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Newark and New Brunswick

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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)

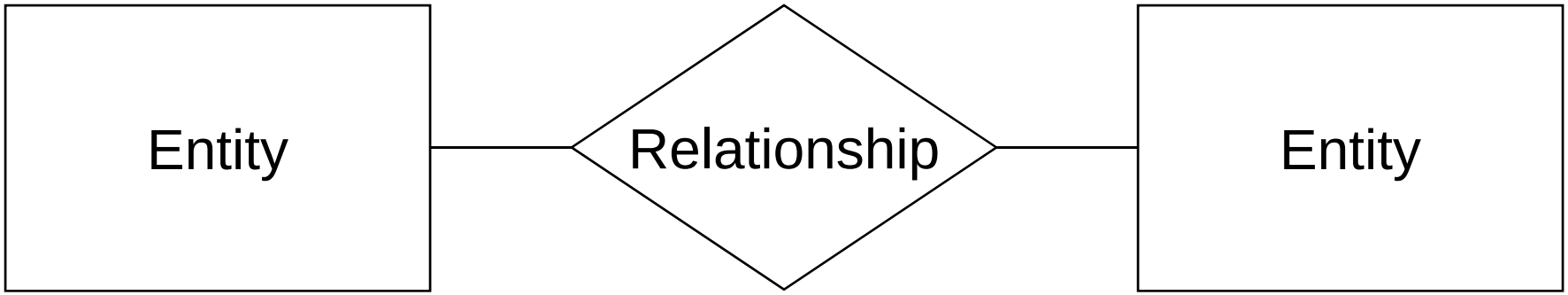
Learning Objectives for Chapter 8

- 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

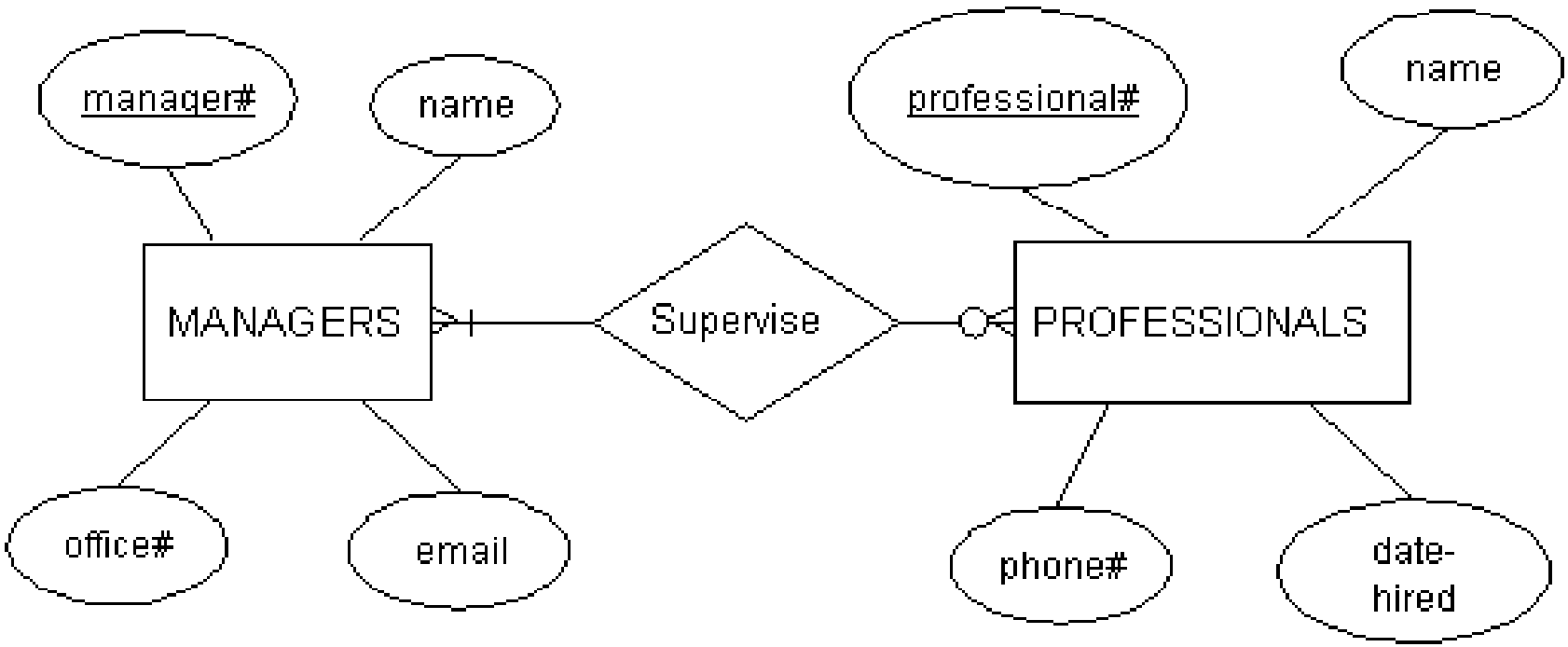


Extended E-R Models

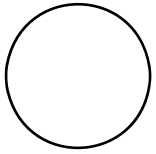
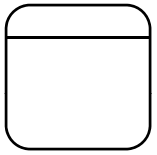
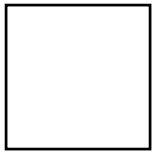
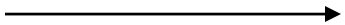
- Optionalities
  - optional or mandatory
- Cardinalities
  - 1:1, 1:M, M:1, or M:M
- Attributes
  - keys and non-key attributes

EER Models

EER Figure 7



Data Flow Diagrams

DeMarco		Gane & Sarson
	Process	
	Data source / sink	
	Data flow	
	Data store	

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

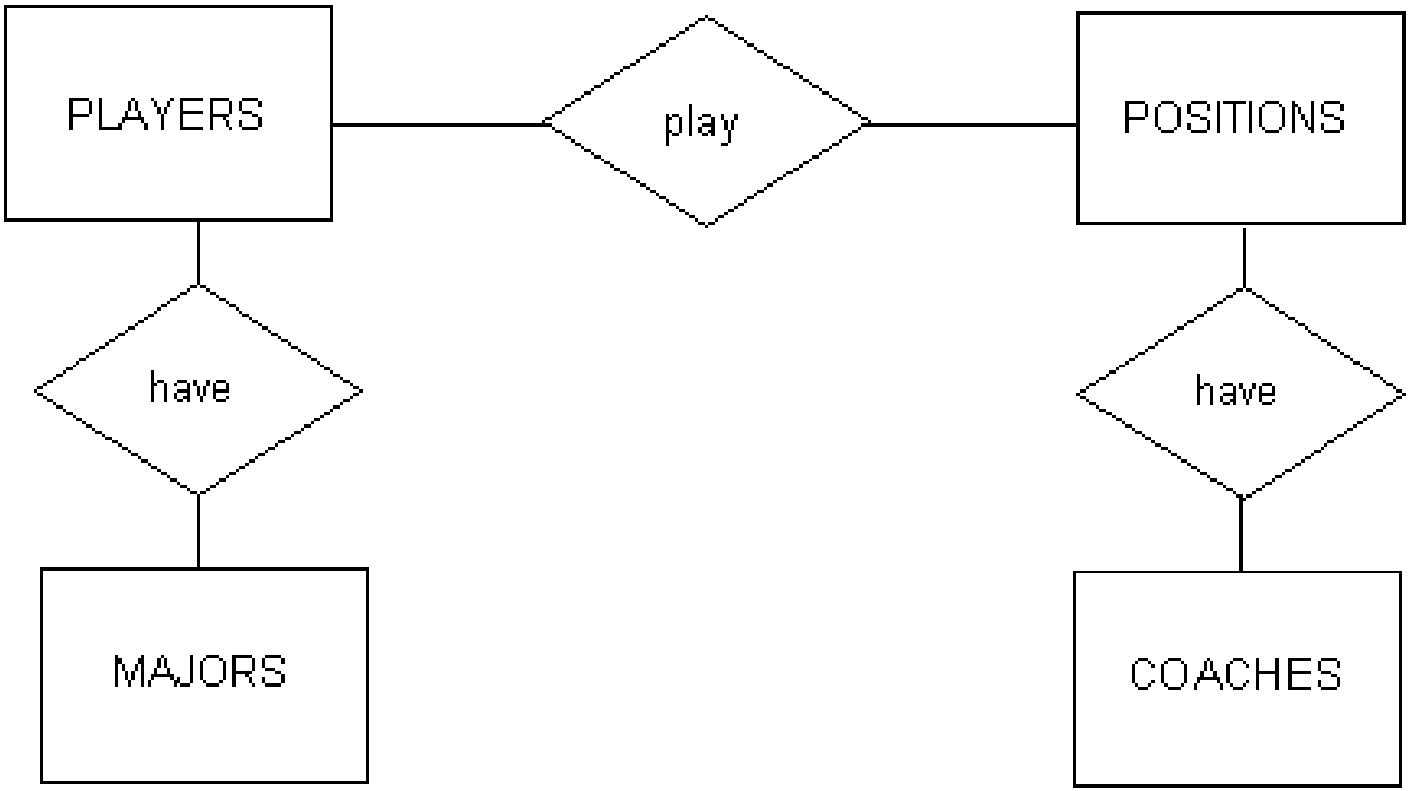
Data Flow Diagrams

- 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

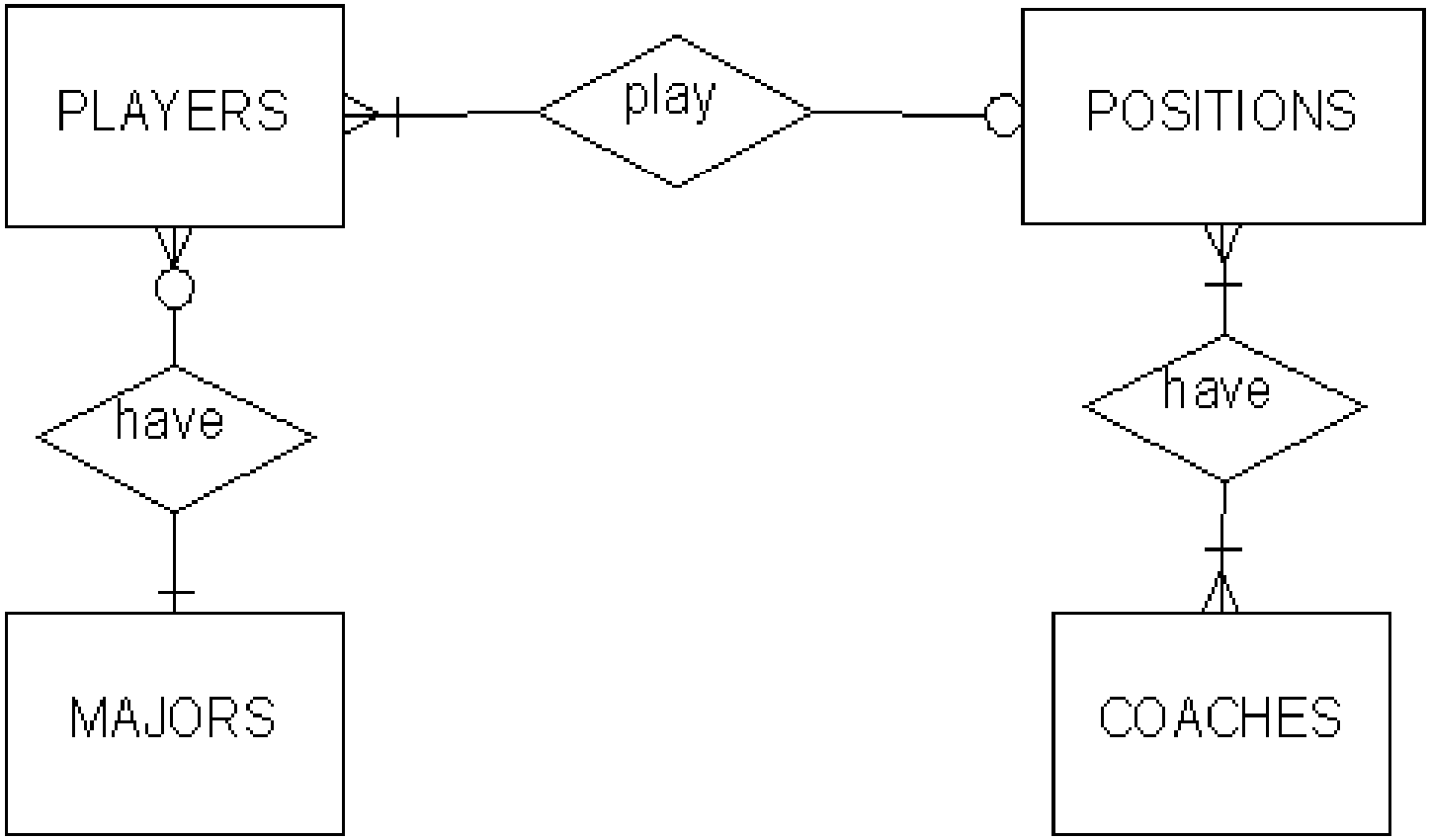
Group Work for Chapter 8 (1)

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

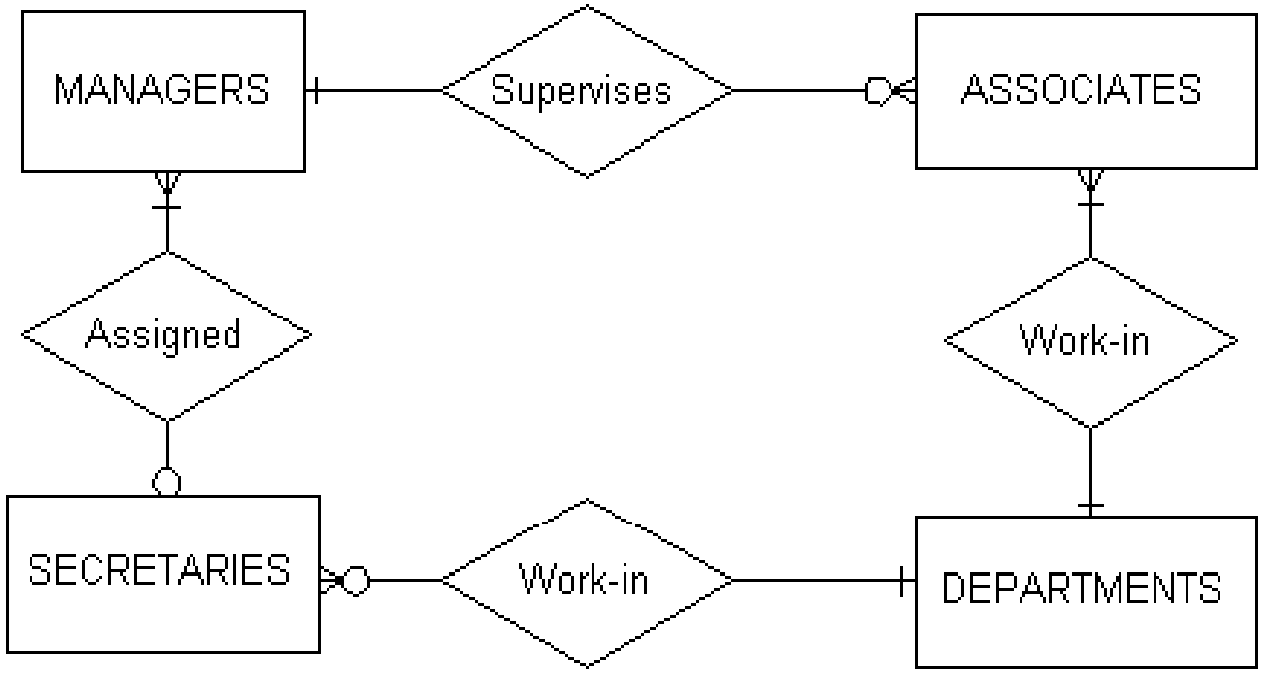
Problem 1



Problem 2



Problem 6


MANAGERS
Supervises
ASSOCIATES
Assigned
Work-in
SECRETARIES
Work-in
DEPARTMENTS

Event-Oriented Models

- Abstraction:

Reality	Symbol (Token)	Symbol (Type or Category)
	Square	Shape
	Triangle	
	Circle	
	Star	
	Cross	

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 3rd 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 "Kenneth Ivy" is an instance of the entity "Partner"
- 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

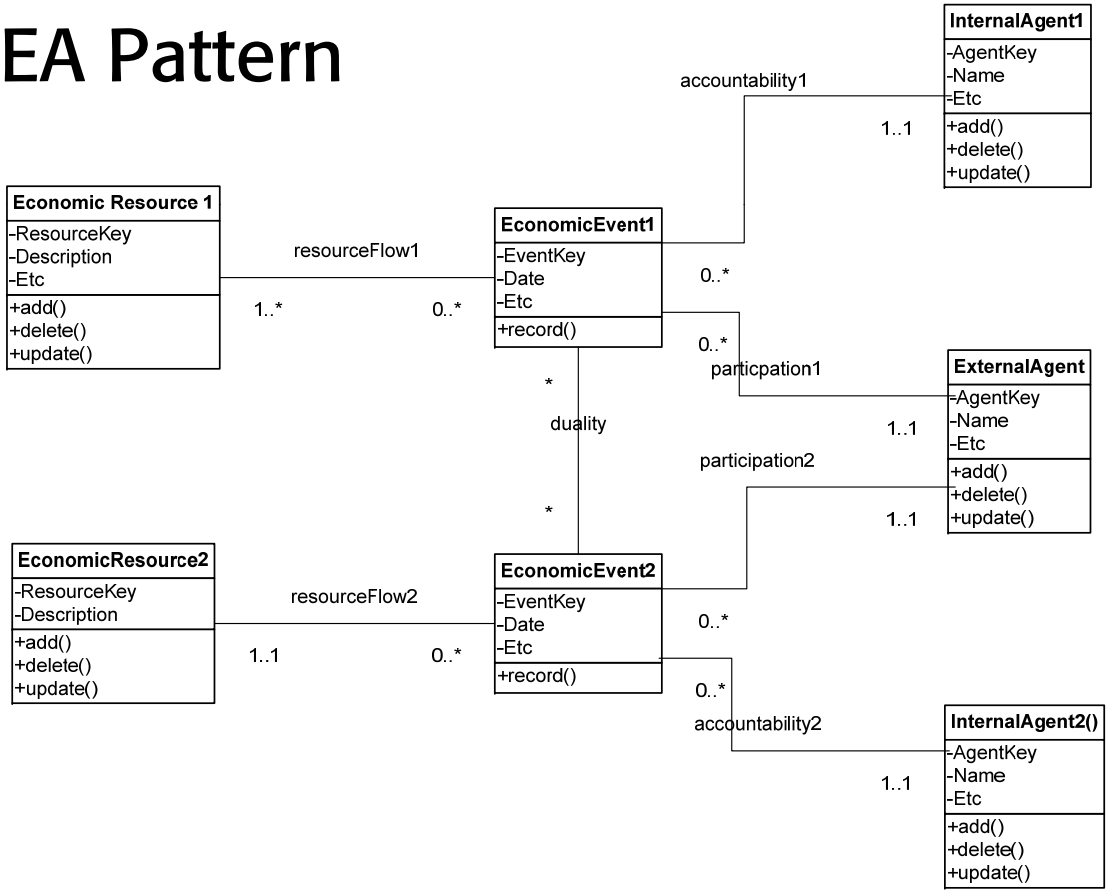
- Business processes may be linked in two ways
  * by sharing common resources
  * by an event in one process triggering an event in another process
- Decision processes may trigger
  * Business events
  * Information processes

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

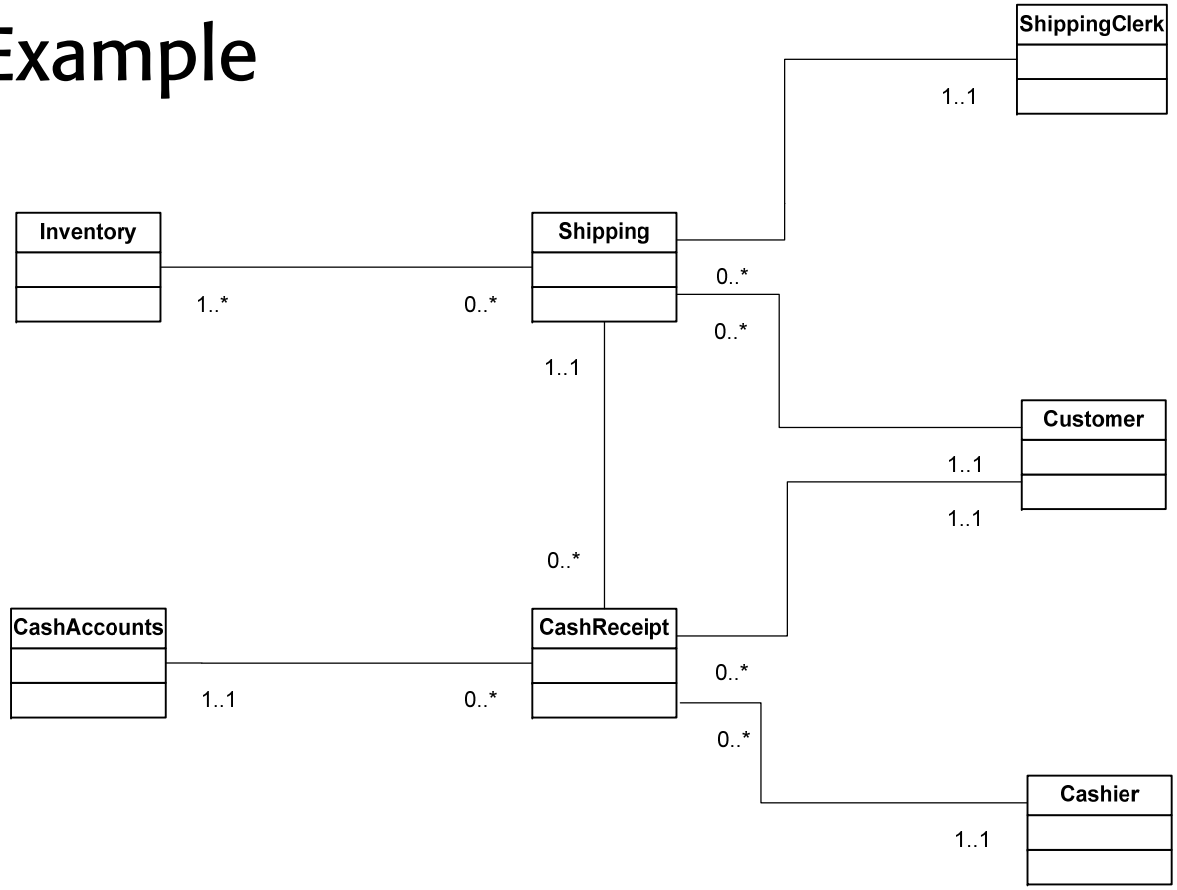
UML Class Diagram (Static Structure)

- 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)

- Orville Ornaments

  Orville Ornaments produces garden gnomes, bird tables, fountains, and other garden ornaments. On Fridays, the production manger creates a Job Order specifying batches of ornaments to be produced the next week. From this the Inventory Manager creates a Materials Requisition identifying the raw materials (stone, plaster, paint, etc.) required to be issued from inventory. The following Monday, the supplies clerks issues the materials to the craftsmen who make the ornaments, and document this Materials Issue. Each ornament requires multiple materials, and over time Orville Ornaments has accumulated an inventory that includes some materials not currently used in production items. Materials are not unique in any way.

  Each ornament has a different name (there are seven different garden gnomes, for example, and three different bird tables). Craftsmen specialize in particular items: one craftsman may produce two of the different gnomes, for example, but not yet have learned how to create the others. Every ornament has at least one craftsman who specializes in its manufacture. Before they have learned to specialize in any ornament, newly hired craftsmen are not engaged in production, but help out in various ways, clean up, and learn their new craft.

  Each batch of ornaments (say, if six Deluxe Bird Tables are to be produced one week, among other items) is considered a separate production event, by a single specialist – though it is possible that earlier batches of the same item were made by different specialists. In its catalog, Orville Ornaments offers some expensive ornaments that have never yet been manufactured, due to lack of customer orders.

  Create an REA-based EER diagram for this scenario, a context diagram, and a Level 0 DFD for the information processes to record what happens. Be prepared to discuss DFDs for maintaining and reporting processes.

- Narrative and flowcharts in the Chapter 1 Appendix for automated Purchases