

IMPORTANT NOTICE TO STUDENTS

These slides are **NOT** to be used as a replacement for student notes.
These **slides** are sometimes **vague and incomplete on purpose** to spark a class discussion

Software Quality Attributes

CS 446 / 646 ECE452
Jun 1st, 2011



how the customer explained it



how the project leader understood it



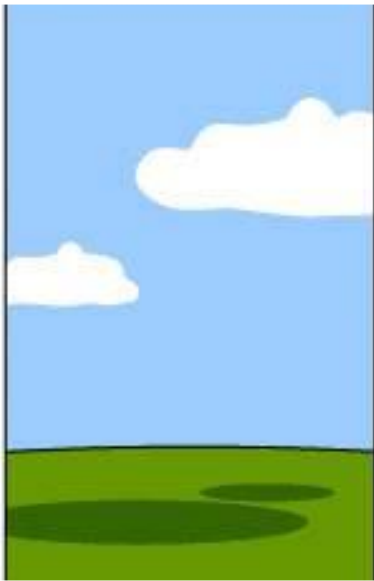
how the analyst designed it



how the programmer wrote it



how the business consultant described it



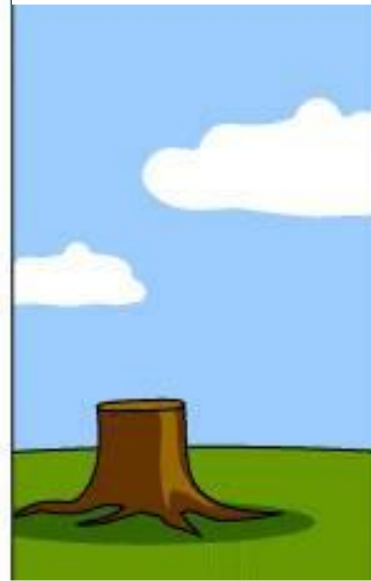
documentation



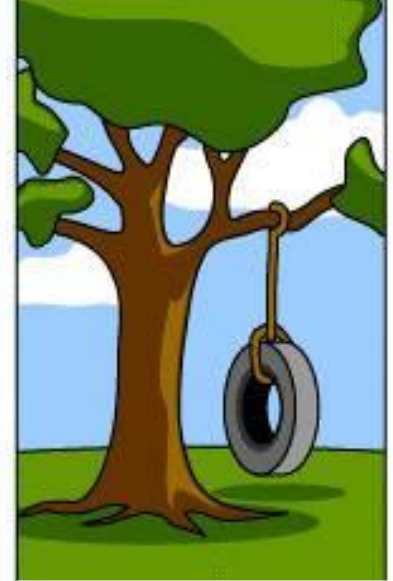
installation



customer was billed for



post installation support



what the customer really needed

Class Activity

Identify the functional & non-functional requirements for your project

Requirements

Classification

- functional & non-functional

System Utility

- “system utility is determined by both its functionality and its non-functional characteristics”[1]

Quality

- function of both technical & real-world challenges

[1] Chung, Lawrence and do Prado Leite, Julio. ***On Non-Functional Requirements in Software Engineering***. Conceptual Modeling: Foundations and Applications Lecture Notes in Computer Science, 2009, Volume 5600/2009, 363-379

Functional Requirements

Description

- functionality a system must provide

First goal is to solve the functional requirements

- meet & exceed the functional requirements
 - “meet” is a must
 - “exceed” is better

Functional Requirements

Match functional requirements to technology



OSS vs Commercial

- what type of support is available
- what type of customization is possible

Non-Functional Requirements

Descriptions

- requirements that focus on non-behavioural aspects

Comments

- many definitions exists
- our description
 - *required system attributes not captured in the functional requirement*
 - *non-functional requirements do not provide or modify core system goals*

Performance

Performance means different things

- hand held application performance
- web application performance
 - banking, eBay, Google
- game performance
- real-time applications
 - robotics

How do we measure it then?

Performance

Throughput

- def:
 - calculations per second
 - transactions per second
 - messages per second
- do you see a trend here?
- campus Internet lunch time gremlins?



Performance

Throughput

- peak throughput
- average throughput
- should a system be designed for peak or average throughput?

Performance

Latency

- “*latency is in the eye of the observer*”
- inherently present in everything
 - can not be eliminated
 - reduction & mitigation
- measuring latency is hard

Response time

- combination of *computational* and *communicational* latencies

Quality

Stability & Bugs



- is there ever a bug free software system?
- what defines a stable system?
- revision control systems
 - how can they help?

Fault-tolerance

In the case of failure....

Redundancy

- at what level
 - application vs component
 - *batman has many suites but one bat-mobile?*



Fault-tolerance

Graceful exit

- what defines a graceful exit?
- recoverable vs. nonrecoverable scenarios
- load balancing and fail-over strategy

A problem has been detected and windows has been shut down to prevent damage to your computer.

DRIVER_IRQL_NOT_LESS_OR_EQUAL

If this is the first time you've seen this Stop error screen, restart your computer. If this screen appears again, follow these steps:

Check to make sure any new hardware or software is properly installed. If this is a new installation, ask your hardware or software manufacturer for any windows updates you might need.

If problems continue, disable or remove any newly installed hardware or software. Disable BIOS memory options such as caching or shadowing. If you need to use Safe Mode to remove or disable components, restart your computer, press F8 to select Advanced Startup Options, and then select Safe Mode.

Technical information:

*** STOP: 0x000000D1 (0x0000000C,0x00000002,0x00000000,0xF86B5A89)

*** gv3.sys - Address F86B5A89 base at F86B5000, DateStamp 3dd991eb

Beginning dump of physical memory
Physical memory dump complete.

Contact your system administrator or technical support group for further assistance.

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15:19:05,912 ERROR ~

@5pn2hofg9

Internal Server Error (500) for request GET /posts/1

Template execution error (In /app/views/tags/display.html around line 10)

Execution error occurred in template /app/views/tags/display.html. Exception raised was ArithmeticException : / by zero.

play.exceptions.TemplateExecutionException: / by zero

```
at play.templates.Template.throwException(Template.java:262)
at play.templates.Template.render(Template.java:227)
at play.templates.Template$ExecutableTemplate.invokeTag(Template.java:359)
at /app/views/Application/show.html.(line:21)
at play.templates.Template.render(Template.java:207)
at play.mvc.results.RenderTemplate.<init>(RenderTemplate.java:22)
at play.mvc.Controller.renderTemplate(Controller.java:367)
at play.mvc.Controller.render(Controller.java:393)
at controllers.Application.show(Application.java:26)
at play.utils.Java.invokeStatic(Java.java:129)
at play.mvc.ActionInvoker.invoke(ActionInvoker.java:124)
at Invocation.HTTP Request(Play!)
```

Caused by: java.lang.ArithmeticException: / by zero

```
at java.math.BigDecimal.divide(BigDecimal.java:1327)
at /app/views/tags/display.html.(line:10)
at play.templates.Template.render(Template.java:207)
... 10 more
```

Availability

Has a direct impact on functional requirements ?

- easy to measure
 - uptime, downtime, guessing
 - what else?
- easy to specify
- disaster recovery strategy

Data Specific Qualities

Size

Interoperability

Changes to schema

Replication

Consistency

Non-Runtime Qualities

Evolution

- code size
- coupling / dependencies

Portability

Reusability

Non-Runtime Qualities

Interoperability

- at what level?
 - system / components
 - data
 - *which one is better?*
- interoperability via standardization
 - communication protocols
 - schema
 - XML

Non-Runtime Qualities

Ease of use

- user interface is the face of the software
- logic is the back end



Operational Qualities

Cost

- what are some of the things that cost money?

Supportability

- user support
- technical support

Configuration & distribution

Release management

- backwards compatibility