

SOFTWARE ENGINEERING

Week 6
Analysis Model

Agenda

1. Requirements Analysis
2. Structured Analysis
 1. Data Model: Database objects and relations
 2. Functional Model: Data flow
 3. Behavioural Model: Control flow, Events and states

Analysis Model 2

1. Requirements Analysis ←
2. Structured Analysis
 1. Data Model
 2. Functional Model
 3. Behavioural Model

Requirements Analysis

6.1

Analysis

Analysis and Design Approaches

Structured Analysis and Design Data / Control Flow Diagrams, (DFD / CFD)	Object-Oriented Analysis and Design Unified Modeling Language Diagrams (UML)
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Analysis Model 4

Elements of Analysis Model

- The **Statement of Software Scope** provides the basis for analysis modelling.
- The following models are built during analysis:
 1. Data model: Database objects and relations
 2. Functional model: Data flow
 3. Behavioural model: Control flow, Events and states

Analysis Model 5

Modeling the Data Domain

- Define data objects
- Establish data relationships
- Specify data content

Analysis Model 6

Modelling the Functions

Basic Idea:

- Software transforms data
- To achieve this it must perform at least three generic functions: **input, processing, output**
- Identify functions that transform data objects

Begin with a context level diagram (**level 0**)

Continue with more functional details in refined levels until all system functionality is represented

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Modeling the Behaviour

Basic Idea:

- Most software responds to **events** from the outside world
- This characteristic forms the basis of the behavioral model
- A computer program always exists in some state: an externally observable mode of behaviour (e.g. waiting, computing, printing, polling) that is changed only when some event occurs

Indicate different **states** of the system

Specify events that cause the system to change state

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1. Requirements Analysis
2. Structured Analysis
 1. Data Model
 2. Functional Model
 3. Behavioural Model

Structural Analysis

6.2

Analysis

1. Requirements Analysis
2. Structured Analysis
 1. Data Model
 2. Functional Model
 3. Behavioural Model

The Data Model

6.2.1

Analysis

The Data Model

- Data modelling is also called Database Modelling.
- In data modelling, **Entity-Relationship Diagrams** are used.
- Also a data dictionary is defined for important data items.

Entity Symbols (Bachman notation)



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Relationship Symbols

A —|—| B One to one, mandatory

A —|—○ B One to one, optional

A —|—< B One to many, mandatory

A —|—○< B One to many, optional

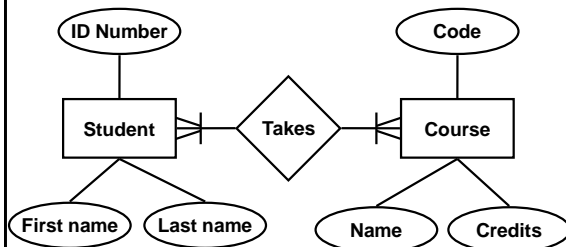
Cardinality

Modality

Analysis Model

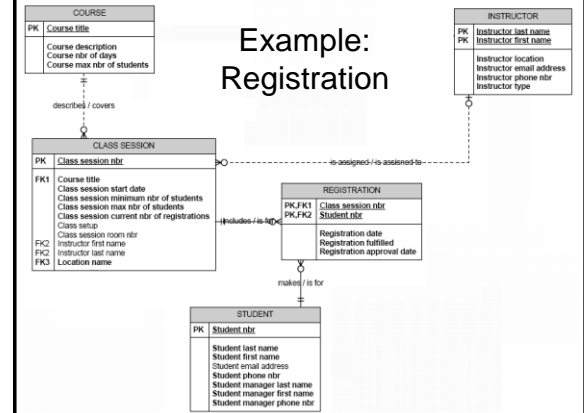
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Example: Students and Courses (Bachman notation)

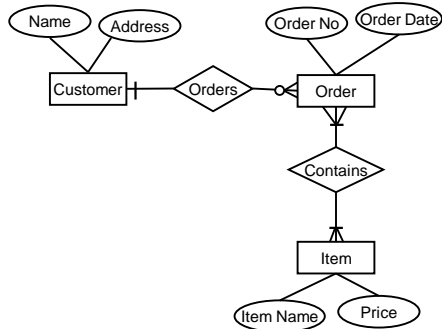


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Example:
Registration

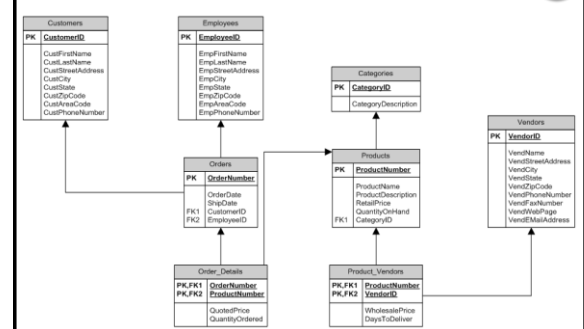
Example : Orders



Analysis Model

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Example : Orders and Products



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Data Dictionary

- Data dictionary is a collection of data item definitions.
- A data item is described with the followings:

Data Name	the primary name of the composite data item
Aliases	other names for the data item
Where used	data transforms (processes) that use the composite data item
How used	the role of the data item (input, output, temporary storage, etc.)
Description	a notation for representing content
Format	specific information about data types, default values (if known)

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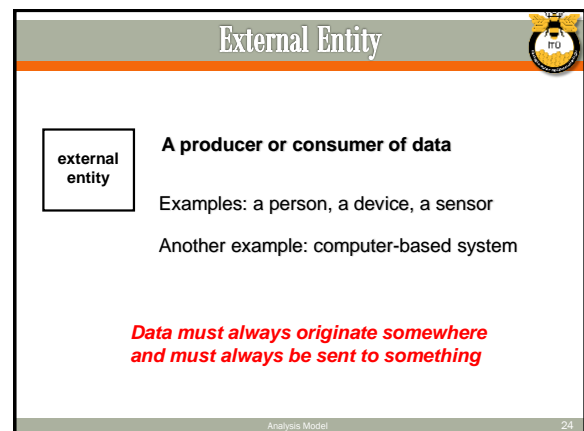
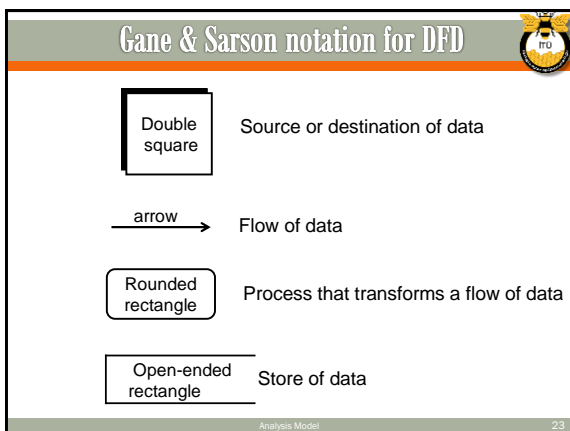
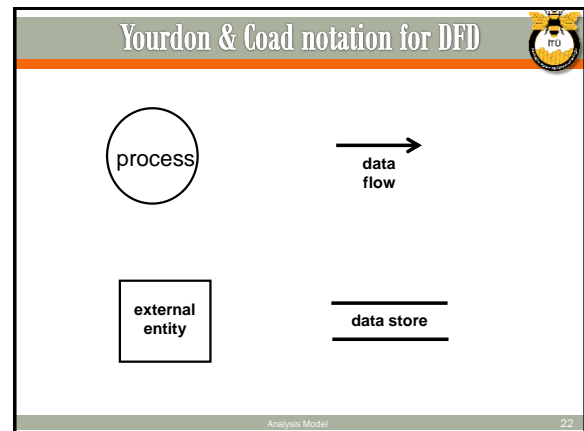
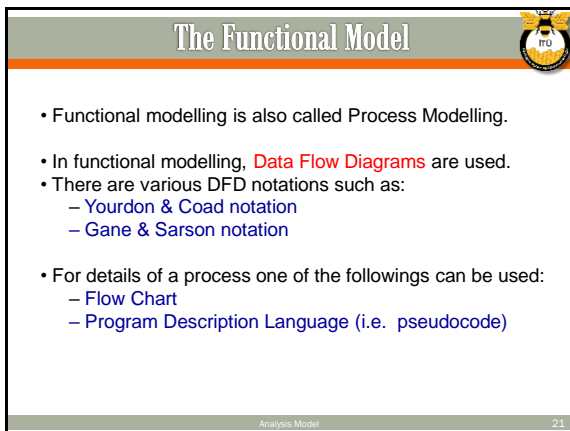
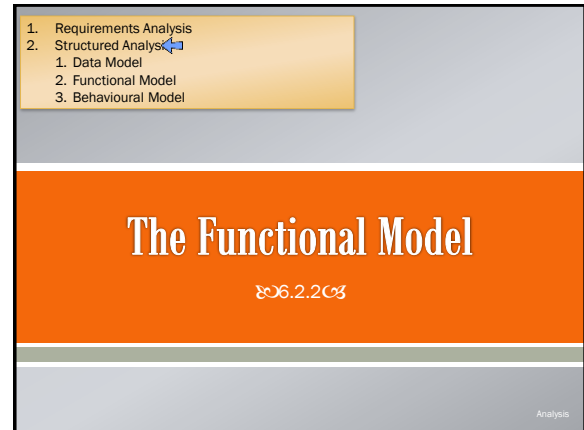
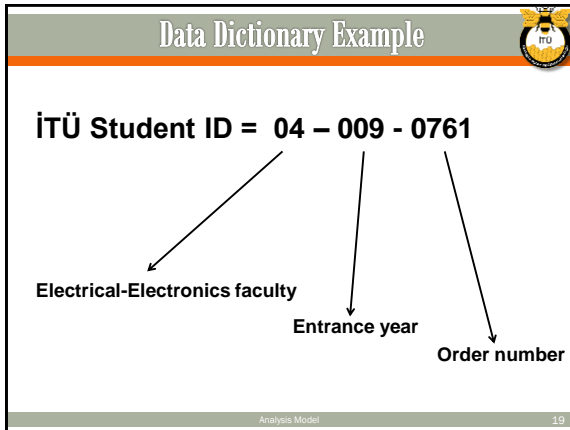
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Data Dictionary Example

<u>name:</u>	telephone number
<u>aliases:</u>	none
<u>where used/how used:</u>	<u>access against set-up</u> (output) <u>dial phone</u> (input)
<u>description:</u>	telephone number = [local number long distance number] local number = prefix + access number long distance number = 1 + area code + local number area code = [800 888 561] prefix = *a three digit number that never starts with 0 or 1* access number = *any four number string*

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Process



A data transformer (changes input to output)

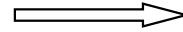
Examples: compute taxes, determine area, format report, display graph

Data must always be processed in some way to achieve system function

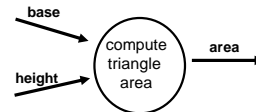
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Data Flow



Data flows through a system, beginning as input and be transformed into output.



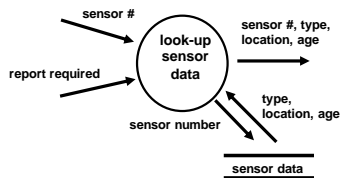
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Data Stores

data store

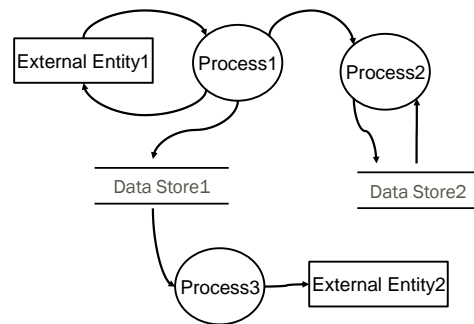
Data is often stored for later use.



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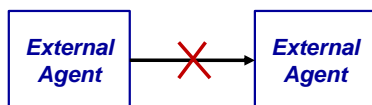
Example: Generic DFD



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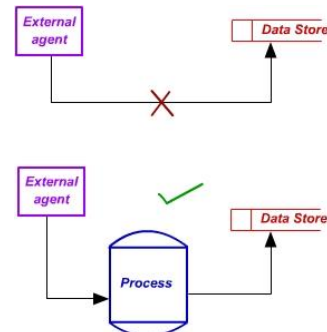
DFD Rules (1)



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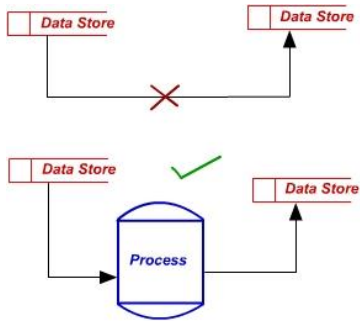
DFD Rules (2)



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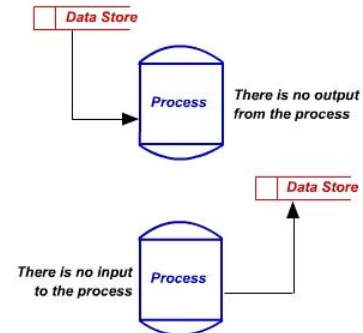
DFD Rules (3)



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DFD Rules (4)



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Data Flow Refinement

- DFD modelling is performed from level-0 to level-1, level-2, etc.
- A suggested expansion ratio between one level and the next level is 1:5
- Most systems require between 3 and 7 levels for an adequate flow model
- If a bubble does a number of different things, it needs further refinement.
- Each bubble is refined until it does just one thing
- The expansion ratio decreases as the number of levels increase

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Example of Data Flow Refinement

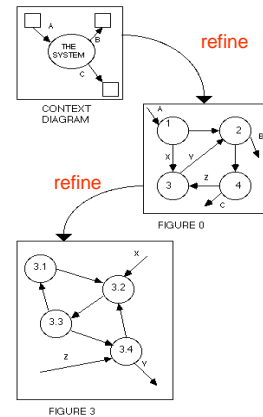
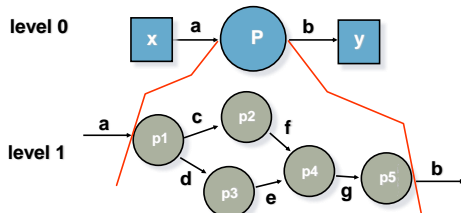


FIGURE 3

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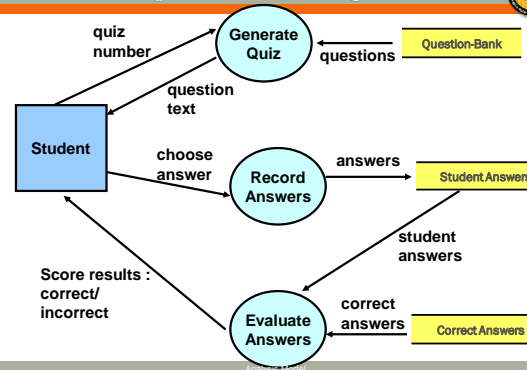
Example Data Flow Hierarchy



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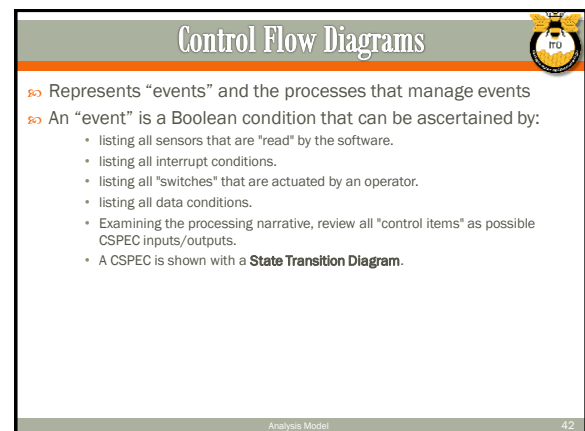
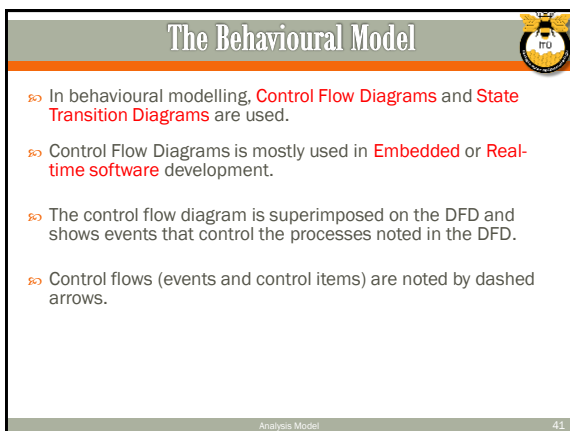
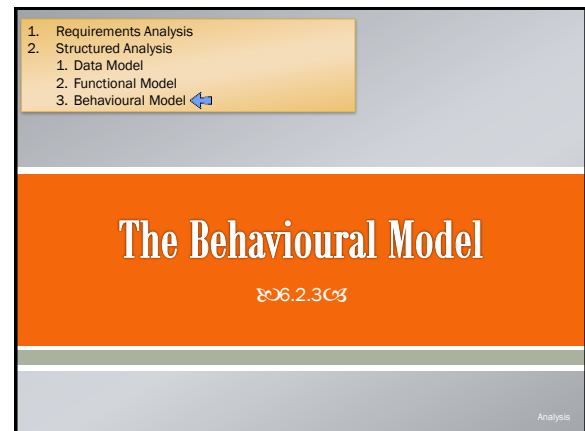
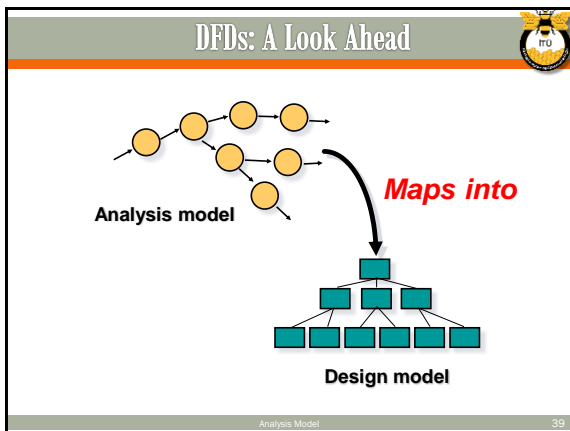
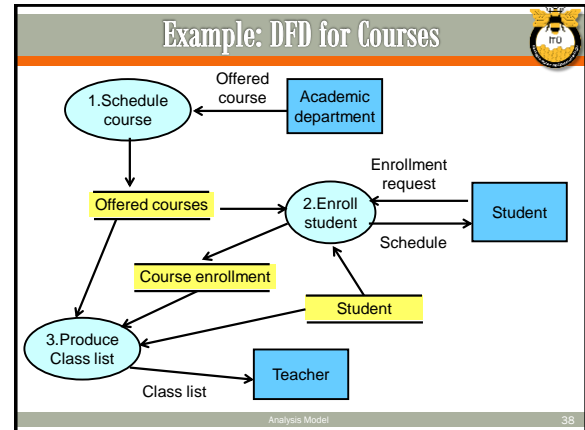
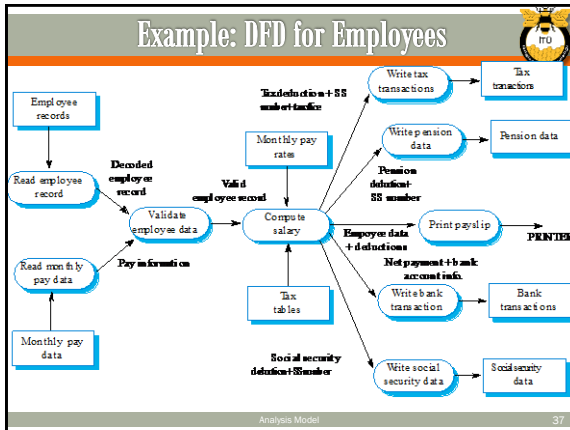
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Example: DFD for Quizzing Software



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Control Flow Diagrams

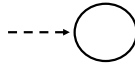
- a dashed arrow entering a vertical bar is an input



- a dashed arrow leaving a process implies a data condition



- a dashed arrow entering a process implies a control input read directly by the process

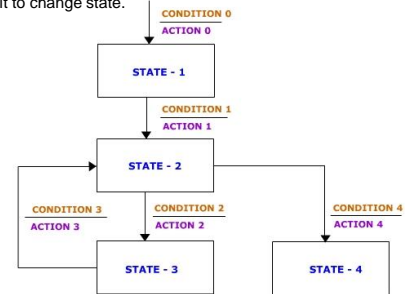


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State Transition Diagrams

- STD can be used to model the state changes of the system.
- A system is in a state and will remain in that state till a condition and an action force it to change state.



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Example:

Vending Machines Management Software

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Statement of Software Scope (1)

- You've been asked to develop a management software for a company which maintains a large number of vending machines (self-service machines to sell snack foods).
- Vending machines are at several locations across the city.
- Each location can have one or more machines.
- Vending machines need to be refilled with different quantities depending on the consumption at each location.

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Statement of Software Scope (2)

- Each location is served by one service personnel.
- All foods are stored in the company's warehouse.
- Before a personnel leaves for servicing, he requests foods from the warehouse for refilling.
- After returning from servicing, the service personnel submits the cash he collected from each machine to the company; returns any unused foods; and informs the company of any problems with the machines.
- When the food stock gets low, a purchase order is generated.

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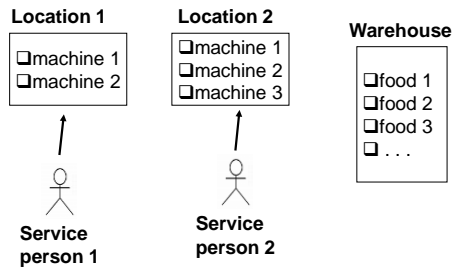
Statement of Software Scope (3)

- The company wants to manage their business using the software that keeps track of the
 - locations,
 - machines,
 - service personnel,
 - food stocks,
 - maintenance history for machines,
 - the amount of food requested and returned by each personnel,
 - total cash generated per machine, per location,
 - details of any purchase orders generated.
- Daily reports (such as total cash report, maintenance summary report, purchase order) will need to be generated.

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System Outline



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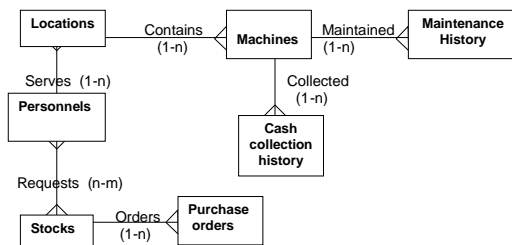
Tasks

- Draw an **Entity Relationship Diagram** that describes the relationships between the different data entities.
 - For each relationship, name the relationship and define its cardinality (1-1, 1-n, or n-m).
 - For each entity, list all data items.
- Produce Level-0 and Level-1 **Data Flow Diagrams** that captures the main processes, data flows, information sources and data stores of this application.
- Produce a **Program Structure Chart**.

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Entity Relationship Diagram (ERD)



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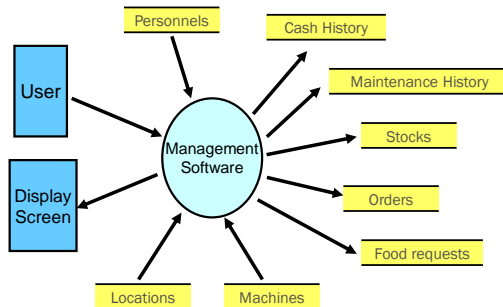
Entities

ENTITY	DATA ITEMS
Locations	Location_ID, Address, Number of consumers, ServicePersonnel_ID
Machines	Machine_ID, Location_ID, Frequency of refilling
Personnels	Personnel_ID, Personnel name
Stocks	Food_ID, Food name, Current amount
Food_Requests	Personnel_ID, Food_ID, Date of request, Amount of request, Returned amount
Cash_Collection_History	Machine_ID, Date of collection, Amount of cash
Maintenance_History	Machine_ID, Date of maintenance, Type of maintenance
Purchase_Orders	Order_ID, Food_ID, Date of order, Amount of order

Analysis Model

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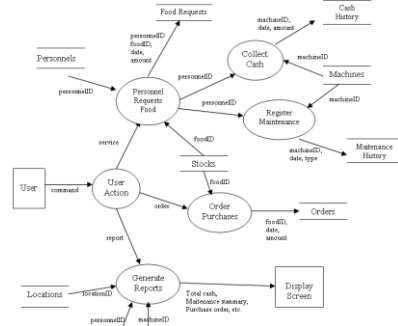
Level-0 DFD



Analysis Model

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Level-1 DFD



Analysis Model

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Statement of Software Scope (3)

- The manager will assign a service request task to an available technician.
- For each service request the followings should be recorded: *Device information (device type, brand, model, warranty status, start date, expiration date); Jobs done at service, Spare parts used if any, Billing amount (TL).*
- For customers who has warranty agreement, periodic maintenances will be tracked. For this purpose, a list of devices which are sorted by warranty expiration date should be available.

Analysis Model

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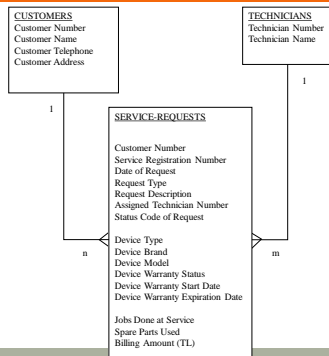
Statement of Software Scope (4)

- "Service Request Lists" should be available with different criteria:
 - by service registration number
 - by customer name
 - by status code
 - by device type
 - by request type
 - by date of request
 - by technician name

Analysis Model

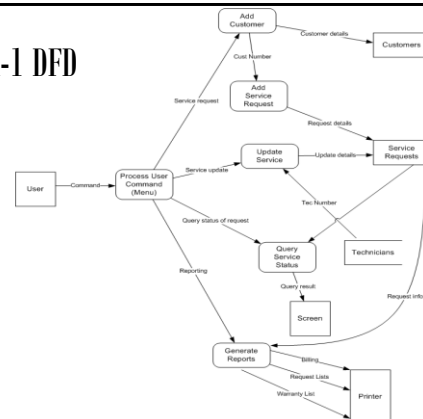
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Entity Relationship Diagram (ERD)

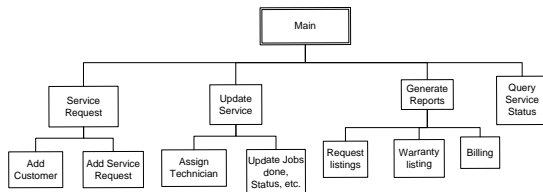


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Level-1 DFD



Program Structure Chart



Analysis Model

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Wrap-up

This week we present

- Structural Analysis: Where the main focus of the analysis stage is handling static and dynamic system behaviour separately
- Object Oriented Analysis: Where the main focus of the analysis is to represent the objects inherent in the requirements as classes with specific data and behaviour

Introduction & UML

1.66

Next Week



✂ We will be covering *Architectural Models and Model Driven Engineering!!!*

Introduction & LHM1.67