# الجامعة المستنصرية / كلية العلوم
# قسم علوم الحاسوب


# OOSE

OBJECT-ORIENTED SOFTWARE ENGINEERING

4

## CHAPTER 4

# Developing Requirements

# 2.10 Difficulties and Risks in Object-Oriented Programming

- Language evolution and deprecated features:
  - Java is evolving, so some features are 'deprecated' at every release
  - But the same thing is true of most other languages

- Efficiency can be a concern in some object oriented systems
  - Java can be less efficient than other languages
    - VM-based
    - Dynamic binding

# 4.1 Domain Analysis

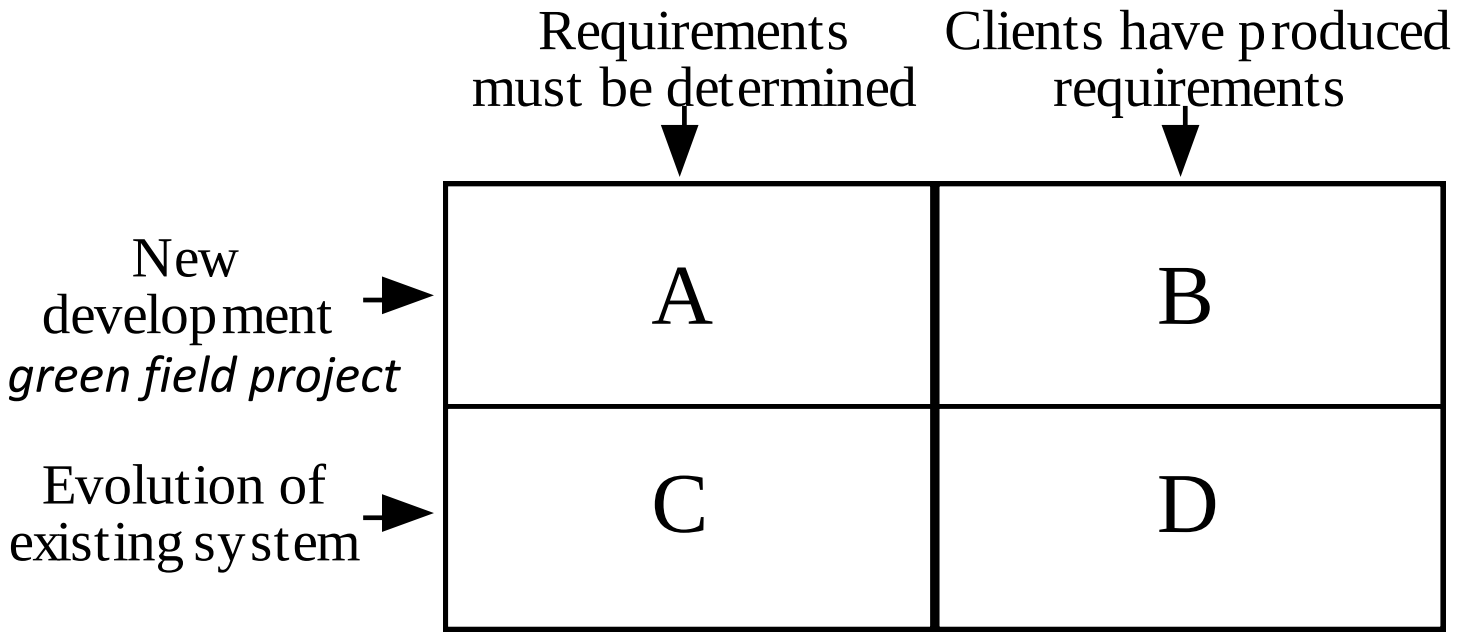
- The process by which a software engineer learns about the domain to better understand the problem:
  - The *domain* is the general field of business or technology in which the clients will use the software
  - A *domain expert* is a person who has a deep knowledge of the domain

- Benefits of performing domain analysis:
  - Faster development
  - Better system
  - Anticipation of extensions

# Domain Analysis document

A. Introduction
B. Glossary
C. General knowledge about the domain
D. Customers and users
E. The environment
F. Tasks and procedures currently performed
G. Competing software
H. Similarities to other domains

# 4.2 The Starting Point for Software Projects



# 4.3 Defining the Problem and the Scope

- A problem can be expressed as:
  - A *difficulty* the users or customers are facing,
  - Or as an *opportunity* that will result in some benefit such as improved productivity or sales.

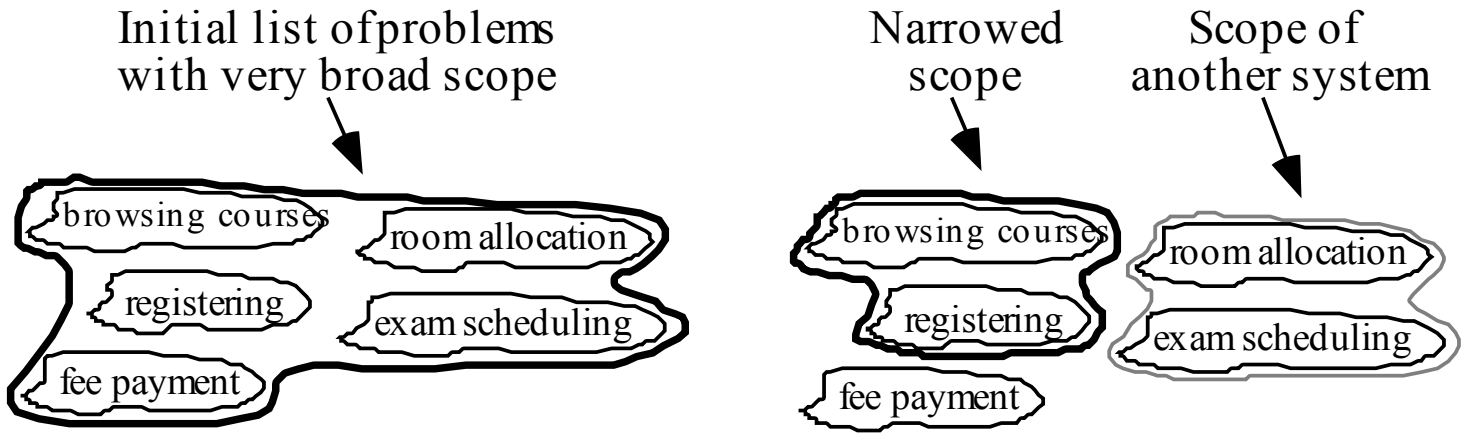
- The solution to the problem normally will entail developing software

- A good problem statement is short and succinct

# Defining the Scope

- Narrow the *scope* by defining a more precise problem
  - List all the things you might imagine the system doing
    - Exclude some of these things if too broad
    - Determine high-level goals if too narrow

- Example: A university registration system



# 4.4 What is a Requirement ?

- It is a statement describing either
  - 1) an aspect of what the proposed system must do,
  - or 2) a constraint on the system's development.
  - In either case it must contribute in some way towards solving the customer's problem;
  - the set of requirements as a whole represents a negotiated agreement among the stakeholders.

- A collection of requirements is a *requirements document*.

# 4.5 Types of Requirements

- Functional requirements
  - Describe *what* the system should do
- Quality requirements
  - *Constraints* on the design to meet specified levels of quality
- Platform requirements
  - *Constraints* on the environment and technology of the system
- Process requirements
  - *Constraints* on the project plan and development methods

# Functional Requirements

- What *inputs* the system should accept
- What *outputs* the system should produce
- What data the system should *store* that other systems might use
- What *computations* the system should perform
- The *timing and synchronization* of the above

# Quality Requirements

- All must be verifiable
- Examples: Constraints on
  - Response time
  - Throughput
  - Resource usage
  - Reliability
  - Availability
  - Recovery from failure
  - Allowances for maintainability and enhancement
  - Allowances for reusability

# 4.6 Use-Cases: describing how the user will use the system

- A *use case* is a typical sequence of actions that a user performs in order to complete a given task
  - The objective of *use case analysis* is to model the system from the point of view of

    … how users interact with this system

    … when trying to achieve their objectives.

    It is one of the key activities in requirements analysis
  - A *use case model* consists of
    - a set of use cases
    - an optional description or diagram indicating how they are related

# Use cases

- A use case should
  - Cover the *full sequence of steps* from the beginning of a task until the end.
  - Describe the *user's interaction* with the system ...
    - Not the computations the system performs.
  - Be written so as to be as *independent* as possible from any particular user interface design.
  - Only include actions in which the actor interacts with the computer.
    - Not actions a user does manually

# Scenarios

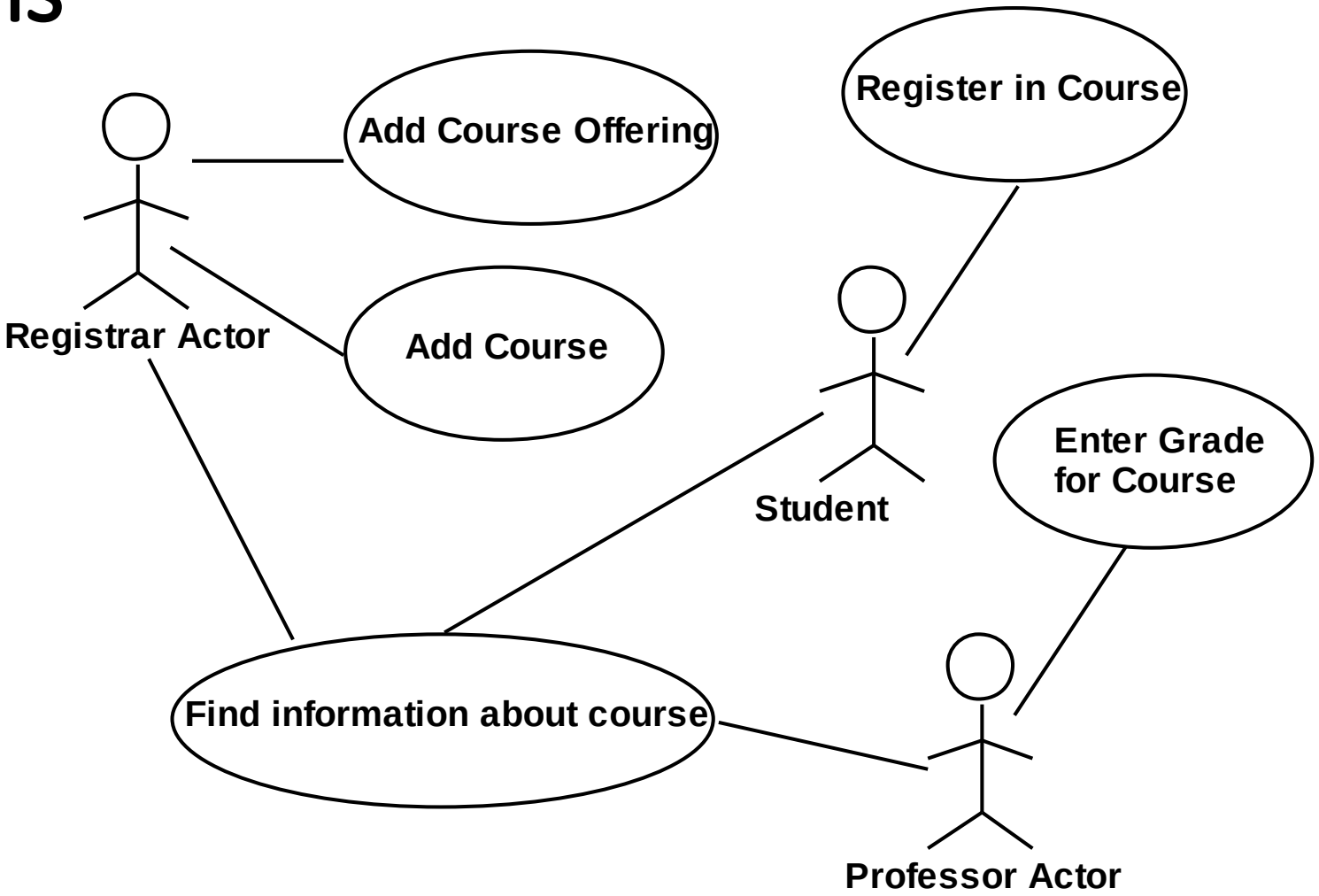
- A scenario is an *instance* of a use case
  - A *specific occurrence* of the use case
    - a specific actor ...
    - at a specific time ...
    - with specific data.

# How to describe a single use case

- **A. Name**: Give a short, descriptive name to the use case.
- **B. Actors**: List the actors who can perform this use case.
- **C. Goals**: Explain what the actor or actors are trying to achieve.
- **D. Preconditions**: State of the system before the use case.
- **E. Summary**: Give a short informal description.
- **F. Related use cases**.
- **G. Steps**: Describe each step using a 2-column format.
- **H. Postconditions**: State of the system in following completion.

- A and G are the most important

# Use case diagrams



# Extensions

- Used to make *optional* interactions explicit or to handle *exceptional* cases.
- Keep the description of the basic use case simple.

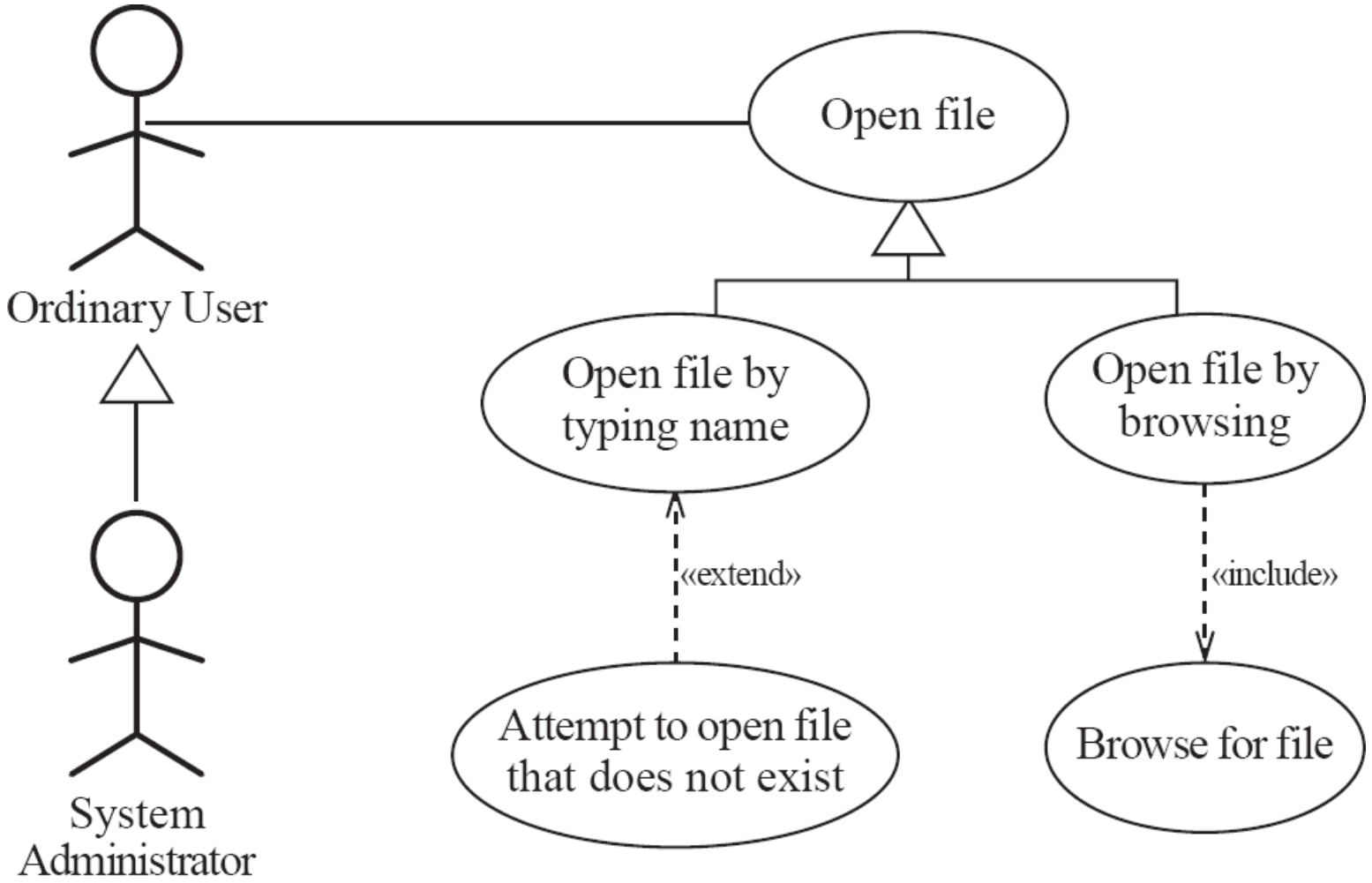
# Generalizations

- Much like superclasses in a class diagram.
- A generalized use case represents *several similar* use cases.
- One or more specializations provides details of the similar use cases.

# Inclusions

- Allow one to express *commonality* between several different use cases.
- Are included in other use cases
  - Even very different use cases can share sequence of actions.
  - Enable you to avoid repeating details in multiple use cases.
- Represent the performing of a *lower-level task* with a lower-level goal.

# Example of generalization, extension and inclusion



# Example description of a use case

**Use case**: **Open file**

**Related use cases:**
Generalization of:
• Open file by typing name
• Open file by browsing

**Steps**:

| **Actor actions** | **System responses** |
| --- | --- |
| 1. Choose ‘Open…’ command | 2. File open dialog appears |
| 3. Specify filename | |
| 4. Confirm selection | 5. Dialog disappears |

# Example (continued)

**Use case**: **Open file by typing name**

**Related use cases:**
Specialization of: Open file

**Steps**:

| **Actor actions** | **System responses** |
|---|---|
| 1. Choose ‘Open…’ command | 2. File open dialog appears |
| 3a. Select text field | |
| 3b. Type file name | |
| 4. Click ‘Open’ | 5. Dialog disappears |

# Example (continued)

**Use case**: **Open file by browsing**

**Related use cases:**
Specialization of: Open file
Includes: Browse for file

**Steps**:

| **Actor actions** | **System responses** |
| --- | --- |
| 1. Choose ‘Open…’ command | 2. File open dialog appears |
| 3. Browse for file | |
| 4. Confirm selection | 5. Dialog disappears |

# Example (continued)

**Use case**: **Attempt to open file that does not exist**

**Related use cases:**
Extension of: Open file by typing name

| **Actor actions** | **System responses** |
| --- | --- |
| 1. Choose ‘Open…’ command | 2. File open dialog appears |
| 3a. Select text field | |
| 3b. Type file name | |
| 4. Click ‘Open’ | 5. System indicates that file does not exist |
| 6. Correct the file name | |
| 7. Click ‘Open’ | 8 Dialog disappears |

# Example (continued)

**Use case**: **Browse for file (inclusion)**

**Steps**:

| **Actor actions** | **System responses** |
| --- | --- |
| 1. If the desired file is not displayed, select a directory | 2. Contents of directory is displayed |
| 3. Repeat step 1 until the desired file is displayed | |
| 4. Select a file | |

# The modeling processes: Choosing use cases on which to focus

- Often one use case (or a very small number) can be identified as *central* to the system
  - The entire system can be built around this particular use case
- There are other reasons for focusing on particular use cases:
  - Some use cases will represent a high *risk* because for some reason their implementation is problematic
  - Some use cases will have high political or commercial value

# The benefits of basing software development on use cases

- They can
  - Help to define the *scope* of the system
  - Be used to *plan* the development process
  - Be used to both develop and validate the requirements
  - Form the basis for the definition of test cases
  - Be used to structure user manuals

# Use cases must not be seen as a panacea

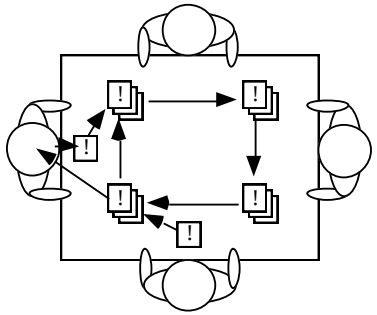
- The use cases themselves must be validated
  - Using the requirements validation methods.
- Some aspects of software are not covered by use case analysis.
- Innovative solutions may not be considered.

# 4.7 Some Techniques for Gathering and Analysing Requirements

- Observation
  - Read documents and discuss requirements with users
  - Shadowing important potential users as they do their work
    - ask the user to explain everything he or she is doing
  - Session videotaping
- Interviewing
  - Conduct a series of interviews
    - Ask about specific details
    - Ask about the stakeholder's vision for the future
    - Ask if they have alternative ideas
    - Ask for other sources of information
    - Ask them to draw diagrams

# Gathering and Analysing Requirements...

- Brainstorming
  - Appoint an experienced moderator
  - Arrange the attendees around a table
  - Decide on a ‘trigger question’
  - Ask each participant to write an answer and pass the paper to its neighbour



- *Joint Application Development (JAD)* is a technique based on intensive brainstorming sessions

# Gathering and Analysing Requirements…

- Prototyping
  - The simplest kind: *paper prototype*.
    - a set of pictures of the system that are shown to users in sequence to explain what would happen
  - The most common: a mock-up of the system's UI يسخر يصل
    - Written in a rapid prototyping language
    - Does *not* normally perform any computations, access any databases or interact with any other systems
    - May prototype a particular aspect of the system

# Gathering and Analysing Requirements…

- Use case analysis
  - Determine the classes of users that will use the facilities of this system (actors)
  - Determine the tasks that each actor will need to do with the system

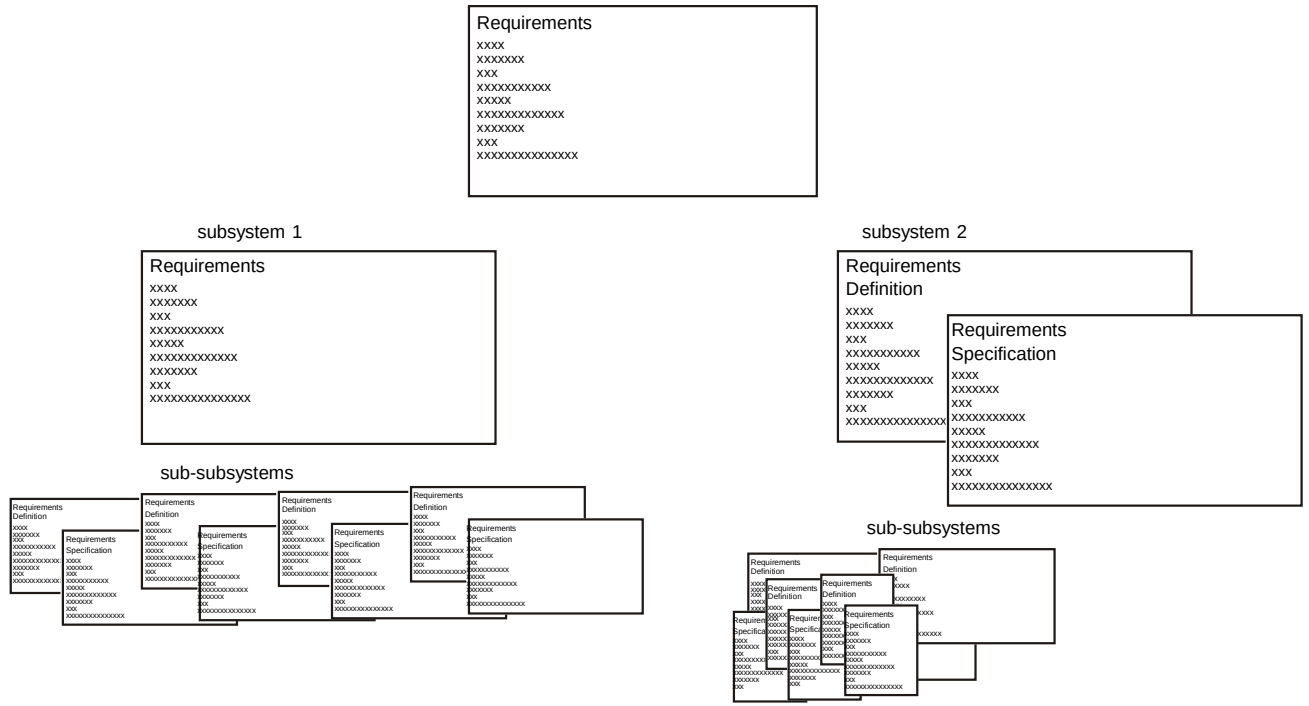
# 4.8 Types of Requirements Document

Two extremes:

An informal outline of the requirements using a few paragraphs or simple diagrams
requirements *definition*

A long list of specifications that contain thousands of pages of intricate detail
requirements *specification*

- Requirements documents for large systems are normally arranged in a hierarchy



# Level of detail required in a requirements document

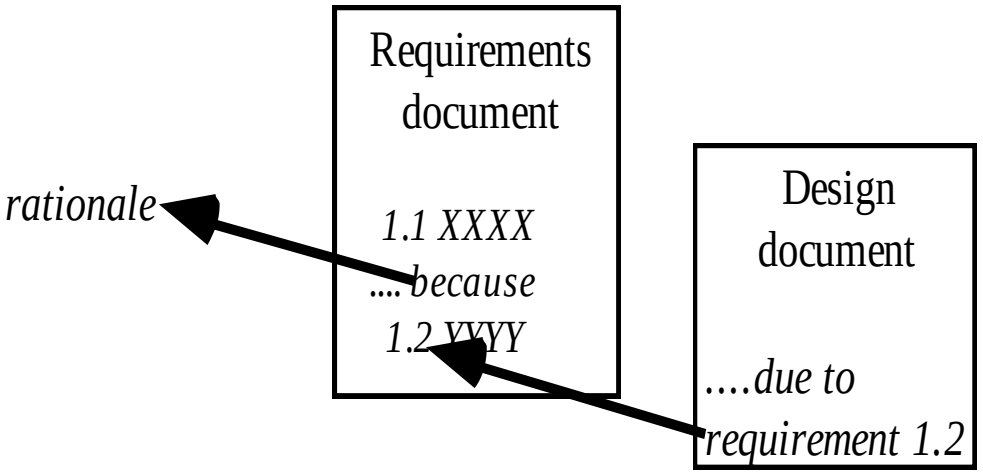
- How much detail should be provided depends on:
  - The size of the system
  - The need to interface to other systems
  - The stage in requirements gathering
  - The level of experience with the domain and the technology
  - The cost that would be incurred if the requirements were faulty

# 4.9 Reviewing Requirements

- **Each individual requirement should**
  - Have **benefits that outweigh the costs** of development
  - Be **important** for the solution of the current problem
  - Be expressed using a **clear and consistent notation**
  - Be **unambiguous**
  - Be **logically consistent**
  - Lead to a system of **sufficient quality**
  - Be **realistic** with available resources
  - Be **verifiable**
  - Be uniquely **identifiable**
  - **Does not over-constrain the design** of the system

# Requirements documents…

- The document should be:
  - sufficiently complete
  - well organized
  - clear
  - agreed to by all the stakeholders
- Traceability:



# Requirements document...

A. **Problem**
B. **Background information**
C. **Environment and system models**
D. **Functional Requirements**
E. **Non-functional requirements**

# 4.10 Managing Changing Requirements

- Requirements change because:
  - Business process changes
  - Technology changes
  - The problem becomes better understood

- Requirements analysis never stops
  - Continue to interact with the clients and users
  - The benefits of changes must outweigh the costs.
    - Certain small changes (e.g. look and feel of the UI) are usually quick and easy to make at relatively little cost.
    - Larger-scale changes have to be carefully assessed
      - Forcing unexpected changes into a partially built system will probably result in a poor design and late delivery
  - Some changes are enhancements in disguise تمويه
    - Avoid making the system *bigger*, only make it *better*

# 4.13 Difficulties and Risks in Domain and Requirements Analysis

- Lack of understanding of the domain or the real problem
  - *Do domain analysis and prototyping*
- Requirements change rapidly
  - *Perform incremental development, build flexibility into the design, do regular reviews*
- Attempting to do too much
  - *Document the problem boundaries at an early stage, carefully estimate the time*
- It may be hard to reconcile conflicting sets of requirements
  - *Brainstorming, JAD sessions, competing prototypes*
- It is hard to state requirements precisely
  - *Break requirements down into simple sentences and review them carefully, look for potential ambiguity, make early prototypes*

# طرق الوقايا من فايروس كورونا

احرص دائما على تطهير يديك بعد
ملامسة الأسطح في الأماكن العامة

غسل اليدين بالماء والصابون لمدة
لا تقل عن 20 ثانية بشكل متكرر

عند السعال والعطس قم بوضع منديل
والتخلص منه عند الإنتهاء في سلة المهملات

ارتدِ قناعا واقيا كإجراء وقائي
في المستشفيات والأماكن المغلقة

قم بتطهير وتنظيف الأسطح التي تلامسها بشكل مُتكرر