



Session 6

Designing the System



Review

- A data model is a formal representation, which hides uninteresting details, highlights important facts, and gives a better understanding of the system to be built.
- A representation of information that has a number of different properties or attributes and that can be understood by software, is called a data object.
- Attributes define the properties of a data object and may serve one of the following purposes:
 - ◆ To name an instance of the data object
 - ◆ To describe the instance
 - ◆ To make references to another instance in another table
- Relationships are verbs used to indicate actions between any two data objects in the system.
- Cardinality defines the maximum number of object-relationships that can participate in an association or relationship.



Review Contd...

- The modality of a relationship is zero if there is no explicit need for the relationship to occur or the relationship is optional. The modality is one if an occurrence of the relationship is mandatory.
- An Entity-Relationship diagram identifies a number of components such as data objects, attributes, relationships and various type-indicators. The main objective of the ERD is to represent data objects and their relationships.
- Data flow diagrams are typically used to represent a system or software at any level of abstraction.
- Data flow diagrams provide mechanisms for function modeling as well as information flow modeling.
- A Control Flow Diagram contains the same processes as the DFD but shows more control flow instead of data flow.
- A data dictionary is a centralized collection of definitions of all the data flowing to or from data stores and/or processes.

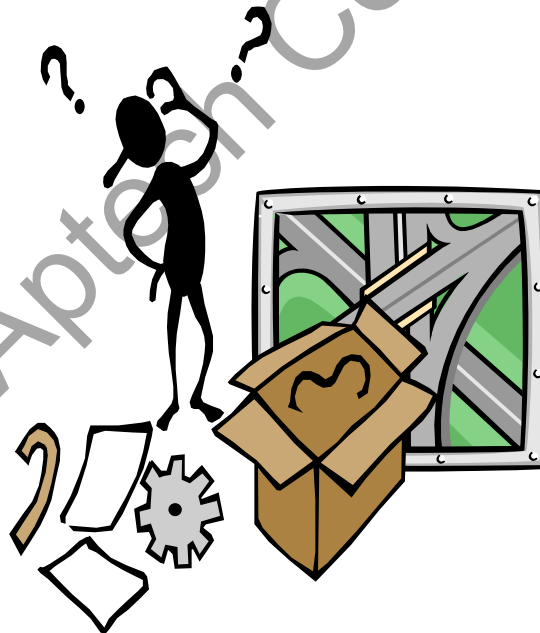


Objectives

- *Describe the design process*
- *Describe the principles of design*
- *Describe the software design concepts*
- *Describe the following design tools:*
 - ◆ *Structure chart*
 - ◆ *Structured flowchart*
 - ◆ *Structured English*

The Design Process

- **Definition:** The process of applying various techniques and principles for defining a device, process or system in detail to permit its physical realization.





Steps in the Design Process

- Architectural Design
- Interface Design
- Procedural Design



Key Issues in the Design Process

- It is an iterative process.
- What are the guidelines for the evaluation of a good design?
- What are the technical criteria to establish a good design?



Design Principles

- Avoid tunnel vision.
- Make the design model traceable to the analysis model.
- Do not reinvent the wheel.
- Minimize the intellectual distance.
- Exhibit uniformity and integration.
- Structure the design to accommodate change.
- Structure the design to avoid sudden and abrupt breakdown.
- Assess the quality as it is being created.
- Review to minimize conceptual errors.



Design Concepts

- Abstraction
 - ◆ Procedural Abstraction
 - ◆ Data Abstraction
 - ◆ Control Abstraction
- Stepwise refinement
 - ◆ Decomposing design decisions to elementary levels
 - ◆ Separating design aspects that are not truly interdependent
 - ◆ Postponing decisions concerning representation details as long as possible
 - ◆ Demonstrating carefully that each successive step is an expansion of the previous steps



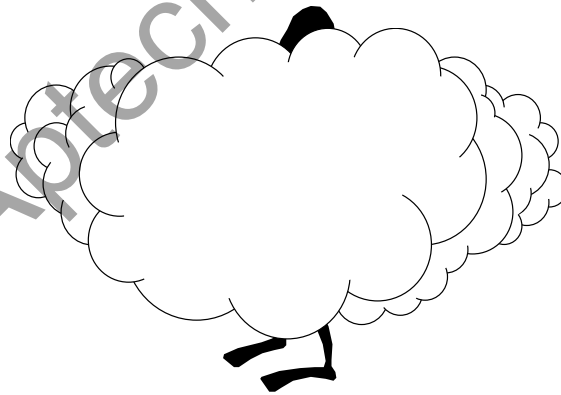
Design Concepts Contd...

- Modularity
- Software architecture
- Control hierarchy
 - ◆ Visibility
 - ◆ Connectivity
- Structural partitioning
 - ◆ Horizontal
 - ◆ Vertical



Design Concepts Contd...

- Data structure
- Software procedure
- Information hiding



Information hiding



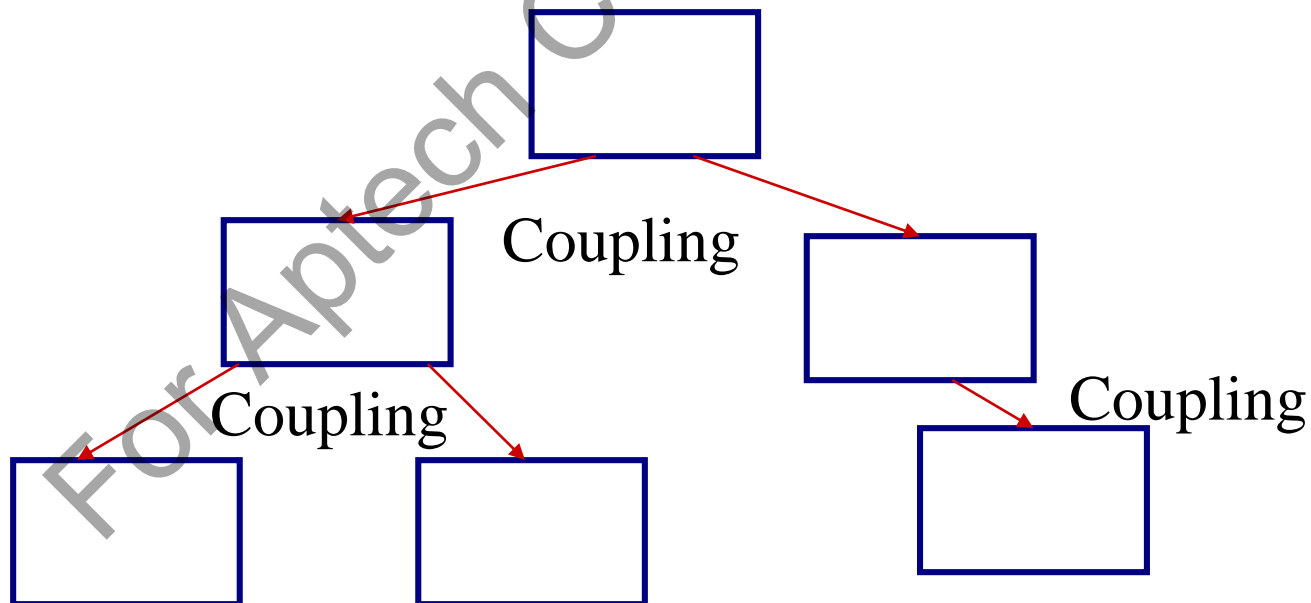
Structured Design

- Structured design involves:
 - ◆ Coupling
 - ◆ Cohesion

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Coupling

- **Definition:** It refers to the strength of the relationship between modules in a system.
- It is a structured design concept.
- Good design involves loosely coupled modules.



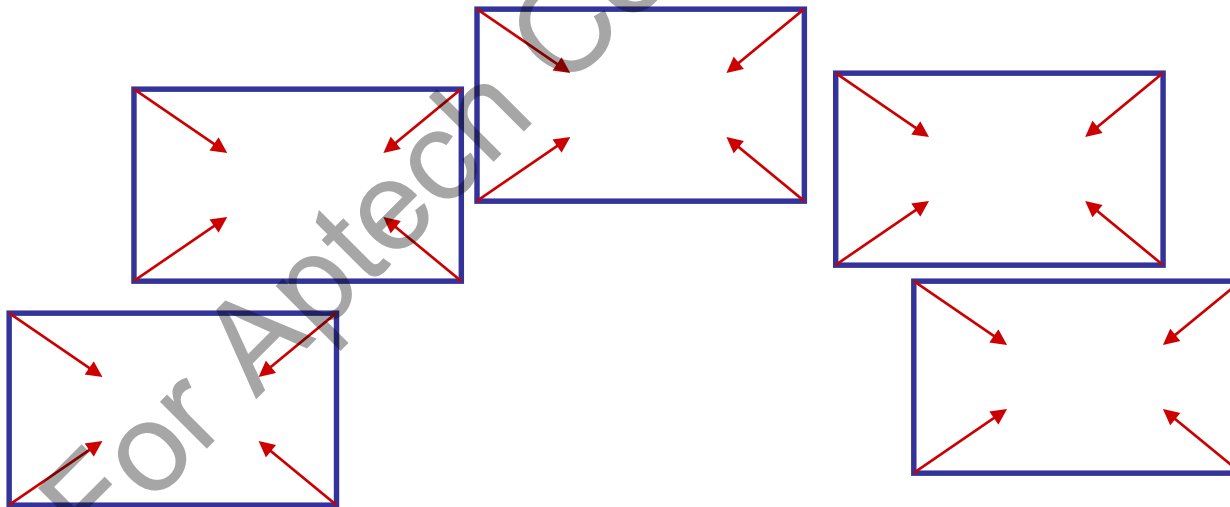


Types of Coupling

- Content coupling (worst)
- Common coupling
- Control coupling
- Stamp coupling
- Data coupling (best)

Cohesion

- **Definition:** It refers to the strength of the relationship between elements of the same module in a system.
- It is a structured design concept.





Types of Cohesion

- Coincidental (worst)
- Logical
- Temporal
- Communication
- Sequential
- Informational
- Functional (best)



Design Tools

- Structure charts
- Structured flowchart
- Structured English

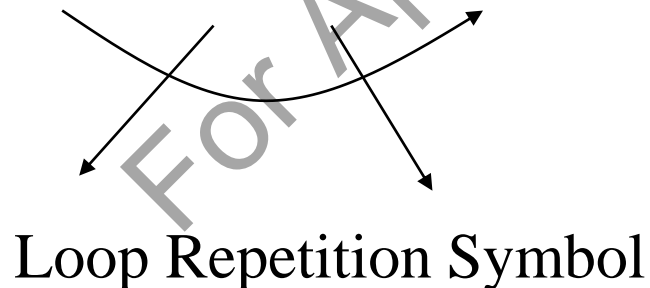
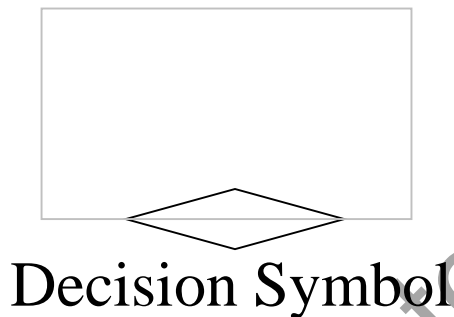
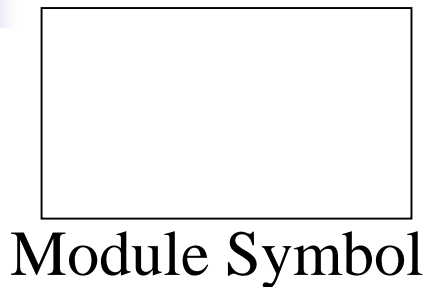
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Structure Charts

- **Definition:** They are graphical descriptions that show the data exchanges between modules that interact with each other.
- It uses the Logical DFDs from the analysis stage as a base.
- It has no decision boxes.
- It can omit the sequential ordering of tasks inherent in a flowchart.

Structure Charts – Common Notations



Calling
Module

Arrow Call Symbol

Called
Module

Sender



Data Couple Symbol

Receiver

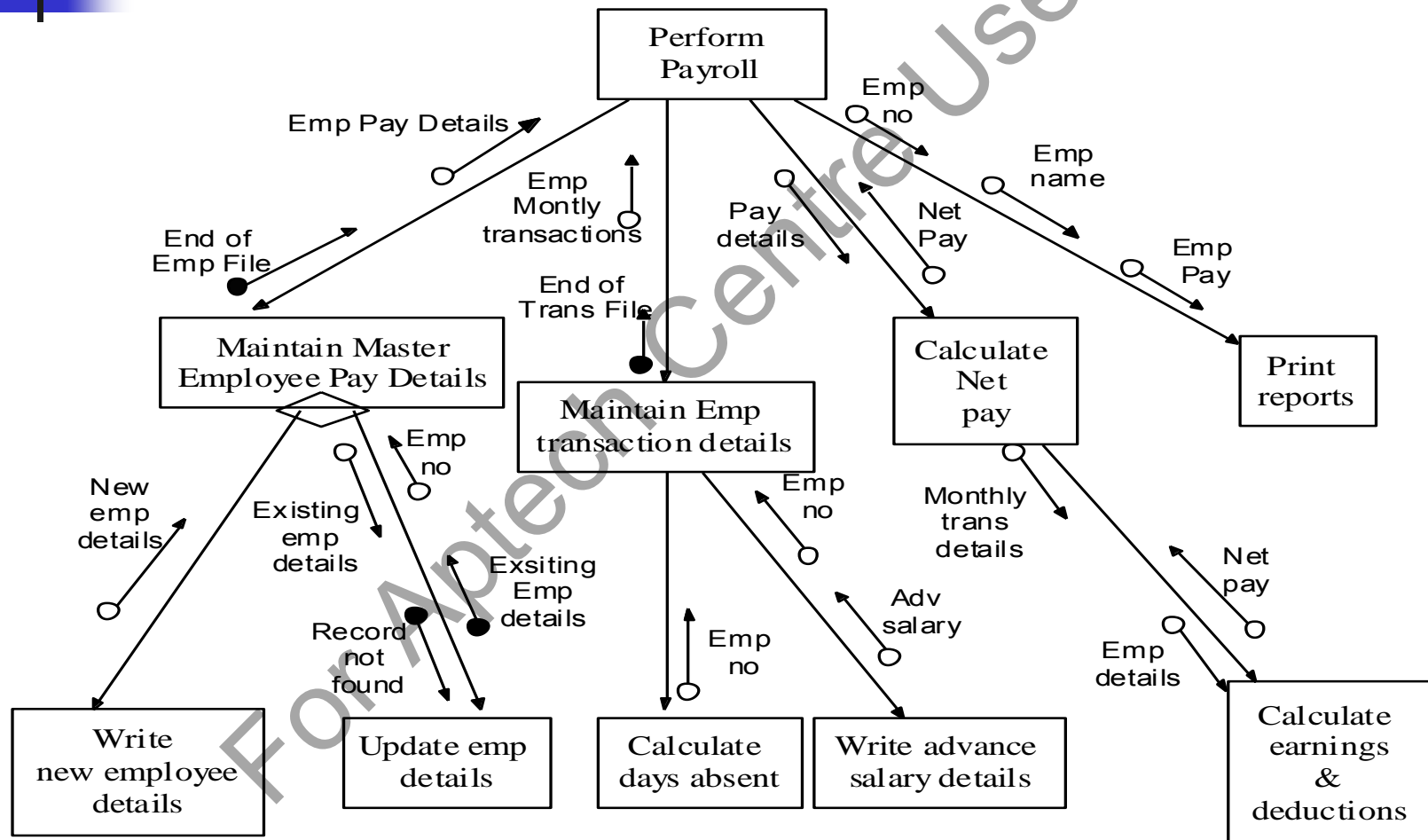
Sender



Control Flag Symbol

Receiver

Structure Chart – An Example





Structured English

- It can be used to provide systematic specification for an algorithm.
- It is similar to a pseudo code.



Structured English - Characteristics

- A predetermined syntax of keywords must provide for all structured constructs, data declarations and modularity characteristics.
- A free syntax of natural language like English that describes processing features.
- Data declaration facilities that should include both simple (scalar, array) and complex (linked list) data structures.



Structured English – An Example

For each MEMBER ID in the MEMBERS file repeat the steps below

If RETURN DATE is greater than DUE DATE
 Calculate FINE for the number of extra days
 Print the Fine Bill



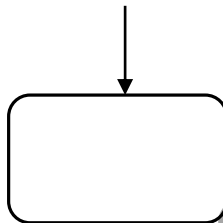
Structured Flowcharts

- **Definition:** They are used to specify and document sequence of steps to solve a problem. However, they are restricted to using only certain basic forms.
- Express control flows with more clarity than the pseudo code.

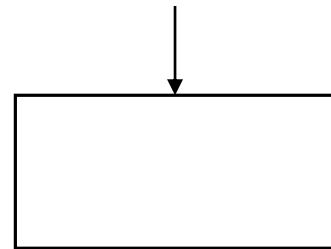
Structured Flowcharts – Basic Symbols



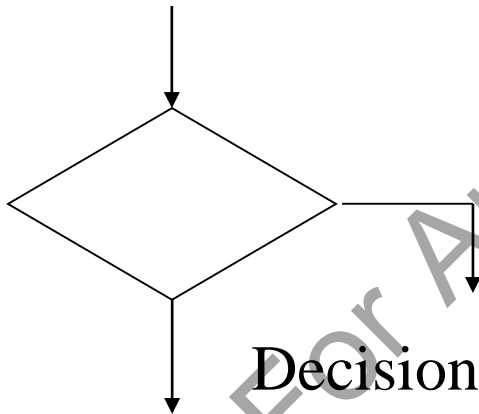
Start Symbol



End Symbol



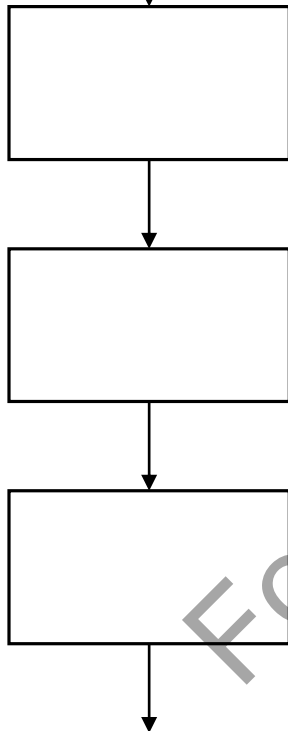
Process Symbol



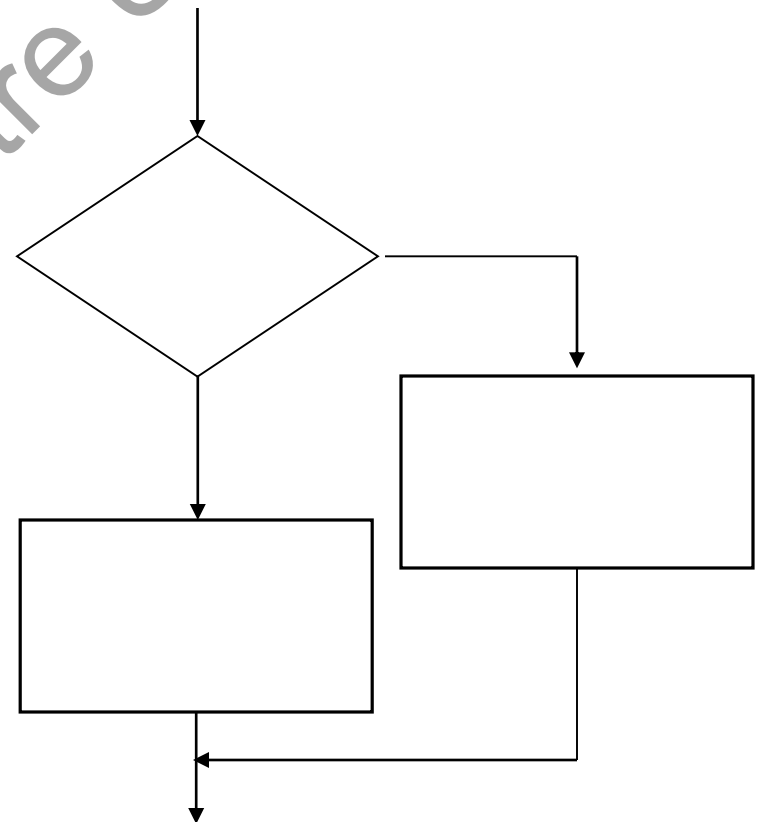
Decision Block

Structured Flowcharts – Basic Structures

Sequence

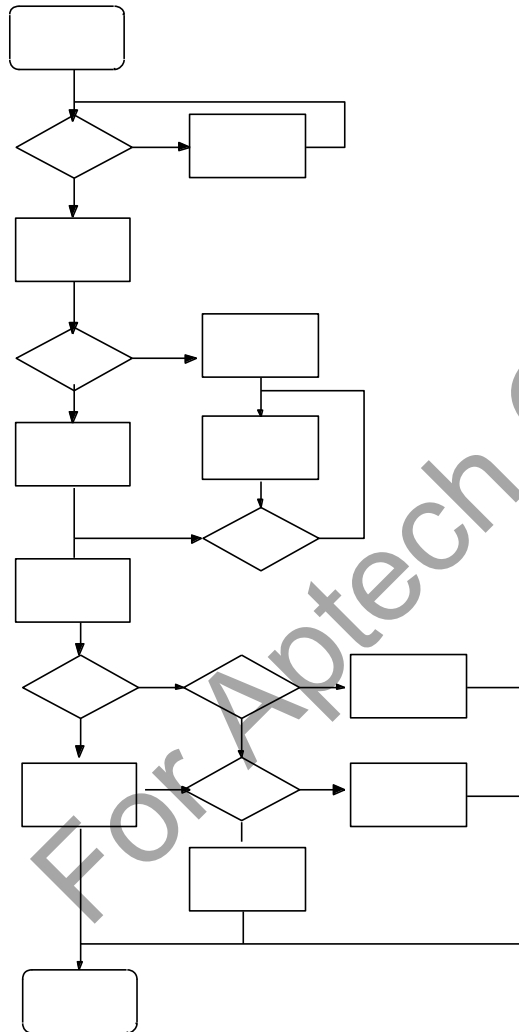


If-then-else

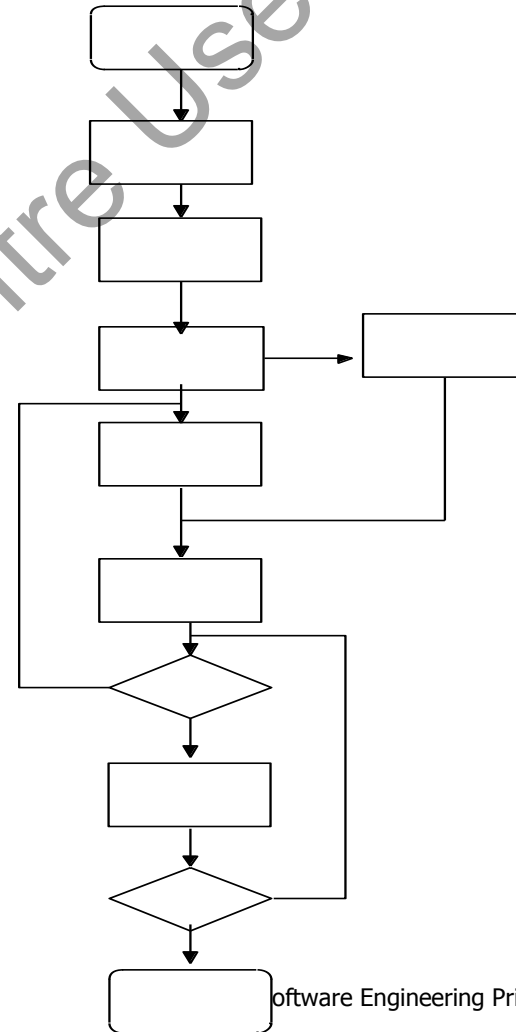


Structured Flowcharts – An Example and a Comparison

Structured
Flowchart



Unstructured
Flowchart





Summary

- Software design is situated at the core of the software engineering process and is always applied irrespective of the software process model used.
- The design model comprises of data design, architectural design, interface design and procedural design.
- The information domain model created during analysis is transformed by data design into the data structures necessary to implement the software.
- Interface design describes how software communicates within itself to systems that interoperate within it and with persons who use it.
- Procedural design transforms structural elements of the program architecture into a procedural description of software components.
- Design is an iterative process during which requirements are translated into an outline for constructing the software.



Summary Contd...

- Vital design concepts include:
 - ◆ Abstraction
 - ◆ Stepwise refinement
 - ◆ Modularity
 - ◆ Software architecture
 - ◆ Control hierarchy
 - ◆ Structural partitioning
 - ◆ Information Hiding
- Coupling refers to the strength of the relationship between modules in a system, and is determined by the data passes between modules and the interdependence between the modules.
- Cohesion refers to the strength of the relationship between elements of the same module in a system. It represents how tightly bound the internal elements of the module are to one another.
- Standard tools used for design are structure charts, structured English, and structured flowcharts.