Interactive System Design
(HCI and Software Engineering)

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Learning Objective

- In the previous lecture, we learned about the idea of “usability”
  - While designing an interactive computing system, what we should do to take care of usability?
- In this lecture, we shall learn about the answer to the above question

Learning Objective

- In particular, we shall learn about the following
  - The difference between a software design and an interactive computing system design
  - User-centered and participatory design
  - The interactive system design life cycle

The Central Idea

- Suppose you are designing a DBMS then what are your design objectives?
  - Efficient storage of large databases (storage)
  - Efficient way to retrieve results of a query from database (retrieval)
  - Allowing the user to access the database (interaction)

The Central Idea

- Note that this is a scenario where the user interacts with the system (database)
- However, the user is a “computer expert”, who has “technical knowledge”
  - Through some query language, the user can access, manipulate and update the database

The Central Idea

- Now consider a tourist information system
- In the background, it is nothing but a database of various tourist-related information
- However, its users may or may not be "computer experts"
  - They do not care about what goes on inside
  - They just want to "get" the information "easily"

The Central Idea

- The term “easily” is very significant
  - It means, we need to have an interface and interaction mechanism that do not require any specialized knowledge
- That is, we need a “usable” system
- **Design goal of an interactive system: increase usability**

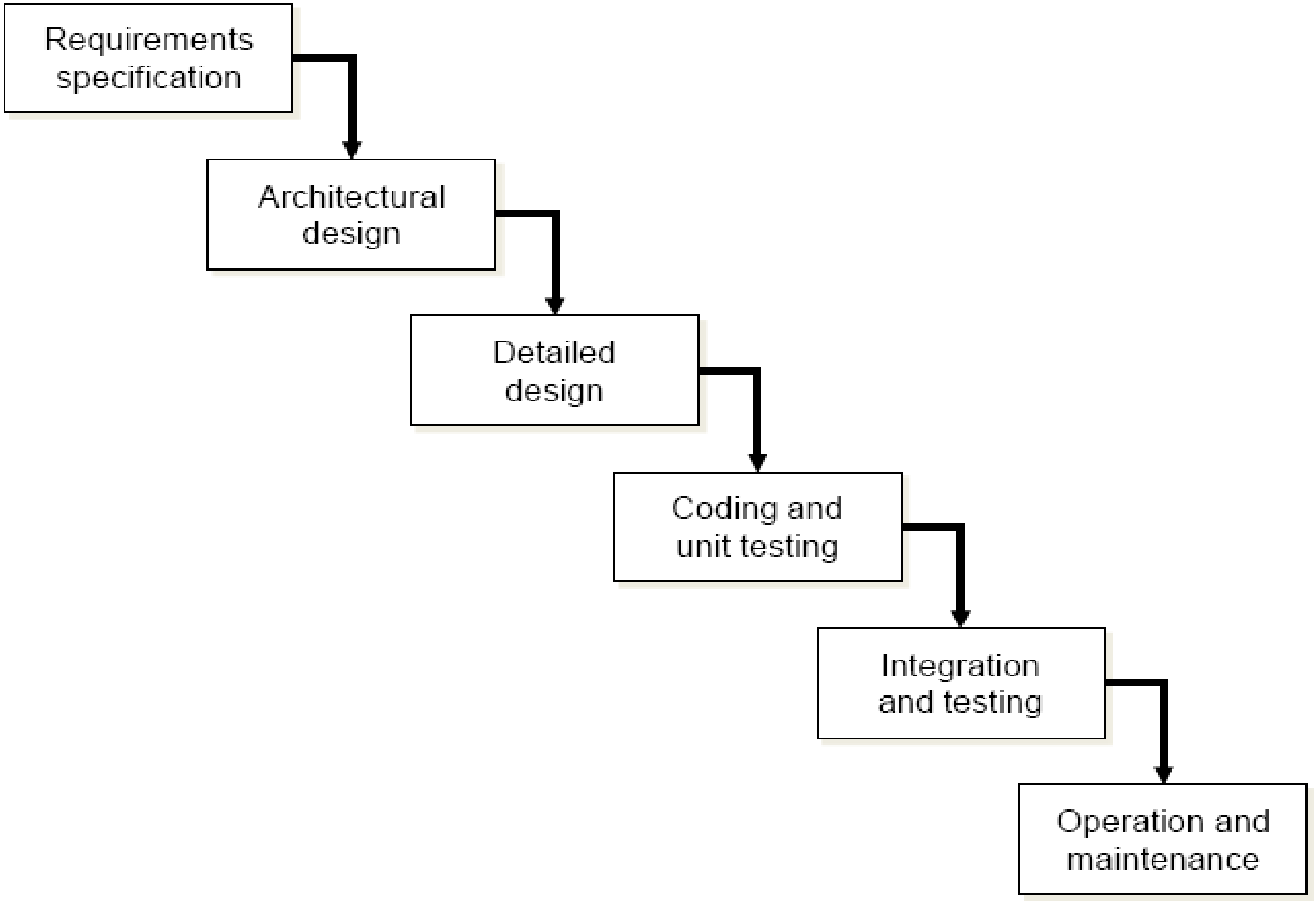
What Happens in Software Engineering

- The waterfall model: the simplest and typical way to visualize software design

- Design process composed of a series of sub-stages

  – Each sub-stage follows the previous stage and precedes the next stage (looks like a waterfall)

The Waterfall Model



What Happens in Software Engineering

- Note the uni-directional flow (that’s how real waterfalls work anyway!!)
- In other words,
  - Each stage depends on the previous stages but not vice-versa

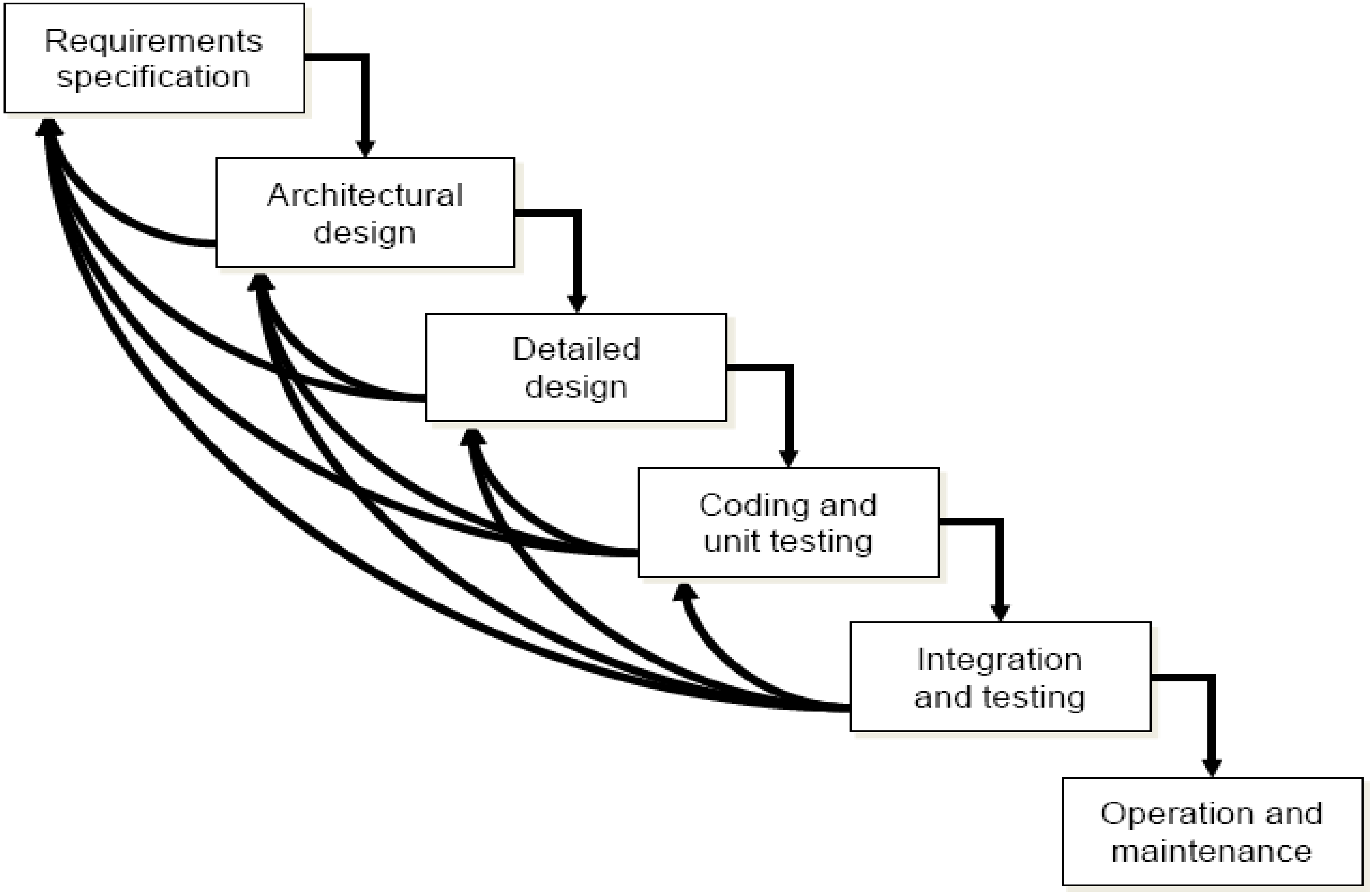
Interactive System Design

- The uni-directional flow is not appropriate for interactive system design

- In other words,
  - Each stage depends on the previous stages. It may also depend on the next stages (feedback).

- It is no longer the (linear) waterfall model

Interactive System Design



Requirements specification

Architectural design

Detailed design

Coding and unit testing

Integration and testing

Operation and maintenance

Why This Difference

- We are trying to design “for” the user
  - Not for a programmer’s convenience or expert’s use
- What should we consider
  - Abilities and needs of the users
  - Their usage context
  - Their work setting
- In other words, we need to “Know the User”

Need: Know The User

- A never ending process because there is so much to know and because the users keep changing
- An interactive system designer should consider the human factors that characterize the users

The Human Factors (Users’ Characteristics)

- Perception: our ability to perceive our surroundings
  - Can be visual, auditory or haptic (touch)
- Cognition: the way we process the perceived information in our “mind” and accordingly take the decisions
- Motor action: this is the mechanism through which we interact with the surrounding
  - Example: Hand movement, Eyeball movement, Speech

Need: Know The User

- The following factors (user characteristics) vary with
  - Age, gender, physical and cognitive abilities, personality
  - Education, cultural or ethnic background
  - Training, motivation, goals
- An interactive system designer should recognize its diversity

Need: Recognize Diversity

- Systems used by several communities of users
  - No single design can satisfy all users and situations
- Designer faces real challenge to cater to the need of each community
  - Designers must characterize users and situations as precisely and completely as possible

A Generic User Characterization

- Novice or First Time Users
  - Know nothing about the task or interface concepts
  - Often anxious about the computer and its functionality
- Knowledgeable or Intermediate Users
  - Have stable task concepts and broad interface concepts
- Expert Users
  - Thoroughly familiar with the task and interface concepts
  - Want to get their job done quickly

So, Why The Difference?

- Designer must know the user
  - This knowledge can not be captured at once
- Design involves acquiring new knowledge and using it to refine design in continuous cycle (till some “acceptable” design is found)
  - The reason for so many “feedbacks” in the waterfall model

User Centered Design (UCD)

- The design process, where designer collects feedback about the design from users and use this to refine design, is known as “user centered design” or UCD

- UCD is based on understanding the domain of work or play in which people are engaged and in which they interact with computers

User Centered Design (UCD)

- Assumptions
  - Result of a good design is a *satisfied user*
  - Process of design is a *collaboration between designers and user*.
  - Design *evolves and adapts* to users' changing concerns, and the process produces a specification as an important byproduct
  - The user and designer are in *constant communication* during the entire process

UCD Drawbacks

- In UCD, user involvement is “passive”
  - The designer elicits the feedback from the user (through interviews, informal discussions etc.)
  - Prepares specification on the basis of user response
  - Take feedback on the design and makes refinements

UCD Drawbacks

- Problems with “passive” involvement of user
  - User intuition about a new interface may not be correct (feedback not reliable)
  - The interview process itself may not be formulated properly (designer asks wrong questions)
  - It is not possible for the designer to identify all possible issues to take feedback from users, as the designer’s knowledge about the user may not be complete

Participatory Design

- Solution: make (representative) users a part of the design team

- Such a design process, where end users are part of the design team, is known as “participatory design”

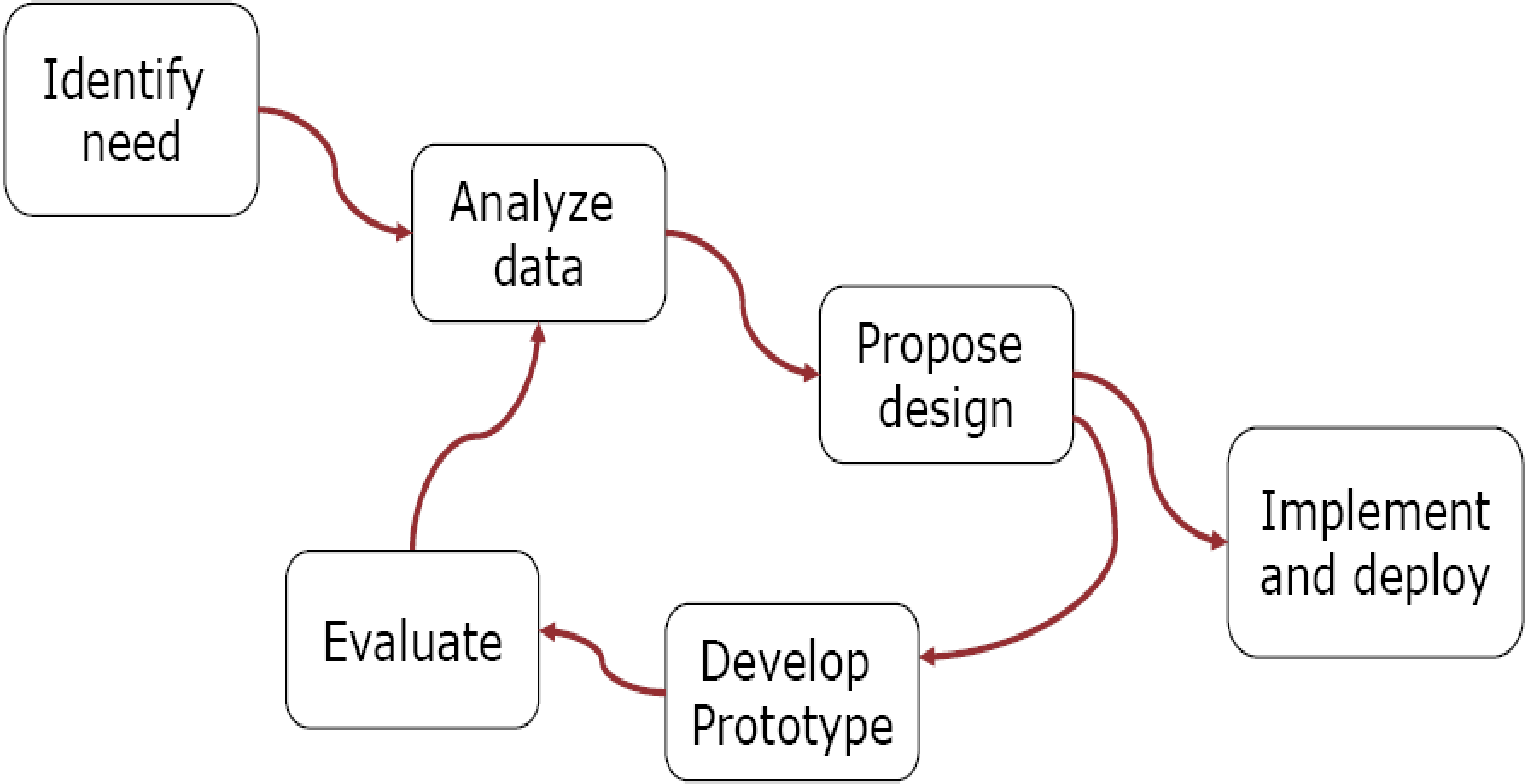
Participatory Design: Key Points

- Users are first-class members of the design team
  - As opposed to their passive involvement in UCD
- Users are considered subject experts
  - Know all about their work context
- Iterative design process
  - All design stages are subject to revision

Interactive System Design Life Cycle (ISLC)

- Key stages
  - Know the user, propose design, evaluate design by the users, refine design
- Iterative design process
  - The above stages are iterated till an acceptable (determined from user feedback) solution is obtained

ISLC: A Consolidated Diagram



Life Cycle Stage: Identify Needs

- What is wanted – identify users and their needs
- Designers make use of one or more methods to identify the needs and requirements
- Such methods include the following:
  - Interview (structured, semi-structured, unstructured)
  - Contextual inquiry
  - Cultural probes
  - Ethnography
  - User models

Life Cycle Stage: Analyze Data

- ❖ Analysis of the data collected
- ❖ Two types of analysis are performed

- ▪ Scenario analysis: analyze data collected from the user on one or more usage scenario of the system
- ▪ Task analysis: analyze tasks required to be carried out by the user to operate the system
  - - System level task analysis: analysis of external tasks required to operate the system
  - - Cognitive task analysis: analysis of tasks performed in the mind of the user

Life Cycle Stage: Propose Design

- Design proposal arrived at from the analysis of collected data
  - Guidelines and principles help in the development of initial design
  - Several sets of guidelines (both general and specific) are there to cater to the specific interface design context

Life Cycle Stage: Develop Prototype

- Implement a prototype of the design for collecting user feedback
- A spectrum of techniques is used in developing prototypes
  - Paper prototype (one extreme)
  - Complete software (other extreme)
  - Lots in between …

Life Cycle Stage: Evaluate Design

- Evaluation of the design by the users

- In the initial design phase, evaluation is done on the prototypes: (i) Cost effective and easier to perform, (ii) Suitable for iterative design process where the evaluation is performed many times

- The full system is typically evaluated at the end (i) Full system evaluation is costly in terms of money, manpower, time and effort (ii) Hence, typically done once or a limited number of times

Life Cycle Stage: Evaluate Design

- Several evaluation methods are available
  - Checklist/guideline based evaluation
    - Heuristic evaluation, cognitive walkthrough
  - Model-based evaluation: employs models (of the system or user or hybrid) for evaluation
    - Hybrid models are essentially models that combines the features of both the system and the user
  - Empirical evaluation – evaluate with real users
    - Involve implementation of the interactive computing system with full functionalities