Requirements Engineering

Requirements engineering

- Process of figuring out
  - Services the customer needs
  - Constraints of operation

- It is about WHAT will be built!

Why Develop Requirements Specs?

I believe that on any non-trivial project (more than about 1 week of coding or more than 1 programmer), if you don't have a spec, you will *always* spend more time and create lower quality code.

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Requirement

- Descriptions of
  - system services
  - constraints

- Gathered during the requirements engineering process.

What is a requirement?

- Depends…
  - high-level abstract statement
  - detailed mathematical functional specification

Formal Specification -- VDM

p1 : Path = mk_token ("A1North");

p2 : Path = mk_token ("A1South");

p3 : Path = mk_token ("A66East");

p4 : Path = mk_token ("A66West");

lights : map Path to Light
= {**p1** |-> <Red>,
p2 |-> <Red>,
p3 |-> <Green>,
p4 |-> <Green>};

= {mk_Conflict(p1,p3),
mk_Conflict(p1,p4),
mk_Conflict(p2,p3),
mk_Conflict(p2,p4),
mk_Conflict(p3,p1),
mk_Conflict(p4,p1),
mk_Conflict(p3,p2),
mk_Conflict(p4,p2)};

Types
Light = <Red> | <Amber> | <Green>;

Requirement Spec Use

- Design
- Communicate
- Test

Types of Requirements

- Functional
  - Behavior of system
  - From users point of view
- Non-functional
  - Non behavior related constraints

Types of requirement

- **User** requirements
  - Written for customers
  - Natural Language
  - Diagrams
- **System** requirements
  - Detailed descriptions system functions, services, and operational constraints.

Types of requirements

- **Functional**
  - Services the system must provide

- **Non-functional**
  - Constraints on the services
    - i.e timing, development process, standards, etc.
  - Apply to whole system rather than functions

Good SRS

- Correct
- Unambiguous
- Complete
- Consistent
- Ranked for importance and/or stability
- Verifiable
- Modifiable
- Traceable

Clear description

- Must be precise
- Ambiguous requirements
  - Different interpretation
- How can we avoid ambiguity?

Completeness & Consistency

- Should be complete & consistent
- Complete
  - All required functionality is stated
- Consistent
  - There are no conflicts between requirements
- In practice: Impossible

Non-functional requirements

- System properties and constraints
  - Up time
  - Response time
  - Storage requirements
  - Usability
- Process requirements
  - IDE
  - Programming language
  - Development method.
- May be more critical than functional requirements

Verifiable Non-functional Requirement Description

- Verifiable non-functional requirement
  - Measurable
  - Can be tested

- Difficult to state **precisely** → difficult to verify.

Metrics for nonfunctional requirements

Property	Measure
Speed	Processed transactions/second User/event response time Screen refresh time
Size	Mbytes Number of ROM chips
Ease of use	Training time Number of help frames

Metrics for NF Req. (cont.)

Reliability	Mean time to failure Probability of unavailability Rate of failure occurrence Availability
Robustness	Time to restart after failure Percentage of events causing failure Probability of data corruption on failure
Portability	Number of target systems

Guidelines for writing requirements

- Use a standard format
- Be consistent
- Use **shall** for mandatory requirements
- Highlight key parts
- Use **structure** to group related requirements
- Enumerate

Requirement Language

- Requirements are often written in natural language (e.g., English).
  - inherently ambiguous
  - should be **reviewed** by an independent party to identify ambiguous language so that it can be corrected

Consistency

- With external objects
  - Incorrect descriptions of real objects
  - Ex: Blue background vs Green background
- Logical (A x B vs A / B)
- Temporal (A after B vs A and B simultaneously)
- Note: Use consistent and precise **terminology**
- Agreement with terminology in a project team is crucial

Requirements engineering processes

- Requirements elicitation
- Requirements analysis
- Requirements validation
- Requirements management
- In practice
  - iterative activity
  - processes are interleaved.

Requirements elicitation and analysis

- Requirements discovery
- Requirements classification and organization
- Requirements prioritization and negotiation
- Requirements specification

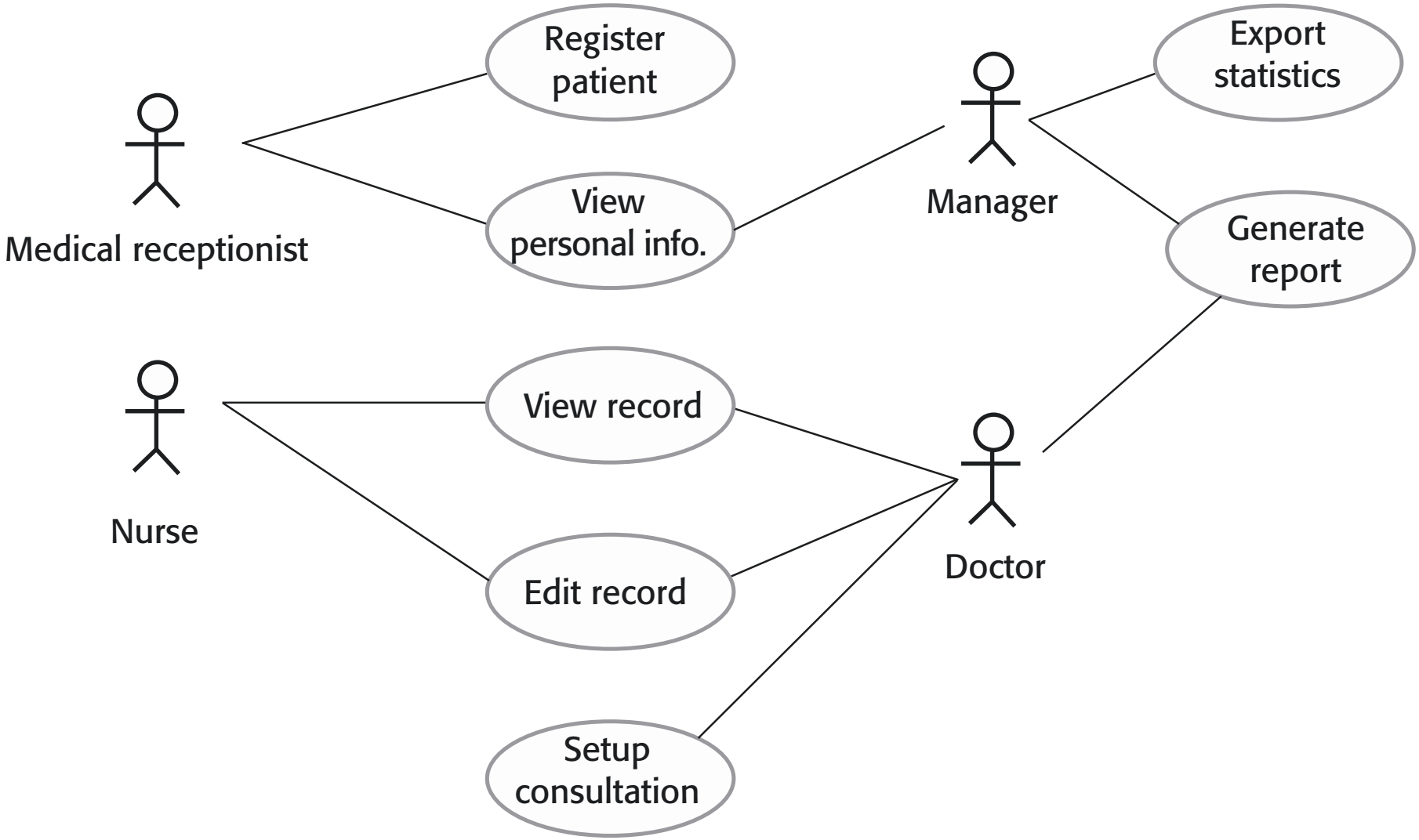
Scenarios

- Scenarios are real-life examples
- Consists of
  - Starting situation
  - Normal flow of events
  - What can go wrong
  - Information about other concurrent activities
  - Finishing situation

Use cases

- Scenario based technique in the UML
- Identifies the actors and the interaction
- A set of use cases should describe all possible interactions with the system.

Use cases for Hospital System



Requirements validation

- Do the requirements define the system that the customer really wants?

- Requirements error is very costly

Requirements checking

- Validity. Does the system provide the functions which support customer needs?
- Consistency. Are there requirements conflicts?
- Completeness. Are all functions required by the customer included?
- Realism. Can the requirements be implemented given available budget/technology
- Verifiability. Can the requirements be checked?

Requirements validation

- Requirements reviews
  - Systematic manual analysis of requirements.
- Prototyping
  - Using an executable model of the system to check requirements.
- Test-case generation
  - Developing tests for requirements to check testability.

Review checks

- Verifiability
  - Is the requirement realistically testable?
- Comprehensibility
  - Is the requirement properly understood?
- Traceability
  - Is the origin of the requirement clearly stated?
- Adaptability
  - Can the requirement be changed without a large impact on other requirements?

Summary

- What software requirements are
- How to write requirements
- Good practices
- Elicitation
- Validation