

# An Introduction to Data Modeling

## E-R and UML Modeling

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Federal Aviation  
Administration



# Presentation Aims

- **Provide enough information to understand the AICM/AIXM model**
  - Not a general data modelling course
  - Starts from first principles
  - E-R diagrams – AIXM 4.x
  - UML diagrams – AIXM 5+



# Scope

- **Data modelling concepts**
  - Class
  - Attributes
  - Associations
- **Notation**



# What are Features?

- **Formal definition:**

- A thing of significance, whether real or imagined, about which information is known or held.

- **Identification of features is domain specific**

- **Feature Instance**

- An occurrence of a feature that is populated with data used to represent an example of the thing modelled by the feature

	<b>UML</b>	<b>E-R</b>
Feature	Class	Entity
Feature Instance	Object	Entity Instance

# Class Notation

UML



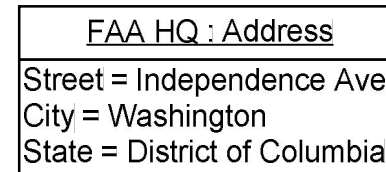
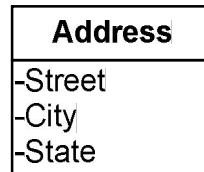
E-R



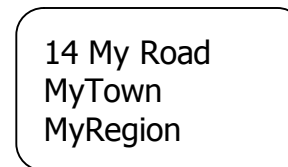
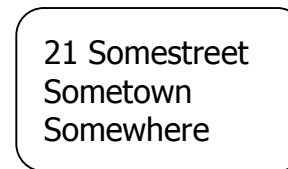
- **Boxes labelled with the feature type name**

# Types and Instances

UML



E-R

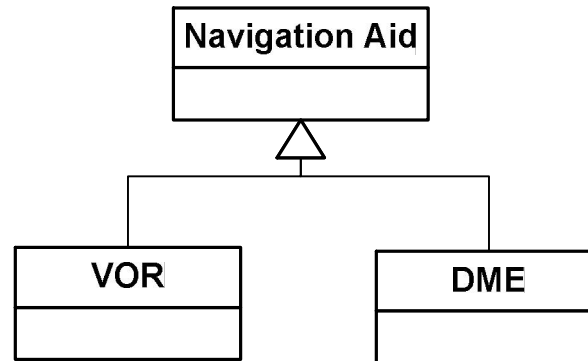


Type

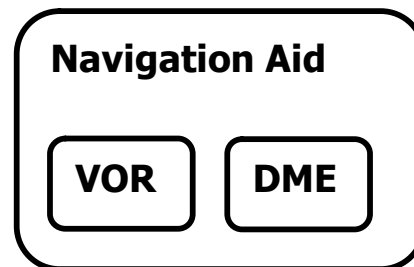
Instances

# Super types and Generalization

UML



E-R



# What are Properties?

- **Formally:**

*Any detail that serves to qualify, identify, classify, quantify or express the state of an class is called an attribute*

- **Property definitions**

- The definition of the entity type detail model

- **Property values**

- The data assigned to an attribute in an entity instance

**UML**

**E-R**

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Property

Property or Attribute

Attribute



# Attribute Notation

UML

E-R

Property



# Property Domains

- **Defines the permitted values for an attribute**
- **Associated with each attribute**
- **Three types:**
  - Data Type
    - Integer, Boolean, String, Telephone Number, Post Code...
  - Data Range
    - E.g. Integer Type from 1 to 100
  - Acceptable values
    - List of all allowed values
    - E.g. an attribute representing primary colours has acceptable values 'red', 'blue' and 'yellow'

• **Detailed in model documentation**

# Property Modality

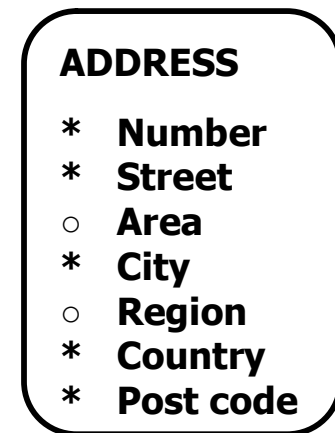
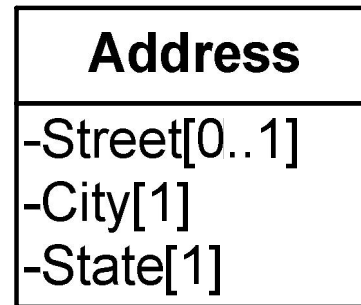
- **Defines whether an property must have a value**
- **Represents the optionality of the attribute**
  - Modality of zero = optional
    - e.g. an Aerodrome may have an ICAO Code
  - Modality of one = mandatory
    - e.g. an Aerodrome must have a name

# Property Notation

UML

E-R

Modality



[0..1] Optional  
[1] = Mandatory

\* = Mandatory  
○ = Optional

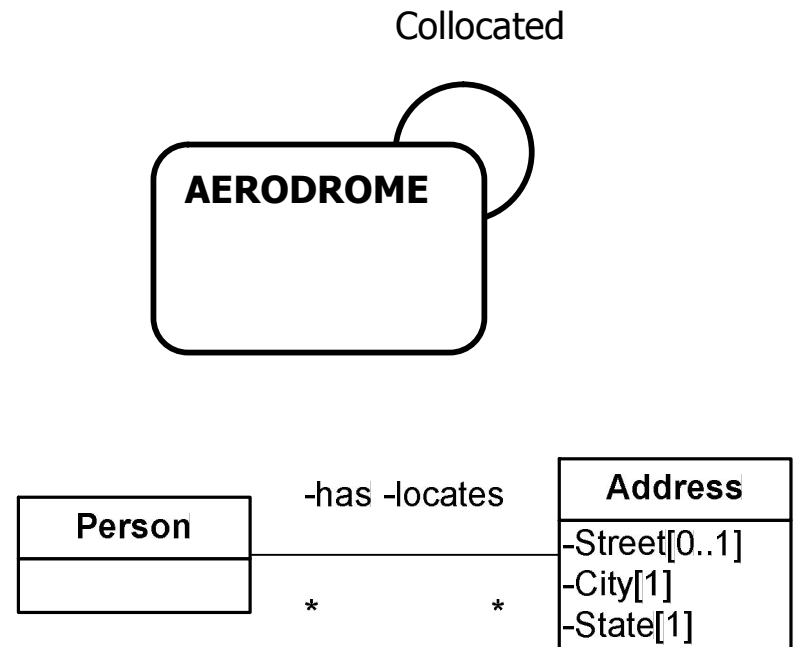
# Relationships

- **What is a relationship?**
  - Defined to describe a linkage between feature types in a data model
- **Examples:**

An Aerodrome	has	a Runway
An Employer	employs	an Employee
An Address	locates	a Person

# Relationship Degree

- **Defines how many entities participate in a relationship**
  - Unary
    - Relationship to and from the same entity
  - Binary
    - Relationship defined between two different entity types



# Relationship Cardinality

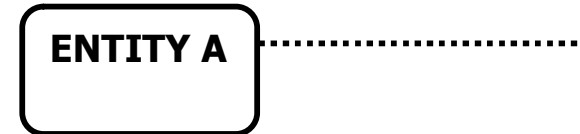
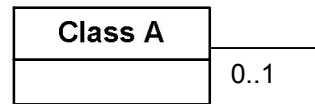
- **Maximum number of instances of each entity that may take part in a relationship**
  - One-to-one
    - e.g. a man is married to one woman
  - One-to-many
    - e.g. a man is married to one or more women
  - Many-to-many
    - ...

# Relationship Cardinality and Modality Notation

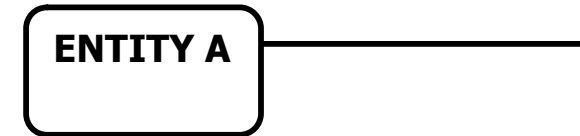
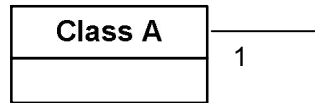
UML

E-R

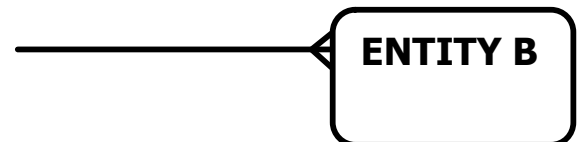
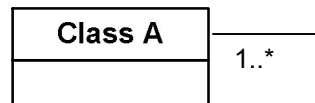
Zero



One



Many



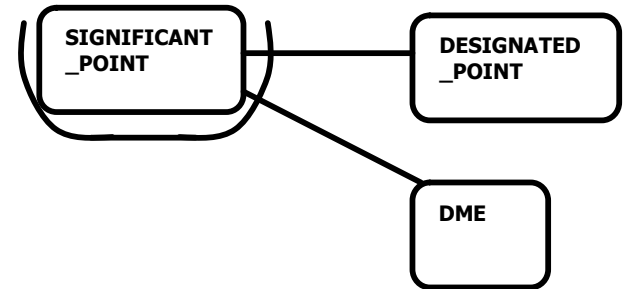
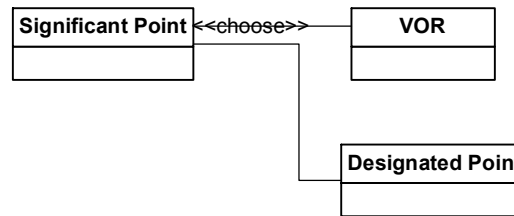


# Relationship Modifiers

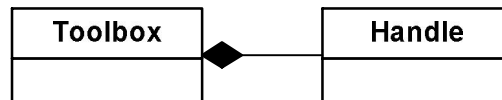
UML

E-R

Exclusivity – only one relationship applies

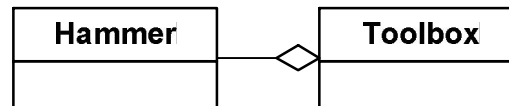


Aggregation



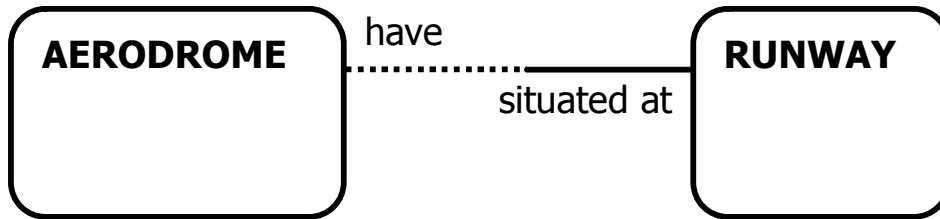
n/a

Composition



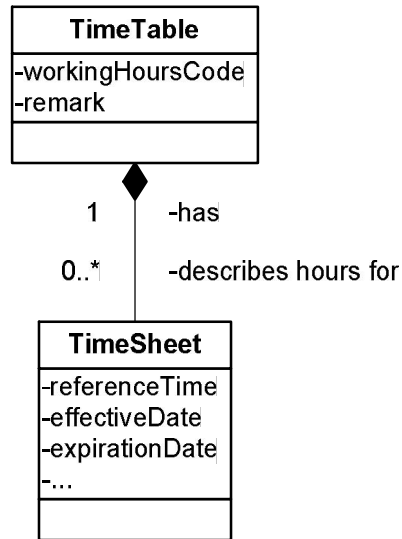
n/a

# Relationship Notation



An Aerodrome **may** have a runway

A runway **must** be situated at an Aerodrome



A TimeTable **may** be **composed** of Timesheets

A Timesheet **must** describe the hours for a TimeTable