Software Engineering and Development I

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Generated on 14.03.2023 09:48:45 with 83 questions

Software Engineering

Ian Sommerville defines Software Engineering as...
an engineering discipline that is concerned with all aspects of software production (from initial conception to operation and maintenance)

What are the fundamental software engineering activities?
Software specification, software design and development, software validation and software evolution

Software dependability includes a range of characteristics including reliability. What does this mean?
Dependable software should not cause physical or economic damage in the event of system failure

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

Software should be efficient. What does this mean?
That it should not make wasteful use of system resources such as memory and processor cycles. Efficiency therefore includes responsiveness, processing time, resource utilization, etc.

For custom software, evolution costs often exceed development costs. Why?
Because requirements change and evolve all the time. And so must software, as a consequence.

Software dependability includes a range of characteristics including security, and safety. What does this mean?
Software has to be secure so that malicious users cannot access or damage the system

What differences has the Internet made to software engineering?
Not only has the Internet led to the development of massive, highly distributed, service-based systems, it has also supported the creation of an “app” industry for mobile devices

Software products may be developed for different general targets. What are they?
The general market or a particular customer

Software should be maintainable. What does this mean?
It means that is must be written in such a way that it can evolve to meet the changing needs of customers

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.

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

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 are the costs of software engineering?
Roughly 60% are development costs, 40% are testing costs

Compared to the more traditional engineering disciplines, we can say that Software Engineering is... (1 word)
young

What are the key challenges software engineering must face?
Increasing diversity, tighter delivery schedules, and dependable software

Ian Sommerville defines software as...
computer programs and associated documentation

Software must be acceptable to the type of users for which it is designed. What does this mean?
This means that it must be understandable, usable, and compatible with other systems that they use

Software Processes

What are the 3 phases of the improvement cycle of software processes?
Measure, analyze, modify.

What is that one constant and underlying element in all software processes, that must always be accounted for (1 word)?
Change

Software evolution is that software process that takes place... when?
When software systems must be changed to satisfy new requirements

One of the general process models is the waterfall model. Describe it briefly in one sentence.
A model that organizes the processes activities in separate and sequential phases and delivers the final system only at the end

One of the general process models is the integration and configuration model. Describe it briefly in one sentence.
A model that delivers the final system by reusing existing component, by configuring and integrating them based on the context of the project

One of the general process models is the incremental model. Describe it briefly in one sentence.
A model that organizes the processes activities in interleaved phases and develops and delivers the system in subsequent versions (increments)

Software engineers should always aim at improving software processes to improve the quality of software products, reduce development time and effort, and reduce costs. What should software processes refinement and change be based on?
Measurements, objective data and their analysis

What are the three main general process models?
Waterfall model. Incremental model. Integration and configuration model.

What do general process models define?
The approach to software development. The organization of software processes.

Iterative process models approach change with... (1 word)
tolerance

Software design and development are those processes that ... serve what purpose?
Turn software specifications into executable software systems

Why is prototyping useful in certain circumstances?

Because it can be used to check requirements and/or feasibility and it helps anticipating change

Software processes are the set of activities aimed at ... software systems. What is the missing word?
producing

What does the waterfall process model approach change with?
With (very) little flexibility

Software validation deals with...
making sure that a software system complies with requirements and that it actually sastifies users' needs

Configuration management

Change Management is the process that is concerned with...
all of the activities around proposing, evaluating and implementing changes to a software system

Configuration management (CM) is concerned with...
...the policies, processes, and tools for managing changing software systems

What is a "system release"?
It is a version of a software system that is distributed to customers

System building is the process of...
creating a complete, executable system by compiling and linking the system components, external libraries, configuration files, and other information

Version management is the process of...
...keeping track of different versions of software components and the systems in which these components are used

Software Versioning

I want to make sure I have all my team mate's latest changes in my dev branch. What is the GIT command I use?
git pull

What does the following GIT command do? git clone <URI>
It creates an identical local copy (clone) of the repository found at the given URL

GIT does not allow multiple developers to work simultaneously at the same software component? True/False? Why?
False. GIT keeps track of changes and guarantees that they are merged (automatically, if possible, or by signalling conflicts and supporting their manual resolution, otherwise)

In what way a Version Control System distinguishes different versions of the same component?
By assigning each version a unique ID

I want to send my changes upstream with GIT. What is the command I use?
git push

From an architectural point of view, a modern Version Control System belongs to one of two types. Which ones?
Centralized or distributed

What is a branching model to a software development team?
It is a set of conventions and procedures team members agree on and follow in order to come to a managed software development process

I am implementing a new feature and I want to avoid running the risk of losing my work. What do I do?
I push my feature branch onto a remote main repository so as to effectively create a shared backup and keep it synced as I make changes

Two software engineers approach the implementation of a feature with GIT in the following different ways.
Whose approach is best and why?
DEV1
git checkout dev
git pull
git checkout -b feature-1234
...
git add .
git commit -m "done feature 1234"
git checkout dev

git pull
git merge feature-1234
git push
DEV2
git checkout dev
git pull
...
git add .
git commit -m "done feature 1234"
git pull
git push
DEV1 conveniently isolates the changes in an separate branch

In what way a Version Control System minimizes the use of storage space?
By ensuring that duplicate copies of identical files are not maintained

Software Dependencies

A "Software dependency" is simply defined as...
Whatever piece of code that is relied upon for a digital service to work properly

I need a password hashing algorithm. I decide to develop my own. Am I making a good decision? Why?
No. The problem has already been solved. My implementation can only be worse than those available.

In developing a software product I want to re-use as much existing code as possible. Indicate at least two reasons why this statement is true or false.
It is true. Re-using existing code speeds up development and reduces the risks of bugs.

In a Java context, what is the name of a dependencies management tool?
Maven

Software dependencies raise an important issue. What is it?
Trust

For the software product I am developing I need a mathematical library. I decide to download one and "vendor" it in my project structure. Is this a good approach?
Rare cases excluded, this is a bad choice. The use of a dependencies management tool is in general a better choice.

A software dependencies management tool typically relies on an Internet repository. What risk does this entail and how can it be mitigated?
The risk is linked to the availability of the repository. We can therefore possibly create our own mirror.

For a given software product I am developing, I define a dependency without fixing its version number. My dependencies management tool will therefore always download the latest available version. When and why is this a good decision and when is it not?
It is a good decision only if I can test the dependency systematically (functionality, security, perforcance, ...). Otherwise it is a bad decision.

What is a "transitive dependency"?
A dependency of a dependency

What is "dependency hell"?
It is a phenomenon in which dependencies cannot be resolved

Software Build

With mvn (Maven) what is the phase normally linked to the building of the final distributable artifact?
package

What is the difference between a statically linked and a dynamically linked executable object?
A statically linked executable packages all its dependencies internally. A dynamically linked executable contains external references to its dependencies, which are then loaded at run-time as needed.

The build process typically involves 3 systems. Which ones?
Development, build and target systems

A software system must always be built from a clean environment. True/False? Why?
True. A clean environment guarantees the build process is not influenced (positively or negatively) by unwanted dependencies

It is alway advisable to build a software system locally before sending a new version upstream. True/False? Why?
True. We want to minimize the risk of sharing a non-buildable (broken) system

With mvn (Maven) what must I configure if I want to distribute my system as an executable .jar file?
A plugin, that allows to assemble my system with all its dependencies

What does a waterfall approach to building a software system minimize?
The number of components to be built, thus minimizing the resources and the time needed

It is always important to automate the build process of a software system. True/False? Why?
True. Building is a very complex process. Automation reduces the risk of manual/human errors and guarantees repeatability

In a C environment, what is an available build tool?
make

In mvn (Maven) what section of the configuration file refers to the building of the artifacts?
The <build> section

Requirements engineering

Look at the two requirements defined below by engineers ENG1 and ENG2. Whose definition is best and why?
ENG1
The password reset procedure must be fast and user-friendly.

ENG2
Users must be able to reset their passwords autonomously.
The procedure must be guided and take at most 2 minutes to complete.
ENG2. She defines a clear and measurable requirement.

According to I.Sommerville, a requirement is...
...a statement of a system service or of a system constraint

Requirements engineering is the process of establishing 3 main aspects about a system. What are they?
(1)The services a customer requires from the system; (2)The constraints under which it must operate; (3)The constraints under which it must be developed

Requirements engineering is an iterative and incremental process, that includes 3 main phases. What are they?
Elicitation, specification and validation

What is a preliminary feasibility study useful to?
To establish if the system can be developed with the given resources, time and constraints

A system stakeholder is...
Any person or organization who is affected by the system and/or has a legitimate interest in it

What is a practical way of describing the difference between user requirements and system requirements?
User requirements describe requirements from the "problem" point of view. System requirements describe them from the "solution" point of view.

In short, functional requirements are...
...statements of services the system should provide

In short, non-functional requirements are...
constraints under which the system must operate, be developed, standards it must abide to, etc.

What are two viable approaches to requirements elicitation?
Interviews (open or closed) and ethnography

What is the resulting artifact of requirements specification?

A Software Requirements Specification (SRS) document

What is requirements validation concerned with?
With demonstrating that requirements define the system that customers really want

Requirements validation must check many aspects of the collected requirements. Name at least three of them.
Validity, consistency, completeness, realism, verifiability, comprehensibility, traceability, adaptability.

In practical terms, what does a use case describe?
It describes typical and exceptional ways in which a real-world actor interacts with the system

What is the typical device to capture requirements in agile models?
User stories