

Object-Oriented Software Engineering

Practical Software Development using UML and Java

Chapter 7: Focusing on Users and Their Tasks

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7.1 User Centred Design

Software development should focus on the needs of users

Understand your users

Design software based on an understanding of the users' tasks

Ensure users are involved in decision making processes

Design the user interface following guidelines for good usability

Have users work with and give their feedback about prototypes, on-line help and draft user manuals

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The importance of focusing on users

Reduced training and support costs

Reduced time to learn the system

Greater efficiency of use

Reduced costs by only developing features that are needed

Reduced costs associated with changing the system later

Better prioritizing of work for iterative development

Greater attractiveness of the system, so users will be more willing to buy and use it

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7.2 Characteristics of Users

Software engineers must develop an understanding of the users

Goals for using the system

Potential patterns of use

Demographics

Knowledge of the domain and of computers

Physical ability

Psychological traits and emotional feelings

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7.3 Developing Use-Case Models of Systems

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.

A *use case model* consists of

- a set of use cases
- an optional description or diagram indicating how they are related

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Use cases

In general, a use case should cover the *full sequence of steps* from the beginning of a task until the end.

A use case should describe the *user's interaction* with the system ...

—not the computations the system performs.

A use case should be written so as to be as *independent* as possible from any particular user interface design.

A use case should only include actions in which the actor interacts with the computer.

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Scenarios

A scenario is an *instance* of a use case

It expresses a *specific occurrence* of the use case

- a specific actor ...
- at a specific time ...
- with specific data.

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How to describe a single use case

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

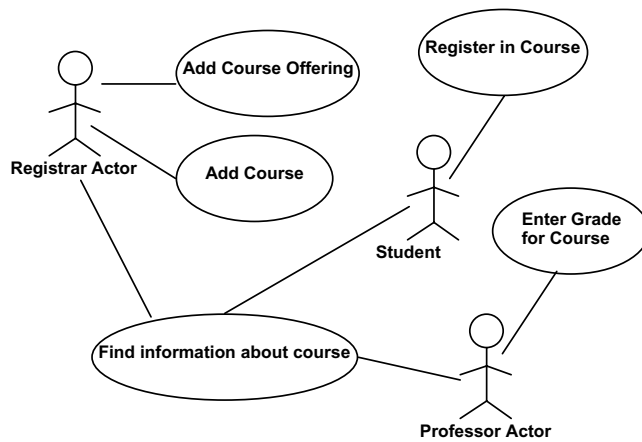
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Use case diagrams



Extensions

Used to make *optional* interactions explicit or to handle *exceptional cases*.

By creating separate use case extensions, the description of the basic use case remains simple.

A use case extension must list all the steps from the beginning of the use case to the end.

—Including the handling of the unusual situation.

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.

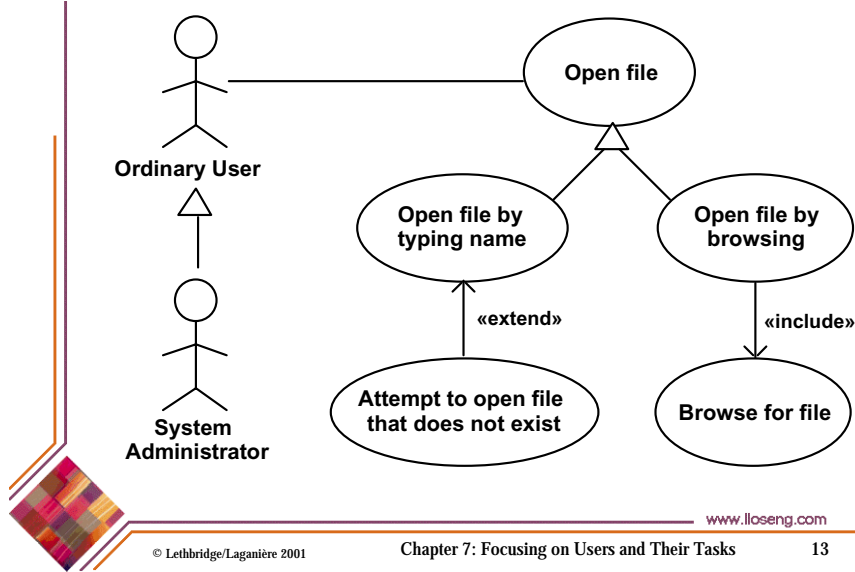
Are included in other use cases

—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

1. Choose 'Open...' command
3. Specify filename
4. Confirm selection

System responses

2. File open dialog appears
5. Dialog disappears

Example (continued)

Use case: Open file by typing name

Related use cases:

Specialization of: Open file

Steps:

Actor actions

1. Choose 'Open...' command
- 3a. Select text field
- 3b. Type file name
4. Click 'Open'

System responses

2. File open dialog appears
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

1. Choose 'Open...' command
3. Browse for file
4. Confirm selection

System responses

2. File open dialog appears
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

1. Choose 'Open...' command
- 3a. Select text field
- 3b. Type file name
4. Click 'Open'
6. Correct the file name
7. Click 'Open'

System responses

2. File open dialog appears
5. System indicates that file does not exist
- 8 Dialog disappears

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Example (continued)

Use case: Open file by browsing (inclusion)

Steps:

Actor actions

1. If the desired file is not displayed, select a directory
3. Repeat step 1 until the desired file is displayed
4. Select a file

System responses

2. Contents of directory is displayed

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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

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The benefits of basing software development on use cases

They can help to define the *scope* of the system

They are often used to *plan* the development process

They are used to both develop and validate the requirements

They can form the basis for the definition of testcases

They can be used to structure user manuals

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Use cases must not be seen as a panacea

The use cases themselves must be validated
—Using the requirements validation methods.

There are some aspects of software that are not covered by use case analysis.

Innovative solutions may not be considered.

7.4 Basics of User Interface Design

User interface design should be done in conjunction with other software engineering activities.

Do use case analysis to help define the tasks that the UI must help the user perform.

Do *iterative* UI prototyping to address the use cases.

Results of prototyping will enable you to finalize the requirements.

Usability vs. Utility

Does the system provide the *raw capabilities* to allow the user to achieve their goal?

This is *utility*.

Does the system allow the user to *learn and to use* the raw capabilities *easily*?

This is *usability*.

Both utility and usability are essential

They must be measured in the context of particular types of users.

Aspects of usability

Usability can be divided into separate aspects:

Learnability

—The speed with which a new user can become proficient with the system.

Efficiency of use

—How fast an expert user can do their work.

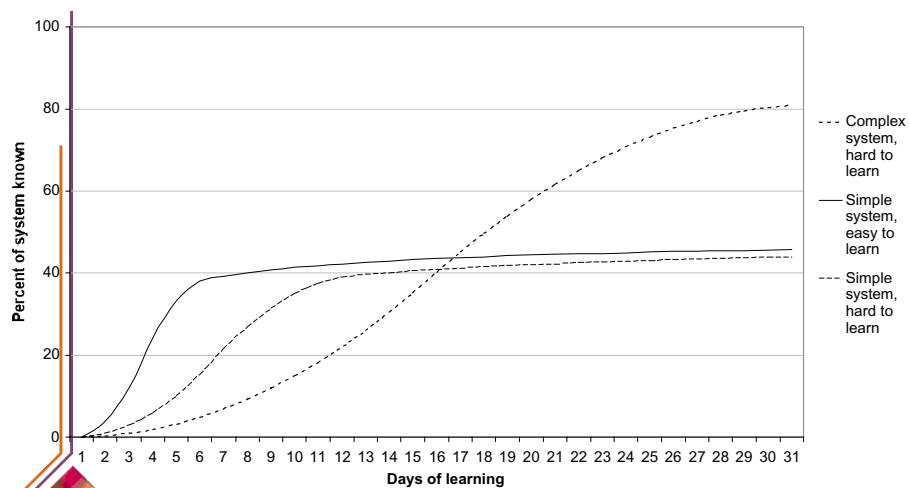
Error handling

—The extent to which it prevents the user from making errors, detects errors, and helps to correct errors.

Acceptability.

—The extent to which users *like* the system.

Different learning curves



Some basic terminology of user interface design

Dialog: A specific window with which a user can interact, but which is not the main UI window.

Control or Widget: Specific components of a user interface.

Affordance: The set of operations that the user can do at any given point in time.

State: At any stage in the dialog, the system is displaying certain information in certain widgets, and has a certain affordance.

Mode: A situation in which the UI restricts what the user can do.

Modal dialog: A dialog in which the system is in a very restrictive mode.

Feedback: The *response from the system* whenever the user does something, is called feedback.

Encoding techniques. Ways of encoding information so as to communicate it to the user.

6.5 Usability Principles

1. Do not rely only on usability guidelines – *always test with users*.
Usability guidelines have exceptions; you can only be confident that a UI is good if you test it successfully with users.
- 2: Base UI designs on users' *tasks*.
Perform use case analysis to structure the UI.
- 3: Ensure that the sequences of actions to achieve a task are as *simple* as possible.
Reduce the amount of reading and manipulation the user has to do.
Ensure the user does not have to navigate anywhere to do subsequent steps of a task.

Usability Principles

- 4: Ensure that the user always knows what he or she can and should do next.
Ensure that the user can see *what commands are available* and are not available.
Make the *most important commands stand out*.
- 5: Provide good feedback including effective error messages.
Inform users of the *progress* of operations and of their *location* as they navigate.
When something goes wrong explain the situation in adequate detail and *help the user to resolve the problem*.

Usability Principles

6: Ensure that the user can always get out, go back or undo an action.

Ensure that all operations can be *undone*.

Ensure it is easy to *navigate back* to where the user came from.

7: Ensure that response time is adequate.

Users are very sensitive to slow response time

—They compare your system to others.

Keep response time less than a second for most operations.

Warn users of longer delays and inform them of progress.

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Usability Principles

8: Use *understandable encoding techniques*.

Choose encoding techniques with care.

Use labels to ensure all encoding techniques are fully understood by users.

9: Ensure that the UI's appearance is *uncluttered*.

Avoid displaying too much information.

Organize the information effectively.

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Usability Principles

10: Consider the needs of *different groups* of users.

Accommodate people from different *locales* and people with *disabilities*.

Ensure that the system is usable by both *beginners* and *experts*.

11: Provide all necessary *help*.

Organize help well.

Integrate help with the application.

Ensure that the help is accurate.

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Usability Principles

12. Be *consistent*.

Use similar layouts and graphic designs throughout your application.

Follow look-and-feel standards.

Consider mimicking other applications.

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Some encoding techniques

- Text and fonts
- Icons
- Photographs
- Diagrams and abstract graphics
- Colours
- Grouping and bordering
- Spoken words
- Music
- Other sounds
- Animations and video
- Flashing

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Example (bad UI)



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Example (better UI)



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7.6 Evaluating User Interfaces

Heuristic evaluation

1. Pick some use cases to evaluate.
2. For each window, page or dialog that appears during the execution of the use case
 - Study it in detail to look for possible usability defects.
3. When you discover a usability defect write down the following information:
 - A short description of the defect.
 - Your ideas for how the defect might be fixed.

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Evaluating User Interfaces

Evaluation by observation of users

- Select users corresponding to each of the most important actors
- Select the most important use cases
- Write sufficient instructions about each of the scenarios
- Arrange evaluation sessions with users
- Explain the purpose of the evaluation
- Preferably videotape each session
- Converse with the users as they are performing the tasks
- When the users finish all the tasks, de-brief them
- Take note of any difficulties experienced by the users
- Formulate recommended changes

7.7 Implementing a Simple GUI in Java

The Abstract Window Toolkit (AWT)

Component: the basic building blocks of any graphical interface.

- Button, TextField, List, Label, ScrollBar.

Container: contain the components constituting the GUI

- Frame, Dialog and Panel

LayoutManager: define the way components are laid out in a container.

- GridLayout, BorderLayout

Example



```
public class ClientGUI
    extends Frame implements ChatIF
{
    private Button closeB = new Button("Close");
    private Button openB = new Button("Open");
    private Button sendB = new Button("Send");
    private Button quitB = new Button("Quit");
    private TextField portTxF = new TextField("");
    private TextField hostTxF = new TextField("");
    private TextField message = new TextField();
    private Label portLB =
        new Label("Port: ", Label.RIGHT);
    private Label hostLB =
        new Label("Host: ", Label.RIGHT);
    private Label messageLB =
        new Label("Message: ", Label.RIGHT);
    private List messageList = new List();
    ...
}
```

Example

```
public ClientGUI(String host, int port)
{
    super("Simple Chat");
    setSize(300,400);
    setVisible(true);

    setLayout(new BorderLayout(5,5));
    Panel bottom = new Panel();
    add("Center", messageList);
    add("South", bottom);
    bottom.setLayout(new GridLayout(5,2,5,5));
    bottom.add(hostLB);
    bottom.add(hostTxF);
    bottom.add(portLB);
    bottom.add(portTxF);
    bottom.add(messageLB);
    bottom.add(message);
    bottom.add(openB);
    bottom.add(sendB);
    bottom.add(closeB);
    bottom.add(quitB);
}
```

Example

```
sendB.addActionListener(new ActionListener() {
    public void actionPerformed (ActionEvent e)
    {
        send();
    }
});

public void send()
{
    try
    {
        client.sendToServer(message.getText());
    }
    catch (Exception ex)
    {
        messageList.add(ex.toString());
        messageList.setVisible(messageList.getItemCount()-1);
        messageList.setBackground(Color.yellow);
    }
}
```

7.8 Difficulties and Risks in Use Case Modelling and UI Design

Users differ widely

- *Account for differences among users when you design the system.*
- *Design it for internationalization.*
- *When you perform usability studies, try the system with many different types of users.*

User interface implementation technology changes rapidly

- *Stick to simpler UI frameworks widely used by others.*
- *Avoid fancy and unusual UI designs involving specialized controls that will be hard to change.*

Difficulties and Risks in Use Case Modelling and UI Design

User interface design and implementation can often take the majority of work in an application:

- *Make UI design an integral part of the software engineering process.*
- *Allocate time for many iterations of prototyping and evaluation.*

Developers often underestimate the weaknesses of a GUI

- *Ensure all software engineers have training in UI development.*
- *Always test with users.*
- *Study the UIs of other software.*