Test 1

Questions – Lecture slides – Answers
Question 1

1. How is the development of cost effective solutions to practical problems through the application of scientific knowledge called?

• Life-cycle
• Building
• Engineering
• Application
What is engineering?

“Engineering is the development of cost-effective solutions to practical problems, through the application of scientific knowledge”

“...Cost-effective...”
- Consideration of design trade-offs, esp. resource usage
- Minimize negative impacts (e.g. environmental and social cost)

“... Solutions ...”
- Emphasis on building devices

“... Practical problems ...”
- solving problems that matter to people
- improving human life in general through technological advance

“... Application of scientific knowledge ...”
- Systematic application of analytical techniques
1. How is the development of cost effective solutions to practical problems through the application of scientific knowledge called?

- Live-cycle
- Building
- **Engineering**
- Application
Question 2

2. What are the major stakeholder interests?

- Development interests
- Usage interests
- Financial interests
- Observational interests
Stakeholders

• **Stakeholder analysis:**
  - Identify all the people who must be consulted during information acquisition

• **Example stakeholders**
  - **Users**
    - concerned with the features and functionality of the new system
  - **Designers**
    - want to build a perfect system, or reuse existing code
  - **Systems analysts**
    - want to “get the requirements right”
  - **Training and user support staff**
    - want to make sure the new system is usable and manageable
  - **Business analysts**
    - want to make sure “we are doing better than the competition”
  - **Technical authors**
    - will prepare user manuals and other documentation for the new system
  - **The project manager**
    - wants to complete the project on time, within budget, with all objectives met.
  - “**The customer**”
    - Wants to get best value for money invested!

• **Financial interests**
  - Customer

• **Development interests**
  - Designer, System analyst, technical author, etc.

• **Usage interests**
  - Users
2. What are the major stakeholder interests?

- Development interests
- Usage interests
- Financial interests
- Observational interests
3. During which activities requirements inconsistencies can be found?

- Requirements validation
- Requirements elicitation
- Requirements documentation
- Requirements management
Conflicts in different RE activities

• **During the elicitation workshop**
  - Two stakeholders state requirements that contradict each other and hence cannot be realised together

• **When documenting requirements**
  - The stakeholders detect a conflict between two requirements that originate from different interviews

• **Requirements management**
  - Conflict occurs during requirements prioritisation – different stakeholders have different opinions regarding the requirements priority

• **Requirements validation**
  - Conflicts occurs while stakeholders check the specified requirements for correctness
  - One stakeholder considers a requirement correct – another objects
3. During which activities requirements inconsistencies can be found?

- Requirements validation
- Requirements elicitation
- Requirements documentation
- Requirements management
Question 4

4. During which activity does requirement engineer establish requirements traceability, prioritise requirements, and manage changes of requirements artefacts?

- Requirements management
- Requirements representation
- Requirements validation
- Requirements documentation
- Establishing requirements traceability
- Prioritising requirements
- Managing changes of requirements artefacts
4. During which activity does requirement engineer establish requirements traceability, prioritise requirements, and manage changes of requirements artefacts?

- **Requirements management**
- Requirements representation
- Requirements validation
- Requirements documentation
Question 5

5. Is elicitation difficult because of the existing bias?

- Yes
- Yes, and also because of the thin spread of knowledge and tacit knowledge
- No
- No, it is difficult because of the thin spread of knowledge and tacit knowledge
Difficulties of Elicitation

- **Thin spread of domain knowledge**
  - The knowledge might be distributed across many sources
    - It is rarely available in an explicit form (i.e. not written down)
  - There will be conflicts between knowledge from different sources
    - Remember the principle of complementarity!

- **Tacit knowledge (The “say-do” problem)**
  - People find it hard to describe knowledge they regularly use

- **Limited Observability**
  - The problem owners might be too busy coping with the current system
  - Presence of an observer may change the problem
    - E.g. Probe Effect; Hawthorne Effect

- **Bias**
  - People may not be free to tell you what you need to know
  - People may not want to tell you what you need to know
    - The outcome will affect them, so they may try to influence you (hidden agendas)
5. Is elicitation difficult because of the existing bias?

- Yes
- Yes, and also because of the thin spread of knowledge and tacit knowledge
- No
- No, it is difficult because of the thin spread of knowledge and tacit knowledge
Question 6

6. What concerns should be included to requirement specification (document)?

- Performance
- Attributes
- Design constraints imposed on and implementation
- Functionality
Specification Contents

• Specification should address:
  • Functionality
    • What is the software supposed to do?
  • External interfaces
    • How does the software interact with people, the system's hardware, other hardware, and other software?
    • What assumptions can be made about these external entities?
  • Performance
    • What is the speed, availability, response time, recovery time of various software functions, and so on?
  • Attributes
    • What are the portability, correctness, maintainability, security, and other considerations?
  • Design constraints imposed on an implementation
    • Are there any required standards in effect, implementation language, policies for database integrity, resource limits, operating environment(s) and so on?
6. What concerns should be included in the requirement specification (document)?

- **Performance**
- **Attributes**
- **Design constraints imposed on and implementation**
- **Functionality**
Question 7

7. Which criterion of good requirements does *often* require quantification?

- Cohesiveness
- External observability
- Understandability
- Testability
Criteria for Writing Good Requirements

• **What, not how (external observability)**
  • Avoid premature design or implementation decisions

• **Understandability, clarity (not ambiguous)**

• **Cohesiveness (one thing per requirement)**

• **Testability**
  • Somehow possible to test or validate whether the requirement has been met, clear acceptance criteria
  • Often requires quantification, this is more difficult for security than e.g. for performance
    • “The response time of function F should be max 2 seconds”
    • “The security of function F should be at least 99.9 %”
7. Which criterion of good requirements does *often* require quantification?

- Cohesiveness
- External observability
- Understandability
- Testability
Question 8

8. Why is it important to resolve requirements conflicts?

• For the interdependence and clarity
• For the complete specification of the requirements
• For the acceptance of the system by stakeholders
• For the successful (i.e., timely, within the budget, and etc.) completion of the project
Conflicts

• **Conflict (in RE)**
  – Exists if the needs and wishes of different stakeholders (or groups of stakeholders) regarding the system contradict each other,
  – Exists if some needs and wishes cannot be taken into account

• **Risks of unresolved conflicts**
  – Compromise acceptance of the system by stakeholders
  – If conflict disregarded or suppressed, some stakeholders may not support development of the system
  – May result in failure of the project

• **Involve relevant stakeholders**
8. Why is it important to resolve requirements conflicts?

- For the interdependence and clarity
- For the complete specification of the requirements
- For the acceptance of the system by stakeholders
- For the successful (i.e., timely, within the budget, and etc.) completion of the project
Question 9

3. What are things in the application domain that are true or not when we ever build the proposed systems?

• Requirements
• Specification
• Domain properties
• Assumptions and expectations
What are requirements?

**Application Domain**
- **D** - domain properties
- **R** - requirements

**Machine Domain**
- **C** - computers
- **P** - programs

- **Domain Properties:**
  - things in the application domain that are true whether or not we ever build the proposed system
  - Synonyms: Assumptions and expectations

- **Requirements:**
  - things in the application domain that we wish to be made true by delivering the proposed system
    - Many of which will involve phenomena the machine has no access to

- **A Specification:**
  - is a description of the behaviours that the program must have in order to meet the requirements
    - Can only be written in terms of shared phenomena!
9. What are things in the application domain that are true or not when we ever build the proposed systems?

- Requirements
- Specification
- Domain properties
- Assumptions and expectations
Question 10

10. What aspects do concern the operational or technical environment in which the system is deployed?

- Subject facet
- Usage facet
- Development facet
- IT system facet
The part of the system environment relevant for defining, understanding, and interpreting the system requirements

- **Subject facet**: objects and events that are relevant for the system, because the system must store or process information about these objects
- **Usage facet**: aspects concerning the usage of the system by people and other systems
- **IT system facet**: aspects concerning the operational or technical environment in which the system is deployed
- **Development facet**: aspects that influence the development of the system, imposed by law, or by client and relate to the development process
10. How are aspect which concern the operational and technical environment where the system is deployed, called?

- Subject facet
- Usage facet
- Development facet
- IT system facet
11. How are systems useful in the context of some human activities supported by the software, which is run on some hardware, called?

- Computer systems
- Information systems
- Software-intensive systems
- Software systems
Software-Intensive Systems

• **Software (on its own) is useless**
  - Software is an abstract description of a set of computations
  - Software only becomes useful when run on some hardware
    - we sometimes take the hardware for granted
  - **Software + Hardware = “Computer System”**

• **A Computer System (on its own) is useless**
  - Only useful in the context of some human activity that it can support
    - we sometimes take the human context for granted
  - A new computer system will change human activities in significant ways
  - **Software + Hardware + Human Activities = “Software-Intensive System”**

• ‘**Software**’ makes many things possible
  - It is complex and adaptable
  - It can be rapidly changed on-the-fly
  - It turns general-purpose hardware into a huge variety of useful machines
11. How are systems useful in the context of some human activities supported by the software, which is run on some hardware, called?

- Computer systems
- Information systems
- **Software-intensive systems**
- Software systems
Question 12

12. What type of conflict does exist if stakeholders are wrongly or incompletely informed about the requirements?

• Values conflict
• Data conflict
• Interest conflict
• Analysis conflict
Data conflict

• Data conflict exists
  • if stakeholders are wrongly or incompletely informed about the requirement
  • If stakeholders interpret the meaning of the requirements differently

• Example:
  R4: The DVD player shall be able to handle re-writable CDs (CD-RW) and DVDs (DVD-RW).
12. What type of conflict does exist if stakeholders are wrongly or incompletely informed about the requirements?

- Values conflict
- **Data conflict**
- Interest conflict
- Analysis conflict
13. Which requirements negotiation activity might include decision (by authority) making?

- Conflict identification
- Conflict analysis
- Conflict resolution
- Conflict documentation
Resolving Conflicts:
Decision

• Higher **authority** makes a decision
  • in favour of one conflicting party

• Example
  • The client is involved as a higher authority. The client decides that the detection range shall be 500 m.

• Voting

• **Third Party Resolution**
  – participants appeal to outside source
    • the rule-book, a figure of authority, or the toss of a coin.
    • can occur with the breakdown of either negotiation or competition as resolution methods.
  – types of third party resolution
    • judicial: cases presented by each participant are taken into account
    • extra-judicial: a decision is determined by factors other than the cases presented (e.g. relative status of participants)
    • arbitrary: e.g. toss of a coin
13. Which requirements negotiation activity might include decision (by authority) making?

- Conflict identification
- Conflict analysis
- **Conflict resolution**
- Conflict documentation
14. Which requirements engineering activity does help to achieve progress in the content dimension by detailing information about existing requirements?

- Requirements validation
- Requirements elicitation
- Requirements management
- Requirements specification
Achieve progress in the content dimension by eliciting new requirements as well as detailed information about existing requirements.

- Elicit all requirements at the level of detail for the system to be developed.
14. Which requirements engineering activity does help to achieve progress in the content dimension by detailing information about existing requirements?

- Requirements validation
- Requirements elicitation
- Requirements management
- Requirements specification
Question 15

15. Which requirements artefacts do specify requirements at the required level of detail, the desired properties and features of the system to be developed?

- Solution-oriented requirements
- Goals
- Scenarios
- Domain properties
Specify requirements at the required level of detail, the desired properties and features of the system to be developed.
15. Which requirements artefacts do specify requirements at the required level of detail, the desired properties and features of the system to be developed?

- **Solution-oriented requirements**
- Goals
- Scenarios
- Domain properties
16. What is the part of the system environment relevant for defining, understanding and interpreting the system requirements?

- System boundary
- Requirement engineering
- Requirements specification
- System context
The part of the system environment relevant for defining, understanding, and interpreting the system requirements.
16. What is the part of the system environment relevant for defining, understanding and interpreting the system requirements?

- System boundary
- Requirement engineering
- Requirements specification
- **System context**
Question 17

17. Which elicitation techniques are used for summarization and feedback, i.e., to conclude on a set of the requirements, to discuss the results of the information gathering, etc.

• Meetings
• Interviews
• Groups elicitation techniques
• Joint/rapid application development
Meetings

• Used for summarization and feedback
  • E.g. meet with stakeholders towards the end of each stage:
    • to discuss the results of the information gathering stage
    • to conclude on a set of requirements
    • to agree on a design etc.
  • Use the meeting to confirm what has been learned, talk about findings

• Meetings are an important managerial tool
  • Used to move a project forward.
  • Every meeting should have a clear objective:
    • E.g. presentation, problem solving, conflict resolution, progress analysis, gathering and merging of facts, training, planning,...
  • Plan the meeting carefully:
    • Schedule the meeting and arrange for facilities
    • Prepare an agenda and distribute it well in advance
    • Keep track of time and agenda during the meeting
    • Follow up with a written summary to be distributed to meeting participants
    • Special rules apply for formal presentations, walkthroughs, brainstorming, etc.
17. Which elicitation techniques are used for summarization and feedback, i.e., to conclude on a set of the requirements, to discuss the results of the information gathering, etc.

- **Meetings**
- Interviews
- Groups elicitation techniques
- Joint/rapid application development
E1

These requirements are extracted from solutions of your colleagues. Do they correspond to the “criteria of good requirements”? If not, please refine them so that they would correspond to the “criteria of good requirements”.
Do not write like this

• Ambiguity – or
  • The ERIS system shall also be able to generate visible or audible caution or warning signal for the attention of security or business analyst

• Multiple requirements – and, or, with, also
  • The warning indicator shall light up when an ERIS intrusion is detected and the current Football Federation Employees workspace or Game report data shall be saved

[Alexander and Stevens, 2002]
Do not write like this

• Let-out clauses
  
  *if, when, except, unless, although, always*

  • The fire alarm shall always be sounded *when* the smoke in Football Federation building is detected, *unless* the alarm is being tested *when* the antivirus is deployed

• Long rumpling sentences
  
  • Provided that the designated Game report input signals from the specified mobile devices are received in the correct order by the way which the ERIS is able to differentiate the designators, the security solution should comply with the required framework to indicate the desired security states

[Alexander and Stevens, 2002]
Do not write like this

• Speculation
  
  *usually, generally, often normally, typically*

  • Umpires and Team Representatives *normally require early indication of intrusion into ERIS*

• Vague, undefinable terms

  *user-friendly, versatile, approximately, as possible, efficient, improved, high-performance, modern*

  • Security-related messages should be *versatile and user-friendly*
  • *The OK status indicator shall be illuminated as soon as possible after ERIS security self-check is completed*

[Alexander and Stevens, 2002]
Do not write like this

• Wishful thinking

  100% reliable/ safe/ secure. Handle all unexpected failures. Please all users. Run on all platforms. Never fail. Upgrade to all future situations.

  • The gearbox shall be 100% secure in normal operation
  • The network shall handle all unexpected errors without crashing

[Alexander and Stevens, 2002]
Do not write like this

• System design:
  no names of components, materials, software objects/procedures, database fields
    • The antenna shall be capable of receiving FM signals, using a copper core with nylon armoring and a waterproof hardened rubber shield

• Mix of requirements and design:
  no references to system, design, testing, or installation
    • The user shall be able to view the current selected channel number which shall be displayed in 14pt Swiss type on an LCD panel tested to standard 657-89 and mounted with shockproof rubber washers

[Alexander and Stevens, 2002]
Good requirements

• Use simple direct sentences
  • Security analyst should be able to view ERIS status.

• Use a limited vocabulary
  • Security analyst should be able to change the infected ERIS component in less than 12 h; or
  • Security analyst should be able to reconfigure the infected ERIS component in less than 12 h

[Alexander and Stevens, 2002]
Good requirements

• Identify the type of user who wants each requirements
  • *The Football Federation Employee shall be able to* …

• Focus on stating result
  • … view game reports …

• Define verifiable criteria
  • … after 2 h after the game.

[Alexander and Stevens, 2002]
Criteria for writing good requirements

- **What**, not how (external observability)
  - Avoid premature design or implementation decisions
- **Understandability, clarity** (not ambiguous)
- **Cohesiveness** (one thing per requirement)
- **Testability**
  - Somehow possible to test or validate whether the requirement has been met, clear acceptance criteria
  - Often requires quantification, this is more difficult for security than e.g. for performance
    - *The response time of button press should be max 2 s.*
    - *The security of function F should be at least 99.9%*
**E1**: These requirements are extracted from solutions of your colleagues. Do they correspond to the “criteria of good requirements”? If not, please refine them so that they would correspond to the “criteria of good requirements”.

**SecReq.1**: The football federation employee, Bob, may remove the league secretary at any time and it should be available.

**SecReq.2**: After match team representatives sign the report and optionally provide comments.

**SecReq.3**: Confirmation of game results by the team shall be allowed only for team representative which represents team under action.

**SecReq.1**: The football federation employee should remove the league secretary.

**SecReq.2.1**: Team representatives should sign the report of the finished match.

**SecReq.2.2**: Team representatives should provide comments.

**SecReq.3**: Only team representative should access the confirmation of game results.
**E1**: These requirements are extracted from solutions of your colleagues. Do they correspond to the “criteria of good requirements”? If not, please refine them so that they would correspond to the “criteria of good requirements”.

**SecReq.4**: Football Federation Employee should be identified before having access to use the functions related to the creation of the game report to prevent unauthorized people to create fake game reports.

**SecReq.4.1**: System should identify Football Federation Employee.

**SecReq.4.2**: Football Federation Employee should create the game report.

**SecReq.5**: ERIS shall allow all Users to view all Data in the Game Report.

**SecReq.5**: User should view *Data* in the *Game Report*. 
**SecReq.6:** Football Federation Employee (legal secretary) needs authorization to insert the initial data, Final confirmation in the game report.

**SecReq.6.1:** System should authorize Football Federation Employee under role Legal Secretary.

**SecReq.6.2:** Legal Secretary should insert initial data and final confirmation in the game report.

**SecReq.7:** Security Criteria: Integrity of creating Team Composition Security Control: Implementing authorization policy for team representatives roles.

**SecReq.7:** ??? I do not know how to fix it!

**SecReq.8:** User must be logged in and have a role of “League Secretary” to confirm game report and “Team Representative” must have submitted Game Report

**SecReq.8.1:** League Secretary” should confirm game report

**SecReq.8.2:** Team Representative” should submit Game Report

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**E1:** These requirements are extracted from solutions of your colleagues. Do they correspond to the “criteria of good requirements”? If not, please refine them so that they would correspond to the “criteria of good requirements”.

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**SecReq.6:** Football Federation Employee (legal secretary) needs authorization to insert the initial data, Final confirmation in the game report.

**SecReq.6.1:** System should authorize Football Federation Employee under role Legal Secretary.

**SecReq.6.2:** Legal Secretary should insert initial data and final confirmation in the game report.

**SecReq.7:** Security Criteria: Integrity of creating Team Composition Security Control: Implementing authorization policy for team representatives roles.

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**SecReq.8:** User must be logged in and have a role of “League Secretary” to confirm game report and “Team Representative” must have submitted Game Report

**SecReq.8.1:** League Secretary” should confirm game report

**SecReq.8.2:** Team Representative” should submit Game Report
E2: Think of the Universities OIS system [https://ois2.ut.ee/](https://ois2.ut.ee/). Describe the four facets of this system context:

**Usage facet:**
- OIS uses by students
  - Perform course registration
  - Keep track of their grades and check course timetable
- Another interaction is from teachers
  - Check student progress
  - Course timetable and other relevant details
- Third interaction is from administrative staff
  - Administrative staff add course information
  - Update course timetable
  - Add students grades and other relevant details
- The OIS system will interact with other University of Tartu systems
  - Hold the student relevant information or require student information
E2: Think of the Universities OIS system [https://ois2.ut.ee/](https://ois2.ut.ee/). Describe the four facets of this system context:

- **Subject facet:**
  - OIS is a platform to provide an administration of academic-related details:
    - OIS would have three different kinds of users i.e. students, teachers and administrative staff
    - The OIS system would contain students course registration, students grades records, timetable, students status, curriculum and other details
E2: Think of the Universities OIS system [https://ois2.ut.ee/](https://ois2.ut.ee/). Describe the four facets of this system context:

- **IT system facet:**
  - The OIS system would have a URL
  - It will deploy on a web server
  - The web server would be managed by the University of Tartu IT department
  - Due to a large number of users, the OIS system should be deployed on the dedicated server
  - The server will take timely backups as well
E2: Think of the Universities OIS system [https://ois2.ut.ee/](https://ois2.ut.ee/). Describe the four facets of this system context:

- **Development facet:**
  - The OIS system will be accessible only after student authentication
  - The security of user personal data should be analysed
  - The OIS system would not disclose or share information to the third party without the consent of the University or Student
  - The OIS system should be compliance with European privacy laws
**E3: Analyse the given accounting document and elicit at least five requirements**

**Mary’s Design Service**  
**Balance Sheet**  
**September 30, 2018**

<table>
<thead>
<tr>
<th>ASSETS</th>
<th></th>
<th>LIABILITIES</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Cash</td>
<td>$ 300</td>
<td>Notes payable</td>
<td>$ 1,000</td>
</tr>
<tr>
<td>Accounts receivable</td>
<td>1,000</td>
<td>Accounts payable</td>
<td>325</td>
</tr>
<tr>
<td>Supplies</td>
<td>160</td>
<td>Wages payable</td>
<td>75</td>
</tr>
<tr>
<td>Prepaid insurance</td>
<td>90</td>
<td>Unearned revenues</td>
<td>100</td>
</tr>
<tr>
<td>Land</td>
<td>10,000</td>
<td>Total liabilities</td>
<td>1,500</td>
</tr>
</tbody>
</table>

**OWNER’S EQUITY**

| M. Smith, Capital | 10,050 |

Total assets: $11,550  
Total liabilities & owner’s equity: $11,550
E3: Analyse the given accounting document and elicit at least five requirements

**ReqFF1:** The system should provide the assets information on the balance sheet

**ReqFF2:** The system should show the date on the generated report

**ReqFF3:** The system should allow an owner to download the report after the calculations

**ReqFF4:** The system should perform calculations 99.9% accurately on the balance sheet

**ReqFF5:** An accountant should be able to confirm the generated report
E3: Analyse the given accounting document and elicit at least five requirements

ReqFF6: The system should allow an owner to see the total assets on the report

ReqFF7: The system should do user authentication before login to the system

ReqFF8: The system should show the liabilities related calculations on the generated report

ReqFF9: The system should show company name on the report