CS342 Software Engineering

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Lecture 10
STRUCTURED SYSTEMS ANALYSIS

Adapted from Software Engineering, by Dr. Paul E. Young
& slides by Dr. Mohammad Daoud

The Analysis Workflow

- The aim of the analysis workflow is to analyze and refine the requirements
- Analysis workflow can't be done within the requirements workflow because:
  - The requirements must be totally understandable by the client
  - The artifact of the requirements workflow must be expressed in a natural language (informal specification)
  - All natural languages are technically not accurate.

Informal Specifications

- Informal specifications are written in a natural language, such as English and Arabic
- Example

  "If the sales for the current month are below the target sales, then a report is to be printed, unless the difference between target sales and actual sales is less than half of the difference between target sales and actual sales in the previous month, or if the difference between target sales and actual sales for the current month is under five percent"

- Natural language is *not* accurate to specify a product requirements.

Informal Specifications - Example

- Manufacturing Information System:
  - “A part record and a plant record are read from the database. If it contains the letter A directly followed by the letter Q, then calculate the cost of transporting that part to that plant”

(factory)

- To what does it refer?
  - The part record? The plant record? Or the database?
- Therefore, two separate workflows are needed
  - The requirements artifacts must be expressed in the language of the client
  - The analysis artifacts must be precise, and complete enough for the designers

Tracing Requirements Artifacts

- Every item in the analysis artifacts must be traceable to an item in the requirements artifacts

Analysis Artifacts

- The analysis artifacts should be checked by means of a review
  - The client and analysis team must be present.
- The Software Project Management Plan (SPMP) must be also checked
  - Pay special attention to the cost and duration (budget and time) estimations

The Specifications Document

- The specifications document
  - It constitutes a contract between the client and the developers
  - It must not have imprecise phrases like "optimal," or "% complete"
  - It must not have contradictions, omissions and incompleteness
  - It must be complete and correct for testing and maintenance purposes

The Specification Document

- The specification document determines the product constraints:
  - Deadline
  - Parallel running
  - Portability
  - Reliability
  - Rapid response time

The Specification Document

- For real-time software
  - Hard real-time constraints must be satisfied
- Acceptance criteria
  - It is important to make a series of tests
  - The product satisfies its specifications if it passes the tests

Structured Systems Analysis Methods

- Three popular graphical specification methods of 1970s
  - DeMarco
  - Gane and Sarsen
  - Yourdon
- All are equivalent and good
- Gane and Sarsen’s method is widely used

Software Shop - Mini Case Study

"Software Shop buys software from various suppliers and sells it to the public. Popular software packages are kept in stock, but the rest must be ordered as required. Educational institutions are given special discount; 10% on up to 4 packages and 15% on 5 packages or more. Software Shop is doing well. Despite its business success, Software Shop has been advised to computerize".

Does it worth to computerize its business?

Software Shop - Objective

- The fundamental issue:

  What is the objective of computerizing the shop business?

  Answer:

  "in order to make more money"

  – We need to perform cost–benefit analysis for each section of the Shop business

Software Shop – Business Functions

- A better question:

  What business functions should be computerized?

  - Accounts payable
  - Accounts receivable
  - Inventory

- More questions:

  How? Batch, or online? In-house or outsourcing?

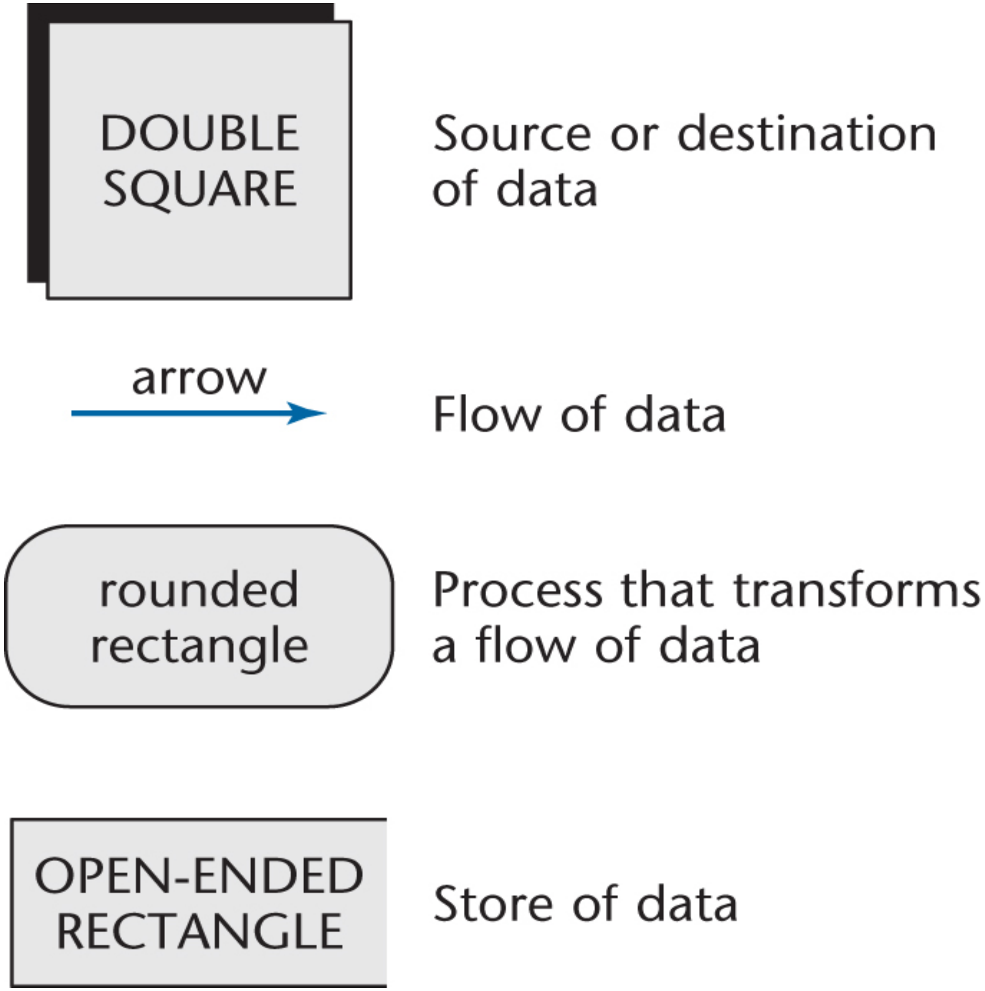
Software Shop – Risk Management

- The risk on many standard approaches
  - First produce the solution, then find out the problem.

Data Flow Diagram

- Gane and Sarsen’s (G&S) method
  - Nine-steps method
  - Stepwise refinement is used in many steps
- The Data Flow Diagram (DFD) is used to show the logical data flow.
- It shows what happens, not how it happens.

Data Flow Diagram Symbols



DOUBLE SQUARE

Source or destination of data

arrow

Flow of data

rounded rectangle

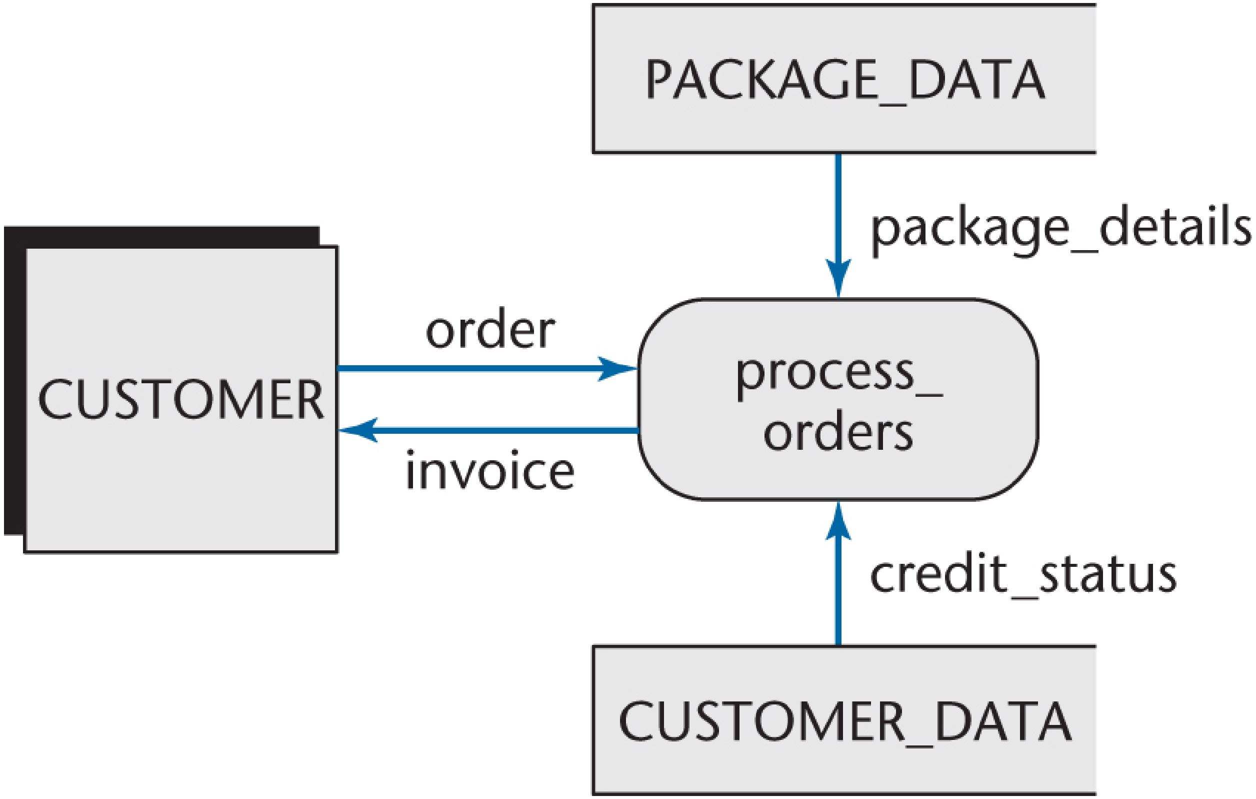
Process that transforms a flow of data

OPEN-ENDED RECTANGLE

Store of data

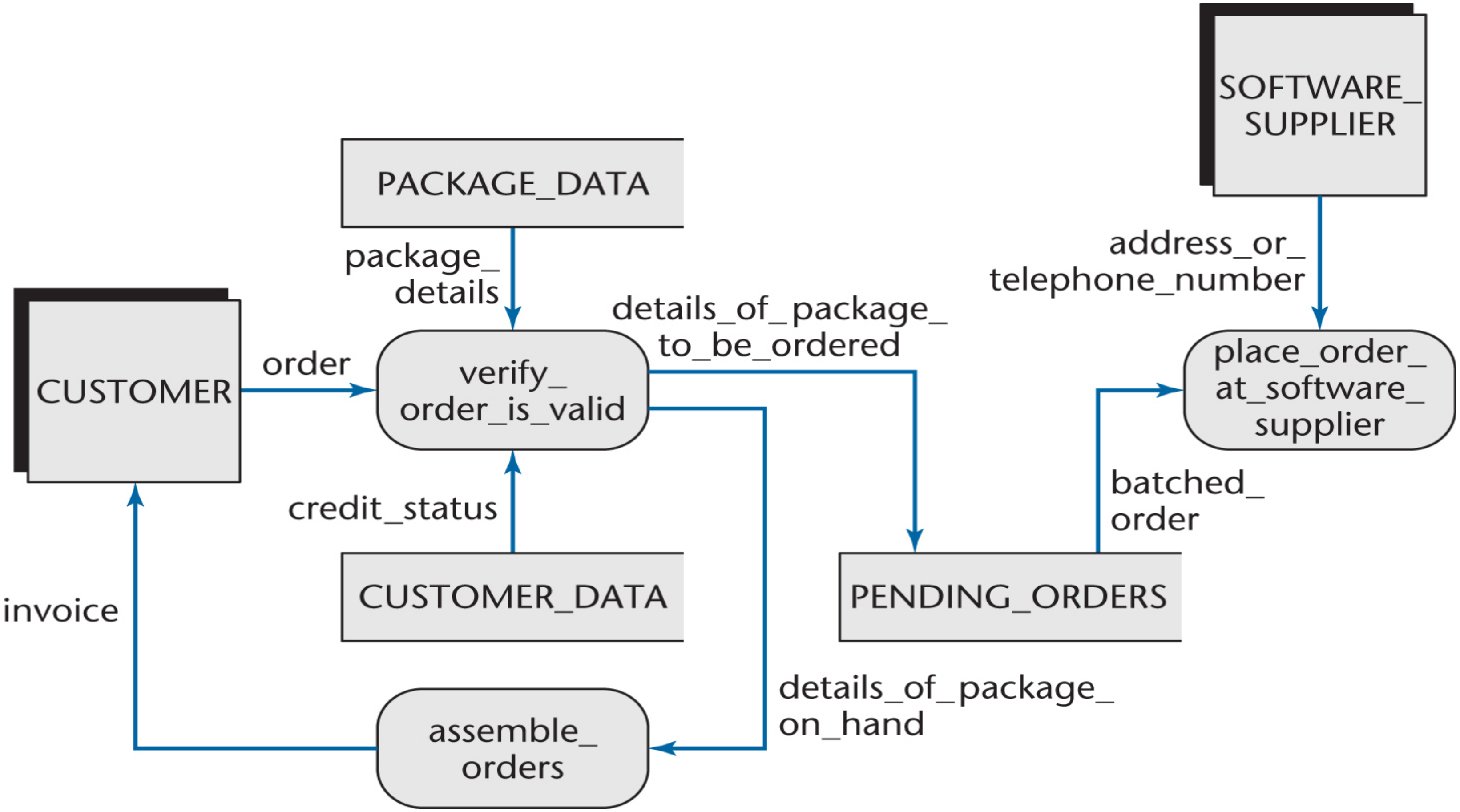
Software Shop DFD - Step 1

- First Refinement - Possible interpretation



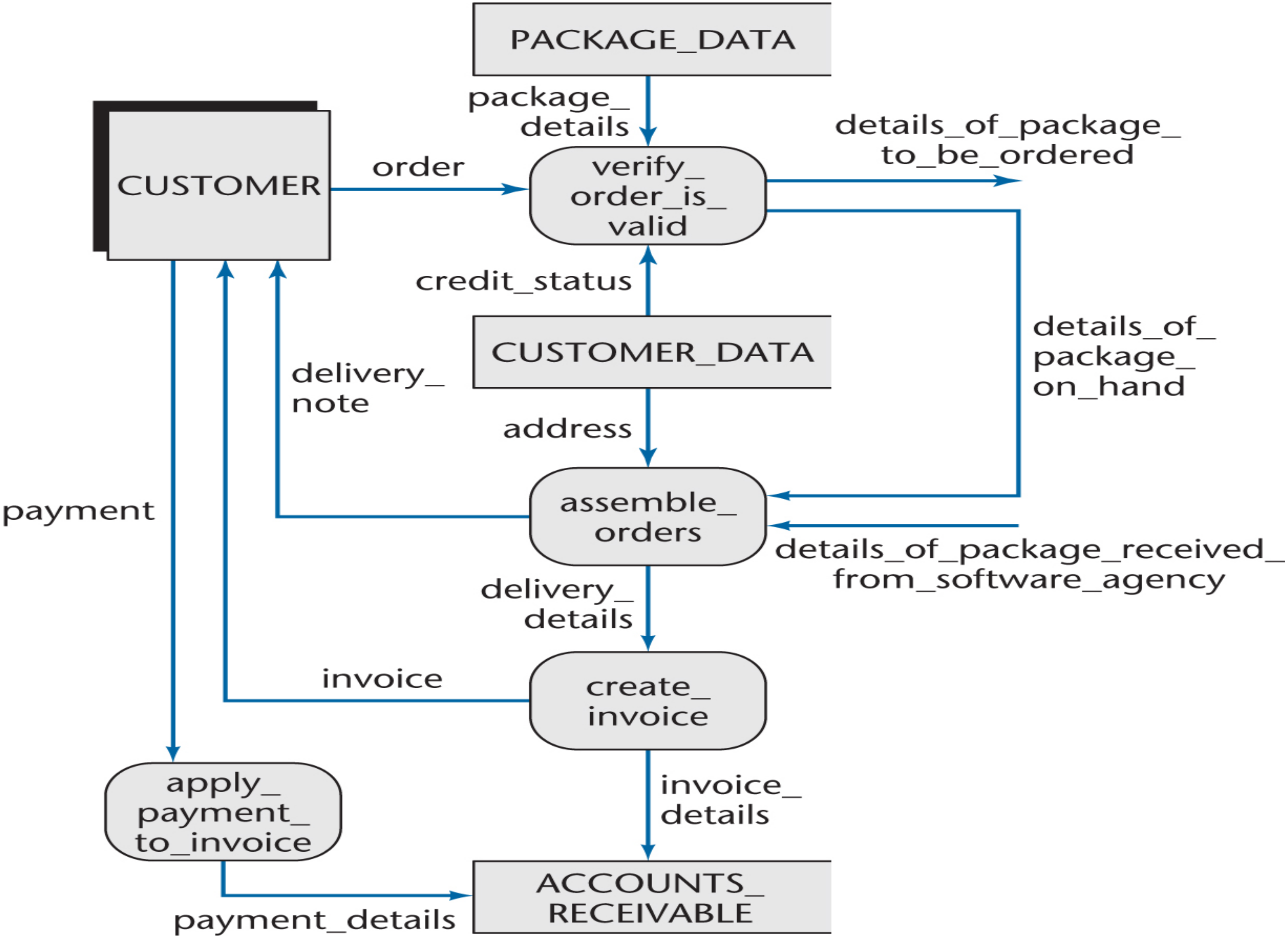
Software Shop DFD - Step 1

- Second Refinement - PENDING ORDERS are scanned daily



Software Shop DFD - Step 1

- Third Refinement - Part of third refinement



Software Shop - Step 2

2. Decide What shop parts need to be Computerized and how:

- Large volumes, tight controls

  Batch processing

- Small volumes, in-house computer

  Online processing

- It depends on how much client decides to spend
- Cost/benefit analysis is required

Software Shop - Step 3

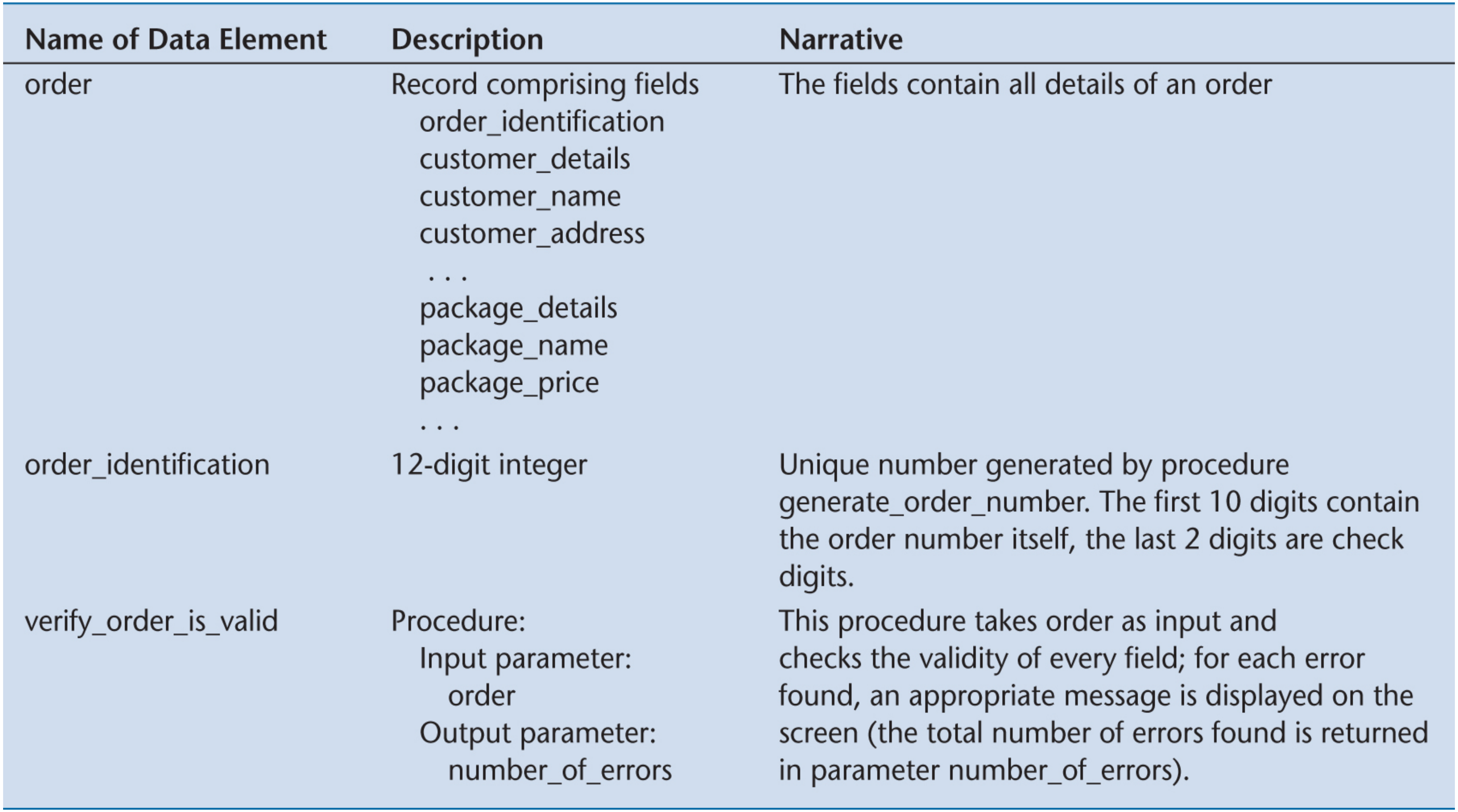
3. *Determine the Details of the Data Flows:*

- Determine the data items for each process
- Refine each flow stepwise
  - Example;

```
order:
  order_identification
  customer_details
  package_details
```

- A data dictionary is needed for large products

Sample Data Dictionary Entries



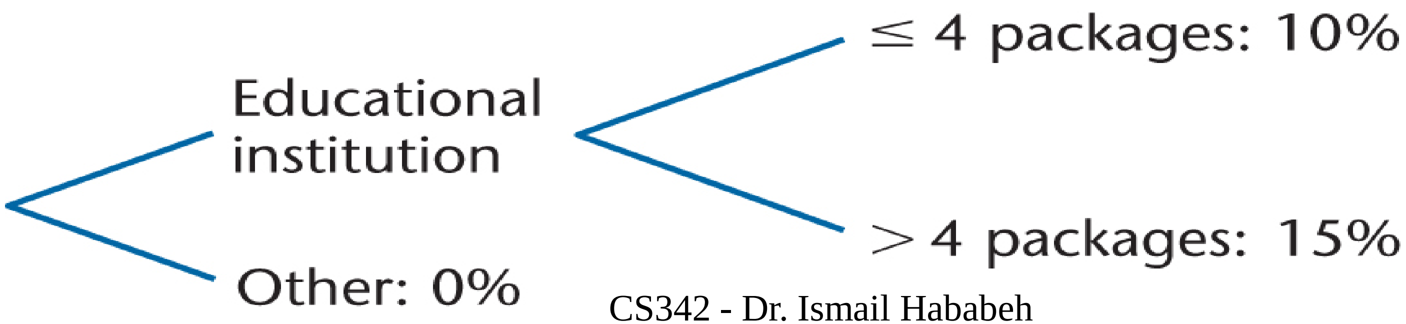
Name of Data Element	Description	Narrative
order	Record comprising fields order_identification customer_details customer_name customer_address . . . package_details package_name package_price . . .	The fields contain all details of an order
order_identification	12-digit integer	Unique number generated by procedure generate_order_number. The first 10 digits contain the order number itself, the last 2 digits are check digits.
verify_order_is_valid	Procedure: Input parameter: order Output parameter: number_of_errors	This procedure takes order as input and checks the validity of every field; for each error found, an appropriate message is displayed on the screen (the total number of errors found is returned in parameter number_of_errors).

Software Shop - Step 4

4. Define the Logic of the Processes:

- The process **give educational discount**
  - Software Shop must explain the discount that should be given to educational institutions
    - 10% on up to 4 packages
    - 15% on 5 or more
- Translate this into a **decision tree**

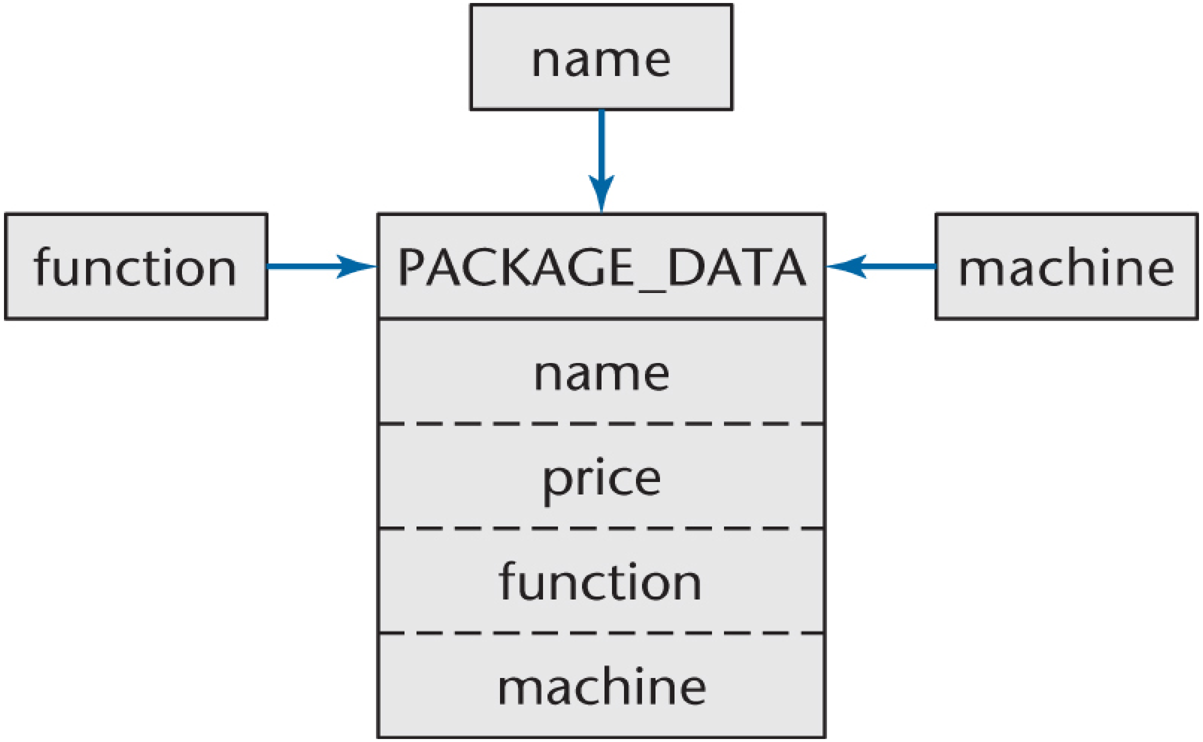
Give educational discount



Software Shop - Step 5

5. *Define the Data Stores:*

- A customer may order a package by name, function, or machine.
- Define the exact contents and representation (format)



Software Shop - Step 6

6. *Define the Physical Resources:*

- For each file, specify
  - File name
  - Type (sequential, indexed, …etc.)
  - Storage medium
  - Data recourse, link, …etc.

Software Shop - Step 7

7. Determine Input/Output Specifications:

- Specify
  - Input forms
  - Input screens
  - Displayed output
  - Printed output

Software Shop - Step 8

8. Determine the project size:

- Obtain the numerical information of:
  - Volume of input (hourly/daily/monthly)
  - Size and frequency of processing data
  - Size/number of records passing between CPU and mass storage
  - Size of each file

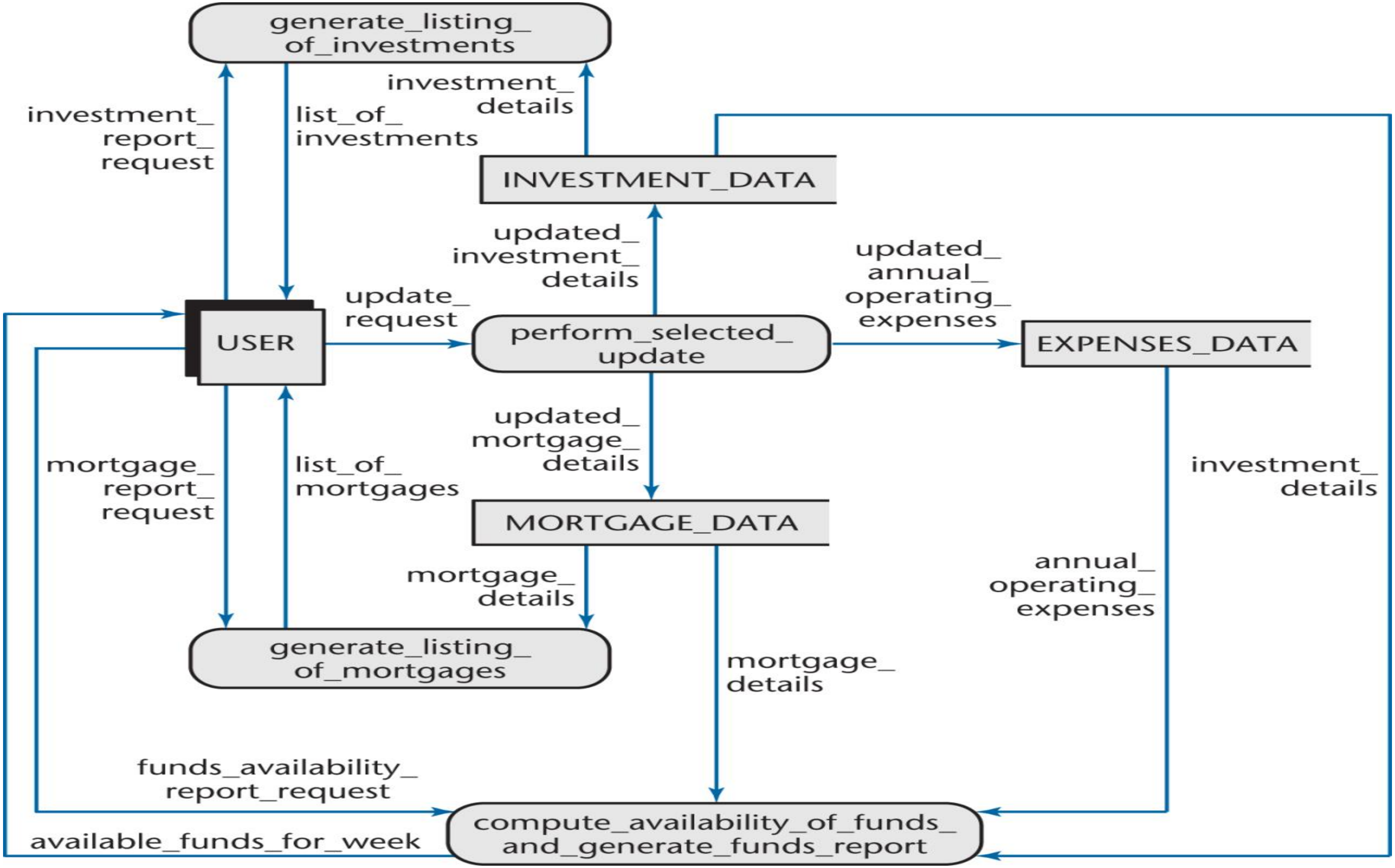
Software Shop - Step 9

9. *Determine the Hardware Requirements:*
   - Mass storage requirements
   - Back-up mass storage
   - Input devices
   - Output devices
   - Evaluate if the existing hardware adequate
     - If not, recommend whether to buy or lease additional hardware

Software Shop - Can we determine ?

- Can we determine: response time, number of I/O channels, and CPU size and speed?
  - Response times cannot be determined
  - The number of I/O channels can only be guessed
  - CPU size and speed can only be guessed
  - Nevertheless, no other method provides these data for arbitrary products

DFD – Example 2 MSG Case Study


generate_listing_of_investments
investment_report_request
list_of_investments
investment_details
INVESTMENT_DATA
updated_investment_details
update_request
USER
perform_selected_update
updated_annual_operating_expenses
EXPENSES_DATA
updated_mortgage_details
mortgage_report_request
list_of_mortgages
MORTGAGE_DATA
investment_details
mortgage_details
annual_operating_expenses
generate_listing_of_mortgages
mortgage_details
funds_availability_report_request
available_funds_for_week
compute_availability_of_funds_and_generate_funds_report