cs121 - software development requirements

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outline

what are requirements?

why requirements?

software requirements specification

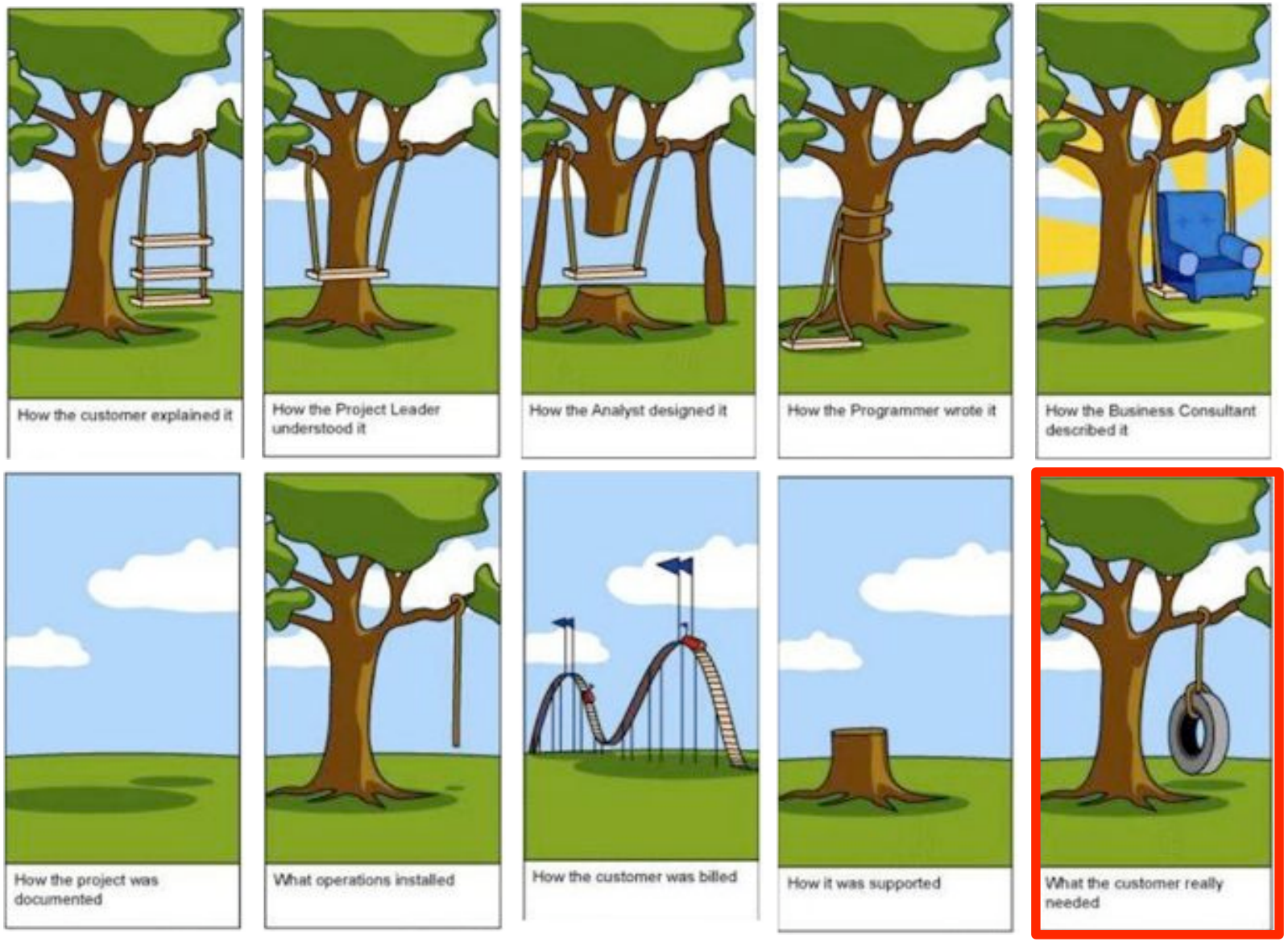
engineering requirements

use cases

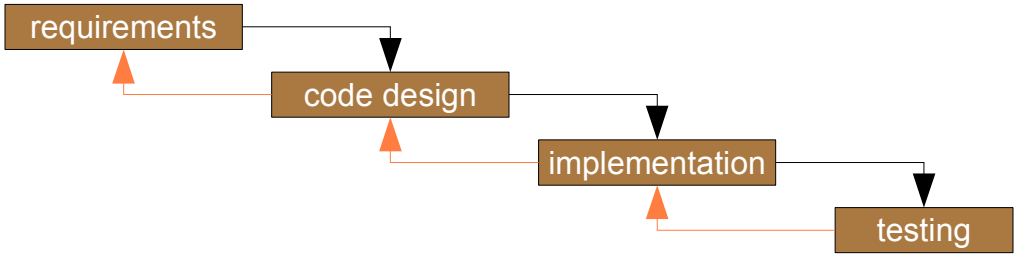
requirements matrix

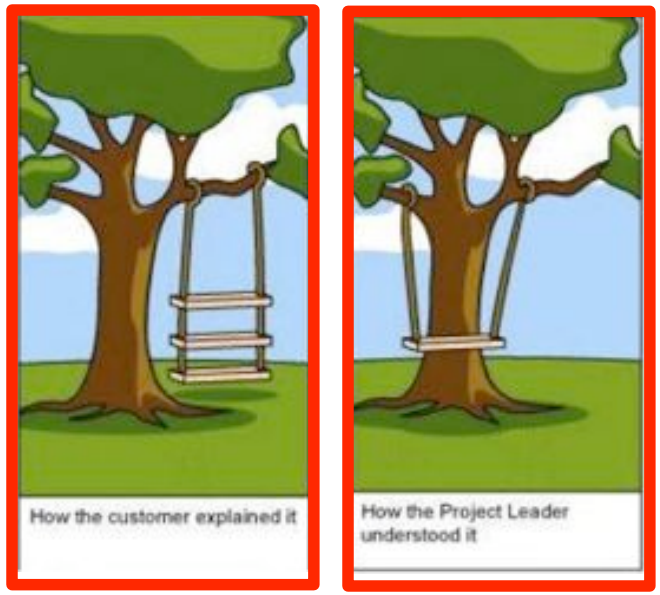
recommendations

from design/idea to software system



from design/idea to software system





what the customer really wants

what are requirements?

concisely worded statement that describes how the software will behave when it is complete

everytime a requirement is implemented, the system *shall* behave in accordance to the conditions that the requirements establish

- functional requirements address the operations that the system performs (behavior).
- nonfunctional requirements apply to the standards or qualities of performance that constrain the design or operations of the system

what are requirements?

requirements (what) are not expressed in the language of implementation (what)

- functionality of the system addressed without reference to implementation: external, or user-oriented perspective.
- example: “the user shall click a dialog button to open a new window” vs. “after the user selects the next level option, the next level appears.”

requirements engineering:

- translate features into functionality
- features come from a variety of sources (many people, some documents created by others)

types of requirements
FURPS+

functional: features, capabilities

usability: human factors, aesthetics, consistency, documentation

reliability: frequency of failure, recoverability, predictability

performance: response times, throughput, accuracy, availability, resource usage

supportability: adaptability, maintainability, configurability

+: others...

why requirements?

engineering involves stating and solving a problem; requirements is how the problem is stated

(engineer vs. hacker/performance artist)

solving the problem: problem must be clearly and precisely stated

planning: without precise specification of all behaviors, impossible to evaluate the time needed to implement the system

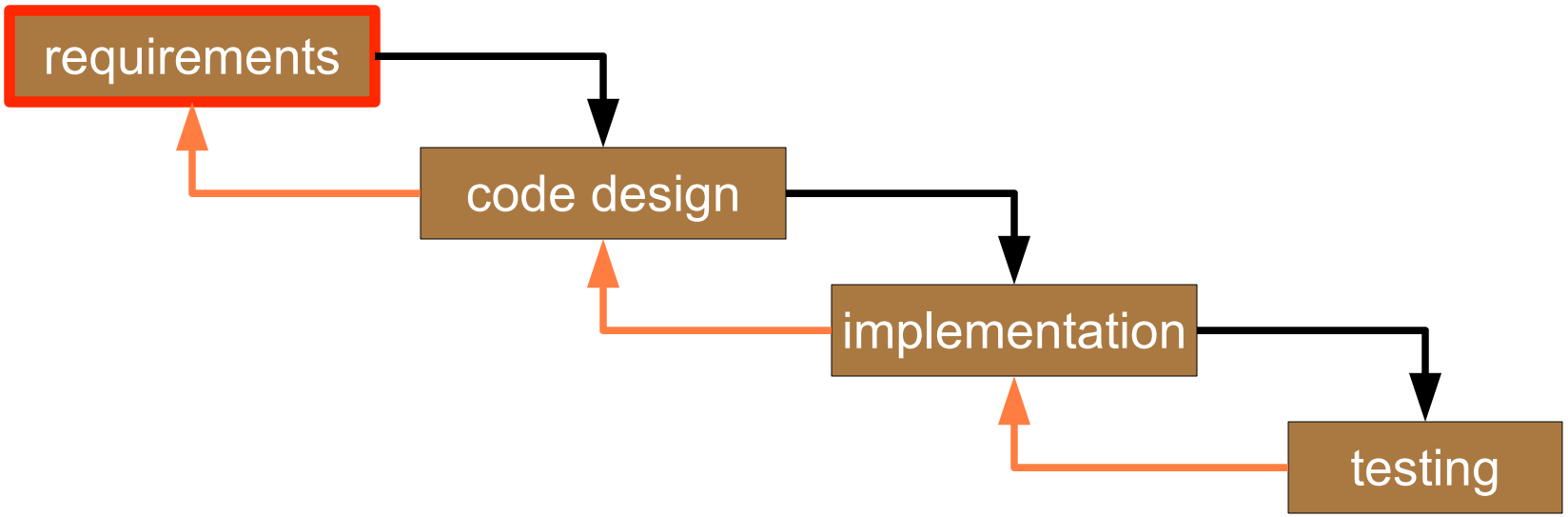
testing: without complete list of behaviors to be supported, impossible to test whether a system implemented actually behaves as it is supposed to

and: extension, cost, maintainability, process improvement

why requirements?

mistakes/failures at the requirements stage are very costly!

mistakes/failures at the requirements stage are surprisingly common!!



requirements challenges

customers can’t tell you what they need
- they don’t know
- they don’t clearly articulate their needs

customers have conflicting needs
- cost vs. quality vs. time

customers' needs change

technology changes

software requirements specification

software requirements specification (SRS) document:

- list of formally stated requirements
- may also combine other approaches to requirements specification (e.g. in case-driven specification)

IEEE provides a document template for SRS (IEEE standard 830), that serves as a starting point to be tailored to a specific project...

srs document (template)
introduction

table of contents

introduction

- purpose
- scope (general constraints)
- definitions, acronyms and abbreviations
- references
- overview (diagram, subsystems organization and interactions)

srs document (template)
overall description (optional)

product perspective (e.g. refer to design document, describe genre of the game, brief description of the game mechanics)

product functions (break down into different subsystems- or modules)

user characteristics (e.g. profile the player of the game)

constraints, assumptions and dependencies (e.g. DirectX, OpenGL, Win32, etc.)

srs document (template)
specific requirements

external interface requirements

- user interfaces: keyboard, mouse, joystick, gamepad, etc.; screens and menus, possibly from design document
- hardware interfaces: modem, joystick, audio, video, ...
- software interfaces: software dependencies: OS, libraries, ...
- communications interfaces (e.g. modem)

srs document (template)
specific requirements

functional requirements

break down requirements according to subsystems or components to which they apply:

subsystem A

(state requirements, number each requirement)

subsystem B

...

srs document (template)
specific requirements: other requirements

performance requirements:

- standards (for specific markets)
- hardware limitations

design constraints

- availability (for networked/distributed systems)
- security
- maintainability (how to upgrade, fix, etc.)

other requirements

srs document (template)
appendices and index

appendices (additional documents)

- test cases
- requirements matrix

index

writing requirements

state requirement in the active voice

use the verb "shall"

each statement should pertain to only 1 feature at a time

use only two subjects: player (or user) and software (or system)

avoid wording that conveys assumptions about implementation

example:

11. software shall show player which player is active

example srs document:

www-scf.usc.edu/~csci201g/Sp2007/crosswinds-RS.pdf

requirements engineering

main delivery of the requirements engineering process is software requirements specification (SRS) document

translate features into functionality

features come from a variety of sources (many people, some documents created by others)

software requirements analyst (requirements engineering = requirements analysis):

- elicits, analyzes, specifies, verifies, and manages the functional and nonfunctional requirements of the software system

IEEE International Requirements Engineering Conference

www.requirements-engineering.org

15th: Dehli, India, October 2007

understanding requirements in the global economy

"As software development is now part of the global economy, requirements engineering is the key bridge between the customer and supplier. Understanding and translating users' needs into effective solutions has always been vital: however, as development is outsourced requirements have to reflect cultures and languages and local needs. Furthermore, understanding requirements becomes a collaborative activity across time and space."

15th IEEE International Requirements Engineering Conference

topics of interest include, but are not restricted to:

- **requirements elicitation, analysis, documentation, validation and verification**
- requirements specification languages, methods, processes, and tools
- requirements management, traceability, viewpoints, prioritization, and negotiation
- modeling of requirements (formal and informal), goals, and domains
- prototyping, simulation, and animation
- interaction between requirements and design
- evolution of requirements over time, product families, and variability
- relating requirements to business goals, products, architecture, and testing
- social, cultural, global, personal and cognitive factors in requirements engineering
- collaborative requirements engineering
- domain-specific problems, experiences and solutions

requirements engineering

engineering is an iterative and incremental process, so is requirements engineering

approach (not a methodology) defines four increments (or phases), iterated as many times as necessary (or possible):

elicitation
exploration
analysis
refinement

requirements engineering: elicitation

gather information about requirements from the design document and other sources

- includes prototypes, UI mockups, etc.

create a first draft of the SRS

game description:

- outer scope (genre, mechanics, etc.) - high level

play narratives (sixty-second-of-play narratives):

- inner scope (what it is like to play the game) - detailed

requirements engineering: exploration

create a candidate list of **use cases**

create an initial list of requirements

update the SRS

develop use cases:

- narratives: informal paragraph that tells a story about how the user interacts with the system
- scenarios: more formal, narrative broken down into a numbered sequence of events
- diagrams (UML)

use cases

concurrently develop use cases and list of requirements

some lines in a use case might refer to one or several more detailed use cases

for games, develop both:

- game context use cases (outer scope), and
- sixty-seconds-of-play use cases (inner scope)

use case template

use case name

requirement(s) explored

player (actor) context (role)

precondition(s)

trigger(s)

main course of action

alternate course(s) of action

exceptional course(s) of action

see examples in:

www-scf.usc.edu/~csci201g/Sp2007/crosswinds-RS.pdf

use cases uses

requirements:

- define functional requirements (behavior)
- expose business rules (constraints on behavior)

planning: suggest an iterative strategy

design: validate design models

testing: provide scenarios for validation

requirements engineering: analysis

develop use cases based on candidate list

test initial list of requirements for completeness and validity

add use cases and requirements

(generate a test case for each use case)

subject candidate requirements to procedures that reveal weaknesses, redundancies and gaps

develop more use case diagrams, scenarios and activity diagrams

requirements engineering: refinement

prioritize the requirements

create a **requirements matrix**

refine requirements language

refine test cases

refine SRS

requirements matrix

a tabular representation of the requirements

headings:

- req number (index)
- **status** (completion %)
- title
- use cases (that reference the requirement)
- test cases (that reference the requirement)
- dependencies
- **priority** (1-5)
- class references

must be kept current!

other modeling tools

use cases are not the only tool

state diagrams, activity diagrams (see UML)

prototypes, mock-ups

anything that helps!

recommendations

Care not to create incomplete, spotty, redundant, or inaccurate requirements; seek to find the essential behavior of the system and to specify this behavior in nontechnical, clearly stated terms

establish the scope of the project: boundary of the engineering effort, from design document (game overview). Inner scope vs. outer scope

identify the customers (stakeholders): end users; but also game/system designers, graphics, music and sound effects designers, voice recorders, etc. who expect that the software system will give life to what they have contributed

recommendations

- feasibility: 3 major risks are
  - number of features
  - amount of money (resources)
  - quality of the product
- uncontrolled growth
  - feature creep: at requirements specification time, go beyond established scope; at implementation time, developers add unspecified functionality
  - goldplating: developers develop the technology they want to develop rather than the product the requirements specify

recommendations

eight basic qualities that make for good requirements specifications:

- make requirements complete
- make requirements correct
- necessary requirements only
- consider the feasibility
- prioritize requirements (critical path vs. secondary)
- eliminate ambiguity
- verify and validate requirements
- manage evolution

quality requirements

specify what not how

unambiguous

testable

feasible

consistent

prioritized

traceable

agreed upon by customer