

**RUTGERS**

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**33:010:458**

**Accounting Information  
Systems**

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## **A.I.S. Class 7: Outline**

- Learning Objectives for Chapter 8
- Entity-Relationship Models
- Extended Entity-Relationship Models
- Data Flow Diagrams
- Group Work for Chapter 8 (1)
- Event-Oriented Models
- Resource-Event-Agent Models (REA)
- Group Work for Chapter 8 (2)

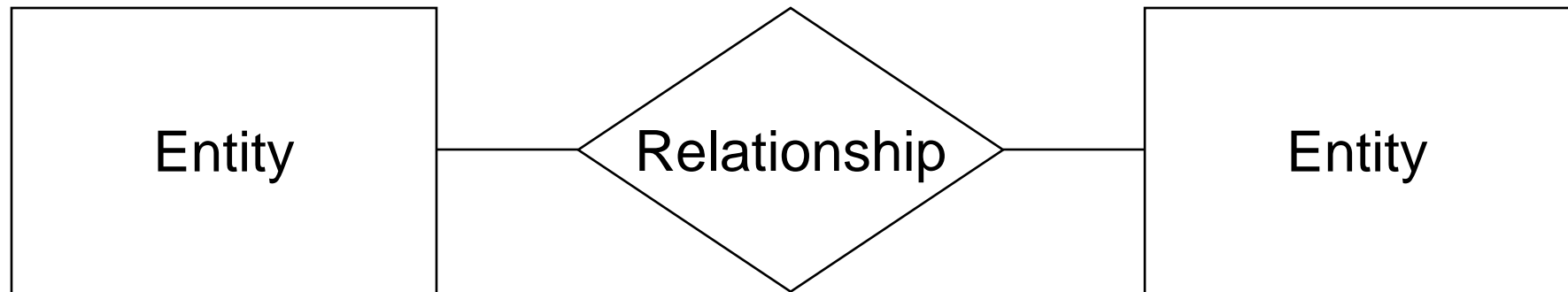
## Learning Objectives for Chapter 8

- After studying this chapter you should be able to:
  - \* distinguish between logical and physical database models
  - \* describe the entity-relationship and extended entity-relationship logical modeling approaches
  - \* describe the elements of data-flow diagrams
  - \* distinguish between different levels of data-flow diagrams, such as context diagrams, Level 0, and Level 1 data flow diagrams

## Learning Objectives for Chapter 8

- After studying this chapter you should be able to:
  - \* identify entities and relationships in a business environment using an event-oriented focus
  - \* construct an extended entity relationship diagram based on a narrative description of a business scenario
  - \* construct context diagrams and data-flow diagrams based on a description of a business process

## Entity-Relationship Models

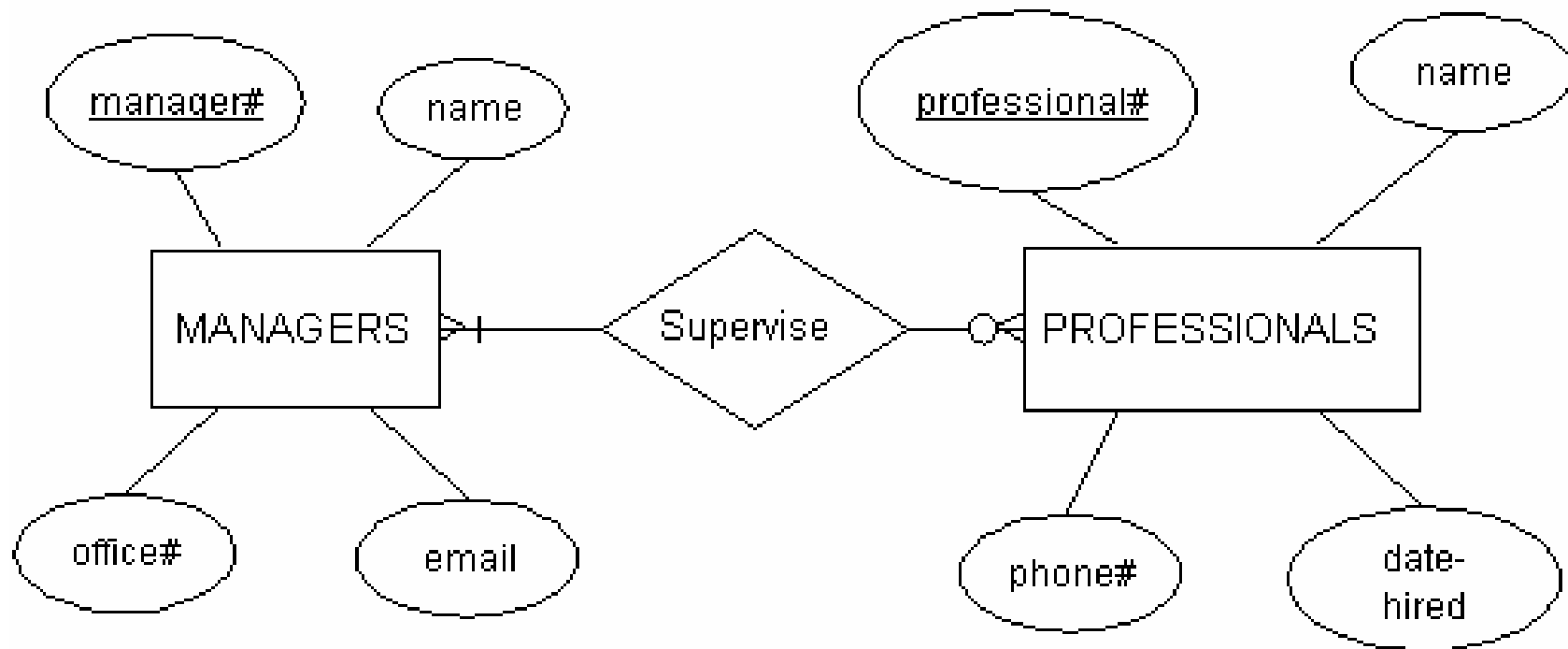


## Extended E-R Models

- **Optionalities**
  - \* optional or mandatory
- **Cardinalities**
  - \* 1:1, 1:M, M:1, or M:M
- **Attributes**
  - \* keys and non-key attributes

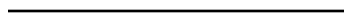
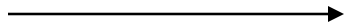
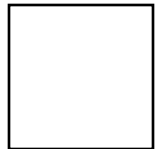
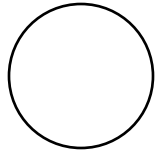
## EER Models

***EER Figure 7***



## Data Flow Diagrams

**DeMarco**



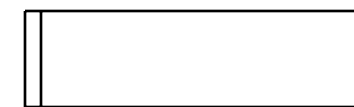
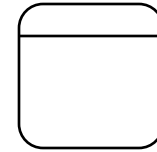
**Process**

**Data source / sink**

**Data flow**

**Data store**

**Gane & Sarson**



## DFD Conventions

- Processes should have unique names and be sequentially numbered (1.0, 2.0, 3.0; 2.1, 2.2, 2.3; etc.)
- A process must have at least one input flow and at least one output flow
- A data flow has at least one end connected to a process
- Data cannot flow directly back to an earlier process
- A data store must have at least one input and at least one output data flow
- Any single DFD should not have more than about seven processes
- Omit error and exception handling from Level 0 diagrams

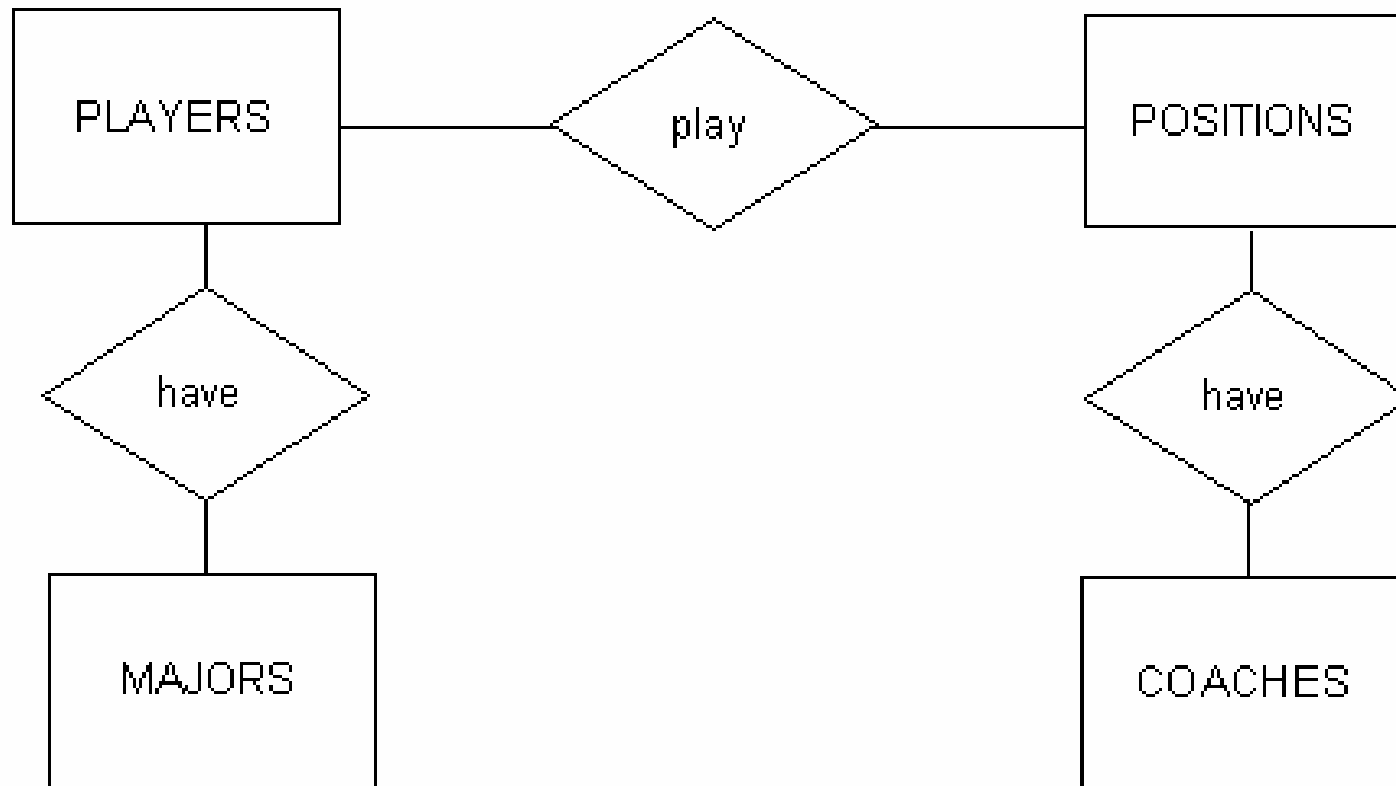
## Data Flow Diagrams

- **Leveled DFDs**
  - \* A series of DFDs used in a hierarchy
- **Balanced DFDs**
  - \* The same sources, sinks and data flows appear at all levels
- **Labeling**
  - \* Officially, all data flows should be labeled
  - \* Practically, we may sometimes omit labels from flows in and out of data stores
- **Data flows**
  - \* Arrows indicate direction and are significant; use double arrows or multiple data flows for read-then-update

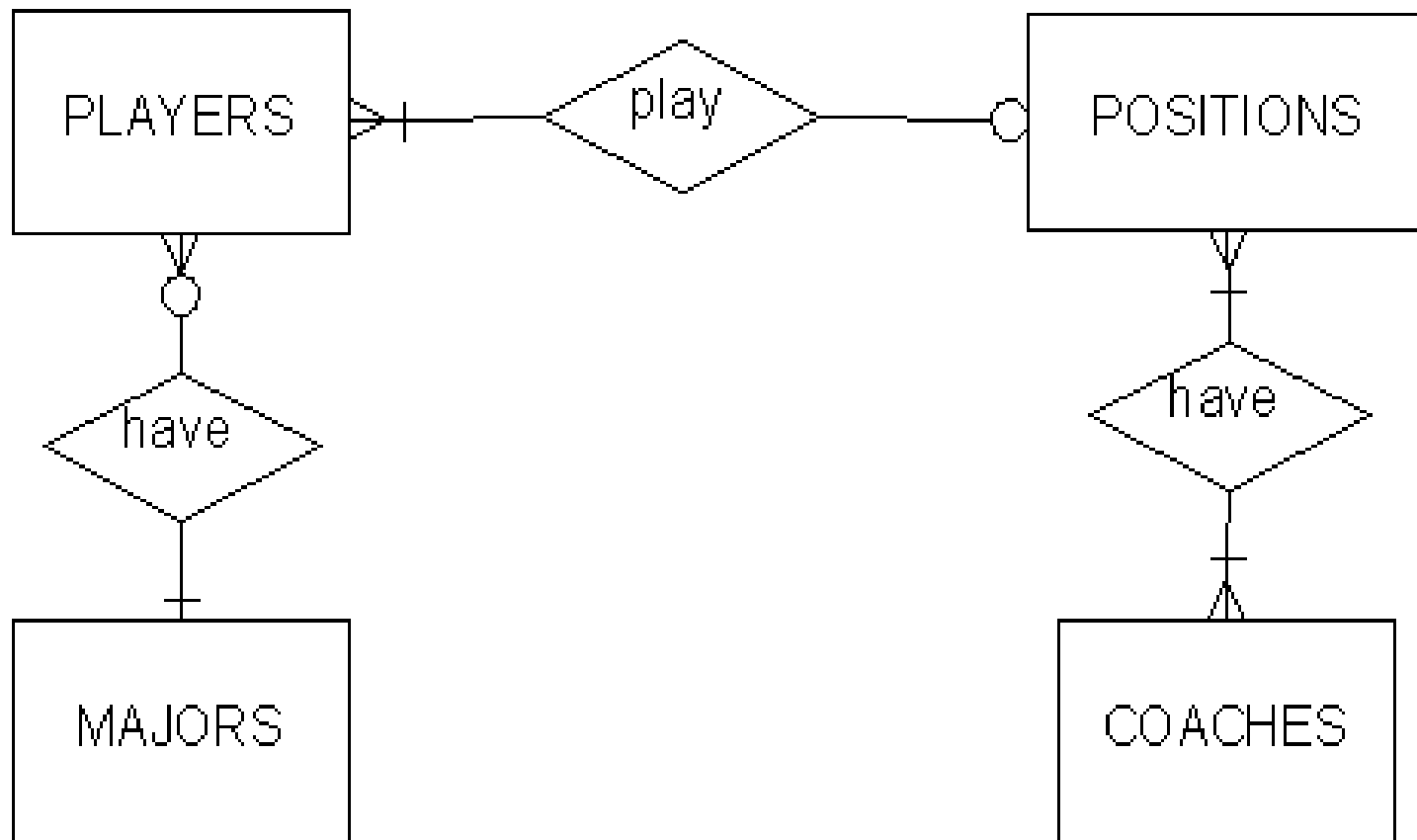
## Group Work for Chapter 8 (1)

- ER and EER Diagrams
  - \* Problems 1, 2 & 6

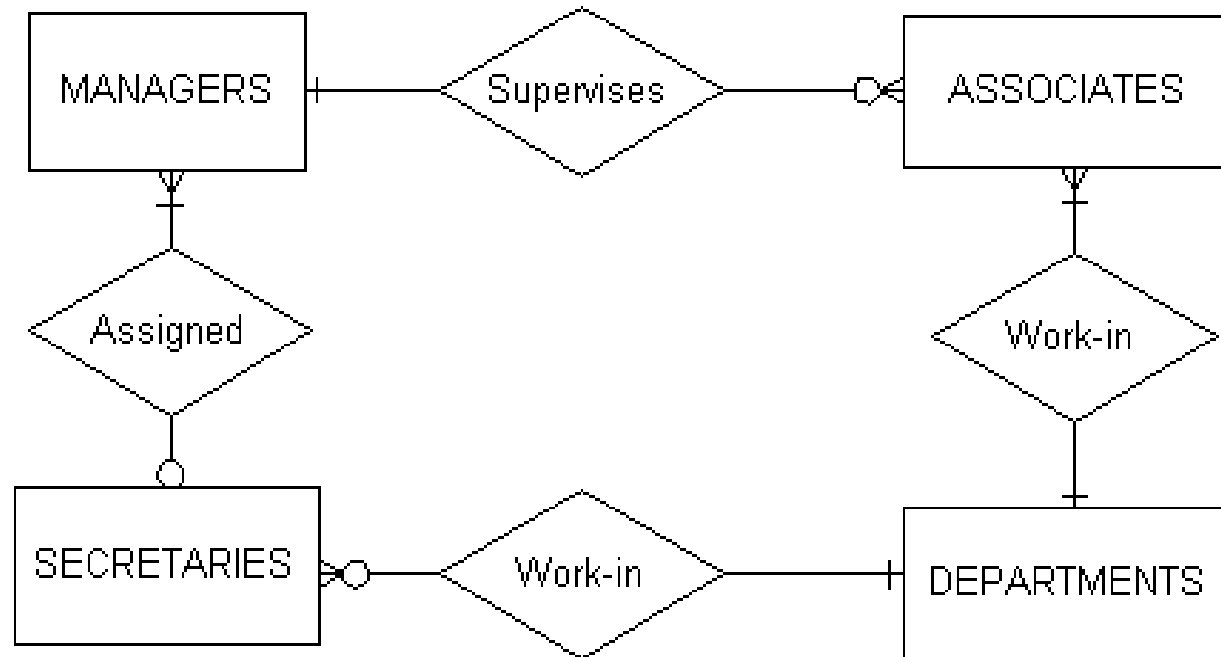
## Problem 1



## Problem 2



## Problem 6



## Event-Oriented Models

### ■ Abstraction:

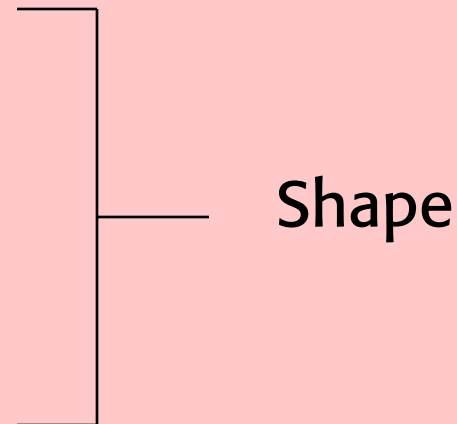
**Reality**



**Symbol  
(Token)**

Square  
Triangle  
Circle  
Star  
Cross

**Symbol  
(Type or Category)**



## Event-Oriented Models

- We store data at the level of token symbols (Colin Sheldon, fabric, etc.)
- To make complexity manageable, our conceptual model represents reality at the level of type symbols (Directors, Raw Materials, etc.)
- In an RDBMS data is ultimately stored in *relations* (tables)
- To avoid various processing anomalies, we decompose the data into small, simple relations that have been *normalized* (into 3<sup>rd</sup> normal form or better)
- Peter Chen's 1976 Entity-Relationship modeling provides a conceptual bridge between reality at the type level and actual normalized tables

## Event-Oriented Models

- At this level, there are only Entities, and Relationships, described by their attributes, and exemplified by their instances
- Thus “Clark Thompson” is an instance of the entity “Director”
- So if instances represent reality as tokens, Entities and Relationships represent reality as types
- But what Entities and Relationships belong in our system?
- Semantic Modeling is an attempt to answer this

## Event-Oriented Models

- **The Semantic Modeling Principle**
  - \* Data in an information system should model the structure of the relevant categories of reality in its application domain

## Event-Oriented Models

- McCarthy's REA methodology resulted from the application of the Semantic Modeling Principle to Accounting Information Systems
- It answered the question: "what entities and relationships should there be?" with:
  - \* Resources
  - \* Events
  - \* Agents
  - \* . . . and the relationships between them

## Event-Oriented Models

- Metaphysics is the branch of philosophy dealing with the nature of reality and the fundamental principles of the universe
- Its major component is Ontology, which deals with the nature of existence or being
- The philosopher Willard Van Orman Quine has famously quipped that the question is simple:  
    “*What is there?*”;  
and the answer short:  
    “*Everything*”.

## Event-Oriented Models

- **Ontology in Computer Science and A.I.**
  - \* The term has been co-opted by Computer Science and Artificial Intelligence in the following sense:
    - An ontology is a specification of a conceptualization
    - That is, an ontology is a description (like a formal specification of a program) of the concepts and relationships that can exist for an agent or a community of agents (Tom Gruber)
    - Now the question is not: “What is there?” but: “What should we represent in a system?”

## Event-Oriented Models

- **Ontology in Computer Science and A.I.**
  - \* **Generic Ontologies**
    - Specify subject-independent categories
  - \* **Domain Ontologies**
    - Specify the basic categories arising within a particular application
- **REA has been extended to be a domain ontology for accounting information systems**

## Event-Oriented Models

- **REA Ontology:**
  - \* **Economic Resources (R)**
  - \* **Events**
    - Economic Events (E)
    - Commitments (C)
    - Business Events (B)
  - \* **Economic Agents**
    - Internal Agents (A)
    - External Agents (A)

## Event-Oriented Models

- **REA Ontology:**
  - \* **Economic Resources** – e.g. Inventory
  - \* **Events**
    - Economic Events – e.g. Receiving Raw Materials
    - Commitments – e.g. Purchase Orders
    - Business Events – e.g. Requisitioning Materials
  - \* **Economic Agents**
    - Internal Agents – e.g. Salespersons
    - External Agents – e.g. Customers

## Event-Oriented Models

- **REA Ontology:**
  - \* **Economic Resources (R)**
  - \* **Events**
    - Economic Events (E)
    - Commitments (C)
    - Business Events (B)
      - Instigation (I)
      - Facilitation (F)
      - Terminal (T)
  - \* **Economic Agents**
    - Internal Agents (A)
    - External Agents (A)

## Event-Oriented Models

- REA Ontology:
  - \* Relationships
    - Duality (E – E)
      - Transfer
      - Transformation
    - Resource-flow (E – R)
      - Inflow
        - » Take
        - » Production
      - Outflow
        - » Use (entirely)
        - » Consumption (in small parts)
        - » Give
    - Participation (E – A)
      - Inside
        - » Accountability
      - Outside
    - Others . . . (more next week)

## Event-Oriented Models

- We will discuss:
  - \* Three kinds of processes
    - Business processes
    - Information processes
    - Decision processes
  - \* A nine-step approach to REA modeling

## **Business Processes and Events**

- Organizations create value through managing their business and information processes
- Organizations typically have three main types of business processes (sometimes called business cycles):
  - \* acquisition/expense/payment process
  - \* conversion process
  - \* sales/collection process

## Business Processes and Events

### ■ What is a process?

- \* A process is a time-dependent sequence of steps governed by a rule called a process law. All processes have five common ingredients:
  - the entities participating in the process
  - the elements describing the steps in a process (called *events* in business processes)
  - the relationships between these elements
  - the links to other processes
  - the resource characteristics of the elements

## Business Processes and Events

- Business processes can be described at various levels of abstraction e.g. the Sales Process:
  - \* Ship Merchandise
  - \* Receive Payment
  - or
  - \* Customer Places Order
  - \* Select, Inspect, and Package Merchandise
  - \* Ship Merchandise
  - \* Receive Customer Payment

## Business Processes and Events

- We are interested in strategically significant events the organization wants to monitor or control
- Significant events can be classified as
  - \* **core events that create distinctiveness**
    - e.g., for a restaurant business, cooking and providing meals are core events that create value for customers
  - \* **support events that facilitate core events**
    - e.g., buying ingredients is a business event that does not itself create value, but without it meals could not be cooked

## Business Processes and Events

- Significant events may also be classified as
  - \* **Economic events**
    - involving increases or decreases in resources
      - e.g., making sales to customers
  - \* **Non-economic events**
    - having implications for future economic events
      - e.g., contacting prospective customers
  - \* **Economic events participate in Duality relationships**

## Business Processes and Events

- We have classified Events as
  - \* **Economic events**
    - Increment or Decrement some economic resource
  - \* **Commitments**
    - Contracts or schedules for the occurrence of future economic events
  - \* **Business events**
    - Occurrences in time that partners to a business transaction wish to monitor or control
    - Supporting events that enable economic events or commitments to take place

## Business Processes and Events

- Characteristics of events in business processes
  - \* What happened?
  - \* When did it happen?
  - \* What roles are performed and by whom?
  - \* What resources were involved, and in what quantities?
  - \* Where did the event occur?

## **Business Processes and Events**

- We distinguish events forming parts of business processes from information processes
- Information processes
  - \* record data about business events
  - \* maintain data
  - \* report useful information to decision makers

## Business Processes and Events

- **Events in business processes**
  - \* selecting a supplier
  - \* transporting and distributing goods
  - \* providing services
  - \* receiving payment
- **Information events**
  - \* recording customer orders
  - \* issuing invoices
  - \* adding new suppliers to master files
  - \* printing customer statements
- **Decision events**
  - \* selecting a new product line to develop
  - \* deciding to raise prices

## Business Processes and Events

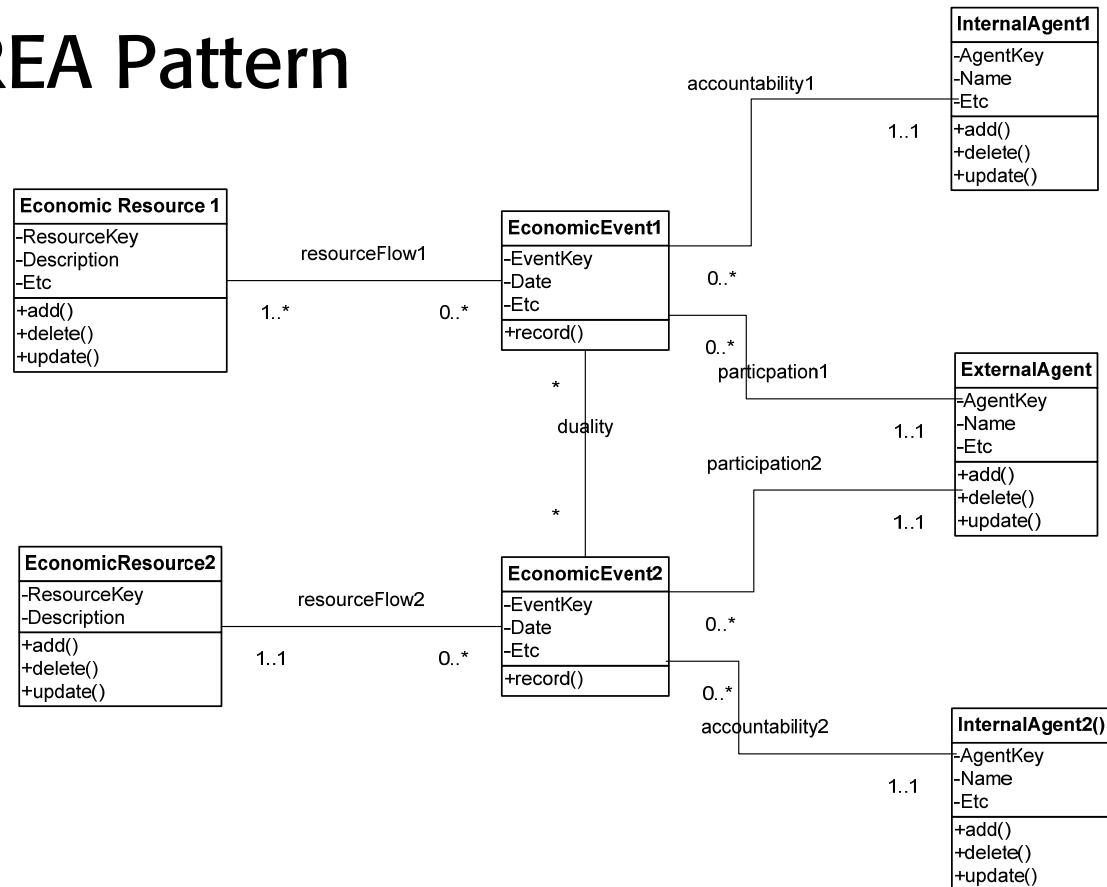
- Business processes may be linked in two ways
  - \* by sharing common resources
  - \* by an event in one process triggering an event in another process
- Decision processes may trigger
  - \* Business events
  - \* Information processes

## Event-Oriented Modeling

- Applies Semantic Modeling specifically to accounting information systems
- Provides a way of identifying the relevant entities for EER diagrams
- The entities (or objects) of interest are the events in the business processes, and the resources, agents involved
- We generally do not model the information or decision processes or events

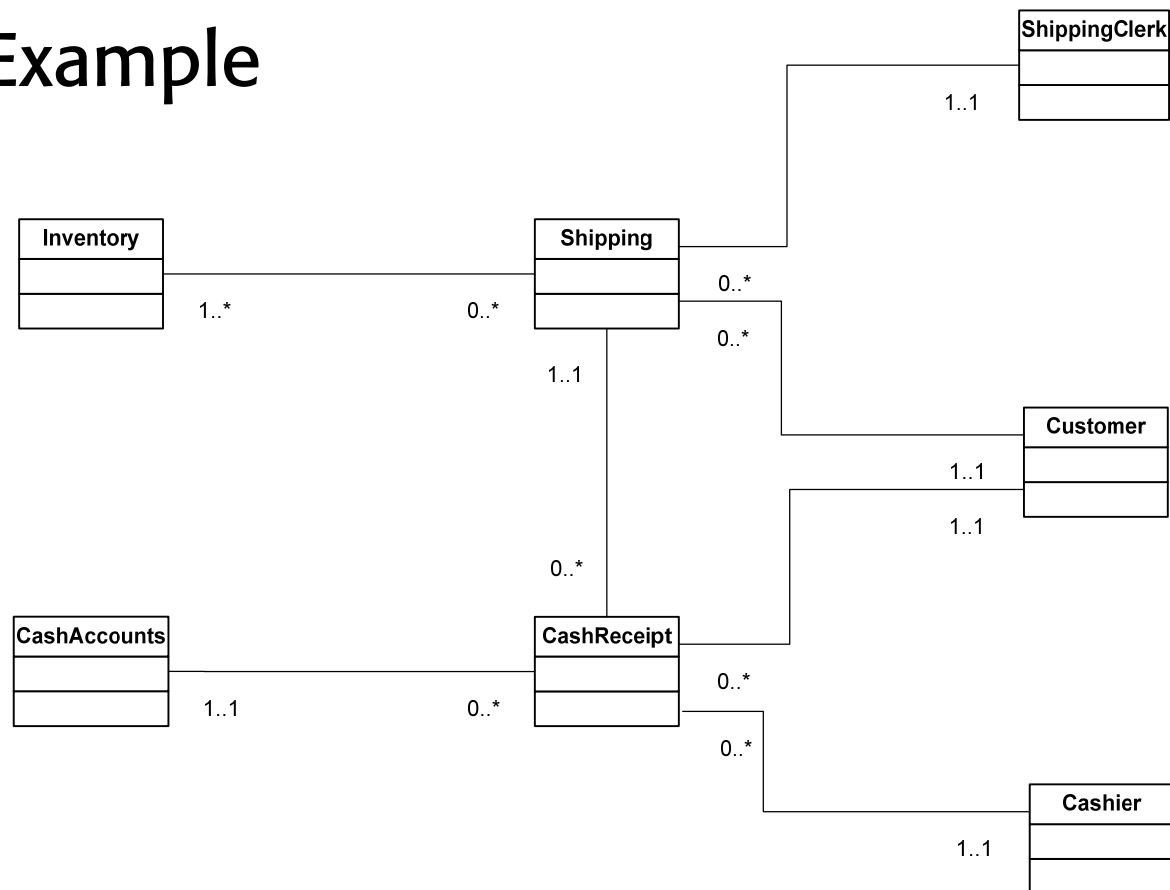
## UML Class Diagram (Static Structure)

### ■ Core REA Pattern



## UML Class Diagram (Static Structure)

- REA Example



## UML Class Diagram (Static Structure)

- We may sometimes omit the names of the relationships when our understanding would not thereby be impaired
- We show optionalities and cardinalities in the form *optionality .. cardinality*  
e.g. 0 ..1    0 .. \*    1 ..1    1 .. \*
- We will generally use lists (data dictionaries) instead of showing attributes on diagrams
- Show primary keys underlined and foreign keys in [ ] when required
  - \* N.B. NOT required on REA diagrams

## REA Modeling Steps

- 1 Identify the significant events
- 2 Identify the related resources
- 3 Identify the related internal and external agents
- 4 Identify relationships between entities
- 5 Specify the optionalities and cardinalities of the relationships
- 6 Identify the attributes of the REA entities
- 7 Identify the information processes
- 8 Design the data repository structure
- 9 Implement the design

## Group Work for Chapter 8 (2)

- **Problem 9**
  - \* Add the sentence:  
“Videos are either picked up from the store shelves or at the front desk where the customer may have called in to reserve a newly released video in high demand”
- **Problem 10**
  - \* Work through the 9 REA steps in sequence
  - \* Use a UML Class Diagram instead of an EER
- **Narrative and flowcharts in the Chapter 1 Appendix for automated Purchases**