System Analysis

Software Engineering

2004-2005

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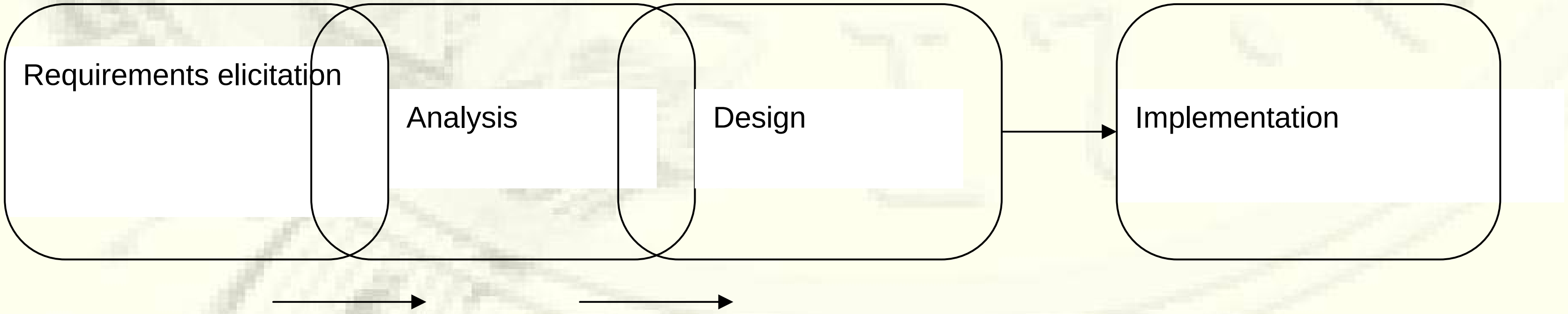
Content

- **Introduction**
- Goals, human actors, & 3 beasts
- Traditional approach
- Diagrams
- Issues & drawbacks

Introduction

- Impossible to provide a precise definition
- A phase between requirement elicitation and system design
  - Purposes of the system are formalized and put in a consistent and coherent framework
- Traditional approach



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Goals, human actors, & 3 beasts

Goals

Understand **requirements**, resolve ambiguities and incompleteness

Lay out **basic model** of system

Understand **what is needed** for development

Human actors

Customer – a stakeholder: orders and pays the system

Manager – a stakeholder: heads and controls the development team

Developer: builds the system

Analyst – specialized developer in system analysis

3 beasts

Uncertainty: customer does not know the requirements, or they are ambiguous, incomplete and unstable

Irreversibility: Once a basic model is decided, changes are costly

Complexity: Requirements and/or basic model too complex

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Traditional approach (1/5)

- Plan-driven approach to analysis:
  - Try to be as specific as possible, resolve up-front all ambiguities, build a complete and consistent set of formal specifications, and develop a solid base on which to build the system

Traditional approach (2/5)

- The Specification Document
  - Goal: reports unambiguously the system requirements
  - Key contractual document: the customer approves and signs it
  - Seldom only textual
  - Data Dictionary
    - Key part of the document
    - Repository containing the definition of all the data and control info entities in input or output to the various modules of the system

Traditional approach (3/5)

- Goal: modeling the system
  - 3 Aspects to model
    - Data structure
    - Functionalities
    - Behaviour
  - Using various types of diagrams & notations
    - Based on info flow, procedures (describe behaviour)
    - Based on database field (describe data structures)

Traditional approach (4/5)

- Most popular diagrams used in "*structured analysis*"
  - Data Flow Diagram
    - Captures the flow of info and control
  - State Diagram
    - Describes the possible states of the system and the admissible state changes
  - Entity-Relationship Diagram
    - Describes the data structure of a database

Traditional approach (5/5)

- Formal specification techniques
  - Goal: describes the system “mathematically”
  - Separating “what” from “how”
  - Providing a complete mathematical (formal) specification of the system
    - using proper notation and languages
  - Ideally, the correctness of the system could be mathematically proven

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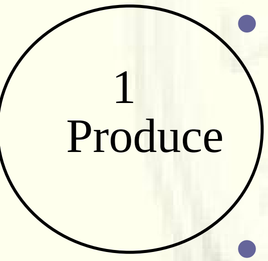
Data flow diagrams – DFD (1/3)

- 2 purposes
  - Define data flow and transformation
  - Specify functions which process and transform data
- Major drawback: difficult to translate DFD into system architecture and into code
- Drawing DFD for complex system adds irreversibility and complexity

Data flow diagrams – DFD (2/3)

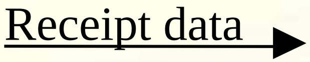
- Basic entities
  - External entity:
    - produces info to be fed into system
    - can be a person or another program

  - Transformation process
    - Represents a system's activity
      - receives input → processes & transforms → produces output

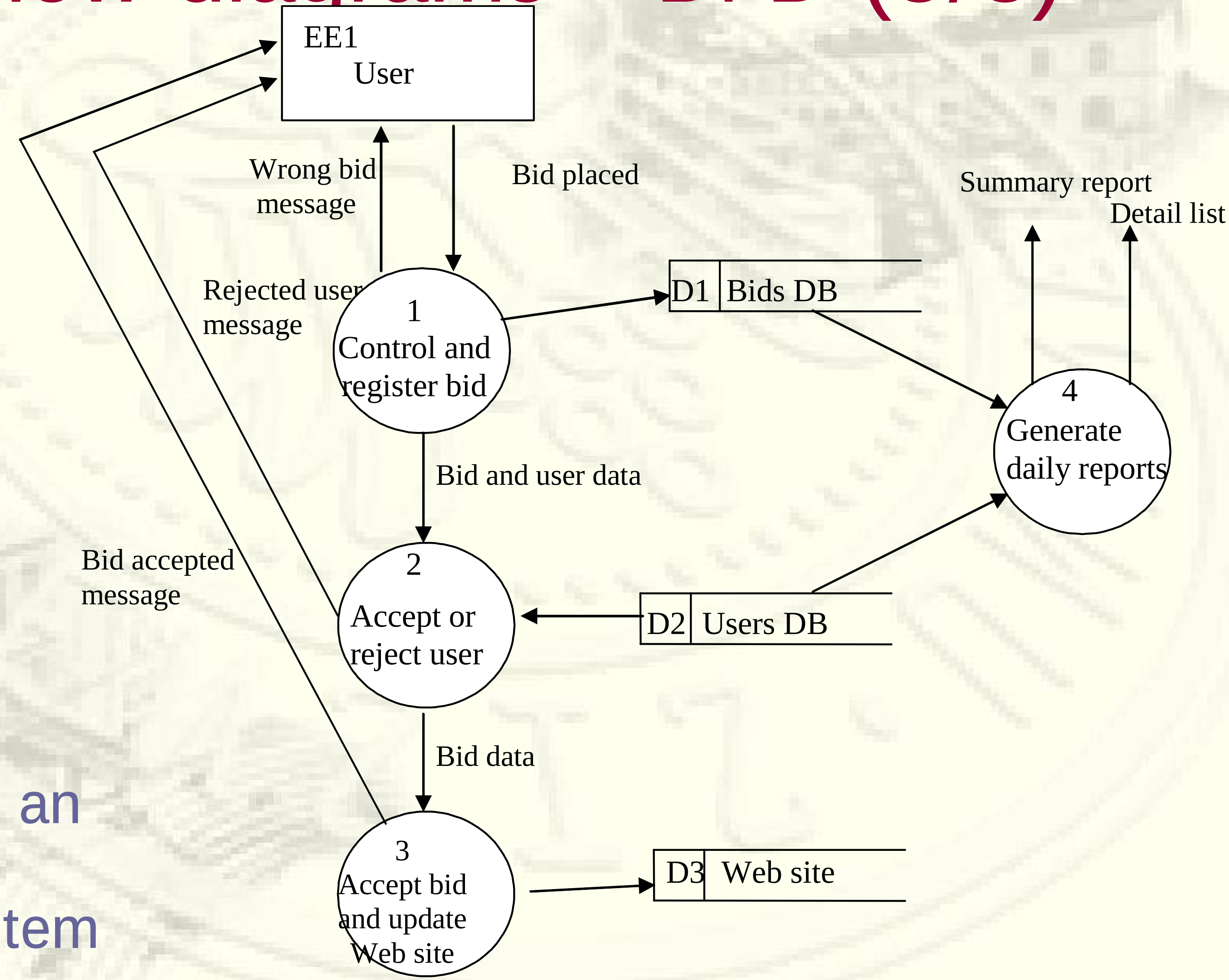


  - Data store
    - file or database table (permanent storage possible)

  - Data flow
    - Refers to info between DFD entities
    - plain data or control info



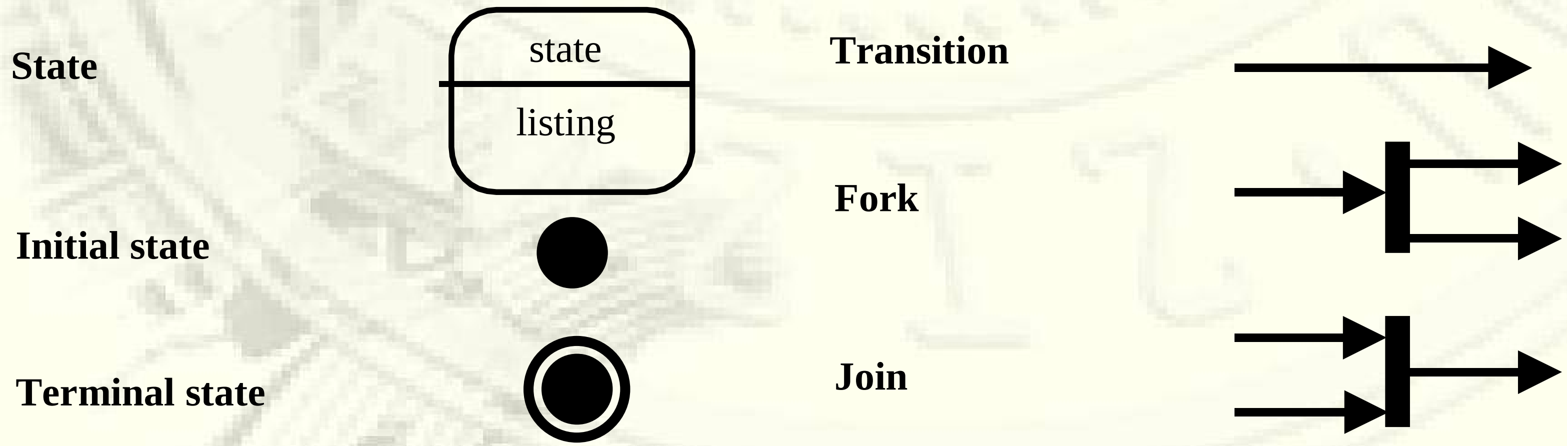
Data flow diagrams – DFD (3/3)



- Example of an automated auction system

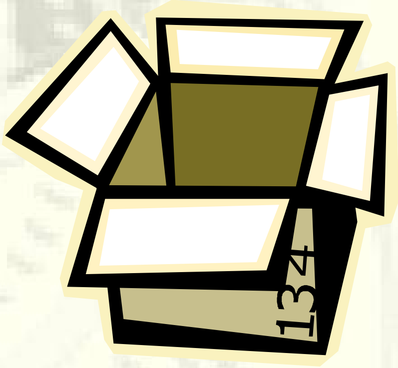
State diagrams (1/3)

- Software systems as finite state machines
- Infeasible to describe entire project with state diagrams
  - but practical when project is broken into subsystems
- UML state diagram symbols:

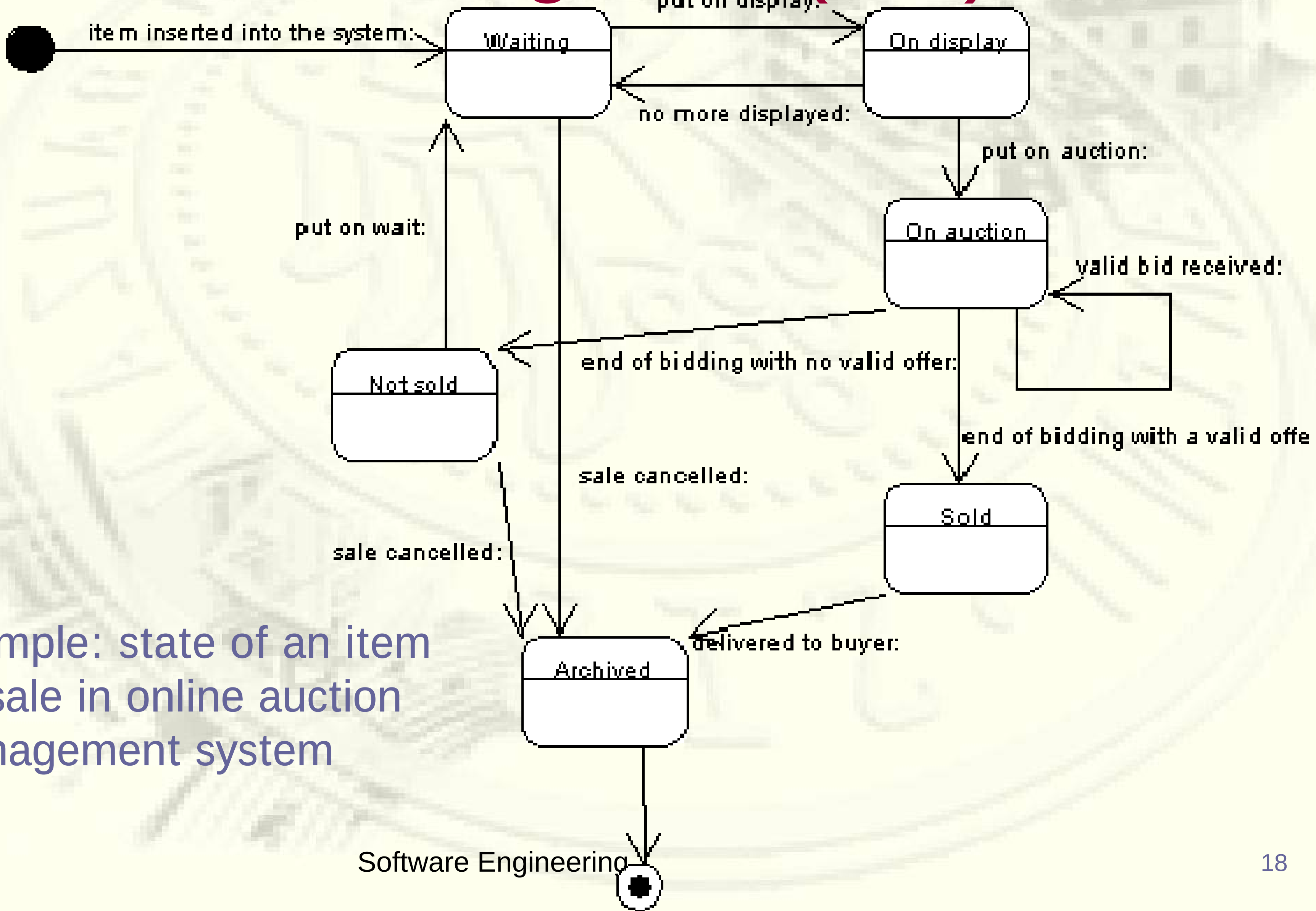


State diagrams (2/3)

- State in a box
  - Lower portion holds listing of internal actions when object remains in the state
- Substates
  - represented in composite state
  - Can be concurrent and/or sequential
  - Fork used when entering composite state
  - Join used when leaving composite state
- State diagrams
  - useful for describing behaviour of <u>parts</u> of a system
  - Part of object oriented analysis and design



State diagrams (3/3)



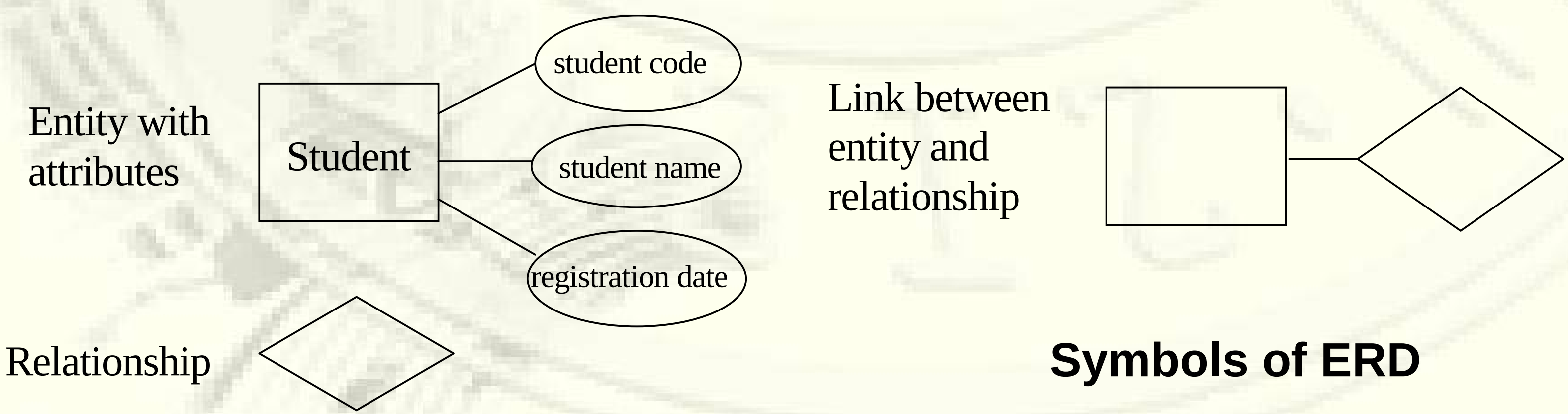
- Example: state of an item on sale in online auction management system

Entity-relationship diagrams (1/2)

- Data modeling: specification of data processed
- Main goal – finding and defining:
  - Primary data objects in terms attributes
  - Relationships among data objects
  - Constraints on the data structure
- Main notation: Entity-Relationship Diagram (ERD)
  - Focuses solely on data
  - Mainly for analysis and design of database of system
- DFD and State diagrams: dynamic views
- ERD diagrams: static views

Entity-relationship diagrams (2/2)

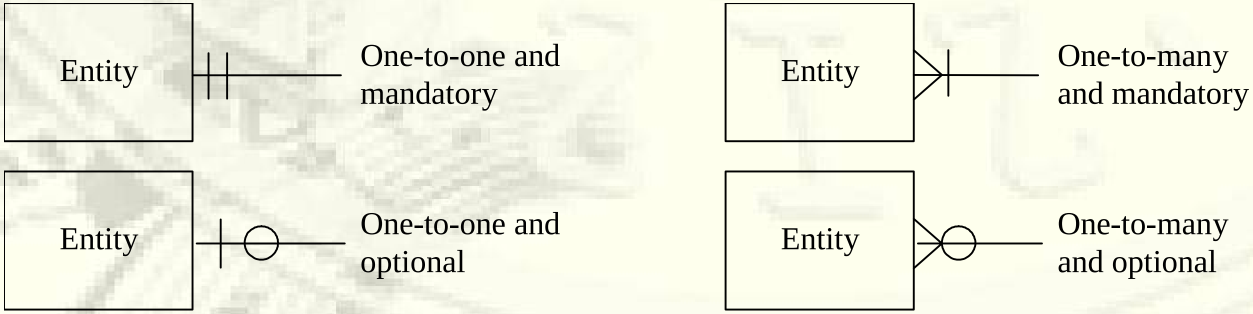
- Entity: data object
  - Composed of and described by attributes
    - Attribute is a data item simple enough to be considered an info unit
  - Distinction between entities and attributes depends on the abstraction level of developers
- Relationship: link among entities
  - Can have attributes



Symbols of ERD

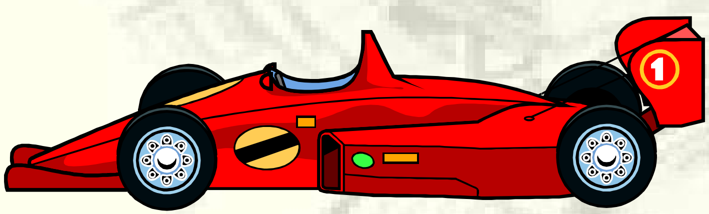
Cardinality and modality (1/2)

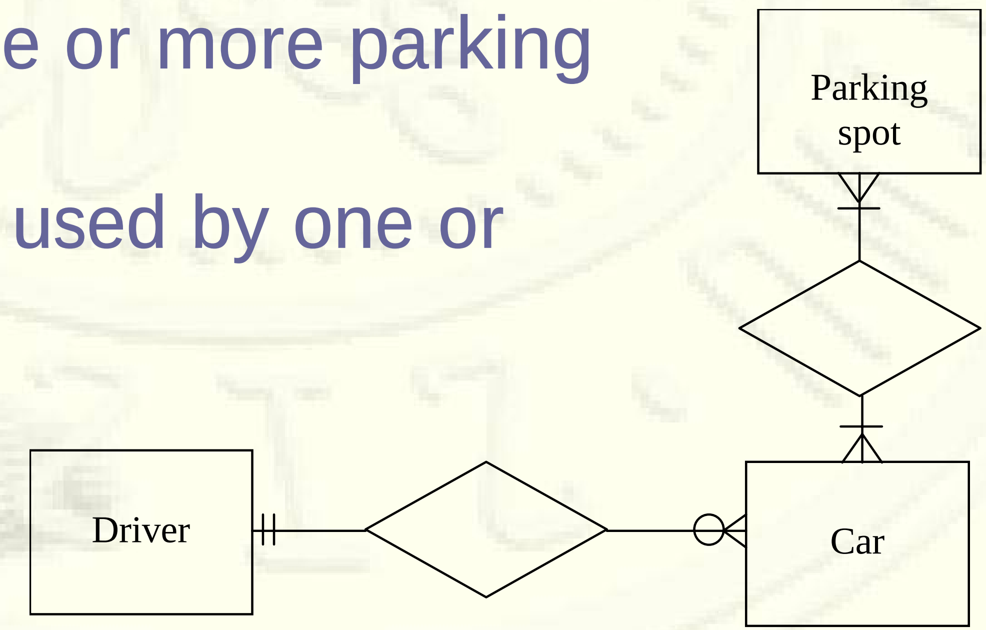
- Cardinality = multiplicity
  - Number of possible occurrences of one entity that can be related to the number of occurrences of the other entity
  - Its value can be either one or many
- Modality = necessity of participation of one entity in a relationship
  - Either optional or mandatory



Cardinality and modality (2/2)

- Example:
  - A driver can drive >= 0 car
  - A car has only one driver
  - A car parks at one or more parking spots
  - A parking spot is used by one or more cars





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Issues & drawbacks

- Enormous specification documents
  - Increases irreversibility and complexity
- Analysis-paralysis: never-ending analysis phase
  - Uncertainty caused by requirement changes
- Loss of customer's interest and support
- Partial solution: incremental (small parts of system) and iterative (subsets of features) approach
- Alternative approach: OO analysis