Systems Analysis and Design

2

Understanding and Modeling Organizational Systems

- Fazle Rabbi

Learning Objectives

- Understand that organizations and their members are systems and that analysts need to take a systems perspective.
- Depict systems graphically using context-level data flow diagrams, and entity-relationship models, use cases, and use case scenarios.
- Recognize that different levels of management require different systems.
- Comprehend that organizational culture impacts the design of information systems.

Three Main Forces Interacting to Shape Organizations

- Levels of management
- Design of organizations
- Organizational cultures

Organizations Are Composed of Interrelated Subsystems

- Influenced by levels of management decision makers that cut horizontally across the organizational system
  - Operations
  - Middle management
  - Strategic management
- Influenced by organizational cultures and subcultures

Major Topics

- Organizations as systems
- Depicting systems graphically
  - Data flow diagram
  - Entity-relationship model
  - Use case modeling
- Levels of management
- Organizational culture

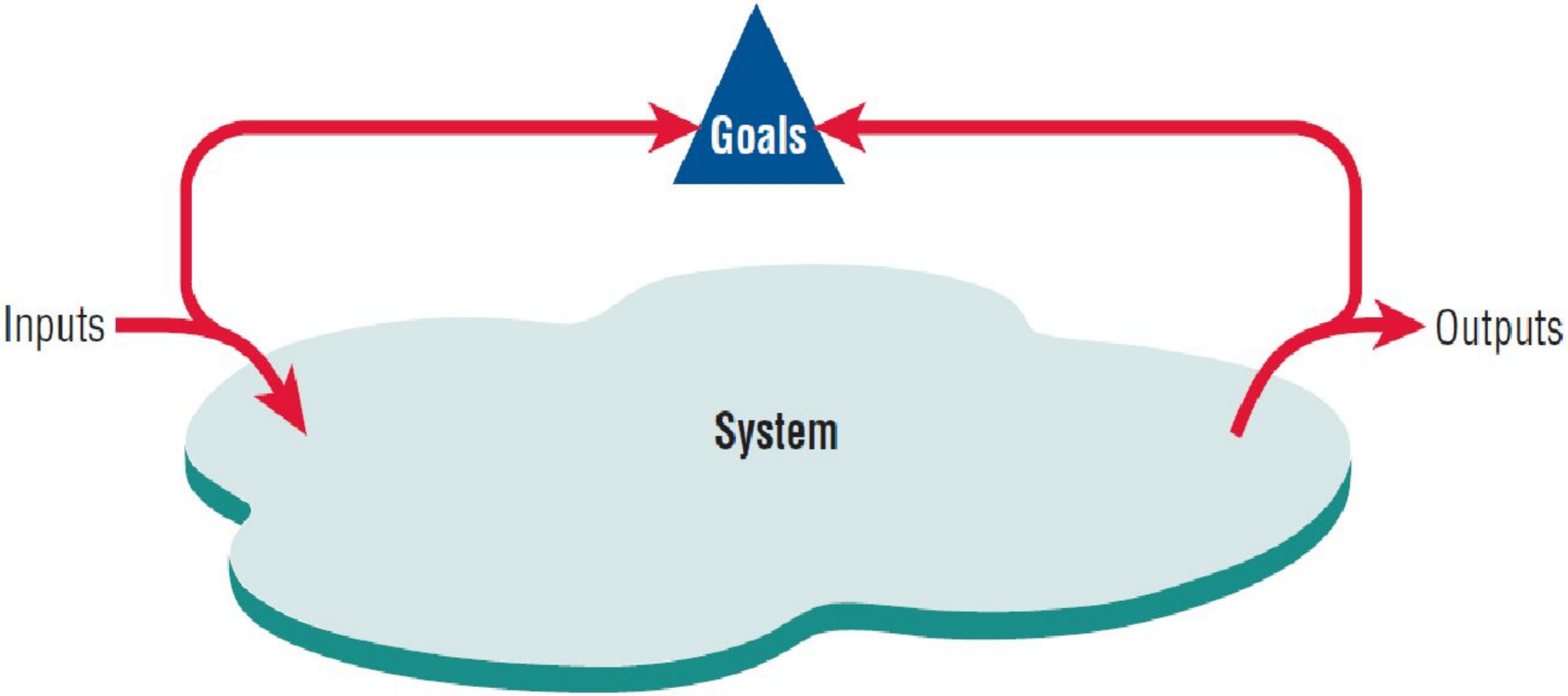
Organizations as Systems

- Conceptualized as systems designed to accomplish predetermined goals and objectives
- Composed of smaller, interrelated systems serving specialized functions
- Typical functions include accounting, marketing, production, data processing, and management.

Interrelatedness and Independence of Systems

- All systems and subsystems are interrelated and interdependent
- All systems process inputs from their environments
- All systems are contained by boundaries separating them from their environments
- System feedback for planning and control
- An ideal system self-corrects or self-regulates itself.

System Outputs Serve as Feedback that Compares Performance with Goals (Figure 2.1)



Organizational Environments

- Community
  - Physical location
  - Demographic profile (education, income)
- Economic
  - Market factors
  - Competition
- Political
  - State and local government
- Legal
  - Federal, state, regional, local laws, and guidelines

Openness and Closedness

- Open
  - Free flow of information
  - Output from one system becomes input to another
- Closed
  - Restricted access to information
  - Limited by numerous rules
  - Information only on a “need to know” basis

Virtual Organizations and Virtual Teams

- A virtual organization has parts of the organization in different physical locations
- Computer networks and communications technology are used to bring virtual teams together to work on projects

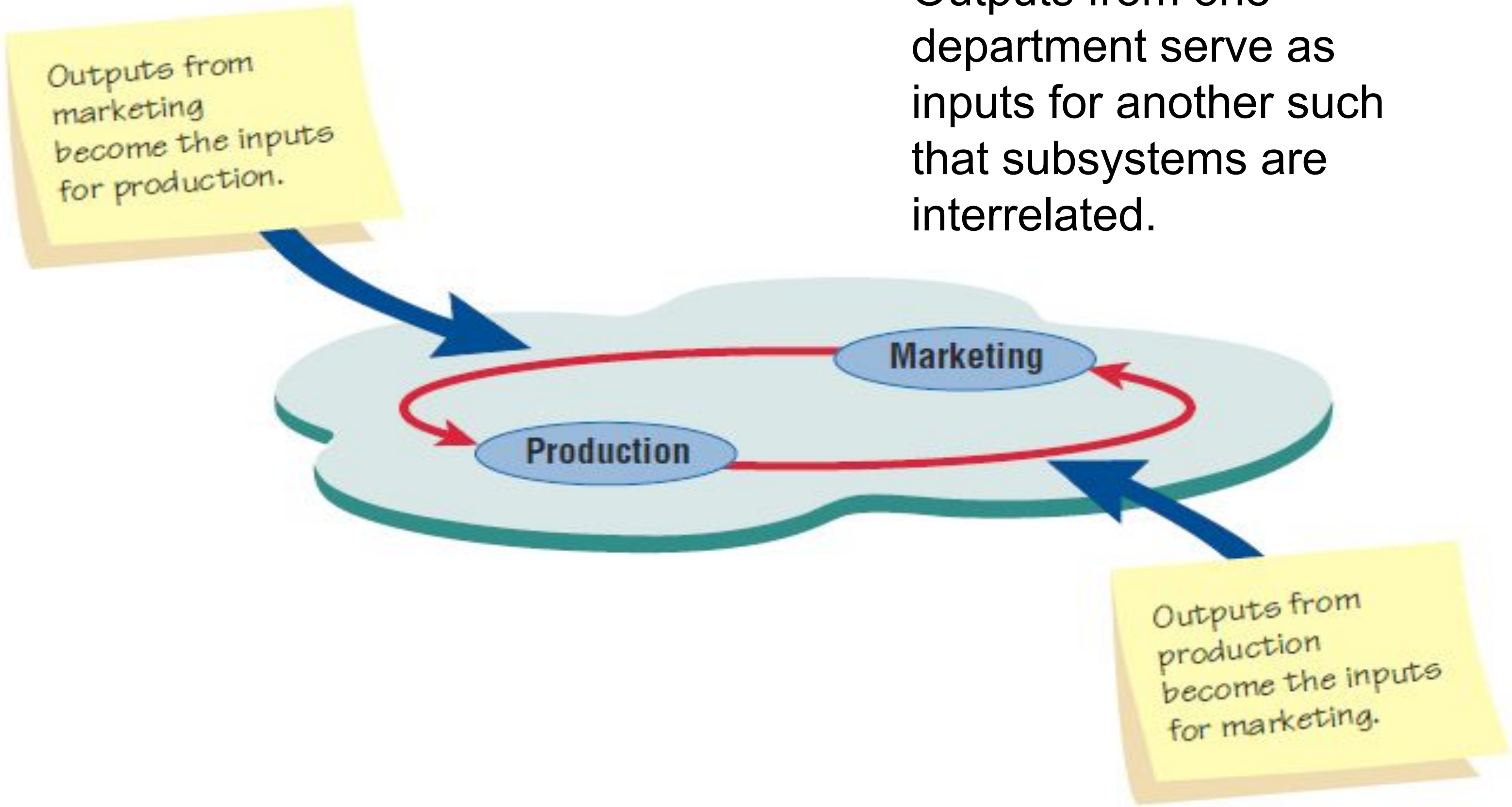
Benefits of Virtual Organizations and Teams

- Possibility of reducing costs of physical facilities
- More rapid response to customer needs
- Helping virtual employees to fulfill their familial obligations to children or aging parents

Taking a Systems Perspective

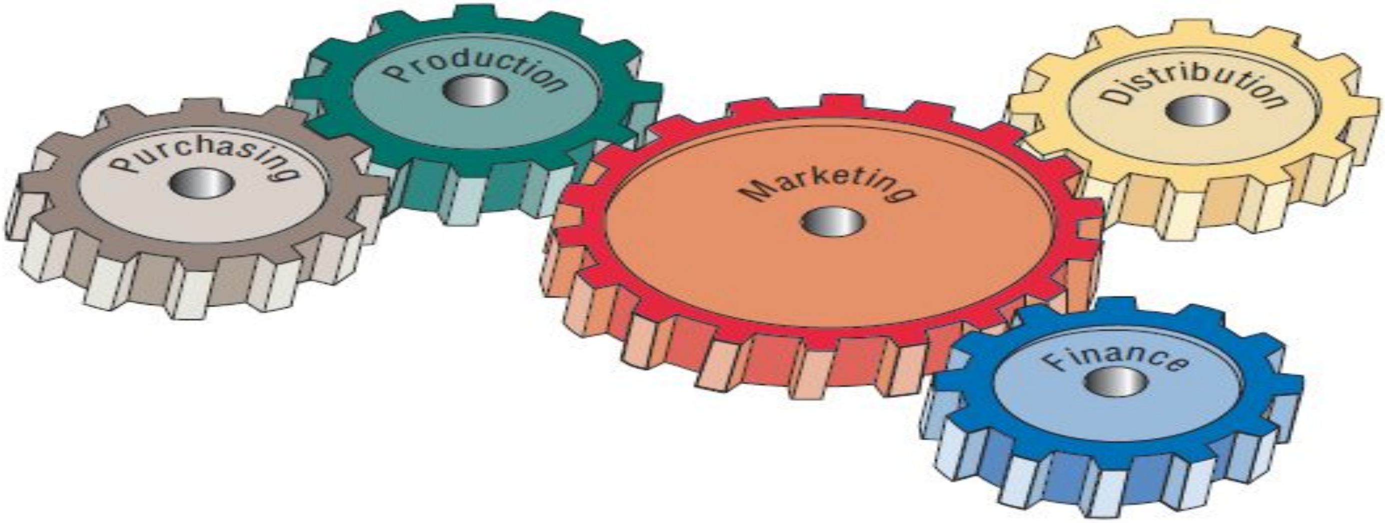
- Allows system analyst to understand businesses before they begin their tasks
- It is important that members of subsystems realize that they are interrelated with other subsystems
- Problems occur when each manager thinks that his/her department is the most important
- Bigger problems may occur when that manager rises through the ranks

Taking a Systems Perspective (Figure 2.2)

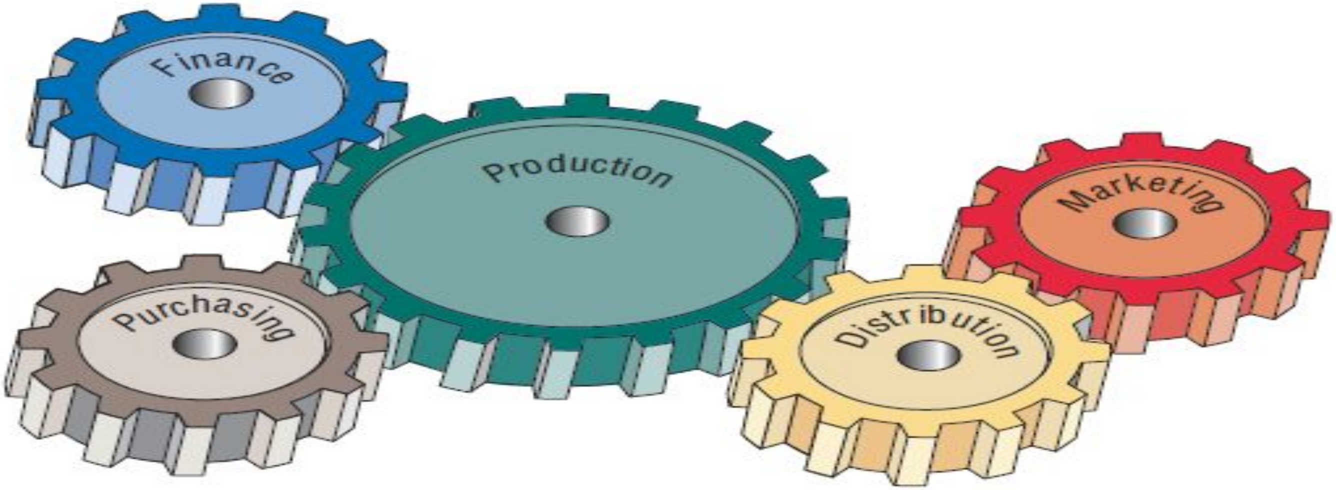

Outputs from marketing become the inputs for production.
Marketing
Production
Outputs from production become the inputs for marketing.

Outputs from one department serve as inputs for another such that subsystems are interrelated.

Perspective of Functional Managers



How a Marketing Manager May View the Organization



How a Production Manager May See the Organization

Enterprise Resource Planning

- Enterprise Systems or Enterprise Resource Planning (ERP) describes an **integrated organizational information system**
- Software that helps the flow of information between the functional areas within the organization

- **ERP systems include**:
  - Manufacturing components
  - Sales and operations planning
  - Distribution
  - Managing the supply train
- **Problems with implementation**:
  - ❖Difficult to analyze a system currently in use and then fit the ERP model to that system
  - ❖Companies tend to design their business processes before ERP is implemented
- ERP, although growing in use is also being viewed with some skepticism.

ERP and the Organization

- ERP can affect every aspect of the organization, including:
  - Design of employees’ work
  - Skills required for job competency
  - Strategic positioning of the company

Issues to be Overcome for ERP Success

- Many issues must be overcome for the ERP installation is to be declared a success:
  - User acceptance
  - Integration with legacy systems and the supply chain
  - Upgrading functionality (and complexity) of ERP modules
  - Reorganizing work life of users and decision makers
  - Expanded reach across several organizations
  - Strategic repositioning of the company

Depicting Systems Graphically

- A system or subsystem as it exists within the corporate organization may be graphically depicted in several ways.
- The various graphical models show the boundaries of the system and the information used in the system.

Depicting Systems Graphically

- Context-level data flow diagrams
- Entity-relationship model
- Use case modeling

Context-Level Data Flow Diagrams

- The first model is the context-level data flow diagram (also called an environmental model).
- Data flow diagrams focus on the **data flowing** into and out of the system and the processing of the data.
- These basic components of every computer program can be described in detail and used to analyze the system for accuracy and completeness.

Context-Level Data Flow Diagrams

- Shows the scope of the system:
  - What is to be included in the system
  - The external entities are outside the scope of the system

The context-level data flow diagram serves as a good starting point for drawing the use case diagram

Context-Level Data Flow Diagrams

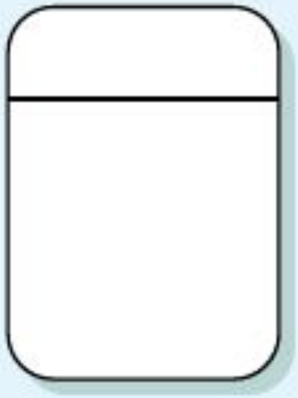
- the context-level data flow diagram employs only **three symbols**:

(1) a rectangle with rounded corners,

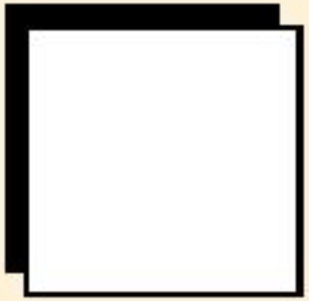
(2) a square with two shaded edges, and

(3) an arrow

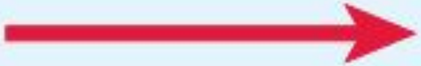
The Basic Symbols of a Data Flow Diagram



A **process** means that some action or group of actions take place.

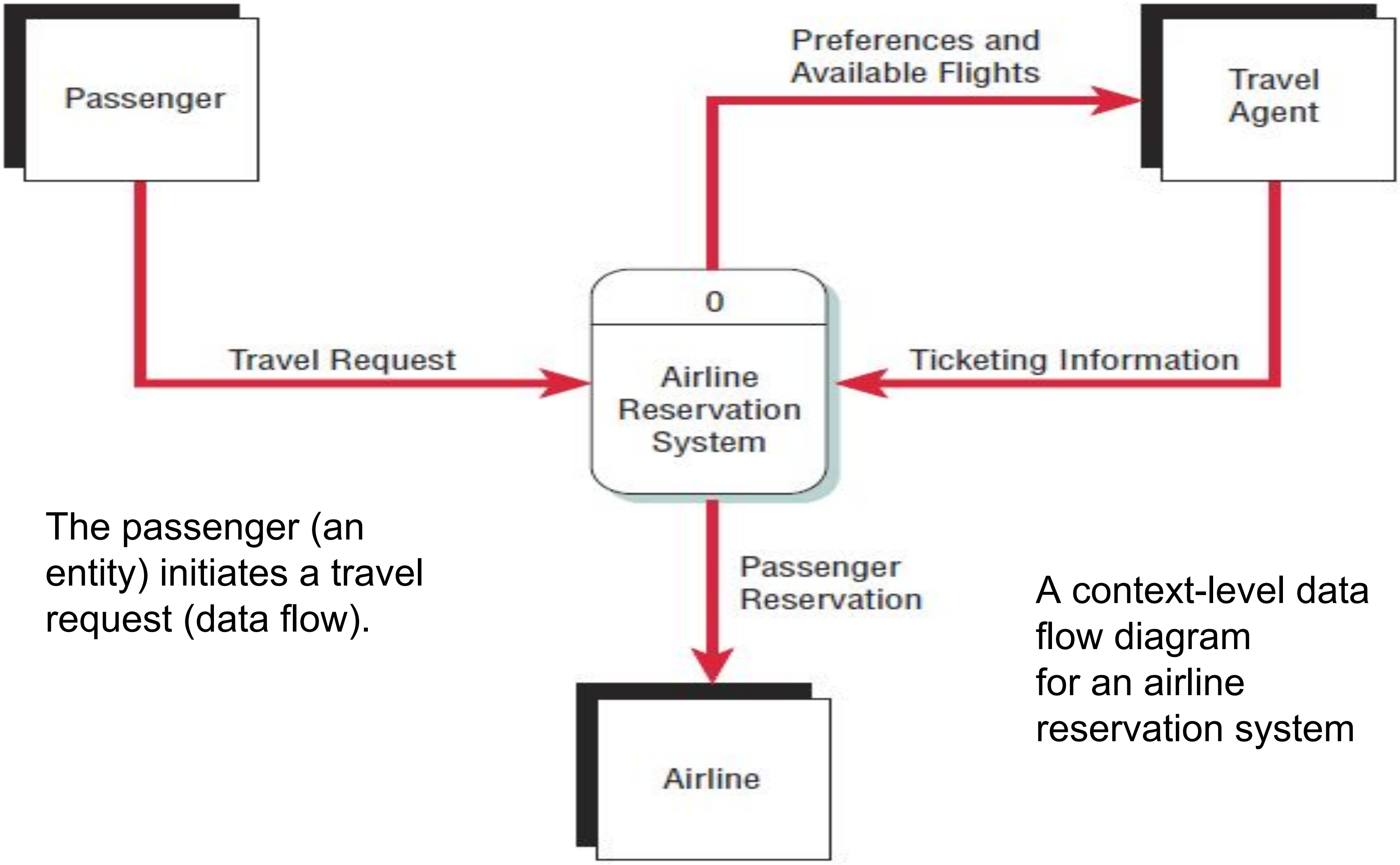


An **entity** is a person, group, department, or any system that either receives or originates information or data.



A **data flow** shows that information is being passed from or to a process.

Airline Reservation System



The passenger (an entity) initiates a travel request (data flow).

A context-level data flow diagram for an airline reservation system

- Processes transform **incoming** data into **outgoing** information, and the context level has **only one process**, representing the entire system.
- The **external entity** represents any entity that supplies or receives information from the system but is **not a part of the system**.
- This **entity may be** a **person**, a **group of people**, a corporate position or department, or **other systems.**
- The lines that connect the external entities to the process are called data flows, and they represent data.

Entity-Relationship Model

- Another way a systems analyst can show the **scope of the system** and define proper **system boundaries** is to use an entity-relationship model.
- The **elements** that make up an organizational system can be referred to as **entities**.
- An entity may be a person, a place, thing, or an event.
- Focus is on the **entities** and their **relationships** within the organizational system
- A relationship is the association that describes the interaction among the entities.

Relationships

- Relationships show how the entities are connected
- Three types of relationships:
  - One-to-one
  - One-to-many
  - Many-to-many

Relationships

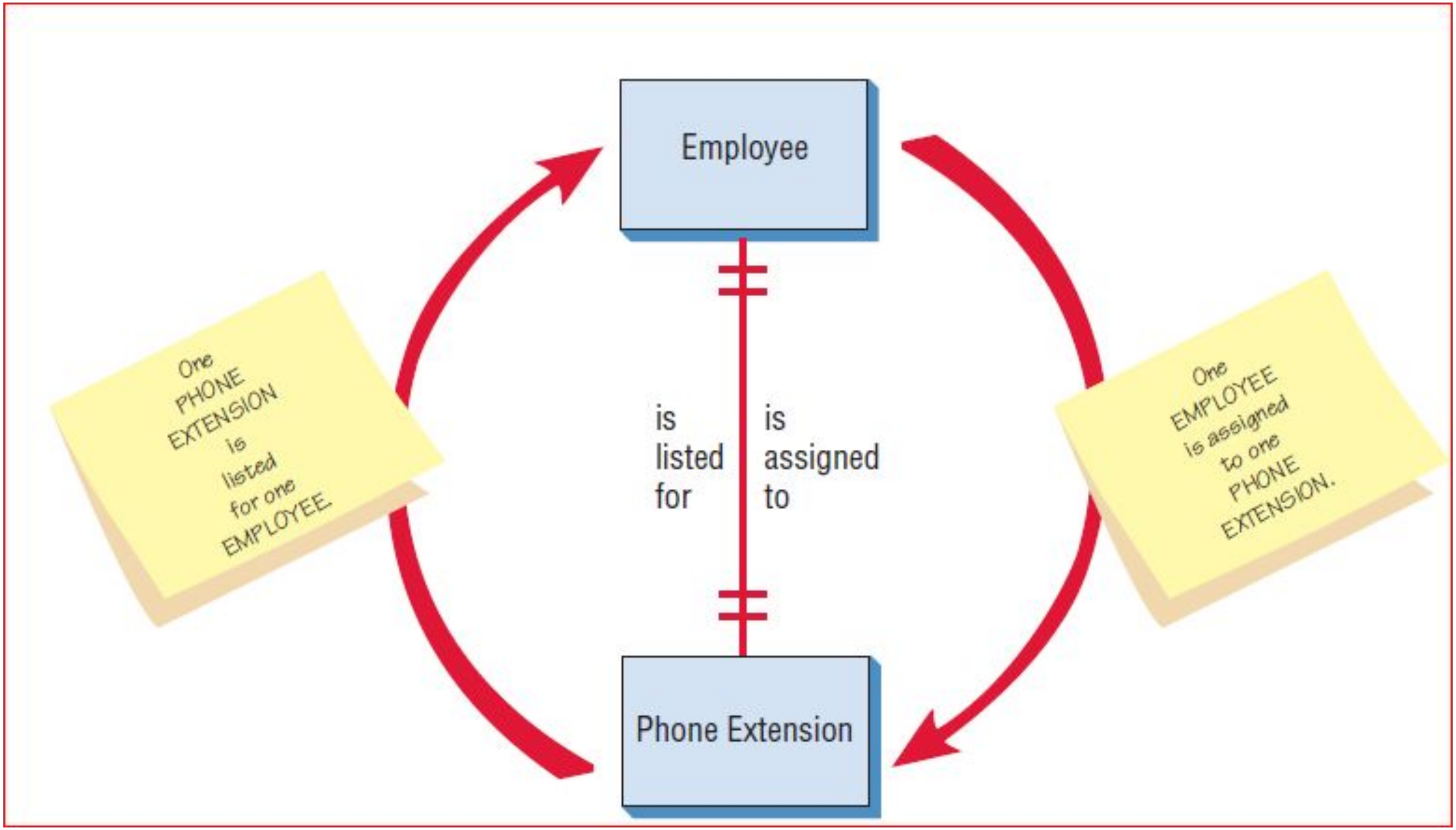
One-to-one —one employee is assigned to one phone extension.

One-to-many —many employees are assigned to a department.

Many-to-many —many passengers fly to many destinations.

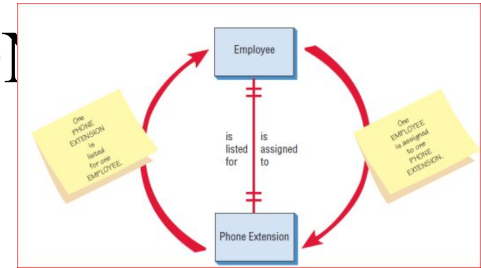
Entity-Relationship Example

a one-to-one relationship


Employee
is listed for
is assigned to
Phone Extension
One PHONE EXTENSION is listed for one EMPLOYEE.
One EMPLOYEE is assigned to one PHONE EXTENSION.

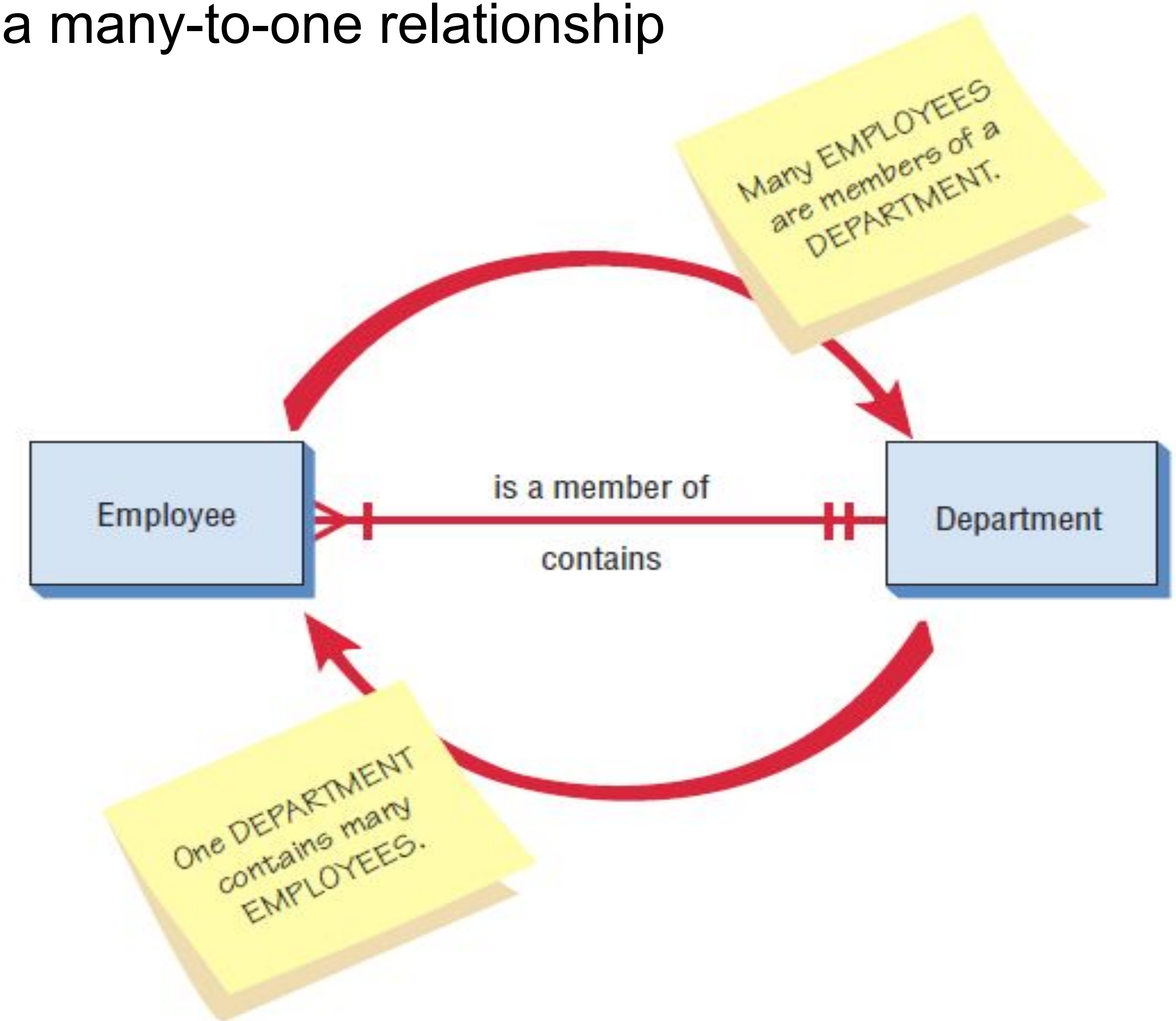
a **one-to-one** relationship

- Two entities are linked together by a line.
- the end of the line is marked with two short parallel marks (| |), signifying that
- this relationship is one-to-one.
- The red arrows are not part of the entity-relationship diagram.
- The phrase on the right side of the line is read from top to bottom as follows:
- One EMPLOYEE is assigned to one PHON EXTENSION


Employee
is listed for
is assigned to
Phone Extension
One PHONE EXTENSION is listed for one EMPLOYEE.
One EMPLOYEE is assigned to one PHONE EXTENSION.

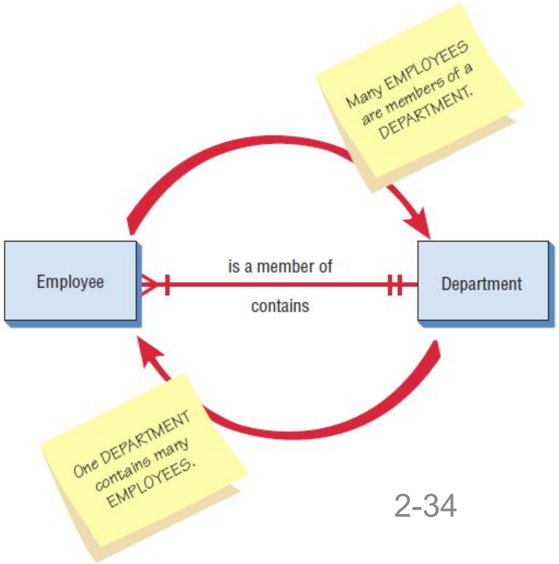
Entity-Relationship Example

a many-to-one relationship


Many EMPLOYEES are members of a DEPARTMENT.
Employee
is a member of
contains
Department
One DEPARTMENT contains many EMPLOYEES.

a many-to-one relationship

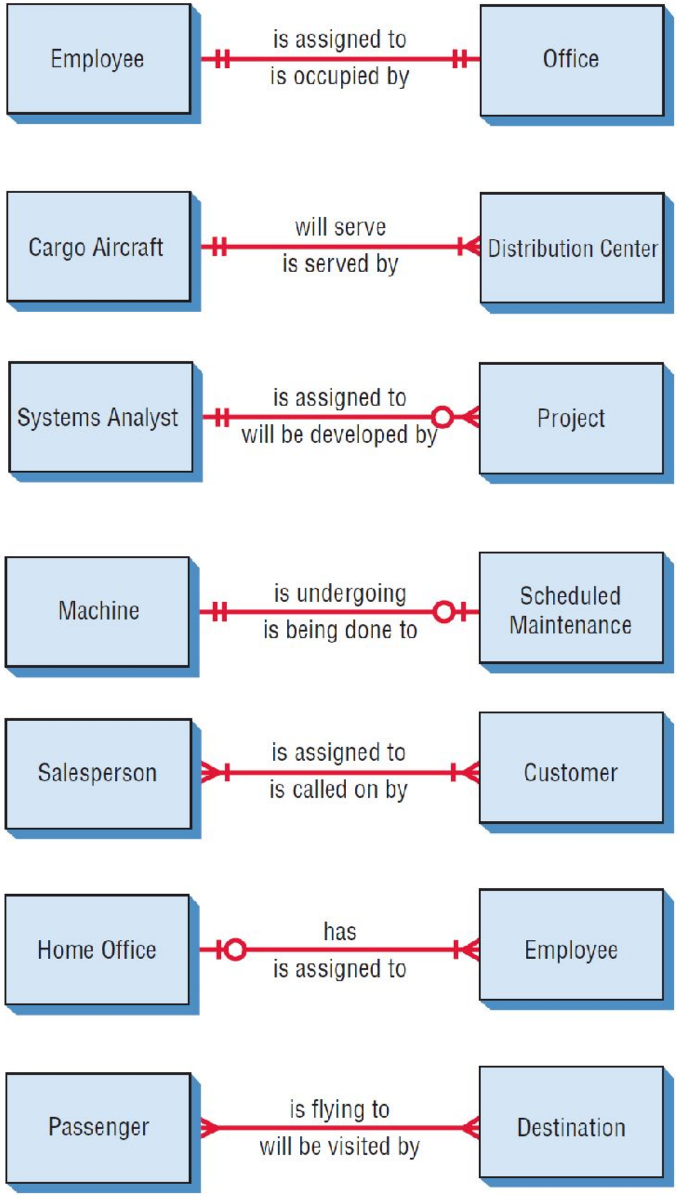
- The crow's foot and the single mark do not literally mean that this end of the relationship must be a mandatory "many."
- Instead, they imply that this end could be anything from one to many.



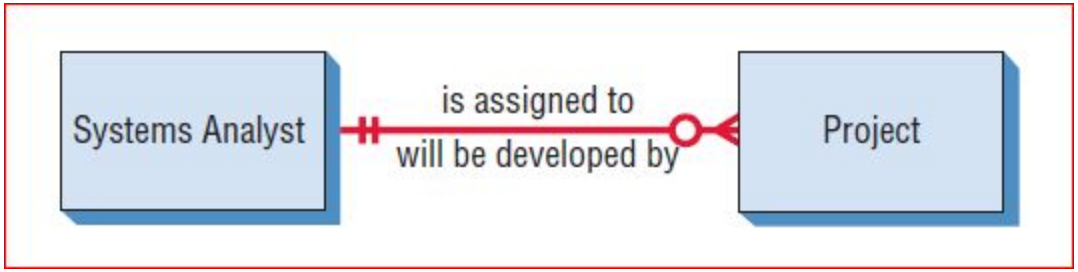
Many EMPLOYEES are members of a DEPARTMENT.

One DEPARTMENT contains many EMPLOYEES.

Examples of Different Types of Relationships in E-R Diagrams (Figure 2.8)

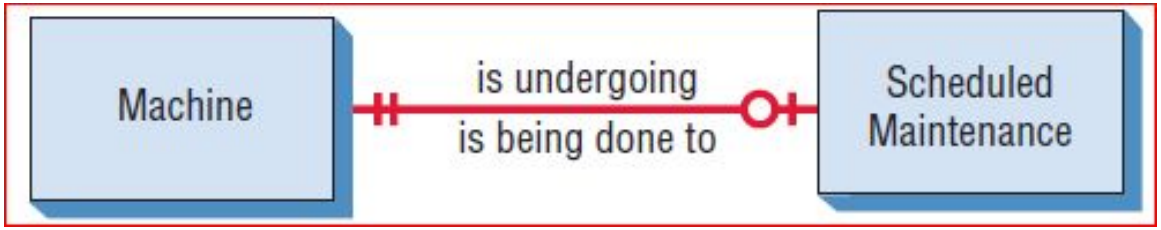


Relationships in E-R Diagrams



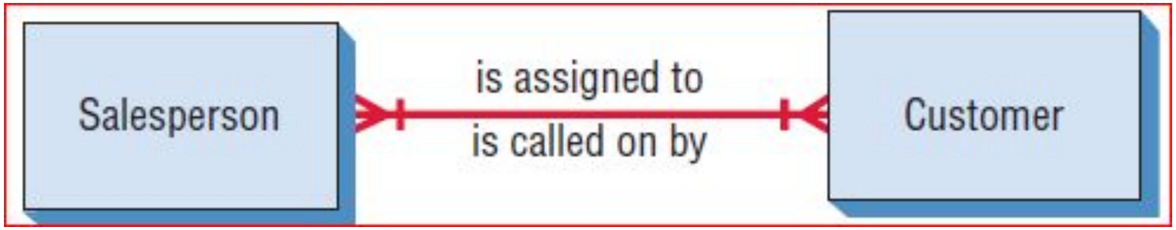
- The third has a circle at one end
- It can be read as “A SYSTEMS ANALYST may be assigned to MANY PROJECTS,”
- meaning that the analyst can be assigned to **no** projects, **one**, or **many** projects.
- no projects that is what the circle (O), for zero, is for.

Relationships in E-R Diagrams

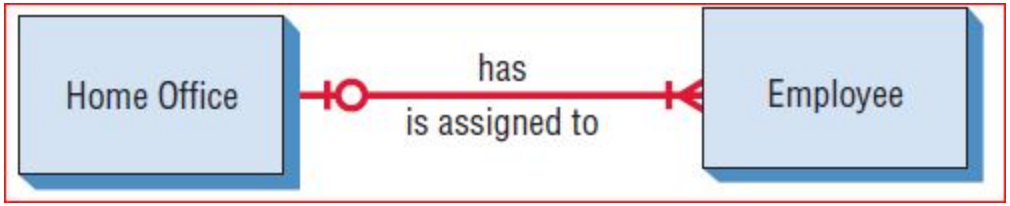


- The circle (O) indicates that none is possible in the relationship.
- Short mark means one
- "A MACHINE may or may not be undergoing SCHEDULED MAINTENANCE."

Many to Many

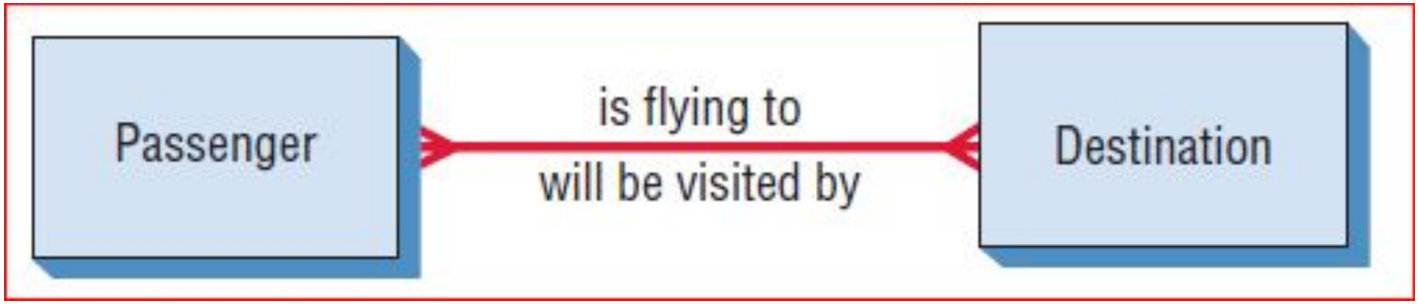


- “One or many SALESPEOPLE (plural of SALESPERSON) are assigned to one or more CUSTOMERs



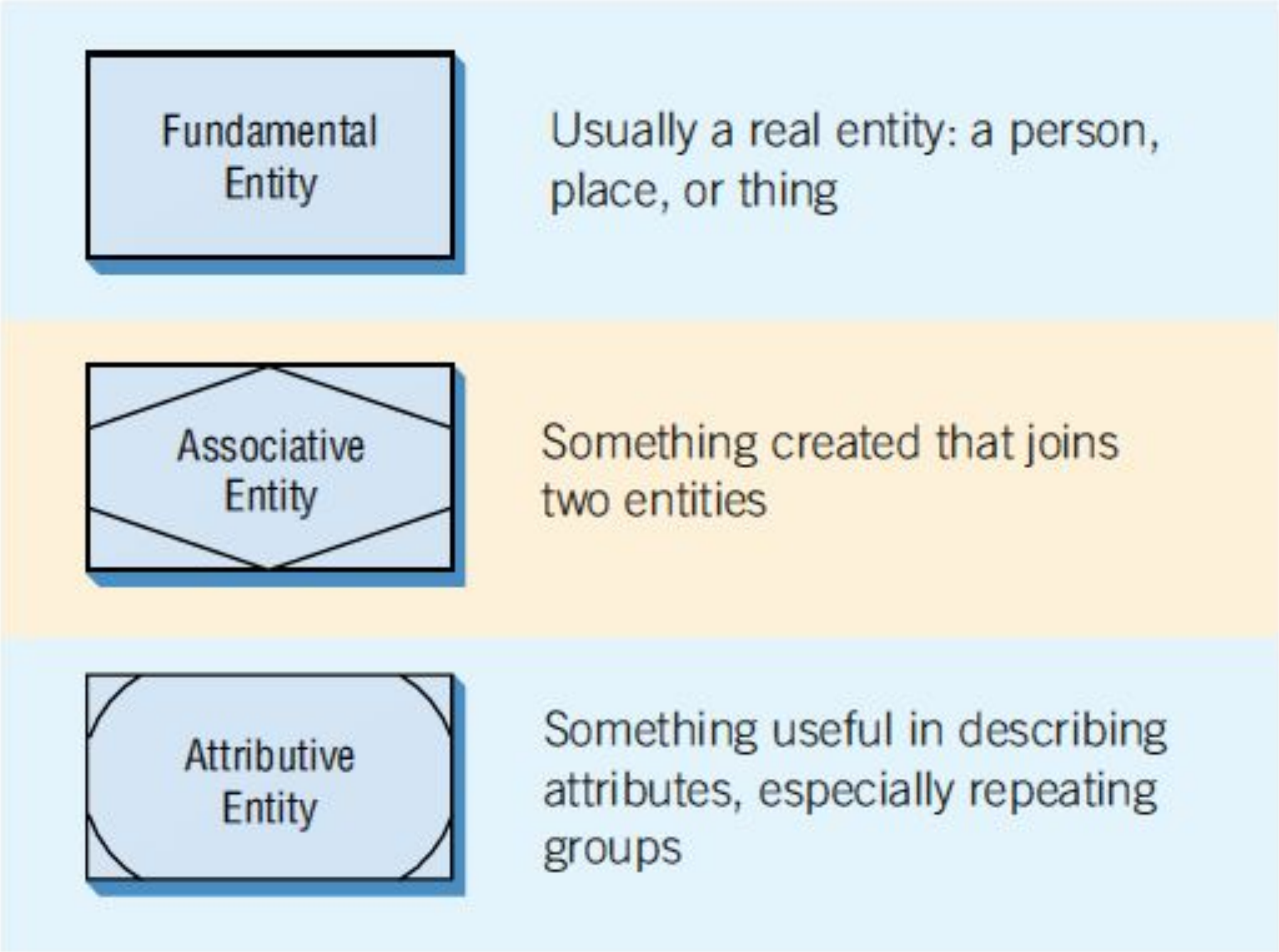
- "The HOME OFFICE can have one or many EMPLOYEEs,"
- or "One or more EMPLOYEEs may or may not be assigned to the HOME OFFICE."
- Once again, the I and O together imply a Boolean situation;
  - in other words, **one** or **zero**.

Relationships in E-R Diagrams



- "Many PASSENGERs are flying to many DESTINATIONs."

Three Different Types of Entities Used in E-R Diagrams (Figure 2.9)



Usually a real entity: a person, place, or thing

Something created that joins two entities

Something useful in describing attributes, especially repeating groups

Entities

- Fundamental entity
- Associative entity
- Attributive entity

An **Associative Entity** can only exist if it is connected to **at least two other entities**.

- Also call it a gerund, a junction, an intersection, or a concatenated entity

Associative Entities

Sometimes, **we create new items** in the process of developing an information system.

- Some examples are **invoices**, **receipts**, files, and **databases**.
- When we want to describe **how a person relates to a receipt**, it becomes convenient to indicate the receipt in a different way, as an associative entity.

Attributive Entities

Attributive: when an analyst wants to show data that are completely dependent on the existence of a fundamental entity, an attributive entity should be used.

Attribute

- For example, when a library had **multiple copies** of the **same book**, an attributive entity could be used
  - to designate which copy of the book is being checked out.
- The attributive entity is useful for showing **repeating groups of data**.

Example

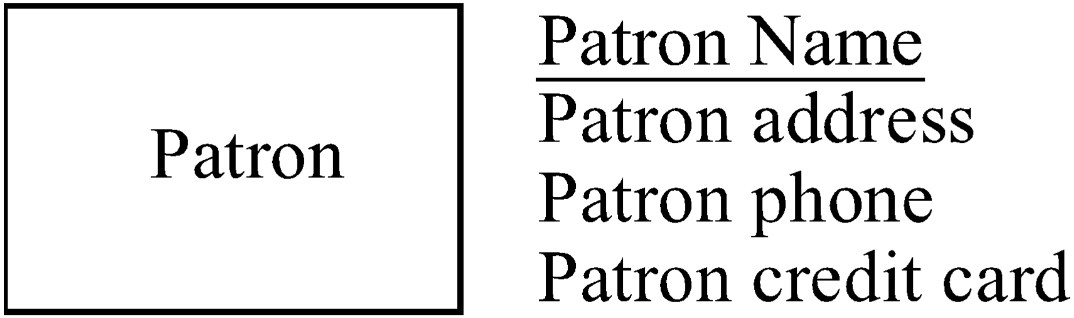
suppose we are going to model the relationships that exist when a customer gets tickets to a train.

- At first glance the CUSTOMER gets a reservation for a TRAIN, and the
- TRAIN can be said to have made a booking for a CUSTOMER.
- CUSTOMER actually makes a RESERVATION
- The Reservation is For a Train.

- The TRAIN holds the RESERVATION, and the RESERVATION is in the name of the CUSTOMER.
- We added an associative entity here because a RESERVATION was created
- due to the information system required to relate the CUSTOMER and the TRAIN

Attributes

- Data attributes may be added to the diagram.



Patron

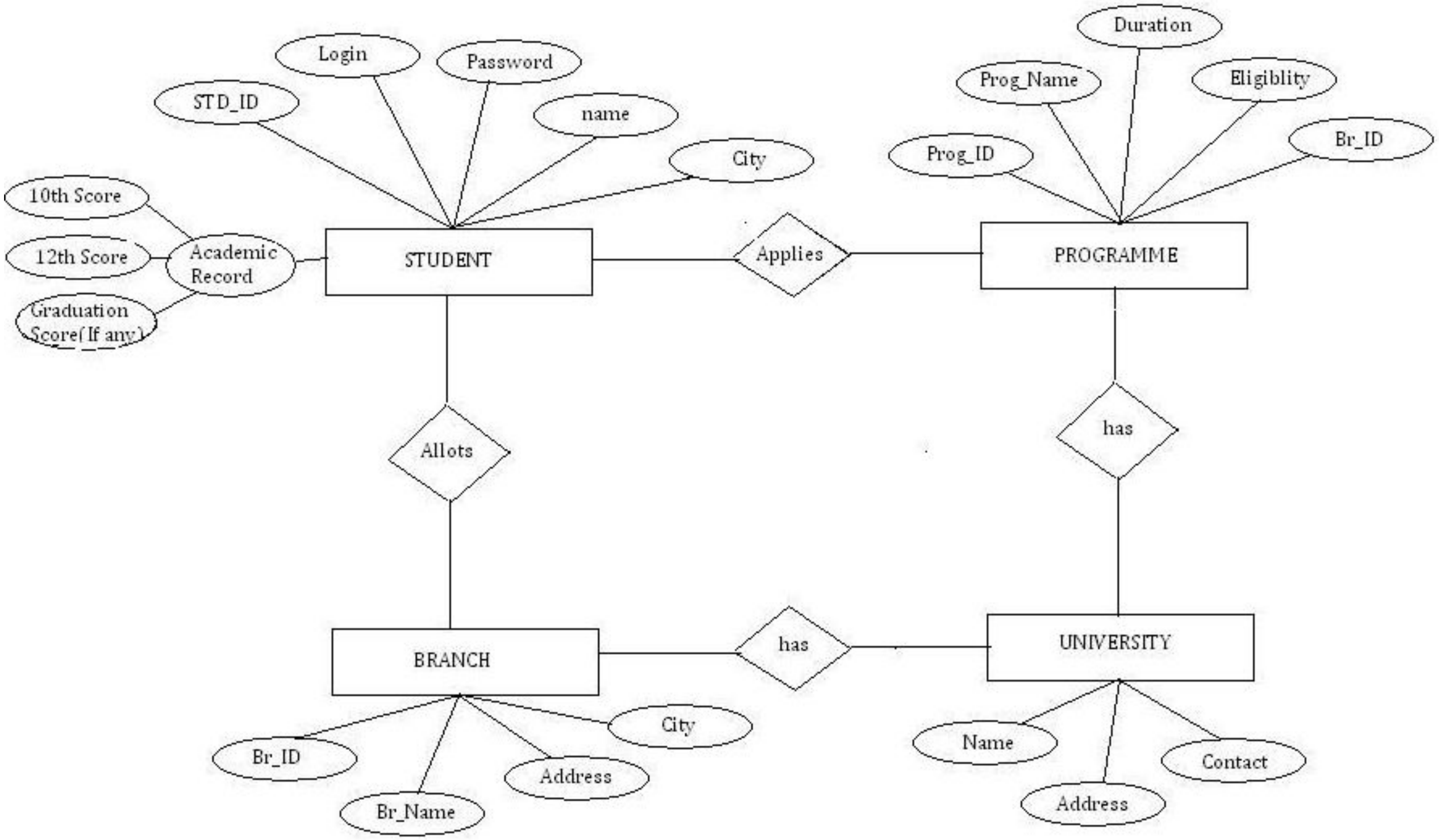
Patron Name
Patron address
Patron phone
Patron credit card

Creating Entity-Relationship Diagrams

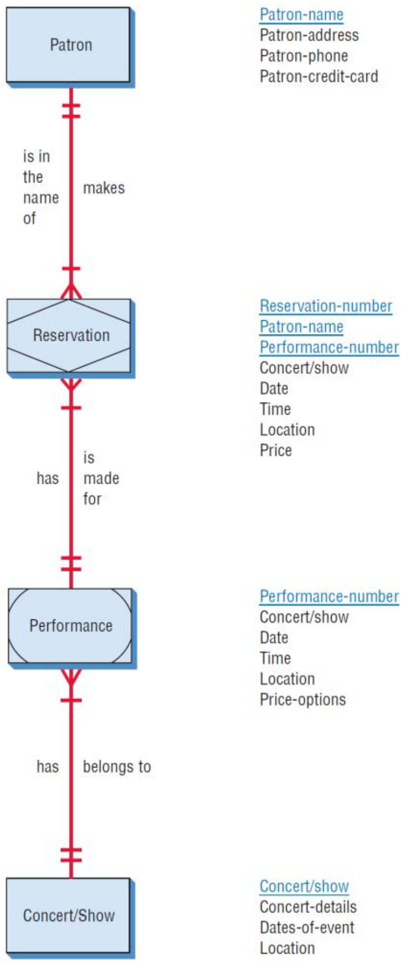
- List the entities in the organization
- Choose key entities to narrow the scope of the problem
- Identify what the primary entity should be
- Confirm the results of the above through data gathering

Notations for the components of ERD:

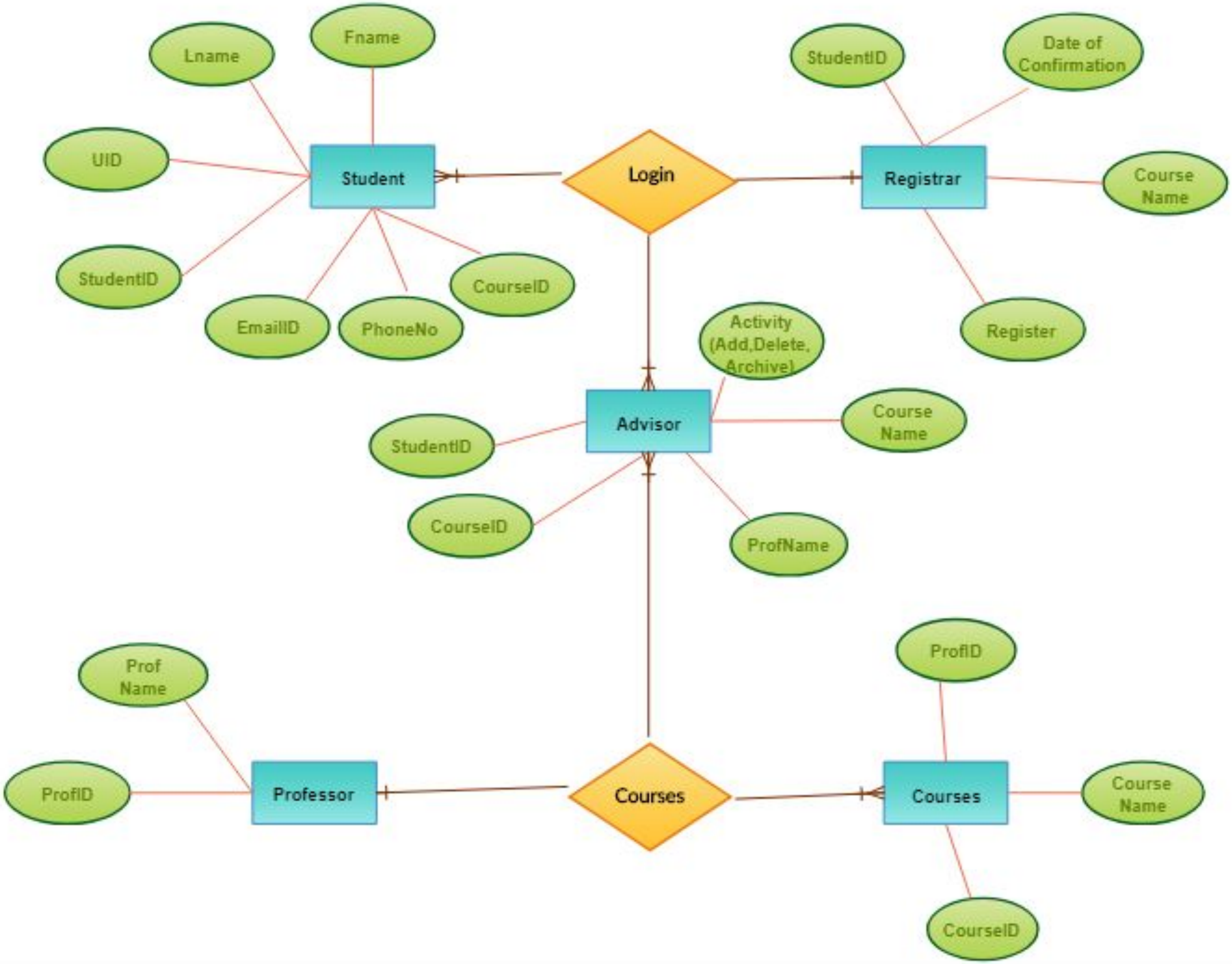
- Entities
- Attribute
- Relationships
- Cardinality


Login
Password
STD_ID
name
City
10th Score
12th Score
Academic Record
Graduation Score(If any)
STUDENT
Applies
Duration
Prog_Name
Eligiblity
Br_ID
Prog_ID
PROGRAMME
has
Allots
BRANCH
has
UNIVERSITY
City
Br_ID
Address
Br_Name
Name
Contact
Address

A More Complete E-R Diagram Showing Data Attributes of the Entities (Figure 2.12)



ER DIAGRAM FOR STUDENT ENROLLMENT SYSTEM



Use Case Modeling

- Describes *what* a system does without describing *how* the system does
  - A logical model of the system
- Use case is a view of the system requirements
- Analyst works with business experts to develop requirements

Use Case Diagram

- Actor
  - Refers to a particular role of a user of the system
  - Similar to external entities; they exist outside of the system
- Use case symbols
  - An oval indicating the task of the use case
- Connecting lines
  - Arrows and lines used to diagram behavioral relationships

Actor

- Divided into two groups
  - Primary actors:
    - Supply data or receive information from the system
    - Provide details on what the use case should do
  - Supporting actors:
    - Help to keep the system running or provide help
    - The people who run the help desk, the analysts, programmers, and so on

A Use Case Always Provides Three Things

- An actor that initiates an event
- The event that triggers a use case
- The use case that performs the actions triggered by the event

Use Case Relations

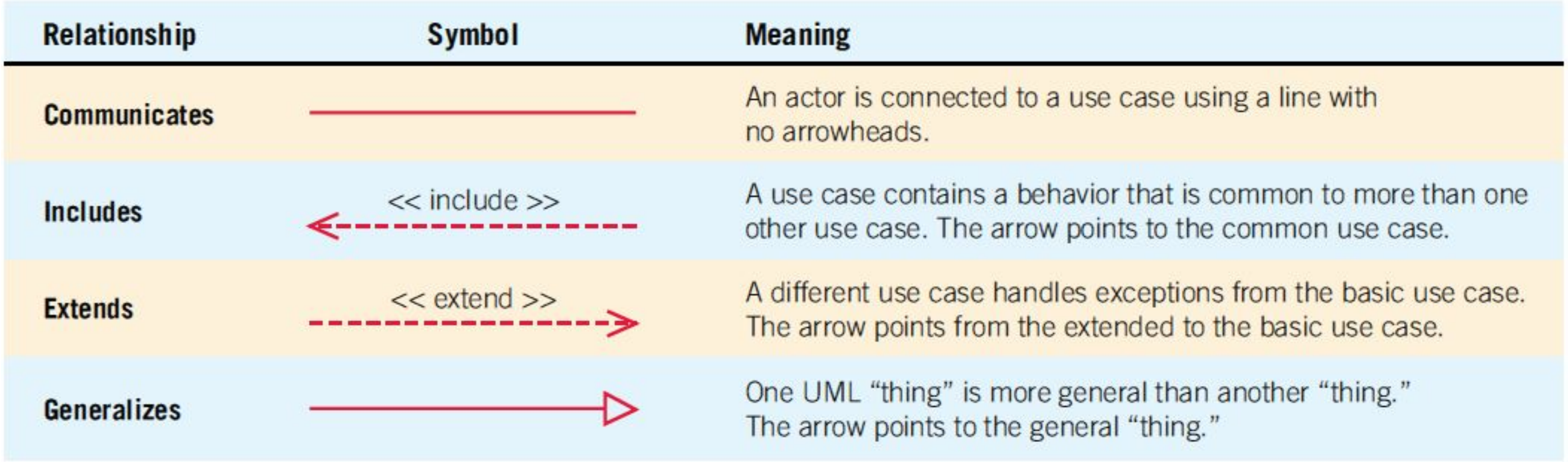
- Behavioral relationships
  - Communicates
    - Used to connect an actor to a use case
  - Includes
    - Describes the situation in which a use case contains behavior that is common to more than one use case

Use Case Relations

- Behavioral relationships (continued)
  - Extends
    - Describes the situation in which one use case possesses the behavior that allows the new case to handle a variation or exception from the basic use case
  - Generalizes
    - Implies that one thing is more typical than the other thing

Four Types Of Behavioral Relationships And The Lines Used To Diagram Each

(Figure 2.13)



Relationship	Symbol	Meaning
Communicates	———	An actor is connected to a use case using a line with no arrowheads.
Includes	<< include >> ←- - - - - - - -	A use case contains a behavior that is common to more than one other use case. The arrow points to the common use case.
Extends	<< extend >> - - - - - - - - -→	A different use case handles exceptions from the basic use case. The arrow points from the extended to the basic use case.
Generalizes	———▷	One UML "thing" is more general than another "thing." The arrow points to the general "thing."

Some components of use case diagrams showing actors, use cases, and relationships for a student enrollment example (Figure 2.14)

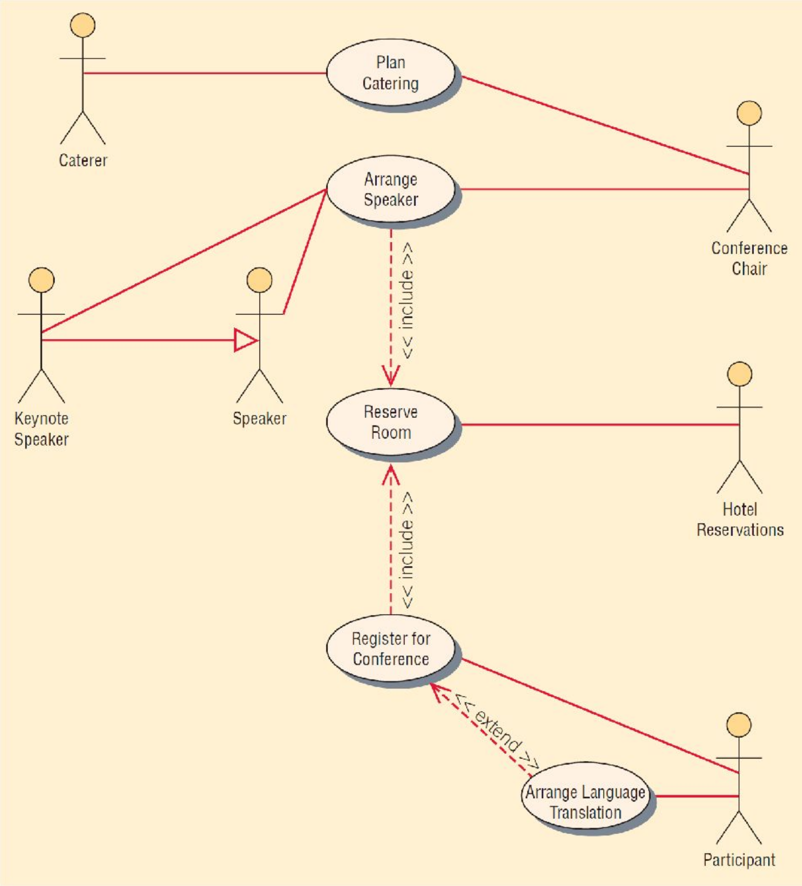
Scope

- System scope defines its boundaries:
  - What is in or outside the system
  - Project has a budget that helps to define scope
  - Project has a start and an end time
- Actors are always outside of scope
- Communication lines are the boundaries and define the scope

Developing Use Case Diagrams

- Review the business **specifications** and identify the **actors** involved
- May use agile stories
- Identify the high-level events and develop the primary use cases that describe those events and how the actors initiate them
- Review each primary use case to determine the possible variations of flow through the use case
- The context-level data flow diagram could act as a starting point for creating a use case

A Use Case Diagram Representing a System Used to Plan a Conference (Figure 2.15)



Developing the Use Case Scenarios

- The description of the use case
- Three main areas:
  - Use case identifiers and initiators
  - Steps performed
  - Conditions, assumptions, and questions

A Use Case Scenario Is Divided into Three Sections (Figure 2.16)

Use case name:	Register for Conference	UniqueID: Conf RG 003
Area:	Conference Planning	
Actor(s): Participant		
Stakeholder	Conference Sponsor, Conference Speakers	
Level	Blue	
Description:	Allow conference participant to register online for the conference using a secure Web site.	
Triggering Event:	Participant uses Conference Registration Web site, enters userID and password, and clicks the logon button.	
Trigger type:	□ External □ Temporal	

Steps Performed (Main Path)	**Information for Steps**
1. Participant logs in using the secure Web server	userID, Password
More steps included here…	
12. Successful Registration Confirmation Web page is sent to the participant	Registration Record Confirmation Number

Preconditions:	Participant has already registered and has created a user account.
Postconditions:	Participant has successfully registered for the conference.
Assumptions:	Participant has a browser and a valid userID and password.
Success Guarantee:	Participant has registered for the conference and is enrolled in all selected sessions.
Minimum Guarantee:	Participant was able to logon.
Requirements Met:	Allow conference participants to be able to register for the conference using a secure Web site.
Outstanding Issues:	How should a rejected credit card be handled?
Priority:	High
Risk:	Medium

Use Case Header Area

- Has a name and a unique ID
- Include application area
- List actors
- Include stakeholders
- Include the level
- Has a brief description of the use case

Use Case Levels

- Use case levels describe how global or detailed the use case description is:
  - White (like clouds): enterprise level
  - Kite: business unit or department level
  - Blue (sea level): user goals
  - Indigo (or fish): functional or subfunctional
  - Black (or clam): most detailed

Alternative Scenarios

- Extensions or exceptions to the main use case
- Number with an integer, decimal point, integer
- Steps that may or may not always be used

Use Case Footer Area

- Preconditions—need to be met before use case can be performed
- Postconditions or the state of the system after the use case has finished
- Assumptions
- Minimal guarantee
- Success guarantee
- Outstanding issues
- Optional priority and risk

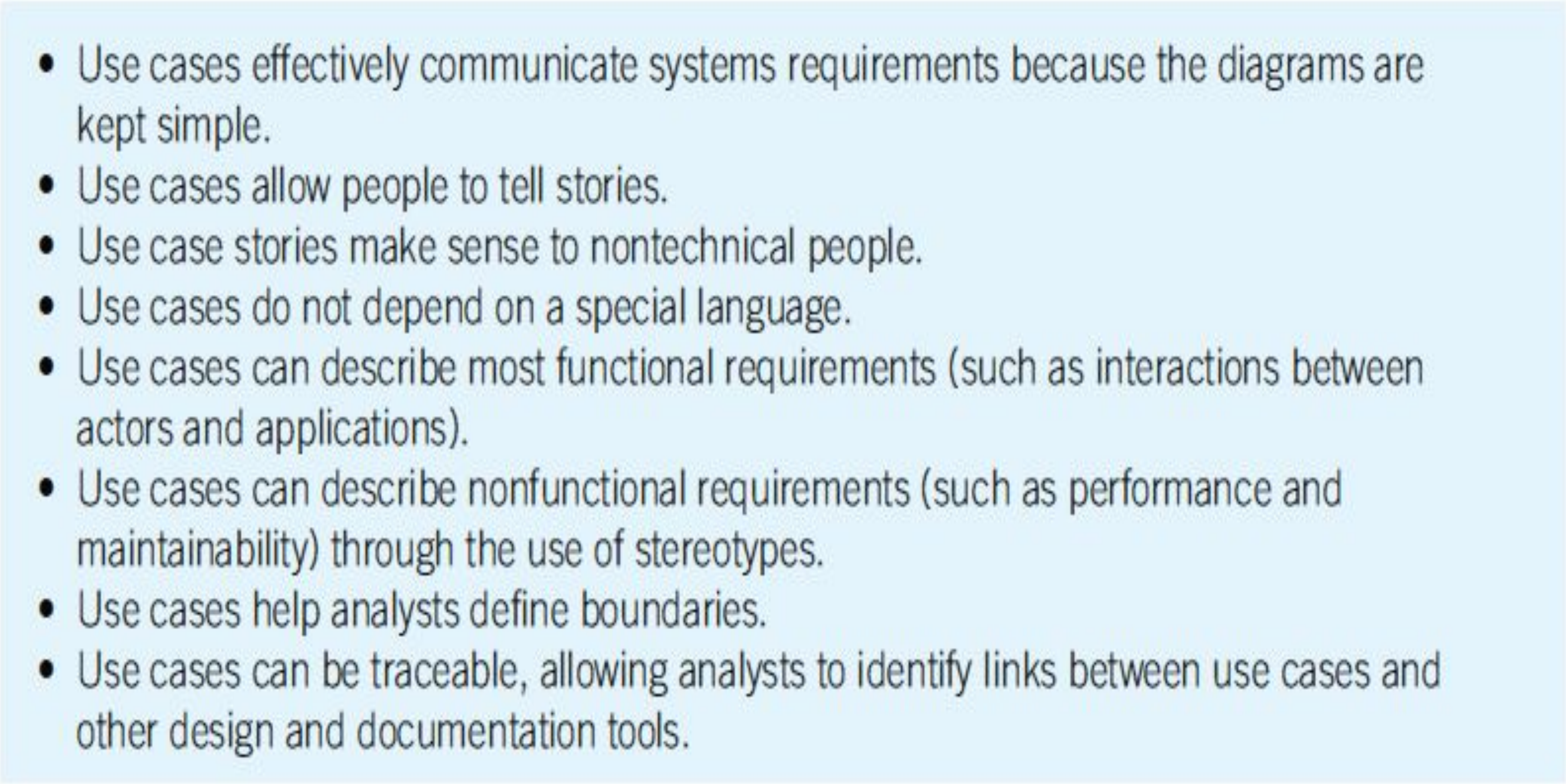
Four Steps Used to Create Use Cases

- Use agile stories, problem definition objectives, user requirements, or a features list
- Ask about the tasks that must be done
- Determine if there are any iterative or looping actions
- The use case ends when the customer goal is complete

Why Use Case Diagrams Are Helpful

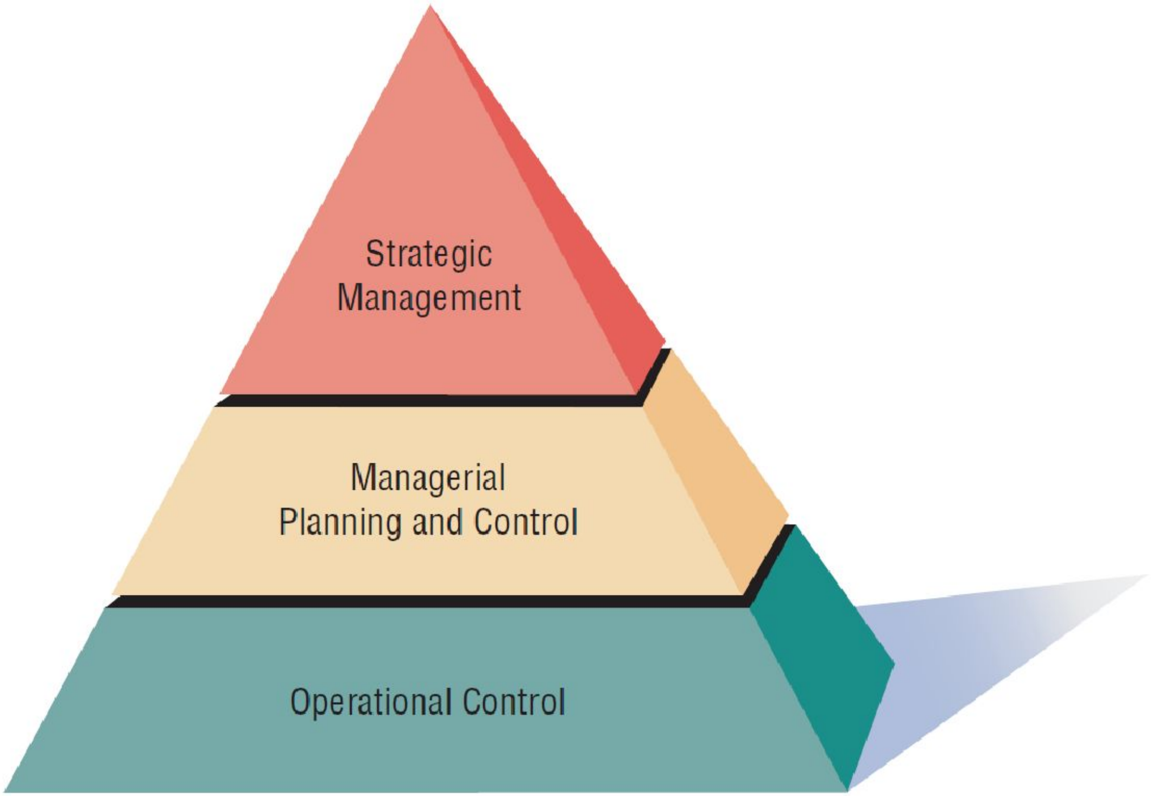
- Identify all the actors in the problem domain
- Actions that need to be completed are also clearly shown on the use case diagram
- The use case scenario is also worthwhile
- Simplicity and lack of technical detail

The Main Reasons for Writing Use Cases Are Their Effectiveness in Communicating with Users and Their Capturing of User Stories (Figure 2.18)



- Use cases effectively communicate systems requirements because the diagrams are kept simple.
- Use cases allow people to tell stories.
- Use case stories make sense to nontechnical people.
- Use cases do not depend on a special language.
- Use cases can describe most functional requirements (such as interactions between actors and applications).
- Use cases can describe nonfunctional requirements (such as performance and maintainability) through the use of stereotypes.
- Use cases help analysts define boundaries.
- Use cases can be traceable, allowing analysts to identify links between use cases and other design and documentation tools.

Management in Organizations Exists on Three Horizontal Levels: Operational Control, Managerial Planning and Control, and Strategic Management (Figure 2.19)



Operations Control

- Make decisions using predetermined rules that have predictable outcomes
- Oversee the operating details of the organization

Managerial Planning and Control

- Make short-term planning and control decisions about resources and organizational objectives
- Decisions may be partly operational and partly strategic

Strategic Management

- Look outward from the organization to the future
- Make decisions that will guide middle and operations managers
- Work in highly uncertain decision-making environment
- Define the organization as a whole

Managerial Levels

- Different organization structure
- Leadership style
- Technological considerations
- Organization culture
- Human interaction
- All carry implications for the analysis and design of information systems

Organizational Culture

- Organizations have cultures and subcultures
- Learn from verbal and nonverbal symbolism

Verbal Symbolism

- Myths
- Metaphors
- Visions
- Humor

Nonverbal Symbolism

- Shared artifacts
  - Trophies, etc.
- Rites and rituals
  - Promotions
  - Birthdays, etc.
- Clothing worn
- Office placement and decorations

Summary

- Organizational fundamentals
  - Organizations as systems
  - Levels of management
  - Organizational culture
- Graphical representation of systems
  - DFD
  - ERD
  - Use case diagrams and scenarios

Summary (continued)

- Levels of managerial control
  - Operational
  - Middle management
  - Strategic
- Organizational culture