



# Chapter 11: User Interface Design (Part 1 - Foundations & Analysis)

Subject: Software Engineering

**Program:** BTech Computer Science and Engineering

**Duration:** 1 Hour

# Introduction to User Interface (UI) Design

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## Beyond Functionality

Making Software Usable, Intuitive, and Efficient

Lecture Introduction & Objectives

# The Tale of Two Interfaces

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## The Worst Software



Think of the most frustrating app or program you've used.

- Why was it terrible?
- Painful?
- Confusing?
- Inefficient?

## The Best Software



Think of the most seamless app you use.

- It feels intuitive—like an extension of your own thoughts.

**The Difference: That difference is User Interface (UI) Design.**

# The Core Philosophy

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## Usability > Aesthetics

### Misconception vs. Reality



**Misconception:** UI Design is just about “making things pretty.”



**Reality:** UI Design is about making things usable.

### The Risk



Bad UI can doom even technically perfect software. If the user can't figure out how to use the feature, the feature might as well not exist.

# Learning Objectives

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By the end of this lecture, you will be able to:



## Apply the Rules

Apply the Three Golden Rules of UI design to evaluate and improve interfaces.



## Understand the Models

Describe the four models involved in UI analysis and design (User, Design, Mental, Implementation).



## Conduct Analysis

Perform key interface analysis activities:

- **User Analysis:** Who are they?
- **Task Analysis:** What are they trying to do?
- **Content & Environment:** Where and with what data are they working?

The background features a dark blue gradient with a subtle pattern of small white stars. On the left side, there is a complex, abstract golden line art design. It consists of numerous thin, curved lines that flow from the top left towards the bottom right, creating a sense of movement and depth. Some lines are thicker and more prominent, while others are thin and delicate. A small, solid golden circle is positioned on one of the lines in the lower-left quadrant.

Part 1: The Golden Rules

# Timeless Principles of UI Design

Source: Articulated by Theo Mandel

Focus: The ethical and practical foundation of all good interface design.



# Rule 1 - Place the User in Control

**Philosophy:** The User is the Actor; the System is the Reactor.

**Goal:** Design for user initiative, not system constraint.

## Key Strategies:

- **Define Flexible Interaction:** Allow choice in interaction modes (Keyboard shortcuts vs. Mouse vs. Voice).
- **Allow User Interruption:** Let users stop mid-stream without losing work (e.g., "Cancel" button, "Undo" function).
- **Streamline Skill Migration:**
  - Novices: Wizards, prompts.
  - Experts: Macros, shortcuts.
  - Allow users to grow from novice to expert.



# Rule 1 (Continued) - Hiding the Internals

## The "Black Box" Approach

### Hide Technical Internals:

- Database schemas.
- APIs or Algorithms.
- File system structures.

### Design for Direct Interaction:

Make screen objects behave like real-world objects.

Example: Drag-and-drop files, direct manipulation of sliders.

The background features a dark blue, starry sky with numerous small white stars. Overlaid on this are intricate, glowing golden lines that form a complex, organic pattern. These lines start as straight vertical lines on the left and curve and flow towards the right, creating a sense of movement and depth. Some lines are thicker and more prominent, while others are thin and delicate. The overall effect is a futuristic and artistic digital landscape.

## Rule 2 – Reduce the User's Memory Load

**Philosophy:** Recognition is better than Recall.

**Goal:** Don't force the user to remember information from one screen to the next.

### **Key Strategies:**

- **Reduce Short-Term Load:** Keep displays simple; consolidate multiple pages where possible.
- **Establish Meaningful Defaults:** Provide sensible, pre-filled choices that users can simply accept or override.
- **Define Intuitive Shortcuts:** Use mnemonics (e.g., Ctrl+C for Copy, where "C" is meaningful) rather than arbitrary keys.

# Rule 2 (Continued) - Presentation & Metaphors

## Making it Familiar

### Disclose Information progressively:

- Don't dump everything at once.
- Use Layered Presentation (e.g., An overview card that expands for details).

### Use Real-World Metaphors:

- Leverage existing knowledge.
- Examples: Desktop, Trash Can, Shopping Cart, Folder.



# Rule 3 - Make the Interface Consistent

## The Most Violated Rule

**Philosophy:** A user should never wonder if different words, situations, or actions mean the same thing.

### Four Levels of Consistency:

- **Navigation:** Menus, buttons, and links are in predictable places.
- **Terminology:** The same label means the same thing everywhere (e.g., Don't mix "Client" and "Customer").
- **Visual Design:** Consistent use of color, fonts, icons, and layout.
- **Effect:** Similar actions should yield similar results.

# In-Class Activity: Think-Pair-Share - Analyzing Our Reality

**Target:** Our College ERP / Student Login Portal.

**Task:** Analyze the portal using one of the Golden Rules.

- Does it **place you in control?** (Can you undo?)
- Does it **reduce memory load?** (Do you have to copy-paste data between screens?)
- Is it **consistent?** (Do the "Submit" buttons look the same?)

**Output:** Identify one thing it does well or one thing it does poorly.

**Time:** 3 Minutes. 



# Part 2: The UI Analysis & Design Process

## Section 11.2

**Focus:** Reconciling the User's Mind with the Designer's Blueprint

**Context:** Moving from Golden Rules to actionable Process.

# Interface Analysis and Design Models

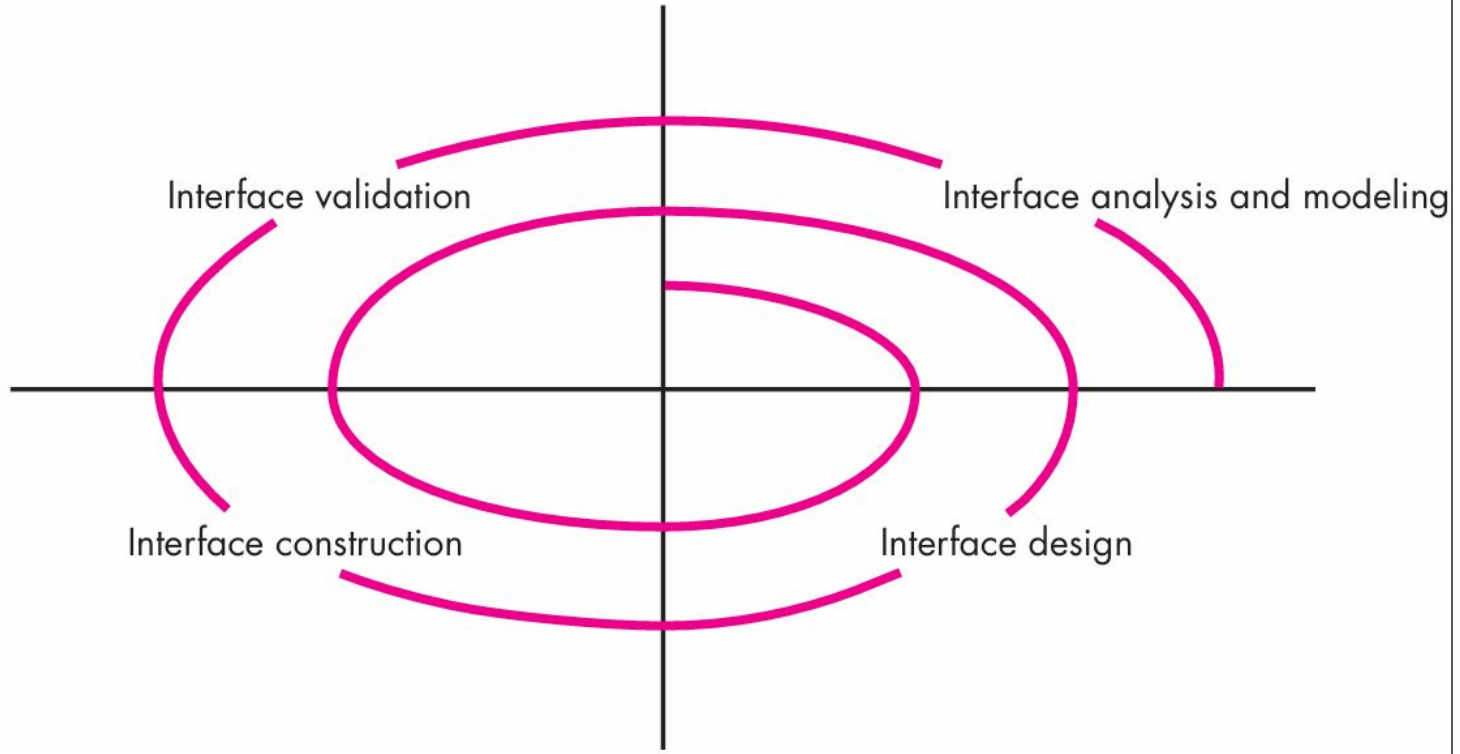
## Four Distinct Models

To succeed, we must reconcile these conflicting perspectives:

- **User Model:**  
The profile of who is using the system (Novice, Expert, etc.).
- **User's Mental Model:**  
The user's perception of how the system works.  
Note: Often incomplete, based solely on their specific tasks.
- **Design Model:**  
The designer's conceptualization of the system.
- **System Image (Implementation Model):**  
What is actually presented to the user via the interface and documentation.

**FIGURE 11.1**

**The user  
interface  
design process**



The analysis and design process for user interfaces is iterative and can be represented using a spiral model similar to the one discussed in Chapter 2. Referring to Figure 11.1, the user interface analysis and design process begins at the interior of the spiral and encompasses four distinct framework activities [Man97]: (1) interface analysis and modeling, (2) interface design, (3) interface construction, and (4) interface validation. The spiral shown in Figure 11.1 implies that each of these tasks will occur more than once, with each pass around the spiral representing additional elaboration of requirements and the resultant design. In most cases, the construction activity involves prototyping—the only practical way to validate what has been designed.



# The Goal of UI Design

## **Bridging the Gap**

### **The Conflict:**

The user thinks the system works one way (Mental Model). The system actually works another way (Implementation Model).

### **The Goal:**

To make the System Image match the User's Mental Model as closely as possible.

### **The Blueprint:**

The Design Model is the bridge we build to achieve this alignment.

# The UI Design Process

## Iterative & Parallel

UI design is not a single step; it runs parallel to software engineering.

## High-Level Steps:

- **Interface Analysis & Modeling:** Focus of Today. Understanding users, tasks, content, and environment.
- **Interface Design:** Next Lecture. Defining screen layouts, interaction modes, and navigation.
- **Interface Construction:** Implementing the design using tools.
- **Interface Validation:** Testing with real users to verify the models match.



# Part 3: Interface Analysis

## Section 11.3

### Focus: Understanding the Context

#### Philosophy:

“Before you design a single button, you must understand.”

# User Analysis

## Section 11.3.1: Who are they?

### Goal:

To understand the people who will use the system.

### Key Questions:

- Roles: Student, Admin, Manager?
- Characteristics: Age, education, technical proficiency, physical abilities.
- Goals: Why will they use the system?
- Frequency: Casual vs. Power User.

### Output:

User Personas (Fictional, archetypal users with names, pictures, and detailed characteristics).

# Task Analysis and Modeling

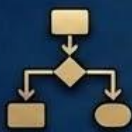
## Section 11.3.2: The Heart of UI Analysis

### Goal:



- To understand the specific work the user needs to accomplish.

### Techniques:



**Task Elaboration:** Refine high-level tasks into finer-grained subtasks (e.g., "Place Order" → "Add Item" → "Checkout").



**Object-Oriented Analysis:** Identify objects (e.g., ShoppingCart, Invoice) and actions performed on them.



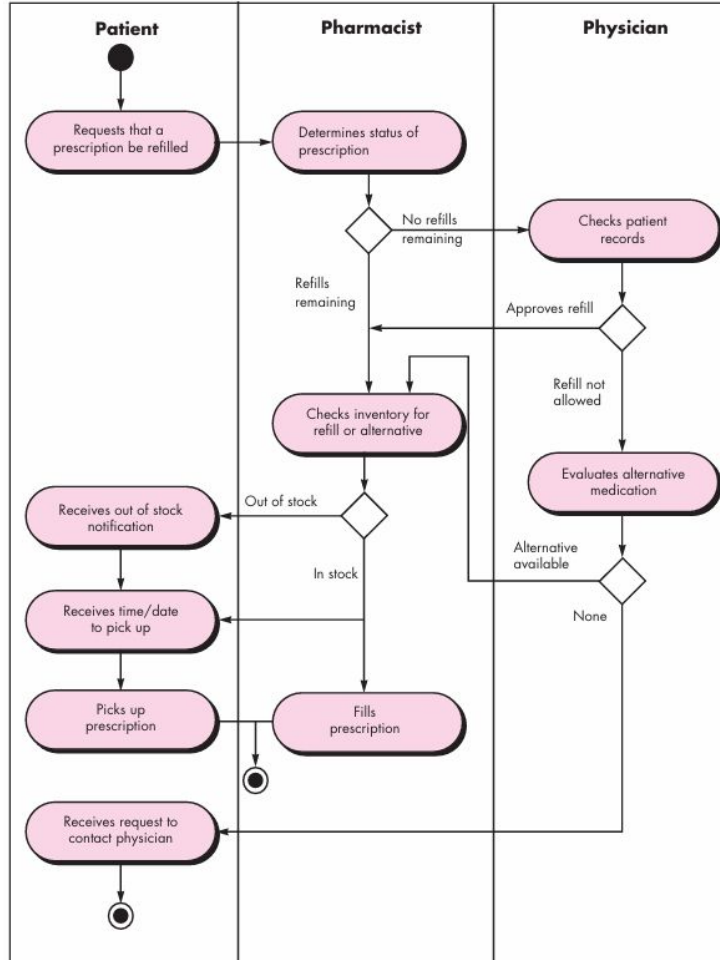
**Workflow Analysis:** Model how a task passes from one user role to another (e.g., Employee → Manager).

### Insight:



The UI should be structured around the User's Tasks, not the System's Database.

**FIGURE 11.2** Swimlane diagram for prescription refill function



We consider only a small part of the work process: the situation that occurs when a patient asks for a refill. Figure 11.2 presents a swimlane diagram that indicates the tasks and decisions for each of the three roles noted earlier. This information may have been elicited via interview or from use cases written by each actor. Regardless, the flow of events (shown in the figure) enables you to recognize a number of key interface characteristics:

1. Each user implements different tasks via the interface; therefore, the look and feel of the interface designed for the patient will be different than the one defined for pharmacists or physicians.
2. The interface design for pharmacists and physicians must accommodate access to and display of information from secondary information sources (e.g., access to inventory for the pharmacist and access to information about alternative medications for the physician).
3. Many of the activities noted in the swimlane diagram can be further elaborated using task analysis and/or object elaboration (e.g., *Fills prescription* could imply a mail-order delivery, a visit to a pharmacy, or a visit to a special drug distribution center).

# Analysis of Display Content

## Section 11.3.3: Presenting Information

### Goal:



- Define what information needs to be presented at each point.

### Questions:



**Data Objects:** What does the user need to see? (e.g., Order Total, Delivery Date).



**Visual Hierarchy:** What is the most important piece of information?



**Computed Data:** Must raw data be computed? (e.g., Show “Tomorrow” instead of “2023-10-12”).



**Format:** Text, Graph, Table, or Icon?

# Analysis of the Work Environment

## Section 11.3.4: Context Matters

### Goal:



- Understand the physical and social context.

### Factors:



**Physical:** Lighting, Noise, Space constraints. (Factory floor vs. Quiet office).



**Social:** Time pressure? Public interaction? Interruptions?



**Technical:** Platform constraints (Screen size, Network speed).

### Why it matters:



An interface designed for a calm, large-monitor office will fail on a noisy construction site tablet.

# Case Study: Self-Checkout Kiosk

## Applying the Analysis

### User Analysis

- Varied technical skill (Grandma vs. Techie).
- Likely in a hurry.

### Task Analysis

- Core:
  - Scan items,
  - Pay.
- Subtasks:
  - Weigh produce,
  - Apply coupons,
  - Bag items.

### Work Environment

- Noisy and Public.
- Social Pressure: Line of people waiting behind you.
- Physical: Dirty screen, glare from overhead lights.





Conclusion & Key Takeaways

# The Invisible Interface

Synthesizing Rules, Models, and Analysis

Final synthesis of the UI Design introduction.

# The Moral Compass



## The Three Golden Rules

These rules guide every design decision:

### **Place the User in Control:**

The user is the driver; the system is the vehicle.

### **Reduce Memory Load:**

Don't make the user remember things; make the system remember for them.

### **Make the Interface Consistent:**

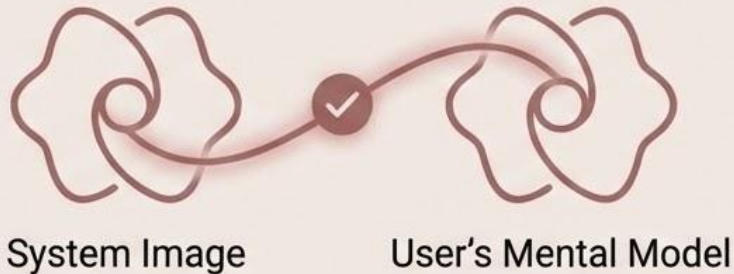
A "Save" button should look and act the same on every single screen.

# The Definition of Success

## Alignment of Models

### The Goal:

UI Design succeeds only when the System Image (what we built) aligns perfectly with the User's Mental Model (what they expect).



### The Failure:

When there is a gap between these two, the user feels confused, frustrated, and incompetent.



# Interface Analysis

## The Mandatory Investigation

Before designing, we must investigate four key areas:



### **Users:**

Who are they?  
(Create Personas).



### **Tasks:**

What do they do?  
(Perform Hierarchical Task Analysis).



### **Display Content:**

What specific data do they need to see?



### **Work Environment:**

Where do they do it?  
(Noisy factory vs. Quiet office).

# The Paramount Rule

## Workflow Over Convenience



Task Analysis is  
Paramount.

### The Shift:



Developer's  
Convenience



User's  
Workflow

The interface must be structured around the User's Workflow, not the Developer's Convenience.

### Reality Check:



Users don't care about your database schema; they care about finishing their work.

# Final Thought

## Invisibility

“ The best UI is invisible. The user doesn't notice it; they simply accomplish their goal with a sense of flow and satisfaction. Achieving this invisibility starts with the deep, empathetic understanding we call **Interface Analysis.** ”

