60% think they need more training on documentation writing
- 60% think more software engineering knowledge needed
- 79% need to write testing plan at work
- 80% think software testing should be a course
- 60% industry people said they need better software engineer

Messages from a Graduate



[redacted]

要是本科的时候职业规划做的再好点就好了

[redacted]

本来想读博 来了之后才发现自己有点想当然了😭

[redacted]

然后赶紧刷leetcode转头去找工作

[redacted]

之前的经历也是ML太多了 其实SDE的岗位要比ML多一个数量级

[redacted]

现在应届生都有些要考架构师的东西了

[redacted]

其实大家都有点跟风做ML了 但还是软件工程师的headcount最多[破涕为笑]

Software Engineer

Software Engineer $\supset$ Programmer

Software Development

Now you can answer the following question:

Software development = ? = Programming

Assignment 1

- Assignment one will be on iSpace in the form of quiz. It contains multiple choice questions. Be sure to review the slides before you do assignment one.

Summary

- Software engineering definition
- Software engineering tries to solve cost, time and quality problem
- Difference between program and software, programming and software, programmer and software engineer
- Software engineering pioneers
- Software engineering has been used in many companies
- Software engineering is researched