

CSIT115 Data Management and Security

CSIT882 Data Management Systems

# Conceptual Modeling

Subject coordinators: Dr Chen Chen, Dr Thanh Le Hoang

Slides created by Dr Janusz R. Getta, School of Computing and Information Technology -  
University of Wollongong

# Conceptual Modeling

## Outline

Methodology

Example 1

Example 2

Example 3

# Methodology

**Input:** Specification of the requirements (usually a natural language description of a database domain)

**Tools:** Object Modeling graphical notation

**Methods:** Systematic transformation of individual components of specification of requirements into the components of Object Modeling notation

**Output:** Conceptual schema - simplified object class diagram

# Methodology

The transformations of specifications are performed in the following sequence of steps:

- **Step 1:** Creating classes of objects
- **Step 2:** Creating associations and association classes
- **Step 3:** Creating attributes and link attributes
- **Step 4:** Creating identifiers
- **Step 5:** Creating qualifications
- **Step 6:** Creating generalizations

# Conceptual Modeling

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# Example 1

An objective is to create a conceptual schema of a small database that contains information about employees and projects

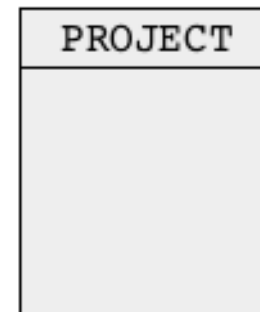
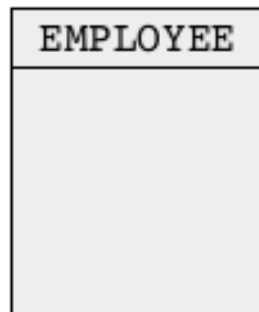
A detailed specification is the following:

- A group of employees works on the projects
- Some of employees supervise other employees
- An employee is described by an employee number and full name
- A project is described by a project title, completion date and budget
- Employees are identified by their employee numbers and projects are identified by titles

# Example 1

## Step 1: Creating classes of objects

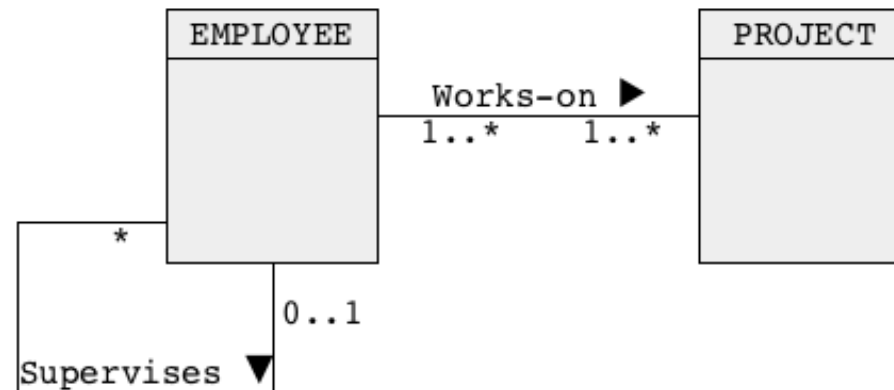
A group of **employees** works on the **projects**. Some of **employees** supervise other **employees**. An **employee** is described by an employee number and full name. A **project** is described by a project title, completion date and budget. **Employees** are identified by their employee numbers and projects are identified by the titles



# Example 1

## Step 2: Creating associations and association classes

A group of **employees** **works on** the **projects**. Some of **employees** **supervise** other **employees**. An **employee** is described by an employee number and full name. A **project** is described by a project title, completion date and budget. **Employees** are identified by their employee numbers and projects are identified by the titles

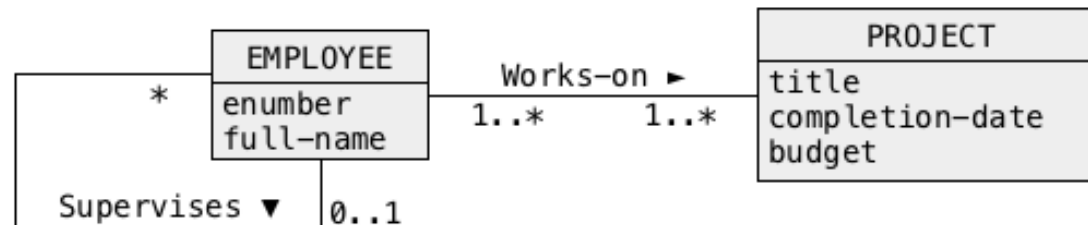




# Example 1

## Step 3: Creating attributes and link attributes

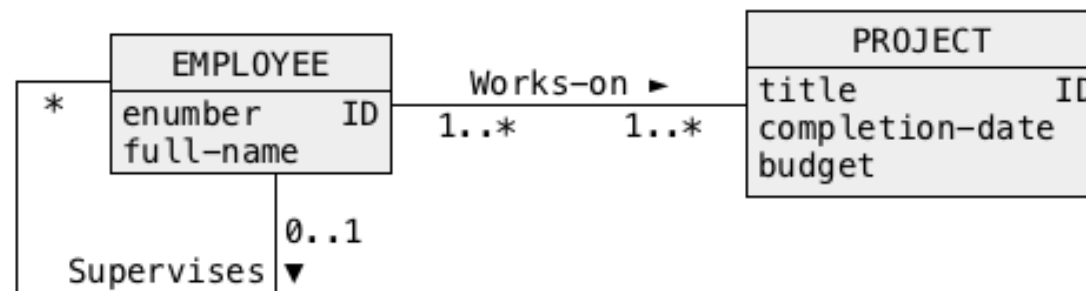
A group of **employees** works on the **projects**. Some of **employees** supervise other **employees**. An **employee** is described by an **employee number** and **full name**. A **project** is described by a **project title**, **completion date** and **budget**. **Employees** are identified by their employee numbers and projects are identified by the titles



# Example 1

## Step 4: Creating identifiers

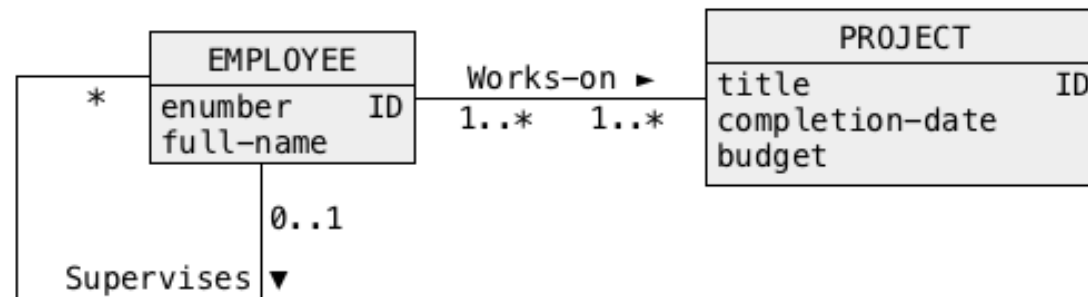
A group of **employees** works on the **projects**. Some of **employees** supervise other **employees**. An **employee** is described by an **employee number** and **full name**. A **project** is described by a **project title**, **completion date** and **budget**. **Employees** are identified by their **employee numbers** and projects are identified by the **titles**



# Example 1

## Step 5: Creating qualifications

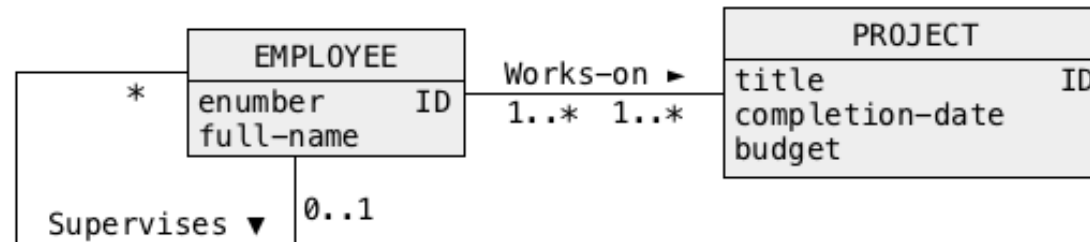
A group of **employees** works on the **projects**. Some of **employees** supervise other **employees**. An **employee** is described by an **employee number** and **full name**. A **project** is described by a **project title**, **completion date** and **budget**. **Employees** are identified by their **employee numbers** and projects are identified by the **titles**



# Example 1

## Step 6: Creating generalizations

A group of **employees** works on the **projects**. Some of **employees** supervise other **employees**. An **employee** is described by an **employee number** and **full name**. A **project** is described by a **project title**, **completion date** and **budget**. **Employees** are identified by their **employee numbers** and projects are identified by the **titles**



# Conceptual Modeling

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## Example 2

An objective is to create a conceptual schema of a small database that contains information about publications such as journals and conference proceedings, published research papers and authors

A detailed specification is the following:

- We would like to store information about publications, such as journals and conference proceedings
- The research papers are included in the journals and proceedings
- There are general editors who take responsibility for editing the research papers
- A research paper is written by one or more authors

# Example 2

## Step 1: Creating classes of objects

We would like to store information about publications, such as **journals** and **conference proceedings**. The **research papers** are included in the **journals** and **proceedings**. There are general **editors** who take responsibility for editing the **research papers**. A **research paper** is written by one or more **authors**

PROCEEDINGS

JOURNAL

PAPER

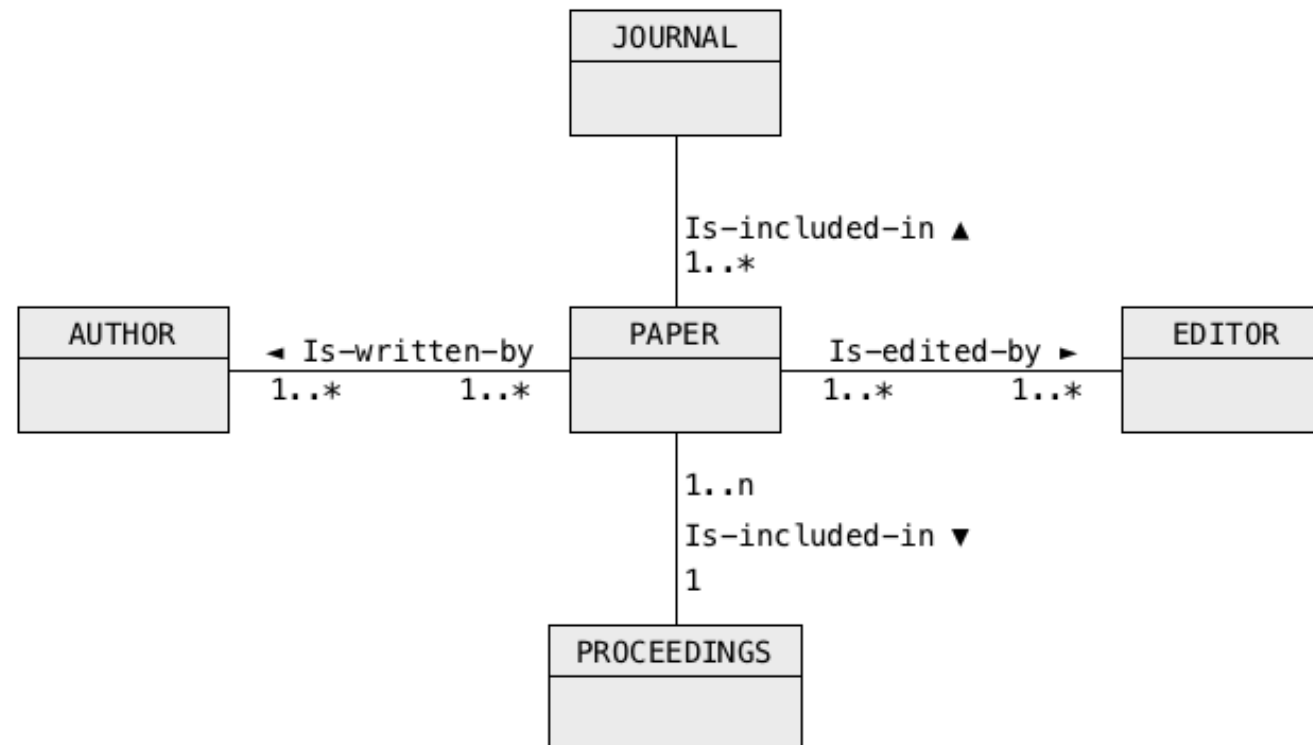
EDITOR

AUTHOR

# Example 2

## Step 2: Creating associations and association classes

We would like to store information about publications, such as **journals** and **conference proceedings**. The **research papers** are **included in** the **journals** and **proceedings**. There are general **editors** who take responsibility for **editing** the **research papers**. A **research paper** is **written** by one or more **authors**

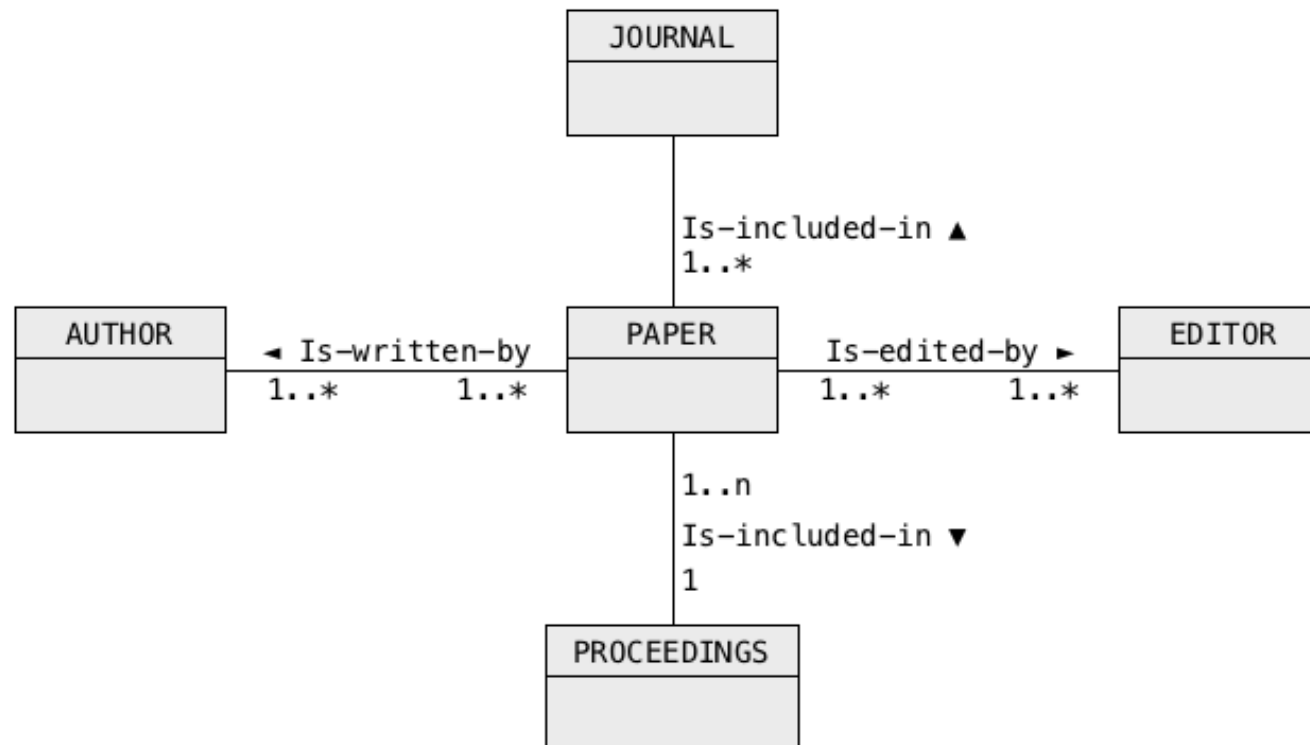




# Example 2

## Step 3: Creating attributes and link attributes

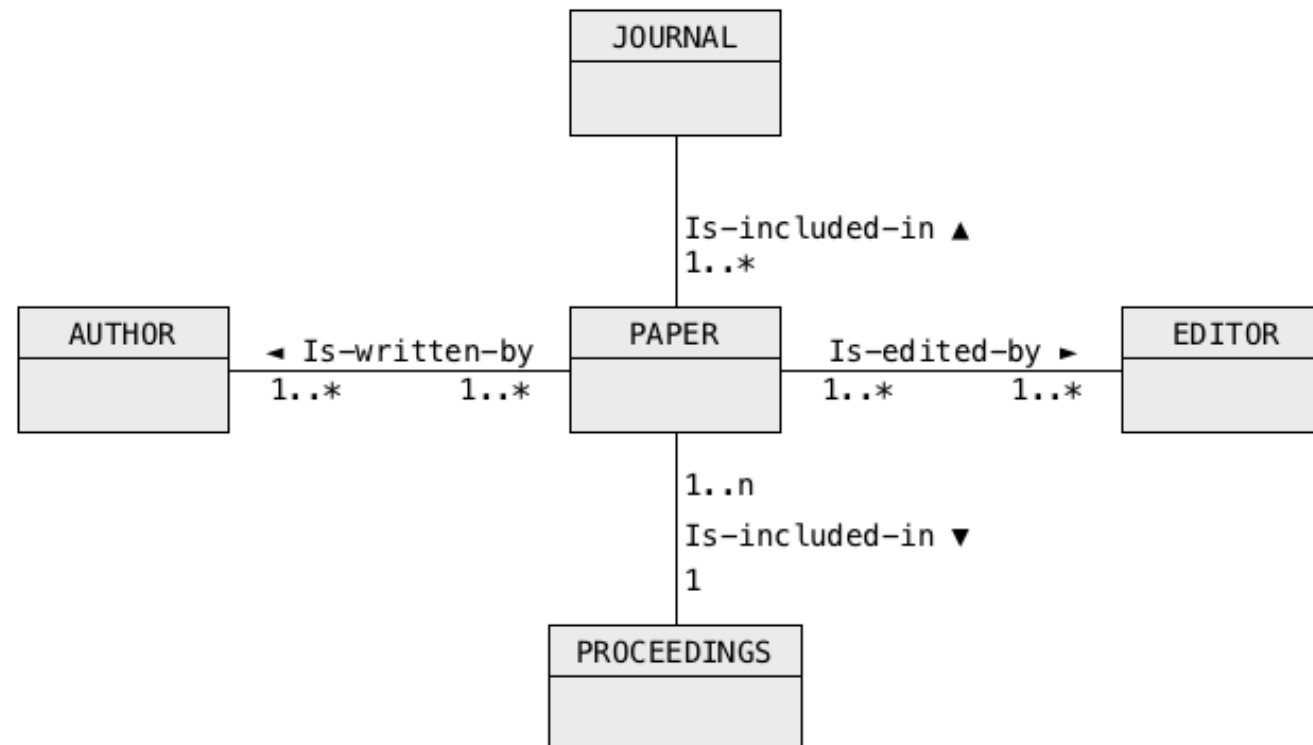
We would like to store information about publications, such as **journals** and **conference proceedings**. The **research papers** are included in the **journals** and **proceedings**. There are general **editors** who take responsibility for **editing** the **research papers**. A **research paper** is **written** by one or more **authors**



# Example 2

## Step 4: Creating identifiers

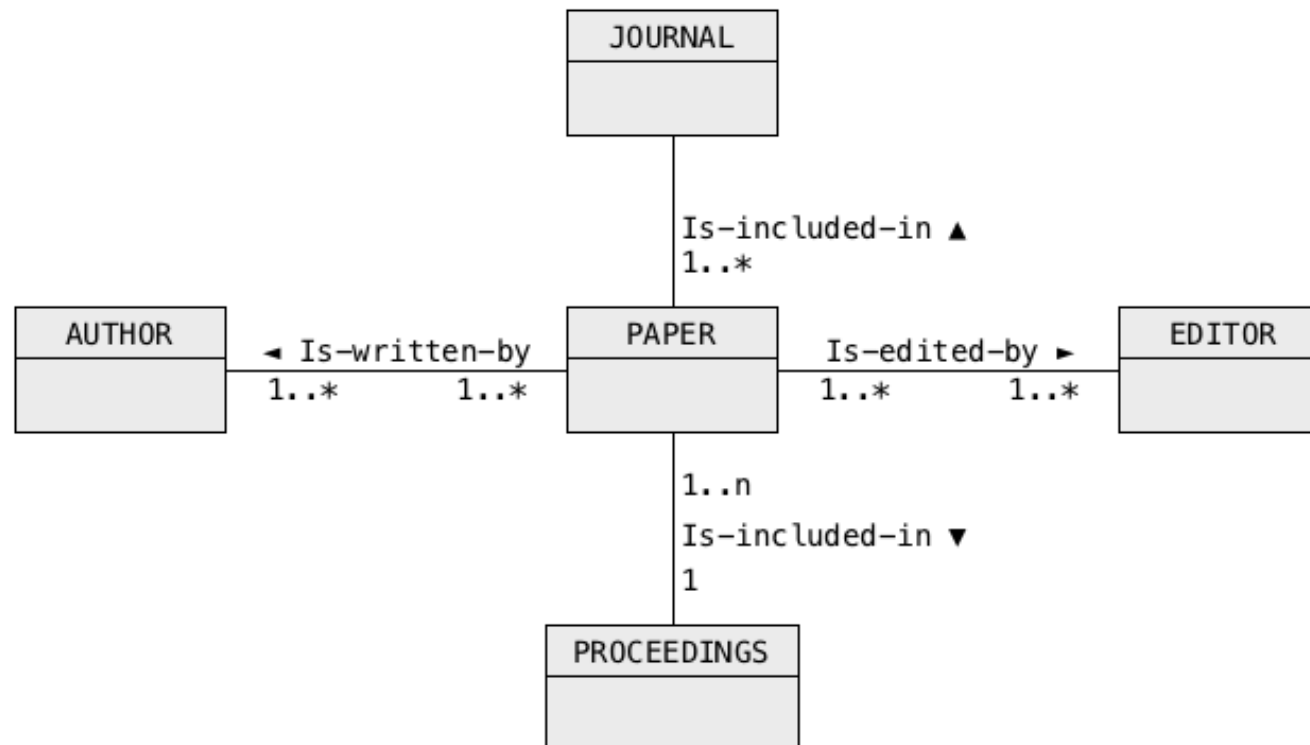
We would like to store information about publications, such as **journals** and **conference proceedings**. The **research papers** are included in the **journals** and **proceedings**. There are general **editors** who take responsibility for **editing** the **research papers**. A **research paper** is **written** by one or more **authors**



# Example 2

## Step 5: Creating qualifications

We would like to store information about publications, such as **journals** and **conference proceedings**. The **research papers** are included in the **journals** and **proceedings**. There are general **editors** who take responsibility for **editing** the **research papers**. A **research paper** is **written** by one or more **authors**

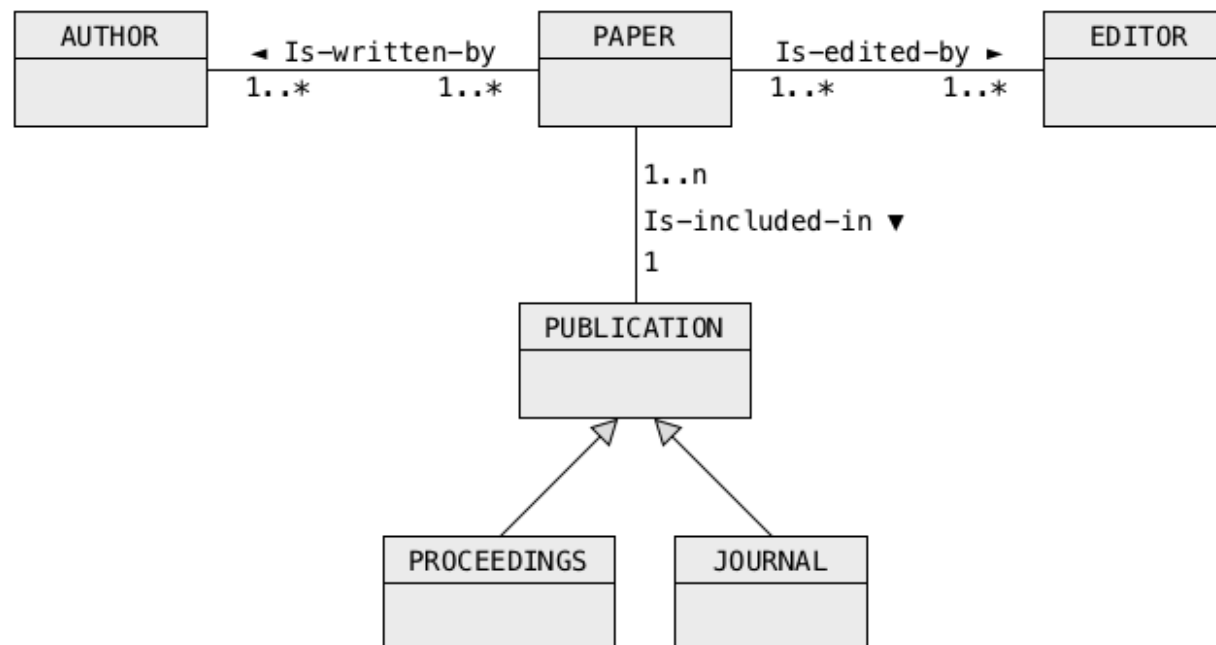


# Example 2

## Step 6: Creating generalizations

We would like to store information about publications, such as **journals** and **conference proceedings**. The **research papers** are included in the **journals** and **proceedings**. There are general **editors** who take responsibility for **editing** the **research papers**. A **research paper** is **written** by one or more **authors**

Journal, proceedings **IS-A** publication



# Conceptual Modeling

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# Example 3

An objective is to create a conceptual schema of a small database that contains information about the construction companies and buildings built by the companies

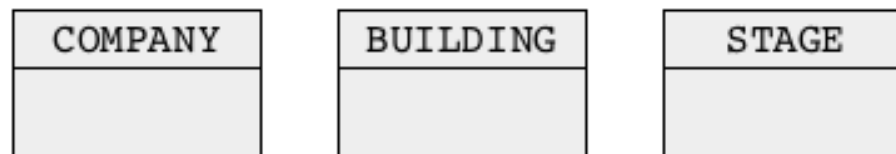
A detailed specification is the following:

- A group of construction companies is involved in the construction of industrial buildings
- A building is located at a different address, it has a unique name and completion date
- A number of construction stages apply to each building
- A construction stage is described by its name, the names of the construction companies involved together with the start date, completion date and the total costs
- A construction company is usually involved in many construction stages of the same building
- Many construction companies are involved in one construction stage

# Example 3

## Step 1: Creating classes of objects

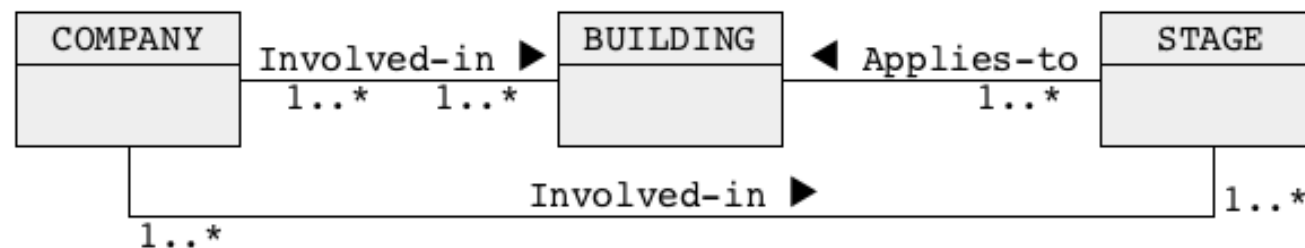
A group of construction **companies** is involved in the construction of industrial **buildings**. A **building** is located at a different address, it has a unique name and completion date. A number of construction **stages** apply to each **building**. A construction **stage** is described by its name, the names of the construction **companies** involved together with the start date, completion date and the total costs. A construction **company** is usually involved in many construction **stages** of the same **building**. Many construction **companies** are involved in one construction **stage**



# Example 3

## Step 2: Creating associations and association classes

A group of construction **companies** is **involved in the construction** of industrial **buildings**. A **building** is located at a different address, it has a unique name and completion date. A number of construction **stages** **apply to** each **building**. A construction **stage** is described by its name, the names of the construction **companies** involved together with the start date, completion date and the total costs. A construction **company** is usually **involved in** many construction **stages** of the same **building**. Many construction **companies** are **involved in** one construction **stage**





# Example 3

Step 2 (improved): Creating associations and association classes

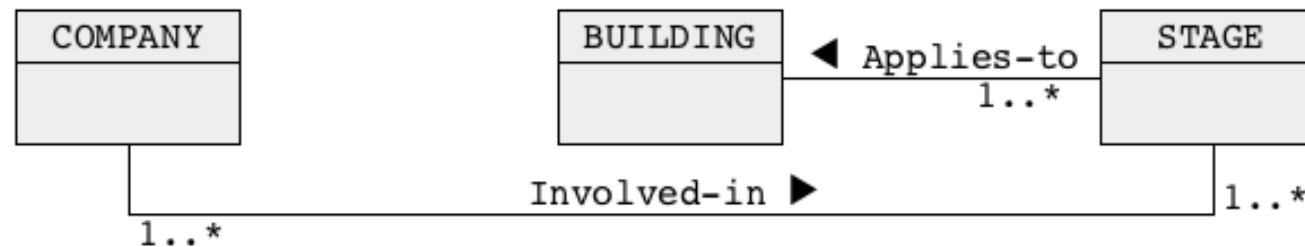
A group of construction **companies** **is involved in the construction** of industrial **buildings**. A **building** is located at a different address, it has a unique name and completion date. A number of construction **stages** **apply to** each **building**. A construction **stage** is described by its name, the names of the construction **companies** involved together with the start date, completion date and the total costs. A construction **company** is usually **involved in** many construction **stages** of the same **building**. Many construction **companies** are **involved in** one construction **stage**

If a **company** **is involved in** a **construction stage** that **applies to** a **building** then such **company** **is involved in** construction of the **building**

# Example 3

Step 2 (improved): Creating associations and association classes

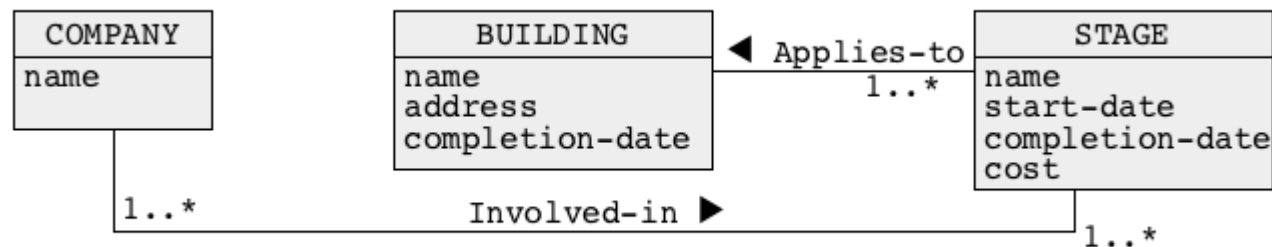
It means that we do not need an association **Involved-in** between the classes **COMPANY** and **BUILDING** because such association can be derived from the other two associations



# Example 3

## Step 3: Creating attributes and link attributes

A group of construction **companies** is **involved in the construction** of industrial **buildings**. A **building** is located at a different **address**, it has a unique **name** and **completion date**. A number of construction **stages** **apply to** each **building**. A construction **stage** is described by its **name**, the **names** of the construction **companies** involved together with the **start date**, **completion date** and the **total costs**. A construction **company** is usually **involved in** many construction **stages** of the same **building**. Many construction **companies** are **involved in** one construction **stage**

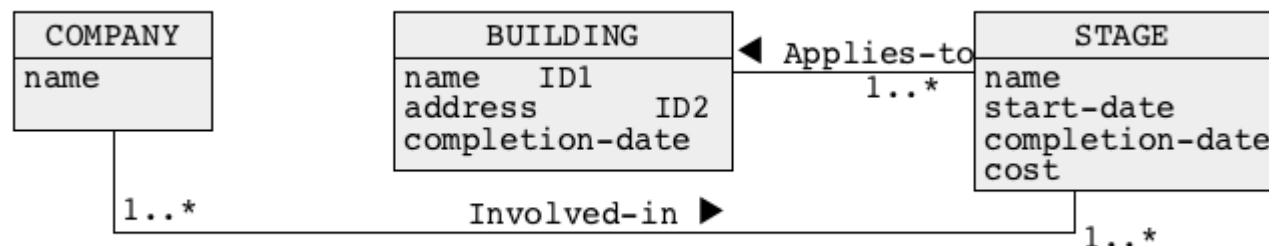


# Example 3

## Step 4: Creating identifiers

A group of construction companies is involved in the construction of industrial buildings. A building is located at a different address, it has a unique name and completion date. A number of construction stages apply to each building. A construction stage is described by its name, the names of the construction companies involved together with the start date, completion date and the total costs. A construction company is usually involved in many construction stages of the same building. Many construction companies are involved in one construction stage

What we know about the reality is that construction companies have unique names

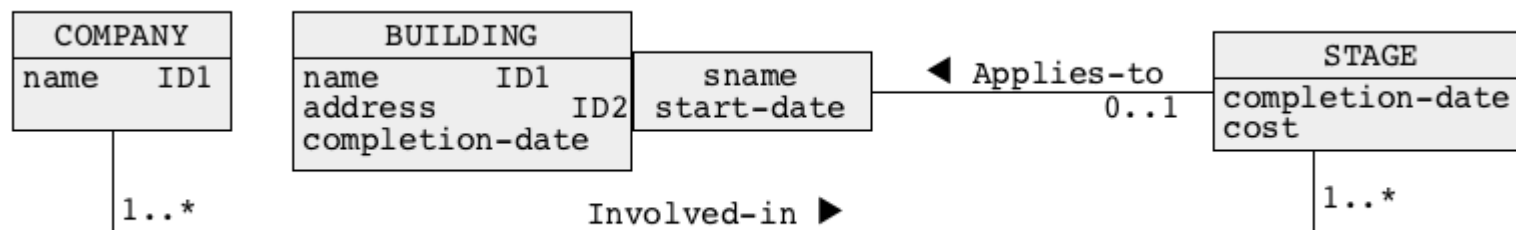


# Example 3

## Step 5: Creating qualifications

A group of construction **companies** is involved in the construction of industrial **buildings**. A **building** is located at a different **address**, it has a **unique name** and **completion date**. A number of construction **stages** apply to each **building**. A construction **stage** is described by its **name**, the **names** of the construction **companies** involved together with the **start date**, **completion date** and the **total costs**. A construction **company** is usually **involved in** many construction **stages** of the same **building**. Many construction **companies** are **involved in** one construction **stage**

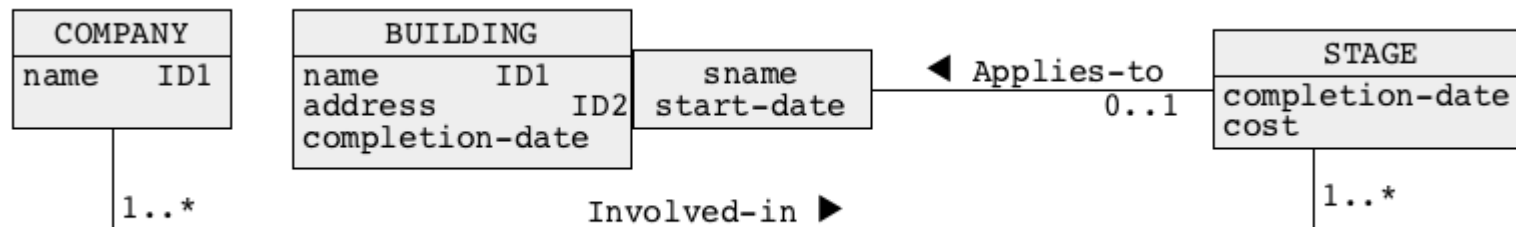
What we also know about the reality is that a construction **stage** of a **building** starts **once** at a given **moment in time**



# Example 3

## Step 6: Creating generalizations

A group of construction **companies** is involved in the construction of industrial **buildings**. A **building** is located at a different **address**, it has a **unique name** and **completion date**. A number of construction **stages** apply to each **building**. A construction **stage** is described by its **name**, the **names** of the construction **companies** involved together with the **start date**, **completion date** and the **total costs**. A construction **company** is usually **involved in** many construction **stages** of the same **building**. Many construction **companies** are **involved in** one construction **stage**



# References

C. Coronel, S. Morris, A. Basta, M. Zgola, Data Management and Security, Chapters 3 and 4, Cengage Compose eBook, 2018,

T. Connolly, C. Begg, Database Systems, A Practical Approach to Design, Implementation, and Management, Chapter 16 Methodology - Conceptual Database Design, Pearson Education Ltd, 2015

How to ... ? Cookbook, How to use UMLetlet for conceptual modeling ?  
Recipe 2.1 How to create very simple conceptual schemas with UMLetlet ?

How to ... ? Cookbook, How to use UMLetlet for conceptual modeling ?  
Recipes 2.2, 2.3, and 2.4 How to do design a conceptual schema with UMLetlet (Design 1, 2, and 3) ?