Software requirements document

- Software requirements document:
  - Can Include Both:
    - a definition of user requirements and
    - a specification of the system requirements.
- NOT a design document:
  - describes WHAT system should do
    not HOW it should do it.

Users of a requirements document

- Req. doc. mainly part of a plan-driven method
  - Agile methods argue requirements change too quickly for a req. doc. to be useful.
  - Large systems and critical systems...
- Many uses for a req. doc.:
Requirements specification process

- Requirements specification is
  - process of writing a requirements document.
  - Includes the user and system requirements.

  User requirements must be

  System requirements are detailed requirements with

- Important to be as complete as possible:
  - may be the basis for system development contract.

Ways of writing a system req. specification

<table>
<thead>
<tr>
<th>Notation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Natural language</td>
<td>Requirements are...</td>
</tr>
<tr>
<td>sentences</td>
<td>in plain English.</td>
</tr>
<tr>
<td>Structured natural</td>
<td>Requirements are in English, but written based on a...</td>
</tr>
<tr>
<td>language</td>
<td>Diagrams and text to describe the system. Ex: UML</td>
</tr>
<tr>
<td>Mathematical</td>
<td>Ex:...</td>
</tr>
<tr>
<td>specification</td>
<td>Unambiguous, but hard for customers to understand.</td>
</tr>
</tbody>
</table>

Requirements and design

- In principle:
  state the system should do;
  describes it does this.

- In practice:
  - Interaction with other systems may generate design requirements.
  - A non-functional requirement may need a specific architecture design.
  - Design constraints may be from regulatory requirements.
Natural language specification

- Natural language:
  - Requirements often written in natural language:
    - Natural language used because it is:
      - It can be understood by customers and developers.

Guidelines for writing requirements

- Create a standard format and use it for all requirements.
- Use language in a consistent way:
  - Use shall for...
  - Use should for...
- Avoid the use of computer jargon:
  - Use domain terminology
- Include an explanation (rationale) of...

Exercise

- Write a natural language specification for the shifter on an automatic transmission

Problems with natural language

- Lack of clarity:
- Requirements confusion
  - Functional and non-functional requirements tend to be mixed-up.
- Requirements amalgamation
  - If several different requirements are expressed together.
- See the cookie recipe: MIL-C-44072C
  - Ex: Sections 3.2.2, 3.3.11.
Structured specifications

- Requirements written in...
  - Works OK for embedded control systems.
  - Too restrictive for business systems.
- Form-based specification
  - Every requirement written in a standardized form.
- Tables:
  - Good for showing different possible ranges of a condition.

Structured spec.: an insulin pump

Action
- CompDose is zero if the sugar level is stable or falling or if the level is increasing but the rate of increase is decreasing.
- If the level is increasing and the rate of increase is increasing, then CompDose is computed by dividing the difference between the current sugar level and the previous level by 4 and rounding the result.
- If the result is rounded to zero then CompDose is set to the minimum dose that can be delivered.

Requirements
Two previous readings so that the rate of change of sugar level can be computed.

Pre-condition
The insulin reservoir contains at least the maximum allowed single dose of insulin.

Post-condition
r0 is replaced by r1 then r1 is replaced by r2.

Side effects
None.

Tabular specification: Insulin pump

<table>
<thead>
<tr>
<th>Condition</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sugar level falling (r2 &lt; r1)</td>
<td>CompDose = 0</td>
</tr>
<tr>
<td>Sugar level stable (r2 = r1)</td>
<td>CompDose = 0</td>
</tr>
<tr>
<td>Sugar level increasing and rate of increase decreasing (( (r2 - r1) &lt; (r1 - r0) ))</td>
<td>CompDose = 0</td>
</tr>
</tbody>
</table>
| Sugar level increasing and rate of increase stable or increasing (\( (r2 - r1) \geq (r1 - r0) \)) | CompDose = \( \text{round} \left( (r2 - r1)/4 \right) \)  
If rounded result = 0 then CompDose = MinimumDose

Exercise

- Write a tabular specification for the shifter on an automatic transmission
Summary

● The software requirements document is
  – an agreed statement of the system requirements.
  – organized so that both system customers and software developers can use it.

● Often written in natural language with diagrams
  – Numbered sentences;
  – Conforming to uniform style.