Chapter II

System Design

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Chapter Outline

- *Designing the human interface*
  - *Interface Prototype*
- *Designing databases*
  - *Logical Database Design*
  - *Physical Database Design*
  - *Normalization*

Systems design

- System analysts must complete **two important activities** in the systems design phase:

  I. Designing the human/User interface (I/O interface)

  II. Designing databases and

I. User interface (UI) design is the process designers use to build interfaces in software or computerized devices, focusing on looks or style.

- **Designers aim** to create interfaces which users find easy to use and pleasurable.
- UI design refers to **graphical user interfaces** and other forms. e.g., voice-controlled interfaces.

II. Database design is the organization of data according to a database model.

- The designer determines what data must be stored and how the data elements interrelate.
- With this information, they can begin to fit the data to the database model.
- Database design involves classifying data and identifying interrelationships.

I. Designing the Human Interface (I/O Interface)

Designing Forms & Reports

- Forms and reports are integrally related to the DFD and E-R diagrams developed during requirements structuring.
- For example, every **input form** is associated with a **data flow entering** a **process** on a DFD, and **every output form or report** is a data flow produced by a process on a DFD.
- **Form:** A business document that contains **some predefined data and may include some areas** where additional data are to be filled in. an instance of a form is typically based on one database record.
- **Report:** A business document that contains **only predefined data**; it is a **passive document** used only for **reading** or **viewing**.
  - A report typically contains data from many **unrelated records or transactior**

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- ***Designing forms and reports*** *is a user focused activity that typically follows a prototyping approach.*
- *Understanding the skills and abilities of the users helps you create an effective design.*
- *the* ***fundamental questions*** *you have to understand when designing forms and reports are presented below.*
  1. *Who will use the from or report?*
  2. *What is the purpose of the form or report?*
  3. *When is the form or report needed and used?*
  4. *Where does the form or report need to be delivered or used?*
  5. *How many people need to use or view the form or report?*

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- Incase of designing forms and reports, **design specifications** are the **major deliverables** and are inputs to the **systems implementation and operation phase**.
- **Design specifications** have **three** sections:
  1. Narrative Overview
  2. Sample Design
  3. Testing and Usability Assessment

1. The narrative overview provides a **general overview** of the characteristics of the target users, tasks, system, and environmental factors in which the form or report will be used.

- **Its purpose** is to explain to those who will actually develop the final form or report, why this form or report exists and how it will be used.
- **So that,** they can make the **appropriate implementation decision.**

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2. In the second section of the specification you will show **a sample design** of the form or report.

- This design may be **hand drawn** using a coding sheet although in most instances it is developed using CASE or standard development tools.

3. The final section of the specification provides all **testing and usability assessment information.**

➢ Some specification information may be **irrelevant** when designing certain forms or reports.

General Formatting Guidelines

- *Several guidelines for formatting information while designing forms and reports have emerged as highlighted below.*
- *These guidelines reflect some of the general truth of formatting most types of information.*

Table 1 guidelines for designing forms and reports.

Guideline	Description
Use meaningful tittles	- Clear and specific titles describing contents and use of form or report. - Revision date or code to distinguish a form or report from prior versions - Current date that identifies when the from or report was generated. - Valid date that identifies on what date (or time) the data in the form report were accurate.
Include meaningful information	- Only needed information displayed. - Information provided in a useable manner without modification.
Balance the layout	- Information balanced on the screen or page. - Adequate spacing and margins used. - All data entry fields clearly labeled.
Design an easy navigation system	- Clearly show how to move forward and backward. - Clearly show where you are (e.g., page1 of 3). - Notify user of the last page of s multiple page sequence.

Displaying Text

- *The display and formatting of system help screens, which often contain **lengthy textual descriptions and examples.***
- *The following the simple guidelines that have emerged from systems design research. appear in Table 2.*

Guideline	Description
Case	- display text in mixed upper and lowercase and conventional punctuation.
Spacing	- use double spacing if space permits. If not, place a blank line between paragraphs.
Justification	- Left-justify text and leave a ragged right margin.
Hyphenation	- do not hyphenate words between lines.
Abbreviations	- use abbreviations and acronyms only when they are widely understood by users and significantly shorter than the full text.

Designing Tables and Lists

- *The usability information displayed on tables and alphanumeric lists is likely to be much more influenced by effective layout than most other types of information display.*
- *As with the display of textual information,* ***tables*** *and* ***lists*** *can also be greatly enhanced by following a few simple guidelines. This are summarized below.*

Guideline	Description
Use meaningful labels	- All columns and rows should have meaningful labels. - Labels should be separated from other information by using highlighting. - redisplay labels when the data extend beyond a single screen or page.
Formatting columns, rows, and text	- Sort in a meaningful order. (e.g., ascending, descending or alphabetic). - place a blank line between every five rows in long column. - Similar information displayed in multiple columns should be sorted vertic (i.e., read from top to bottom, not left to right. - Columns should have at least two spaces between them. - allow white spaces on printed reports for user to write notes. - use a single typeface, except for emphasis. - use same family of typefaces with in and across display and reports. - avoid overlay fancy.
Formatting numeric, textual, and alphanumeric data	- Right-justify numeric data and align columns by decimal points or other delimiter. - Left-justify textual data. Break long sequence of alphanumeric data into small groups of three to fou characters each.

Designing Interfaces and Dialogues

- Interface and dialogue design focuses on how information is provided to and captured from users.
- Dialogues are analogous to a conversation between two people .
- The design of interfaces and dialogues involves defining the manner in which humans and computers exchange information.
- A good human-computer provides a uniform structure for **finding**, **viewing**, and **invoking** the different components of a system.
- Similar to designing forms and reports, the process of designing interfaces and dialogues is a user-focused activity.
- The deliverables and outcome from system interface and dialogue design is the **creation of a design specification**.
- This specification is **similar** to the specification produced for **form and report designs** with **one exception**(additional , the ways users can move from one display to another.)

Guidelines for the Design of Human-Computer Dialogues

- ***Consistency:*** *dialogues should be consistent in sequence of actions, keystrokes, and terminology (e.g., use the same labels for the same operations on all screens and the same location of the same information on all displays).*
- ***Shortcuts and Sequences:*** *allow advanced users to take* ***shortcuts*** *using special keys (e.g., CTRL-C to copy highlighted text). A natural sequence of steps should be followed (e.g., enter first name before last name, if appropriate).*
- ***Feedback:*** *feedback should be provided for every user action (e.g., confirm that a* ***record has been added****, rather than simply putting another blank from on the screen).*
- ***Closure:*** *dialogues should be* ***logically grouped*** *and have beginning, middle, and end (e.g., the last in the sequence of screens should indicate that there are* ***no more screens****).*

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- ***Error Handling:*** *all errors should be detected and reported. Suggestions on how to proceed should be made (e.g., suggest why such errors occur and what the user can do to correct the error).*
- ***Reversal:*** *dialogues should, when possible,* ***allow the user to reverse actions*** *(e.g., undo a deletion); data should* ***not be deleted without confirmation.***
- ***Control:*** *dialogues should make the user (especially an experienced user) feel in control of the system (e.g., provide a consistent response time at a pace acceptable to the user).*
- ***Ease:*** *dialogues should provide* ***simple*** *means for users to enter information and navigate between screens (e.g., provide means to move forward, backward, and to a specific screen, such as first and last)*

II. Designing databases

- ***A Database*** *is a shared collection of related data which is used to support the activities of a particular organization.*
- *A database can be viewed as a* ***repository of data*** *that is defined once and then is accessed by various users.*
- *A database has the following properties:*
  - *It is a representation of some aspect of the real world.*
  - *A database is logical, coherent and internally consistent.*
  - *A database is designed, built, and populated with data for a specific purpose.*
  - *Each data item is stored in a field,*
  - *A combination of fields makes up a table.*
- *A Database Management System (DBMS) is a collection of programs that enable users to create, maintain databases and control all the access to the databases.*

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- Logical and physical database design has **five purposes:**

1. Structure the data in stable structures that **are not** likely to change over time and that have **minimal redundancy**.
2. Develop a logical database design that reflects the actual data requirements that exist in the form and reports of an information system.
3. Develop a **logical database design** from which we can do physical database design.
4. Translate a relational database model into a technical file and database design.
5. Choose data storage technologies (such as floppy disks, CD-ROM, or optical disk)

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- ***File and database design occurs in two steps.***
- *You begin by developing a logical database model,*
  - ***which describes data using a notation*** *that corresponds to a data organization used by a database management system.*
  - *The most common style for a logical model is the* ***relational database model*** *(data represented as set of* ***related tables*** *or relations).*
- ***Once you develop a clear and precise logical database model,*** *you are ready to prescribe the technical specifications for computer files and databases in which to store the ultimately (A physical database design provides these specifications).*

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- ***Logical database*** *design driven* ***is not only*** *from* ***the previously developed*** *E-R data model for the application but also* ***from form and report layouts.***
- *In logical database design you use a process called* ***normalization.***
  - *which is a way to build a data model that has the properties of*
    - *simplicity,*
    - *Non-redundancy, and*
    - *minimal maintenance.*
- ***Normalization*** *is the process of converting complex data structures into simple, stable, data structure..*

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- ***As revision, here are the most commonly used normal forms:***

1. ***First normal form(1NF):*** *an attribute (column) of a table cannot hold multiple values. It should hold only atomic values.*
2. ***Second normal form(2NF):*** *A table is said to be in 2NF if both the following conditions hold:*
   - *Table is in 1NF (First normal form)*
   - *No non-prime attribute is dependent on the proper subset of any candidate key of table.*
   - *An attribute that is not part of any candidate key is known as non-prime attribute.*
3. *Third normal form(3NF): A table design is said to be in 3NF if both the following conditions hold:*

- *Table must be in 2NF*
- *Transitive functional dependency of non-prime attribute on any super key should be removed.*

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- *for each functional dependency X-> Y at least one of the following conditions hold:*
  - *X is a super key of table*
  - *Y is a prime attribute of table*
- *An attribute that is a part of one of the candidate keys is known as prime attribute.*

4. *Fourth Normal Form(4NF):*

- *it comes into picture when Multi-valued Dependency occur in any relation.*
- *In this tutorial we will learn about Multi-valued Dependency, how to remove it and how to make any table satisfy the fourth* ***normal form.***

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INF	2NF	3NF	BCNF	4NF
Eliminate repeating groups in individual tables	Should be in 1NF.	Should be in 2NF.	Should be in 3NF.	Should be in BCNF
Identify each set of related data with a primary key - Create a separate table for each set of related data.	Remove partial dependency - Relate these tables with a foreign key.	Remove transitive functional dependency - Relate these tables with a foreign key.	Check for non-key attribute determines key attribute or the table should not contain any spurious data because of multiple candidate keys.	Eliminate non-trivial multi-valued dependencies by projecting into simpler tables.

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- *There are **four key steps** in **logical database modeling and design**.*

1. ***Develop a logical data model for each known user interface** (form and report) for the application using normalization principle.*
2. ***Confine normalized data requirements** from all user interfaces into one consolidated logical database model; this step is called **view integration**.*
3. ***Translate the conceptual E-R data** model for the application developed without explicit consideration of **specific user interfaces**, into normalized data requirements.*
4. ***Compare the consolidated logical database design** with the translated E-R model and produce, through view integration, one final logical database model for the application.*

- *During physical database design, you use the results of these four key logical database design steps.*

Transforming E-R Diagrams into Relations

- *Transforming an E-R diagram into normalized relations and then merging all relations into one final, consolidated set of relation can be accomplished into **four steps**.*

1. ***Represent entities:*** *each entity type in the E-R diagram becomes a relation.*
   - *A relation is a named, two dimensional table of data.*
   - *Each relation consists of a set of named columns and an arbitrary number of unnamed rows.*
   - *The identifier of the entity becomes the **primary key** of the relation, and other attributes of the entity type become non primary key attributes of the relation.*

2. ***Represent relationships:*** *each relationship in E-R diagram must be represented in the relational database design. How we represent a relationship depends on its nature.*

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3. ***Normalize the relation:*** *the relations created in step 1 and step 2 may have* ***unnecessary redundancy.***

- *So, we need to normalize these relations to make them well structured.*

4. ***Merge the relation:*** *there may be redundant relations (two or more relations that describe the same entity type) that must be merged and* ***renormalized*** *to remove the redundancy.*

Designing Physical Tables

- *A **relational database** is a set of related tables (tables are related by foreign key referencing primary keys).*
- *In **logical database design** you grouped into a relation those attributed that concern some unifying, normalized business concept, such as a customer, product, or employee.*
- *In contrast, **a physical table** is a named set of rows and columns that specifies the fields in each row of the table.*
- *The design a physical table has **two goals different** from those of normalization:*
  - *efficient use of secondary storage and*
  - *Efficient use data processing*

End of chapter Two

Any Question?