Module CS6003ES Advanced Software Engineering

Advanced Software Engineering

Overview Software Engineering process

By

Dr. L. Ranathunga

Overview

- Professional Software Engineering
- System Engineering
- Managing Software Projects
- Quantitative Techniques in Software Project Management
- Requirements Engineering
- Software Design
- Software Implementation
- Software Quality and Quality Assurance
- Software Documentation
- Software Maintenance
- Software Reviewing and Testing
- Software Configuration Management

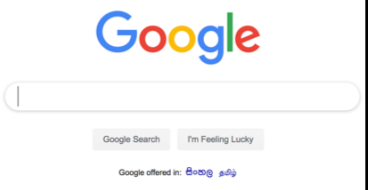
Assessment includes
Two pieces of coursework
Two in-class tests
Final exam

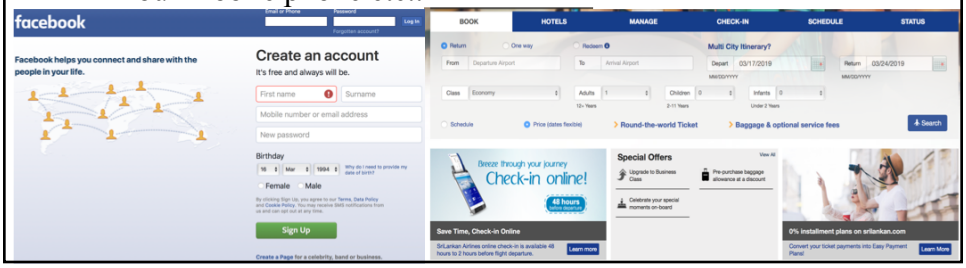
References

- Learning resources on the module Website *WebLearn*.
- Pressman R.S. *Software Engineering: Practitioner's Approach*. Fifth edition. McGraw-Hill Higher Education, 2005. ISBN 0-07-285318-2 (main bookon software development and project management) (Or later editions.)
- Hambling B. (Editor). *Software Testing: An ISEB Foundation*. The British Computer Society, 2007. ISBN 978-1-902505-79-4 (main book on software testing)
- Graham D. at al. *Foundation of Software Testing: ISTQB Certification*. Thomson, 2007. ISBN 978-1-84480-355-2 (main book on software testing) Additional Reading:
- Lunn K. *Software Development with UML*. Palgrave Macmillan, 2003, ISBN 0-333-98595-8 (recommended book)
- Patton R. *Software Testing*. Second Edition. SAMS Publishing, 2006. ISBN 0-672-32798-8 (recommended book)
- Web Resourses:
  - Pressman's Web site: http://www.rspa.com/
  - Object Management Group: *Unified Modelling Language* (UML) http://www.uml.org/
  - RaG Systems: *A UML Tutorial Introduction* http://www.cragsystems.co.uk/uml_tutorial/

Importance of software

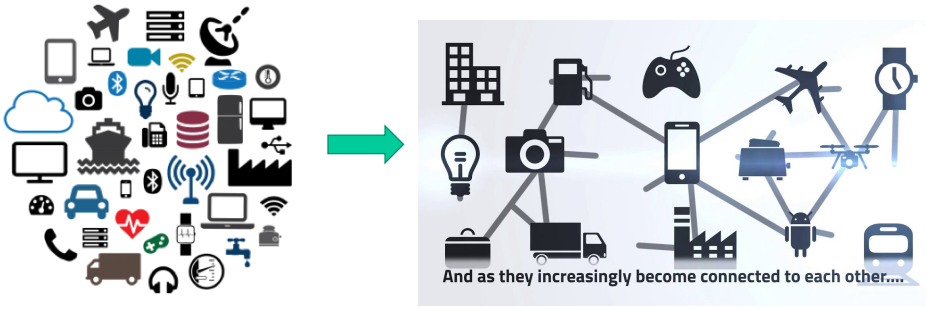
- Software can have a huge impact in any aspect of society.
- Where can we find software?
  - Air ticket booking
  - Google
  - Facebook
  - Your mobile phone etc..





Importance of Software …

- Software is almost every where



Introduction to 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.
- Expenditure on software represents a significant fraction of Gross National Product (GNP) in all developed countries.

Why Software Engineering?

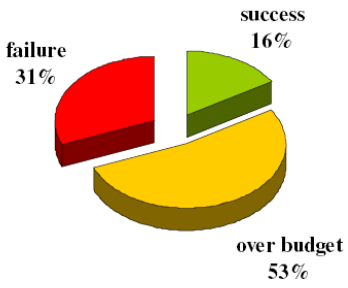
- Provide your reasons …

Common issues of Software

- The final Software doesn´t fulfill the needs of the customer.
- Hard to extend and improve: if you want to add a functionality later is mission impossible.
- Bad documentation.
- Bad quality: frequent errors, hard to use, ...
- More time and costs than expected

Cross section of Software Projects

- Software industry is in crisis



Source: The Standish Group International, Inc

Recent Report

MODERN RESOLUTION FOR ALL PROJECTS

	2011	2012	2013	2014	2015
SUCCESSFUL	29%	27%	31%	28%	29%
CHALLENGED	49%	56%	50%	55%	52%
FAILED	22%	17%	19%	17%	19%

The Modern Resolution (OnTime, OnBudget, with a satisfactory result) of all software projects from FY2011–2015 within the new CHAOS database. Please note that for the rest of this report CHAOS Resolution will refer to the Modern Resolution definition not the Traditional Resolution definition.

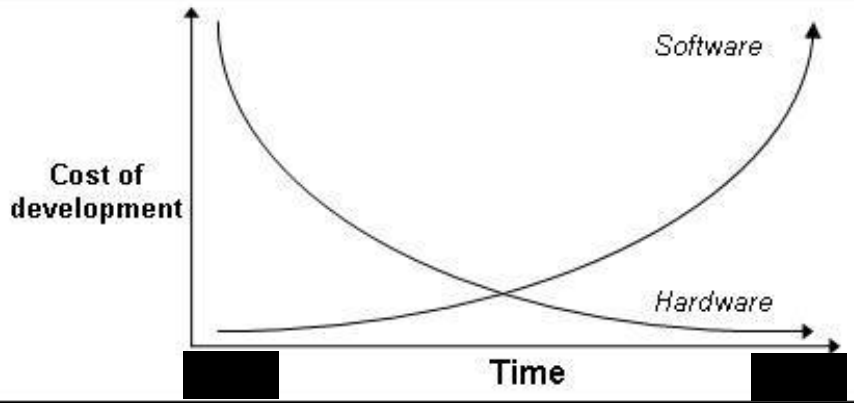
Recent Reports ...

CHAOS RESOLUTION BY PROJECT SIZE

	SUCCESSFUL	CHALLENGED	FAILED
Grand	2%	7%	17%
Large	6%	17%	24%
Medium	9%	26%	31%
Moderate	21%	32%	17%
Small	62%	16%	11%
TOTAL	100%	100%	100%

The resolution of all software projects by size from FY2011–2015 within the new CHAOS database.

Software vs Hardware



Software costs

- Software costs often dominate computer 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. For systems with a long life, maintenance costs may be several times development costs.
- Software engineering is concerned with cost-effective software development.

Failuires

Ariane 5

It took the European Space Agency **10 years and $7 billion** to produce Ariane 5, a giant rocket capable of hurling a pair of three-ton satellites into orbit with each launch and intended to give Europe overwhelming supremacy in the commercial space business.

The rocket was destroyed after 39 seconds of its launch, at an altitude of two and a half miles along with its payload of four expensive and uninsured scientific satellites.

Failure …

When the guidance system's own computer tried to convert one piece of data the sideways velocity of the rocket from a 64 bit format to a 16 bit format; the number was too big, and an overflow error resulted after 36.7 seconds. When the guidance system shutdown, it passed control to an identical, redundant unit, which was there to provide backup in case of just such a failure. Unfortunately, the second unit, which had failed in the identical manner a few milliseconds before.

Failure …

Patriot Missile

- First time used in Gulf war
- It Used as a defense from Iraqi Scud missiles
- Failed several times including one that killed 28 US soldiers in Dhahran, Saudi Arabia
- **Reasons:**
- A small timing error in the system's clock accumulated to the point that after 14 hours, the tracking system was no longer accurate. In the Dhahran attack, the system had been operating for more than 100 hours.

Failure and Recover

Windows XP

- Microsoft released Windows XP on October 25, 2001.
- On the same day company posted 18 MB of compatibility patches on the website for bug fixes, compatibility updates, and enhancements.
- Two patches fixed important security holes.
- This is our **Software Engineering.**

Software Crisis

- The time schedule and cost estimates of software projects are grossly inaccurate
- Software systems may not have the required quality
- Difficulty in maintenance
- Productivity of software people is not satisfactory to satisfy the demand
- Software bugs, accuracy and malfunctions
- ***Answer for these problems is "Software Engineering"***

Software products

- Generic products
  - Stand-alone systems that are marketed and sold to any customer who wishes to buy them.
  - Examples – PC software such as graphics programs, project management tools; CAD software; software for specific markets such as appointments systems for dentists.
- Customized products
  - Software that is commissioned by a specific customer to meet their own needs.
  - Examples – embedded control systems, air traffic control software, traffic monitoring systems.

Software

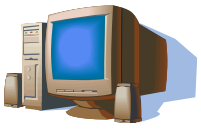
- **Computer software**, or just **software**, is a collection of computer programs and related data that provides the instructions for telling a computer what to do and how to do it. Software refers to one or more computer programs and data held in the storage of the computer for some reasons. In other words, software is **a set of *programs, procedures, algorithms* and its *documentation*** concerned with the operation of a data processing system.

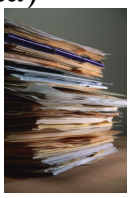
Product specification

- Generic products
  - The specification of what the software should do is owned by the software developer and decisions on software change are made by the developer.
- Customized products
  - The specification of what the software should do is owned by the customer for the software and they make decisions on software changes that are required.

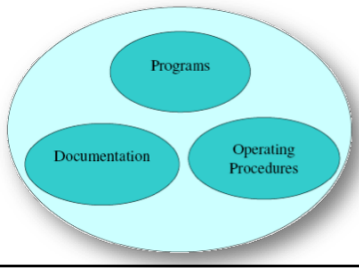
What is Software?

- Computer Program (Instructions) and Associated documents (data)





Components of software:
Software=Program + Documentation + Operating Procedures



Definition for Software Engineering

- Use of Systematic and scientific techniques in every stage of software development and also to use good project management techniques with appropriate CASE tools
- All types of Software uses SE techniques
  - System software (OS, compilers, interpreters, etc..)
  - Application software (eg: Excel, word, google search engine, etc..)

Frequently asked questions about software engineering

Question	Answer
What is software?	Computer programs and associated documentation. Software products may be developed for a particular customer or may be developed for a general market.
What are the attributes of good software?	Good software should deliver the required functionality and performance to the user and should be maintainable, dependable and usable.
What is software engineering?	Software engineering is an engineering discipline that is concerned with all aspects of software production.
What are the fundamental software engineering activities?	Software specification, software development, software validation and software evolution.
What is the difference between software engineering and computer science?	Computer science focuses on theory and fundamentals; software engineering is concerned with the practicalities of developing and delivering useful software.
What is the difference between software engineering and system engineering?	System engineering is concerned with all aspects of computer-based systems development including hardware, software and process engineering. Software engineering is part of this more general process.

Frequently asked questions about software engineering

Question	Answer
What are the key challenges facing software engineering?	Coping with increasing diversity, demands for reduced delivery times and developing trustworthy software.
What are the costs of software engineering?	Roughly 60% of software costs are development costs, 40% are testing costs. For custom software, evolution costs often exceed development costs.
What are the best software engineering techniques and methods?	While all software projects have to be professionally managed and developed, different techniques are appropriate for different types of system. For example, games should always be developed using a series of prototypes whereas safety critical control systems require a complete and analyzable specification to be developed. You can't, therefore, say that one method is better than another.
What differences has the web made to software engineering?	The web has led to the availability of software services and the possibility of developing highly distributed service-based systems. Web-based systems development has led to important advances in programming languages and software reuse.

Essential attributes of good software

Product characteristic	Description
Maintainability	Software should be written in such a way so that it can evolve to meet the changing needs of customers. This is a critical attribute because software change is an inevitable requirement of a changing business environment.
Dependability and security	Software dependability includes a range of characteristics including reliability, security and safety. Dependable software should not cause physical or economic damage in the event of system failure. Malicious users should not be able to access or damage the system.
Efficiency	Software should not make wasteful use of system resources such as memory and processor cycles. Efficiency therefore includes responsiveness, processing time, memory utilisation, etc.
Acceptability	Software must be acceptable to the type of users for which it is designed. This means that it must be understandable, usable and compatible with other systems that they use.

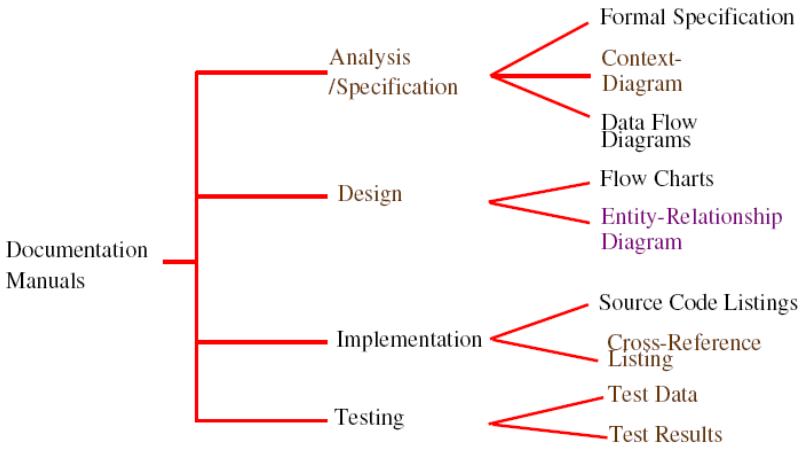
Software engineering

- Software engineering is an engineering discipline that is concerned with all aspects of software production from the early stages of system specification through to maintaining the system after it has gone into use.
- Engineering discipline
  - Using appropriate theories and methods to solve problems bearing in mind organizational and financial constraints.
- All aspects of software production
  - Not just technical process of development. Also project management and the development of tools, methods etc. to support software production.

What is software Engineering?

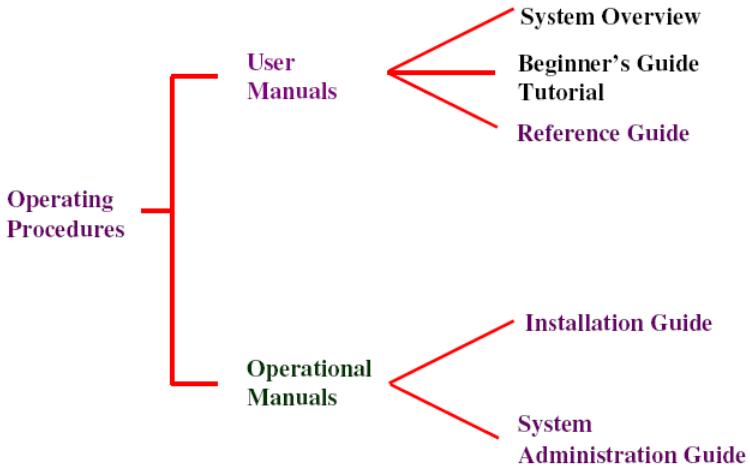
- **Software Engineering: (1) The application of a systematic, disciplined, quantifiable approach to the development, operation, and maintenance of software; that is, the application of engineering to software.**

Software Components: Documentation



List of documentation manuals

Software Components: Operation Procedures



List of operating procedure manuals.

Software process activities

- Software specification, where customers and engineers define the software that is to be produced and the constraints on its operation.
- Software development, where the software is designed and programmed.
- Software validation, where the software is checked to ensure that it is what the customer requires.
- Software evolution, where the software is modified to reflect changing customer and market requirements.

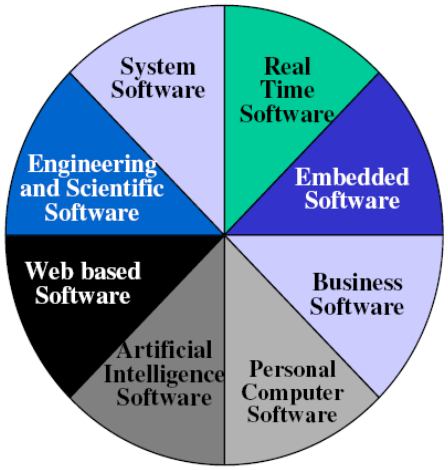
Software Product

- Software product is a product designated for

Software engineering diversity

- There are many different types of software system and there is no universal set of software techniques that is applicable to all of these.
- The software engineering methods and tools used depend on the type of application being developed, the requirements of the customer and the background of the development team.

Nature of Software



Application types

- Stand-alone applications
  - These are application systems that run on a local computer, such as a PC. They include all necessary functionality and do not need to be connected to a network.
- Interactive transaction-based applications
  - Applications that execute on a remote computer and are accessed by users from their own PCs or terminals. These include web applications such as e-commerce applications.
- Embedded control systems
  - These are software control systems that control and manage hardware devices.Numerically, there are probably more embedded systems than any other type of system.

Application types

- Batch processing systems
  - These are business systems that are designed to process data in large batches. They process large numbers of individual inputs to create corresponding outputs.
- Entertainment systems
  - These are systems that are primarily for personal use and which are intended to entertain the user.
- Systems for modelling and simulation
  - These are systems that are developed by scientists and engineers to model physical processes or situations, which include many, separate, interacting objects.

Application types

- Data collection systems
  - These are systems that collect data from their environment using a set of sensors and send that data to other systems for processing.
- Systems of systems
  - These are systems that are composed of a number of other software systems.

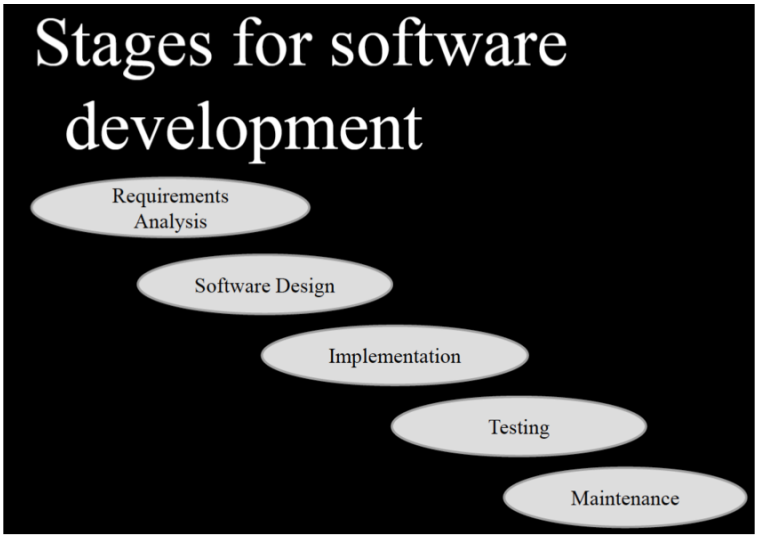
Change of Nature of Software

- Trend has emerged to provide source code to the customer and organizations.
- Software where source codes are available are known as *open source software*.
- Examples:
- Open source software: LINUX, MySQL, PHP, Open office, Apache webserver etc.
- Open Source software could be customized and evolve rapidly where centralized management is required to monitor the reusability and further enhancement

Software engineering fundamentals

- Some fundamental principles apply to all types of software system, irrespective of the development techniques used:
  - Systems should be developed using a managed and understood development process. Of course, different processes are used for different types of software.
  - Dependability and performance are important for all types of system.
  - Understanding and managing the software specification and requirements (what the software should do) are important.
  - Where appropriate, you should reuse software that has already been developed rather than write new software.

Basic Stages of Software Process



Software engineering and the web

- The Web is now a platform for running application and organizations are increasingly developing web-based systems rather than local systems.
- Web services allow application functionality to be accessed over the web.
- Cloud computing is an approach to the provision of computer services where applications run remotely on the 'cloud'.
  - Users do not buy software buy pay according to use.
  - SaaS, IaaS, PaaS,

Web software engineering

- Software reuse is the dominant approach for constructing web-based systems.
  - When building these systems, you think about how you can assemble them from pre-existing software components and systems.
- Web-based systems should be developed and delivered incrementally.
  - It is now generally recognized that it is impractical to specify all the requirements for such systems in advance.
- User interfaces are constrained by the capabilities of web browsers.
  - Technologies such as AJAX allow rich interfaces to be created within a web browser but are still difficult to use. Web forms with local scripting are more commonly used.
  - Local database technology added advantages
    - HTML5 - Web SQL, SQLite

Web-based software engineering

- Web-based systems are complex distributed systems but the fundamental principles of software engineering discussed previously are as applicable to them as they are to any other types of system.
- The fundamental ideas of software engineering, discussed in the previous section, apply to web-based software in the same way that they apply to other types of software system.

- Questions?