Me

- Dr. Alexander **Serebrenik**
- MDSE/Software Engineering & Technology

- MF 6.087
- 040 247 3595

- a.serebrenik@tue.nl
- @aserebrenik
- http://www.win.tue.nl/~aserebre/
## Week schedule

- **Quartile 3, block E**

<table>
<thead>
<tr>
<th>Tuesday</th>
<th>Thursday</th>
</tr>
</thead>
<tbody>
<tr>
<td>13:45-15:30</td>
<td>8:30-10:30</td>
</tr>
<tr>
<td>Lecture</td>
<td>Group meetings</td>
</tr>
<tr>
<td>15:45-17:30</td>
<td>(15 minutes)</td>
</tr>
<tr>
<td>Instruction</td>
<td>Lecture</td>
</tr>
<tr>
<td></td>
<td>10:45-12:30</td>
</tr>
<tr>
<td>AUD 2</td>
<td>MF 5.144</td>
</tr>
<tr>
<td>Flux 1.03</td>
<td>MF 5.145</td>
</tr>
<tr>
<td>Flux 1.09</td>
<td>MF 5.146</td>
</tr>
<tr>
<td>Flux 1.11</td>
<td>AUD 4</td>
</tr>
</tbody>
</table>
Instructors

Kees Huizing
MF 6.092
040 247 4120
c.huizing@
~keesh/
@mackees

Anton Wijs
MF 6.077
040 247 3991
a.j.wijs@
~awijs

Sarmen Keshishzadeh
MF 6.082
040 247 4139
s.keshishzadeh@
On-line


- Peach – 2IW80
  - https://peach.win.tue.nl/
  - If you are registered in OASE, within 1 hour you should be able to access Peach.
  - If you cannot login please contact me immediately!
Assessment

- **50% 2IW81 final exam:**
  - Multiple choice + Small exercises.
  - Preparation: during instructions, homework, lectures

- **50% 2IW82 assignments:**
  
  \[ 0.1 \times H + 0.15 \times R + 0.25 \times (S + PRC1) + 0.5 \times (A + PRC2) \]

  - **H** – sum of 5 best homework grades out of 7; *individual*
    - Grades: 0, 1, 2
    - Submit between *Tuesday 17:15 and Thursday 8:00*.
  
  - **R, S, A** – group projects, 6-7 students per group
    - Grades: 0-10 with halves
  
  - **PRC** – peer-review correction
    - Between -1 and 1
Group assignments

• Group assignments: 6-7 students per group
• Groups meet their supervisor on Thursday
  • 15 minutes per group + 5 minutes between the groups
  • Individual feedback on the homework
  • Evt: questions about the group assignments

• Book your time slots online:
  • http://tinyurl.com/2IW80Reg
  • First comes, first served

• Deadlines are strict
  • No late submissions will be accepted
Effort

- $5 \times 28 = 140$ hours
  - Weekly meetings:
    - Lectures $4\text{h/week} + \text{instructions } 2\text{h/week} + \text{groups } 0.25\text{h/week}$
    - $6.25\text{ h/week} \times 7\text{ weeks} = 43.25\text{ hours}$
  - Final exam: $3\text{ hours}$
  - Homework, group assignments, exam preparation: $96.75\text{ hour}$
  - Focus: **you** work, **we** help
2IW80 as part of the Software Engineering

B.Sc.

2IP90 Programming

2IPC0 Programming methods

2IW80 Software specification & architecture

2IPD0 Software engineering

2IPE0 Software engineering project

M.Sc.

2IS15 Generic language technology

2IF85 Program verification techniques

2IS55 Software evolution

2IP45 Software project management

2IS95 Seminar Software Engineering and Technology
There are **lots of books** on software specification and architecture.

You do not need to buy these books!

You are welcome to consult them.
Learning objectives

The student can describe

existing or to be developed software systems

by means of basic specification techniques.

Based on these specifications, the student can derive

an architectural description for these software systems.
Where do we start?

Can anyone write me a program that reads and writes to a text file...

Who can write me a program that runs strcmp function without using...

Please help me write c program that calculates GPA ...

Could someone write me a program that will make my ...

More results from answers.yahoo.com
Where do we start?

Google

"write me a program that"

Rent a coder.
Programming and design services.

Search keyword: design

Browse projects

Convert VB application to mobile application

I would like to have a mobile version created of a vb application. Ideally, the mobile application would function multiple mobile device platforms. The initial mobile device is iOS. The application can be found at www.hoopsnet.com and a trial version can be downloaded at www.hoopsnet.com/p...

Categories: Other

Posted by hoopsnet on 10/15/2013

App or Website to mark floor plans

I am interested in a platform (apk or web based) that would allow for two to four users on different devices to interact with the same 2d floor plan, where the users could select one of the assigned numbered floor spaces, see who it is assigned to, and be able to change its color/status/leave a note ...

Categories: Cad, Java, Javascript, Other, Web design

Posted by decay9 on 16/15/2013

Kick Ass Developer Job

Join the revolution! We are looking for extraordinary developers. People who can make the difference, passionate about software development and driven to develop the perfect solution for the end customer. Kick Ass developers wanted! Join the revolution. Numerac's software development team was ...

Categories: Other

Posted by Numerac on 1/15/2014

About 661 results (0.66 sec)

Can anyone help me with this?

Aug 27, 2012

L3

Who can answers your question?

Dec 1, 2009

<< *str2++

Please help me!
Could someone help me with this?

More results...
We always build software for somebody

Customer

Software engineer
Software specification: contract

- **Software specification**: contract between the *specifier* and the *implementor* defining the system to be constructed [Balzer, Goldman 1981].

- What does this imply? What is a good specification?
Software specification: contract

- **Software specification**: contract between the *specifier* and the *implementor* defining the system to be constructed [Balzer, Goldman 1981].

- What does this imply? What is a good specification?
  
  ⇒ Clear to both parties
  ⇒ Realistic
  ⇒ Conformance should be verifiable
  ⇒ Easy to modify
Clear to both parties: April 15, 1999

Altitude: 1500 m
Clear to both parties: April 15, 1999

Altitude: 1500 m

1500 feet (~457 meters)
Clear to both parties: April 15, 1999

8 dead, 37 injured, aircraft lost

Altitude: 1500 m

1500 feet (~457 meters)
How can one verify conformance?

• Depends on the specification mechanism…

• In general,
  • Testing – 2IPD0 Software engineering (and testing)
  • Formal analysis – 2IW26 System validation
  • Review
  • …

• However,
  • each approach has its limitations
  • frequently we cannot guarantee conformance even with thorough testing and formal analysis
Why should specifications be easy to modify?

Software usually represents the real world (or operates in it)

Real World → Model → Program

Study of how software changes, why, by whom and how can we make it easier: software evolution, 2/S55 (Master)
In this course...

• **We discuss** a number of specification techniques

• **Apply** them on examples (*instructions* and *homework*) and a larger case study (*group assignments*)

• **Evaluate** the advantages/disadvantages of these specification techniques wrt
  • Ease of unambiguous specification
  • Realism
  • Ease of verification
  • Suitability for evolution
The next step

• We know **what** the customer wants
• but we still do not **know** how to achieve this…
The next step

• We know **what** the customer wants
• but we still do not **know** how to achieve this…

• [ISO/IEC/IEEE 42010:2011] **Software architecture** is the fundamental organization of a system embodied in
  • its **elements**,
  • **relationships**,  
  • and in the principles of its **design** and **evolution**.
In this course...

• **We discuss**
  • different concerns pertaining to architecture, and
  • a number of architecture description techniques

• **Apply** them on small examples (*instructions* and *homework*) and a larger case study (*group assignment*)

• **Evaluate** the advantages/disadvantages of these techniques wrt the concerns identified
Requirements specification

• **Textual** description of system behavior
• **Basic** specification technique
• Most used in **practice**
What is requirement?

• requirement, functional

A statement of some function or feature that should be implemented in a system [Sommerville 2011].
What is requirement?

- requirement, functional

A statement of some **function** or **feature** that should be implemented in a system [Sommerville 2011].
What is requirement?

• requirement, functional
A statement of some **function** or **feature** that should be implemented in a system [Sommerville 2011].

• requirement, non-functional
A statement of a **constraint** <…> that applies to a system [Sommerville 2011].
What is requirement?

- **requirement, functional**
  A statement of some **function** or **feature** that should be implemented in a system [Sommerville 2011].

- **requirement, non-functional**
  A statement of a **constraint** that applies to a system [Sommerville 2011].

  
  
  **Functional (A) of non-functional (B)?**

  The system sends an email to the customer when she places a new order.
What is requirement?

• requirement, functional
A statement of some function or feature that should be implemented in a system [Sommerville 2011].

• requirement, non-functional
A statement of a constraint <…> that applies to a system [Sommerville 2011].

Functional (A) of non-functional (B) ?

The system sends an email to the customer when she places a new order.
What is requirement?

• requirement, functional
A statement of some function or feature that should be implemented in a system [Sommerville 2011].

• requirement, non-functional
A statement of a constraint that applies to a system [Sommerville 2011].

Functional (A) of non-functional (B)?

The mail should be send not later than 12 hours after the order has been placed.
What is requirement?

- **requirement, functional**
  A statement of some **function** or **feature** that should be implemented in a system [Sommerville 2011].

- **requirement, non-functional**
  A statement of a **constraint** <…> that applies to a system [Sommerville 2011].

---

**Functional (A) of non-functional (B)?**

The mail should be send not later than 12 hours after the order has been placed.

**non-functional**
What is requirement?

• requirement, functional
A statement of some function or feature that should be implemented in a system [Sommerville 2011].

• requirement, non-functional
A statement of a constraint <…> that applies to a system [Sommerville]

what?

how fast?
how many failures?
how accurate?
how secure?
...
Functional requirements frequently describe

Inputs & outputs

Computations

Data for/from other systems
Non-functional requirements

- Non-functional requirement relates to quality attributes: e.g., performance, learnability, availability

- Functional requirement: "when the user presses the green button the Options dialog appears”:
  - performance: how quickly the dialog appears;
  - availability: how often this function may fail, and how quickly it should be repaired;
  - learnability: how easy it is to learn this function.

Example by © Len Bass, Paul Clements, Rick Kazman, distributed under Creative Commons Attribution License
Popular Quality Attributes (1)

- reliability
  - availability, fault tolerance, recoverability, ...

- performance
  - time, resource utilization

- operability
  - appropriateness recognizability, ease of use, use of interface aesthetics, technical accessibility, …
Popular Quality Attributes (2)

- security
  - confidentiality, integrity, authenticity, ...

- compatibility
  - co-existence, interoperability

- maintainability
  - modularity, reusability, modifiability, testability, analyzability

- portability
  - adaptability, replaceability, installability
Non-functional requirements…

The system can connect to the scheduling system of the Human Resource department.

<table>
<thead>
<tr>
<th></th>
<th>reliability</th>
<th>D</th>
<th>compatibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>B</td>
<td>performance</td>
<td>E</td>
<td>maintainability</td>
</tr>
<tr>
<td>C</td>
<td>operability</td>
<td>F</td>
<td>portability</td>
</tr>
</tbody>
</table>
Non-functional requirements…

The system can connect to the scheduling system of the Human Resource department.

<table>
<thead>
<tr>
<th></th>
<th>retrieval</th>
<th></th>
<th>compatibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>reliability</td>
<td>D</td>
<td>compatibility</td>
</tr>
<tr>
<td>B</td>
<td>performance</td>
<td>E</td>
<td>maintainability</td>
</tr>
<tr>
<td>C</td>
<td>operability</td>
<td>F</td>
<td>portability</td>
</tr>
</tbody>
</table>

Answer: D (compatibility)
Be careful…

• Sometimes the same idea may be expressed either as a \textit{functional} or \textit{non-functional} requirement.

• The system shall ensure that data is protected from unauthorised access.
  • Conventionally: non-functional requirement (security)
  • Expressed as functional requirement:
    − The system shall include a user authorization procedure where users must identify themselves using a login name and password. Only users who are authorized in this way may access the system data

http://www.iai.uni-bonn.de/III/lehre/vorlesungen/SWT/RE05/slides/09_Non-functional%20Requirements.pdf
The big question

How good are requirements as a specification technique?
The big question

How good are requirements as a specification technique?

Do you recall what we expect from a good specification mechanism?
The big question

How good are requirements as a specification technique?

Do you recall what we expect from a good specification mechanism?

- Ease of unambiguous specification
- Ease of verification
- Suitability for evolution
Ease of unambiguous specification


http://www.microdot.net/nlp/hypnotic-language/ambiguous-language.shtml
Ease of unambiguous specification

Ease of unambiguous specification

- Solution: be **specific**, i.e., clear and unambiguous; without vagaries and platitudes
Tips and tricks for being specific

• Avoid
  • obviously, clearly, certainly, …
  • some, several, many, …
  • etc, and so on, such as, …

• Clarify references
  • When module A calls B its message history file is updated

• Speed of the simulation flight should exceed 300,000 km/s

• What do you think?
  a) good
  b) bad
Realistic

- Speed of the simulation flight should exceed 300,000 km/s

- What do you think?
  a) good
  b) bad

- Check:
  - Specific?
  - Good for evolution?
Realistic

- Speed of the simulation flight should exceed 300,000 km/s

- What do you think?
  a) good
  b) bad

- Check:
  - Specific?
  - Good for evolution?
    - No, requires reconsideration every time
Realistic

- Speed of the simulation flight should exceed 300,000 km/s

- What do you think?
  a) good
  b) bad

- Check:
  - Specific?
  - Good for evolution?
    - No, requires reconsideration every time
    - Solution: be **attainable**
Tips & tricks for attainability

• Is there a **theoretical solution** to the problem?

• Has it been **done before**?
  • If not, why not?
  • Has a feasibility study been done?

• Are there **physical constraints** on the size of the memory, processor or peripherals?

• Are there **environmental constraints** such as temperature, compressed air?
Not everything attainable can be built...

- **Limited** resources, time, budget, ...

- Solution: check whether requirements are **realizable**

- Tips & tricks: prioritize requirements
  - **Must** satisfy
  - **Should** satisfy
  - **Could** satisfy
  - **Would** not satisfy [in this release]
  
  ➢ MoSCoW
Ease of verification

OASE should be as clear as possible.

(Student elections campaign Dec. 2013)

a) good
b) bad
Ease of verification

OASE should be as clear as possible.

(Student elections campaign Dec. 2013)

• How do we know whether OASE is clear enough?
Ease of verification

How do we know whether OASE is clear enough?

Solution: be measurable.

OASE should be as clear as possible.

(Student elections campaign Dec. 2013)
Suitability for evolution

• What happens if business needs change?
Suitability for evolution

- What happens if business needs **change**?
- We need to know how individual business need **impacts** requirements, architecture, implementation and tests
Suitability for evolution

- What happens if requirements **change**?

- We need to know how individual business need **impacts** requirements, architecture, implementation and tests

- Solution: **traceability** links
### Traceability matrix

- **Means of expressing traceability information**

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Design Elem.</th>
<th>Func</th>
<th>Test Case</th>
</tr>
</thead>
<tbody>
<tr>
<td>SR-28</td>
<td>Class Catalog</td>
<td>sort</td>
<td>7, 8</td>
</tr>
<tr>
<td>SR-44</td>
<td>Class Catalog</td>
<td>import</td>
<td>12, 13</td>
</tr>
</tbody>
</table>

#### Two popular techniques

**What are their advantages and disadvantages?**

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Design element</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Class Catalog</td>
</tr>
<tr>
<td>SR-28</td>
<td>*</td>
</tr>
<tr>
<td>SR-44</td>
<td>*</td>
</tr>
<tr>
<td>SR-62</td>
<td>*</td>
</tr>
<tr>
<td>SR-73</td>
<td></td>
</tr>
</tbody>
</table>
Requirements used as a specification technique

To be useful as a specification technique, requirements should be

• **Specific**
• **Measurable**
• **Attainable**
• **Realisable**
• **Traceable**
What is requirement?

• requirement, functional
A statement of some function or feature that should be implemented in a system [Sommerville 2011].

• requirement, non-functional
A statement of a constraint <…> that applies to a system [Sommerville 2011].

Functional (A) of non-functional (B)?
The system sends an email to the customer when she places a new order.

Requirements used as a specification technique

• To be useful as a specification technique, requirements should be
  • Specific
  • Measurable
  • Attainable
  • Realisable
  • Traceable

SMART
Group assignment

• Read the “Foxes and Dolphins” description

• Think about omissions and vagueness

• Distill requirements based on the omissions

http://www.minibottlelibrary.com/mbl/alpha/jim-beam/fox-on-dolphin.jpg
Exercise 1: Functional or Non-functional

a) The system shall be able to process at least 40 executing jobs at a time.

b) The system shall provide the means for the resource provider to see on which project his resource is working.

c) The system shall provide the means for the system admin to perform his actions on a computer with Windows XP, Mac OS X or Linux.

d) If one of the resource disappears while it was performing a job, the system should requeue the job.

e) The (de-)installation of the software needed by resource providers should not require a computer expert.
Exercise 1: Functional or Non-functional

a) The system shall be able to process at least 40 executing jobs at a time. **non-functional, performance**

b) The system shall provide the means for the resource provider to see on which project his resource is working. **functional**

c) The system shall provide the means for the system admin to perform his actions on a computer with Windows XP, Mac OS X or Linux. **non-functional, portability**

d) If one of the resource disappears while it was performing a job, the system should requeue the job. **function**

e) The (de-)installation of the software needed by resource providers should not require a computer expert. **non-functional, installability**
Exercise 2: SMART or not? Why?

a) The information which is stored on the database can be accessed by any standard computer on the CERN network.

b) In order to obtain a CERN car sticker the person must have a valid CERN ID.

c) The opening of the software shall take less than 3-4 seconds under normal working conditions.

d) The user shall have access to French – English dictionary (this is outside the scope of the application). The user shall ask questions or propose suggestions for words translations by mailing to the administrators.

e) The software will be available 24hrs 365d/year.
Exercise 2: SMART or not? Why?

a) The information which is stored on the database can be accessed by any standard computer on the CERN network.

b) In order to obtain a CERN car sticker the person must have a valid CERN ID.  OK

c) The opening of the software shall take less than 3-4 seconds under normal working conditions.

d) The user shall have access to French – English dictionary (this is outside the scope of the application). The user shall ask questions or propose suggestions for words translations by mailing to the administrators.

 e) The software will be available 24hrs 365d/year. OKish, R depends on the context
Reminder

- Book your time slots online: 
  - http://tinyurl.com/2IW80Reg

- Instructions in Flux…
  - Flux 1.03 – Anton Wijs
  - Flux 1.09 – Kees Huizing
  - Flux 1.11 – Sarmen Keshishzadeh

- Flux can be reached via Meta Forum and Gemini