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Object-Oriented Modeling with UML

Structural Modeling

Explanation of Exercise Examples

Christian Huemer and Marion Scholz

Presented by Nicholas Bzowski

Structural Modeling
Example: Meeting

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Example: Meeting

Model the following situation:

For each meeting, the title, start and end time, duration and number of meetings are saved. Meetings can be announced and canceled. A meeting can take place in a meeting room. This has a room number and a capacity. You can reserve a meeting room and release it again. You can also search for a free meeting room.

Structural Modeling

Example: Car Ownership and Usage

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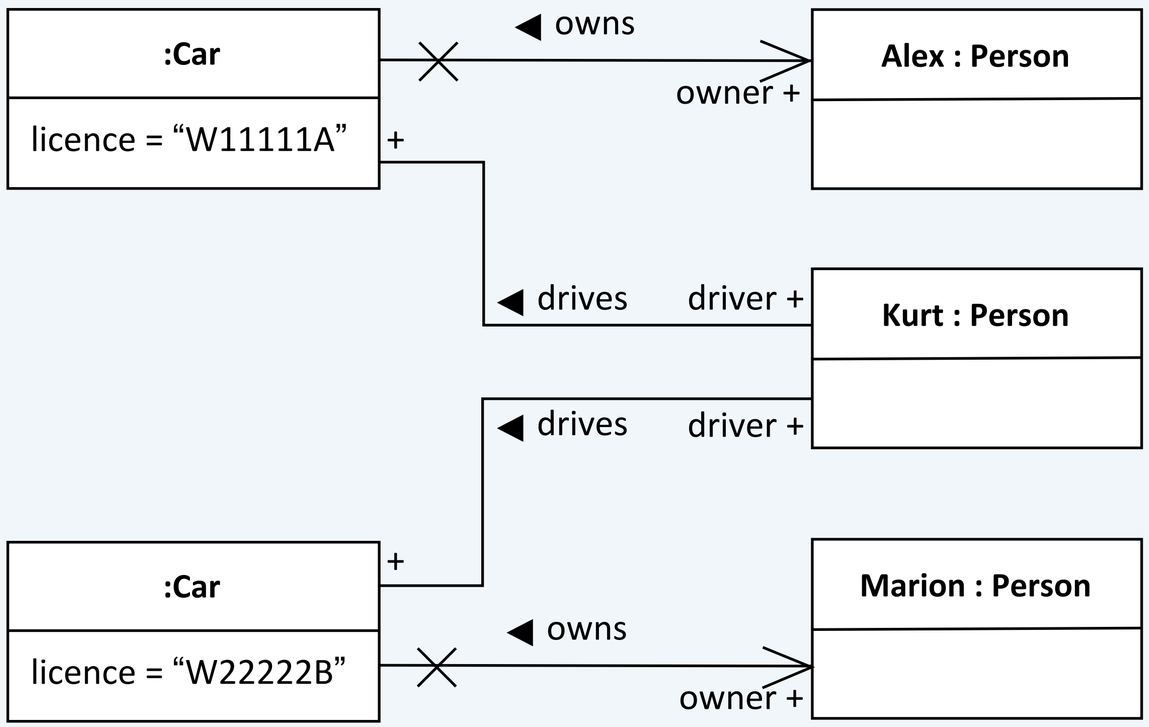
Presented by Nicholas Bzowski

Example: Car Ownership and Usage

The following object diagram is given. Create a class diagram from it.



Structural Modeling

Example: Cruise

Christian Huemer and Marion Scholz

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Example: Cruise

Model the following situation:

A cruise is organized by a specific cruise operator, each operator has a name and a location. A cruise is identified by a number and a name and has a start and end date. A cruise requires many employees, each of whom has a name and a social security number.

Several guests take part in a cruise, each guest has a name and it is also noted whether they are a VIP or not. Of course, a guest can also take several cruises.

For each ship, the name of the ship, the number of decks, the length of the ship and the number of passengers are known. A ship can be used for several cruises.

A cruise is booked through a travel agency. Each ticket has a unique ticket number and an issue date. A travel agency has a name and an address.

A cruise always sails to a specific destination, each destination has a name and the name of the sea is also noted. On a cruise, guests are offered several shows, each show has a title and a certain duration.

Structural Modeling

Example: From Object Diagram to Class Diagram

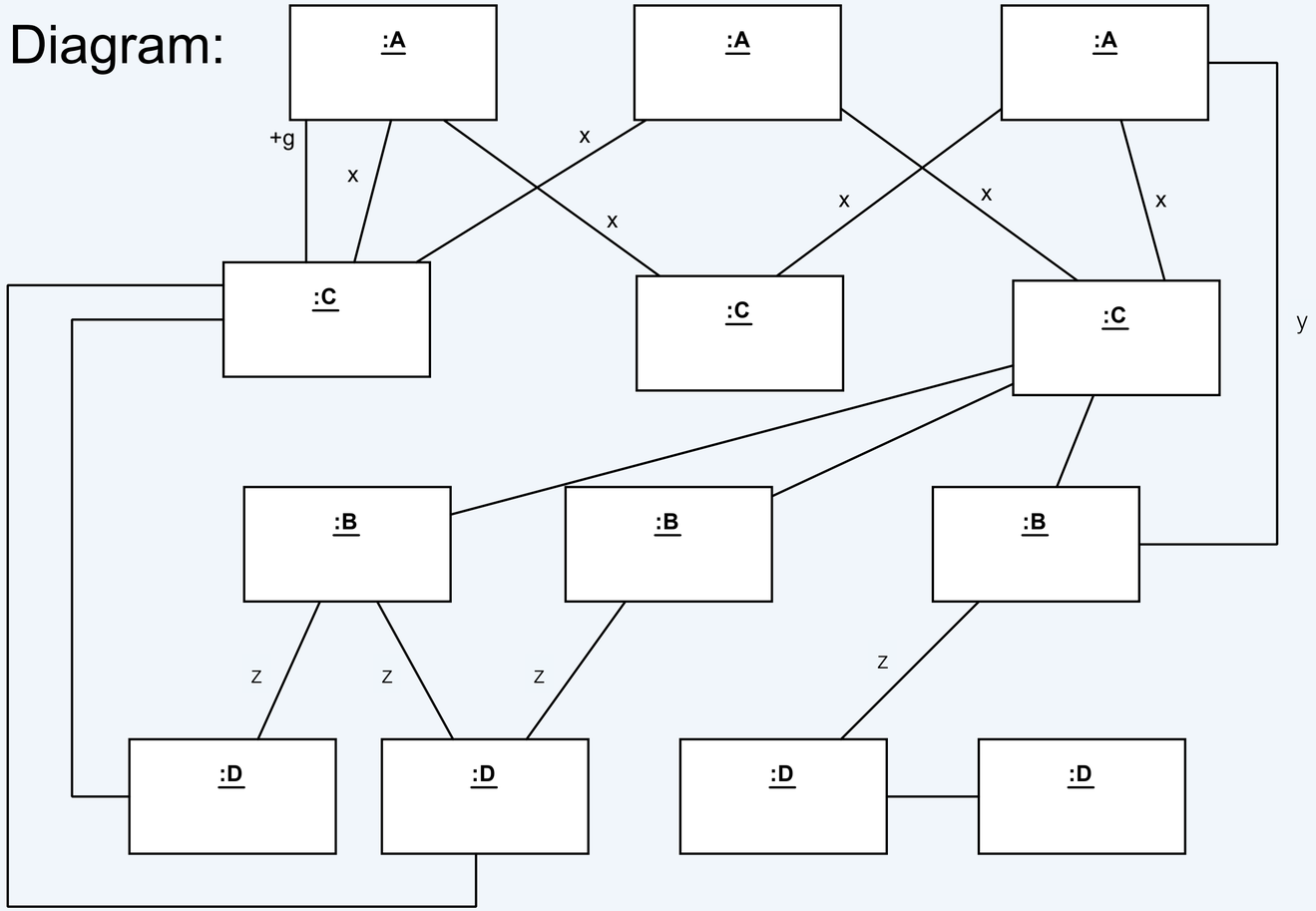
Christian Huemer and Marion Scholz

Presented by Nicholas Bzowski

Example: From Object Diagram to Class Diagram

Design a class diagram to which the following object diagram conforms. Define the cardinalities at the association ends as precisely as possible. You can assume that these object diagrams represent the maximum possible number of relationships with objects of another class.

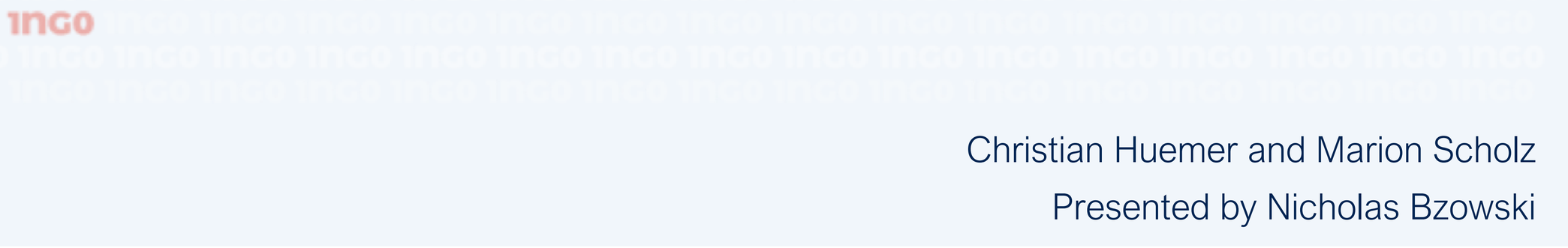
Object Diagram:



Class Diagram:

Strucutural Modeling

Example: Working in Restaurants



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Example: Working in Restaurants

Model the following situation:

Several employees work in a restaurant; an employee can of course also be employed in several restaurants. Each employee earns different salaries in different restaurants.

Structural Modeling

Example: Olympic Games

Christian Huemer and Marion Scholz

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Example: Olympic Games

Model the following situation:

There are several competitions at the Olympic Games. Exactly one nation can win each competition in any given year. The name of the competition is stored, as well as the name of the country and the year and whether it is summer or winter games.

Structural Modeling

Example: Cruise Part 2

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Example: Cruise Part 2

Model the following situation:

A cruise has several guests and each guest can participate in several cruises. Several tickets are issued for each cruise. A ticket belongs to exactly one cruise. A guest can have any number of tickets, but only one ticket per cruise.

Structural Modeling

Example: Air Squadron

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Example: Air Squadrons

Model the following situation:

The type designation of each airplane is stored. An airplane can be part of one or more squadrons; the name of the formation in which the squadron flies is stored. A flight recorder is installed in each airplane and cannot be removed. The designation and date of installation of the flight recorder are stored.

Structural Modeling

Example: Exam Questions

Christian Huemer and Marion Scholz

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Example: Exam Questions

Model the following situation:

Each exam has a date, a time and a place. An exam is made up of several exam questions, an exam question only appears in one exam. An exam question can also consist of several sub-questions; a sub-question belongs to a maximum of one super-question.

Structural Modeling

Beispiel: Train Railcars

Christian Huemer and Marion Scholz

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Example: Train Railcars

Model the following situation:

A train has a train number and several railcars. A railcar belongs to exactly one train. There are exactly two different types of railcars: baggage cars and passenger cars; there are no other railcars. The volume of a baggage car is known. A passenger car has a certain number of seats. Furthermore, a distinction is made between sleeper cars and compartment cars, but there are also other passenger cars. It is known whether a sleeper car has a shower or not and you know the category of sleeper car. The number of seats per compartment in a compartment car is also known.

Strukturmodellierung

Beispiel: From Object to Class Diagramm, Part 2

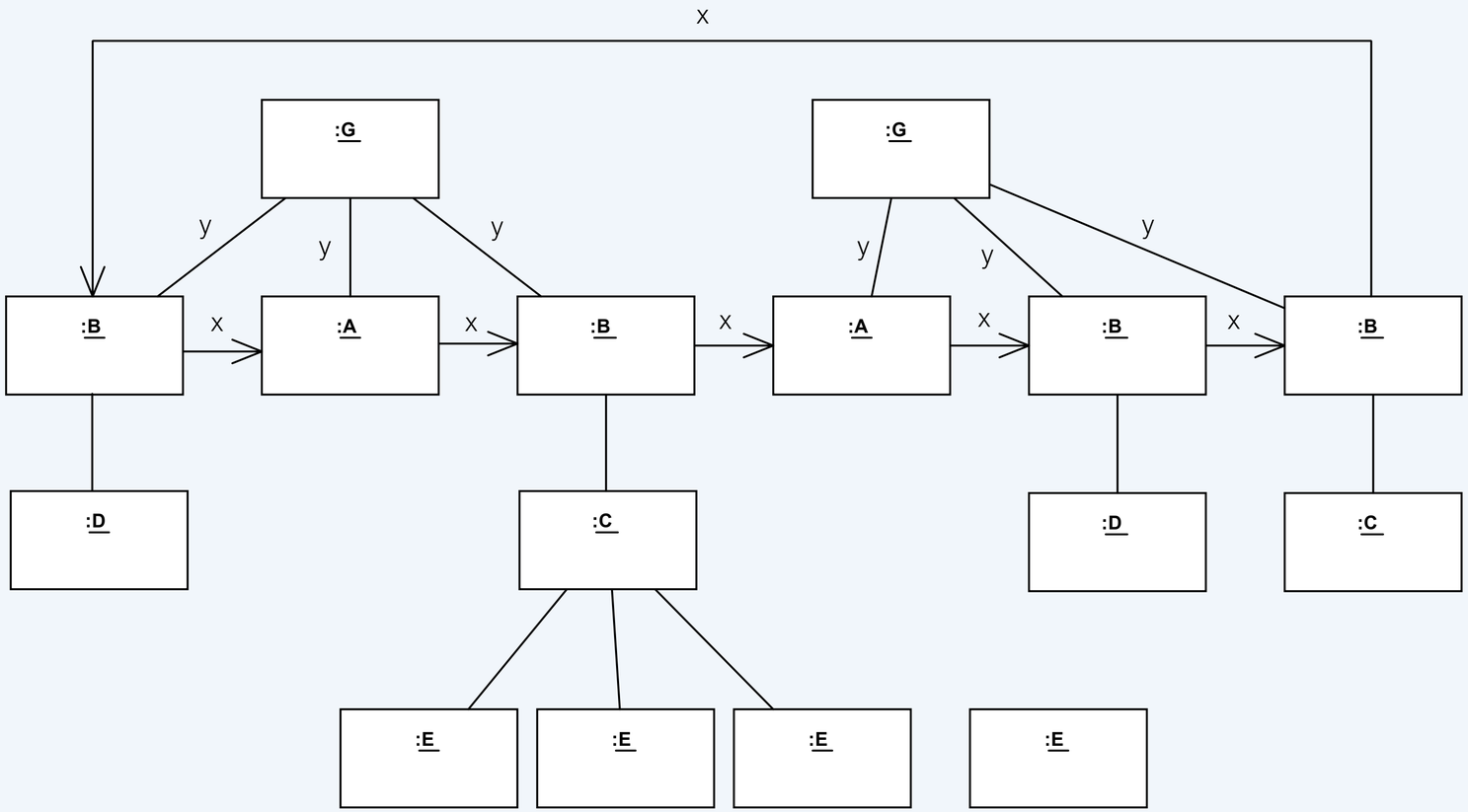
Christian Huemer and Marion Scholz

Presented by Nicholas Bzowski

Example: From Object Diagram to Class Diagram, Part II

Draw a class diagram to which the following object diagram conforms. Select the cardinalities at the association ends as precisely as possible. You can assume that these object diagrams represent the maximum and minimal possible number of relationships with objects of another class. The name of each relationship is unique in the class diagram. Furthermore, possible generalizations or XOR relationships should be identified.

Object Diagram:



Class Diagram:

Structural Modeling

Example: Fitness Equipment Maintenance

Christian Huemer and Marion Scholz

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Example: Fitness Equipment Maintenance

Model the following situation:

A maintenance company has a name and an address. A piece of fitness equipment has an inventory number, a brand and a type. It may be serviced by several maintenance companies over time, and one maintenance company is responsible for servicing several fitness machines. The date and a memo about the maintenance performed is stored for each piece of fitness equipment that has been serviced by a given maintenance company.

Structural Modeling

Example: Air Travel

Christian Huemer and Marion Scholz

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Example: Air Travel

Illustrate the following facts with a class diagram:

The name, type, year of construction and date of the next inspection are stored for airplanes. An airplane operates several flights, of which the flight number and date are stored.

Several passengers travel on a flight and their names and passport numbers are stored. A passenger can travel on several flights. The (individual) ticket for each flight is saved in the form of the ticket number and price. It is also stored whether an upgrade is required.

Passenger planes are special airplanes for the exclusive transportation of passengers. The number of seats on each passenger plane is also stored.

A passenger plane can contain several seat categories. The description of each category is stored, whether it offers an entertainment program or not and how many seats there are in this category. Each ticket is for a specific seat category.

Each airplane can be part of an airline for which the name is stored.

An airline employs several flight attendants and pilots. For flight attendants, the name, start date of employment and whether they are a chief flight attendant are stored. For pilots, the name, start date of employment and license are stored.

Several flight attendants work on a flight. One pilot serves as captain of the airplane and one or two other pilots serve as co-pilots.

The name, address and number of runways are stored for airports. Each airplane can have a home airport. Each flight has a departure airport and a destination airport.

Structural Modeling
Example: House

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Example: House

The following UML class diagram is given. Unfortunately, some errors have occurred during modeling. Our task is to find the errors and correct them in the diagram.

The address and building material (wood, brick or concrete) are stored for each house. A house can have a basement. The size and the name of the basement are saved. There are exactly two different types of basements, namely root cellars and concrete basements. Root cellars also store the level of humidity. Concrete basements store the concrete quality. A special kind of house is the semi-detached house. It also stores whether it has its own garden and how many windows it has. Each semi-detached house has either two carports or a garage. For carports, it is recorded whether they are double carports and whether they have a flat roof; for the garage, it is recorded whether it has an automatic garage door. Each house is serviced by several companies, whose names and addresses are stored. Whenever a company carries out a job in a house, the number of hours and the agreed price are recorded in a job log.

Structural Modeling

Example Forward-Engineering: Telephone Book

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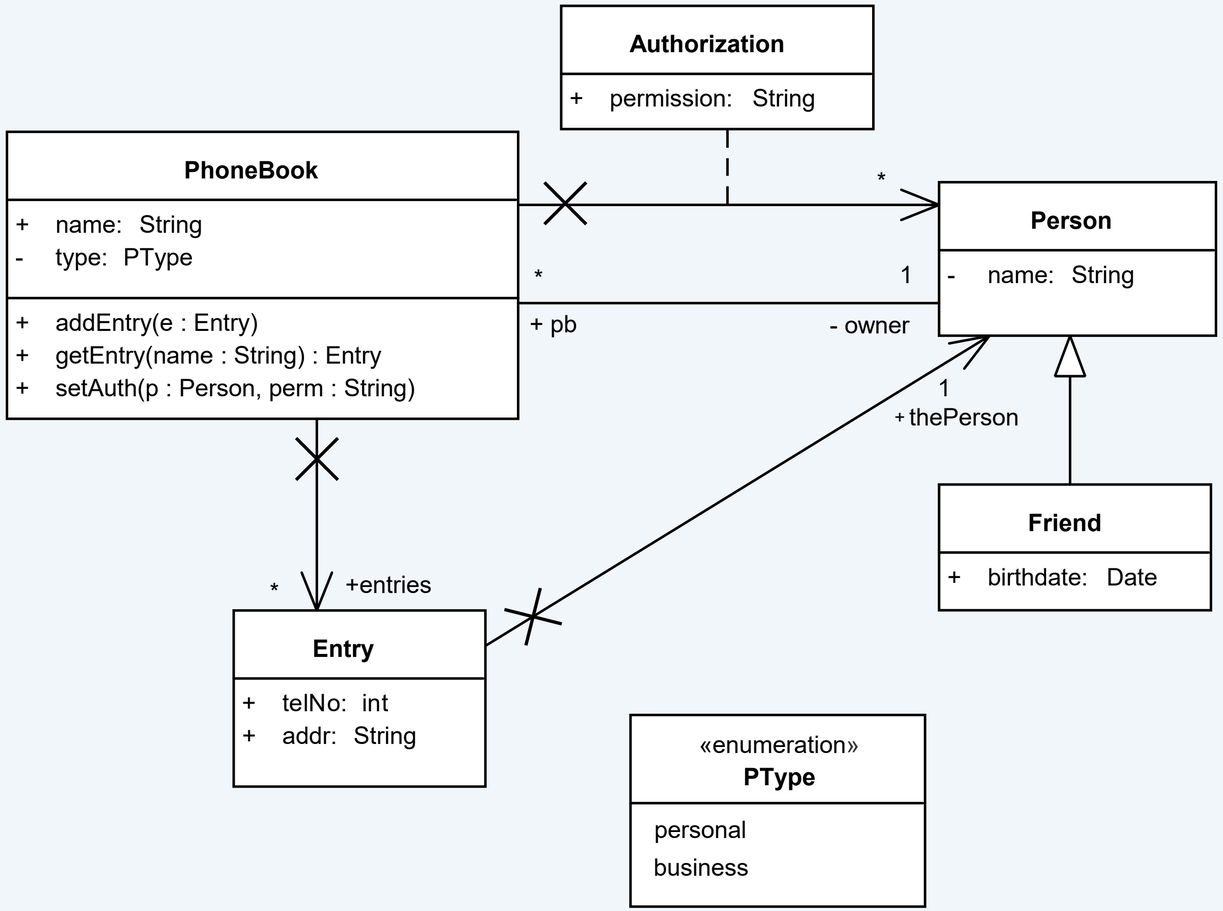
Presented by Nicholas Bzowski

Example – Forward Engineering: Telephone Book

Given this UML class diagram, translate the diagram into Java-like code. In other words, you must produce Java-like code that corresponds semantically to the class diagram.



Structural Modeling

Example Reverse Engineering: Train Routes

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Example – Reverse Engineering: Train Routes

Given the Java-like code below, reverse engineer the code into a UML class diagram.
This means that you must design a UML class diagram that corresponds semantically to the Java code.
If possible, represent references using associations.

```
abstract class Train {
   private int trainNo;
   public TrainStation [] b;
   public Hashtable stop;
      //Key: station (Type: TrainStation)
      //Value: time (Type: Time)

   public int getTrainNo() {
      return trainNo;
   }
   public void setTrainNo ( int trainNo ) {
      this.trainNo = trainNo ;
   }
}

class PassengerTrain extends Train {
   private int seats;
}

class FreightTrain extends Train {
   private DriveType drive;
}
```

```
class TrainStation {
   public String name;
   public Track [] t;
   public Track sd; //siding
}

class Track {
   private int trackNo;
   public TrainStation ts;
}

Enumeration DriveType {
   diesel;
   wood;
   coal;
}
```