Mittuniversitetet
MID SWEDEN UNIVERSITY

PROJEKT
Trains

Object-oriented programming in C++ (DT060G) vt term 2018 v1.3

In this project you will construct and implement a prototype of a train simulator for a fictional railway company. The simulation will be implemented in an object-oriented approach.
The first phase of the project is about building up the vehicle hierarchy based on different attributes of the train. The second phase in the project is to develop the simulation application.

When the simulation finishes, a summary of the result is displayed before the program ends.

The program menu

Simulation time must be entered before the simulation starts and will not be changed after the simulation has started. Only the trains departing between the selected, will be logged, but a train already started must end their journey before the program ends.

Start menu
1. Change start time [00:00]
2. Change end time [23:59]
3. Start simulaton
0. Exit

Note:
Simulation time: If you choose a different start time than 00:00, the simulation must run from the start to make sure that the conditions are correct when the simulation starts at the new time. So let simulation roll from 00:00 until the new start time without any prints on the screen or interruptions.

Option > 3 (Start simulaton)

Simulation menu : current time [00:00]
1. Change interval [00:10]
2. Run next interval
3. Next event

4. Finish (Complete simulation)
5. Change log level [Low]
6. Train menu
7. Station menu
8. Vehicle menu
0. Return

Option > 2 (Run next interval**)** *current time [00:40]*

```
00:42 Train [50] (ASSEMBLED) from Dunedin 01:12 (01:12) to
GrandCentral 02:05 (02:05)  delay (00:00) speed = 0 km/h
is now assembled, arriving at the platform at 01:02

00:44 Train [17] (ASSEMBLED) from Liege-Guillemins 01:14
(01:14) to GrandCentral 02:37 (02:37)  delay (00:00) speed =
0 km/h
is now assembled, arriving at the platform at 01:04

00:44 Train [115] (ASSEMBLED) from Hauptbahnhof 01:14 (01:14)
to GrandCentral 02:17 (02:17)  delay (00:00) speed = 0 km/h
is now assembled, arriving at the platform at 01:04

00:46 Train [1] (ASSEMBLED) from GrandCentral 01:16 (01:16)
to Liege-Guillemins 02:46 (02:46)  delay (00:00) speed = 0
km/h
is now assembled, arriving at the platform at 01:06

00:46 Train [34] (ASSEMBLED) from ST.Pancras 01:16 (01:16) to
GrandCentral 02:30 (02:30)  delay (00:00) speed = 0 km/h
is now assembled, arriving at the platform at 01:06

00:47 Train [99] (ASSEMBLED) from Shinjuku 01:17 (01:17) to
GrandCentral 01:57 (01:57)  delay (00:00) speed = 0 km/h
is now assembled, arriving at the platform at 01:07
```

Simulation menu : current time [00:50]

Option > 3 (Next event**)**

```
00:51 Train [67] (ASSEMBLED) from MilanoCentrale 01:21
(01:21) to GrandCentral 01:48 (01:48)  delay (00:00) speed =
0 km/h
```

is now assembled, arriving at the platform at 01:11

Option > 4 (Finish/Complete simulation**)**

```
00:42 Train [50] (ASSEMBLED) from Dunedin 01:12 (01:12) to
GrandCentral 02:05 (02:05)  delay (00:00) speed = 0 km/h is
now assembled, arriving at the platform at 01:02

00:44 Train [17] (ASSEMBLED) from Liege-Guillemins 01:14
```

```
(01:14) to GrandCentral 02:37 (02:37)  delay (00:00) speed =
0 km/h is now assembled, arriving at the platform at 01:04

 00:44 Train [115] (ASSEMBLED) from Hauptbahnhof 01:14
(01:14) to GrandCentral 02:17 (02:17)  delay (00:00) speed =
0 km/h is now assembled, arriving at the platform at 01:04

 00:46 Train [1] (ASSEMBLED) from GrandCentral 01:16 (01:16)
to Liege-Guillemins 02:46 (02:46)  delay (00:00) speed = 0
km/h is now assembled, arriving at the platform at 01:06
.................................
.................................


1:00:59 Train [32] (FINISHED) from Liege-Guillemins 21:40
(23:50) to ST.Pancras 22:52 (1:00:39)  delay (01:47) speed =
199 km/h is now disassembled.
```

Simulation menu : current time [1:00:59]
1. Change log level [Low]
2. Print statistics
3. Train menu
4. Station menu
5. Vehicle menu
0. Return

Option > 1

Log level menu
1. Low log level
2. Normal log level
3. High log level
0. Return

Option > 2 (**Print statistics**)

Number of vehicles at start of simulation:
GrandCentral = 102
Liege-Guillemins = 87
ST.Pancras = 83
Dunedin = 101
MilanoCentrale = 108
Luz = 77
Shinjuku = 79
Hauptbahnhof = 104

Result at end of simulation:

Total delay time = 14h 30min
End time for simulation = 01:22

Trains that never left the station (5):

Train [81] from MilanoCentrale 20:36 (00:36) to GrandCentral 21:02 (01:02)
    Vehicles:
        [Electric locomotive] id: 70, max speed: 224 km/h, power 4955 kw.
        [Covered goods wagon] id: 451, Cargo volume 118 m^3.
    Missing vehicles:
        Covered goods wagon
        Covered goods wagon

Train [82] from MilanoCentrale 21:52 (00:32) to Liege-Guillemins 23:07 (01:47)
    Vehicles:
        [Electric locomotive] id: 71, max speed: 217 km/h, power 4913 kw.
        [Diesel locomotive] id: 265, max speed: 228 km/h, fuel consumption: 553 l/h.
    Missing vehicles:
        Covered goods wagon
        Covered goods wagon
        Covered goods wagon

Train [96] from Luz 20:01 (00:31) to Hauptbahnhof 20:38 (01:08)
    Vehicles:
        [Diesel locomotive] id: 89, max speed: 231 km/h, fuel consumption: 610 l/h.
        [Open goods wagon] id: 222, cargo capacity: 66 ton, cargo area 30 m^2.
        [Open goods wagon] id: 223, cargo capacity: 62 ton, cargo area 32 m^2.
    Missing vehicles:
        Open goods wagon

Train [97] from Luz 21:15 (00:35) to GrandCentral 22:36 (01:56)
    Vehicles:
        [Electric locomotive] id: 72, max speed: 220 km/h, power 4714 kw.
    Missing vehicles:
        Open goods wagon
        Open goods wagon
        Open goods wagon

Train [124] from Hauptbahnhof 13:18 (00:38) to ST.Pancras 14:55 (02:15)
    Vehicles:
        [Diesel locomotive] id: 181, max speed: 228 km/h, fuel consumption: 643 l/h.
        [Passenger car] id: 2, 95 seats, internet onboard.
        [Passenger car] id: 3, 83 seats, no internet onboard.
    Missing vehicles:
        Passenger car

Delayed trains (6):

```
Train [32] from Liege-Guillemins 21:40 (23:50) to ST.Pancras
22:52 (01:02)
Train [87] from Luz 07:21 (07:51) to MilanoCentrale 08:39
(09:09)
Train [91] from Luz 12:48 (17:38) to Liege-Guillemins 13:00
(17:50)
```

```
Train [94] from Luz 17:03 (17:13) to MilanoCentrale 18:19
(18:29)
Train [121] from Hauptbahnhof 09:11 (11:41) to Shinjuku 09:42
(12:12)
Train [127] from Hauptbahnhof 17:16 (21:36) to Luz 17:54
(22:14)
```

Note!

For the grade A, the result of the simulation will look different.
If some trains are delayed at departure, they will try to reach the destination by increasing the train's speed. The idea is that the trains should arrive as close to the regular arrival time as possible. The speed of the train must not exceed its maximum speed and the train must not arrive too early. In this situation total departure delay time will be different from total arrived delay time and some trains will arrive at time even if they left the station late.

A train's lifecycle for grade A for one day

```
06:51 Train [87] (INCOMPLETE) from Luz 07:21 (07:31) to
MilanoCentrale 08:39 (08:49)  delay (00:10) speed = 0 km/h is
now incomplete, next try at 07:01

07:01 Train [87] (INCOMPLETE) from Luz 07:21 (07:41) to
MilanoCentrale 08:39 (08:59)  delay (00:20) speed = 0 km/h is
now incomplete, next try 07:11

07:11 Train [87] (INCOMPLETE) from Luz 07:21 (07:51) to
MilanoCentrale 08:39 (09:09)  delay (00:30) speed = 0 km/h is
now incomplete, next try 07:21

07:21 Train [87] (ASSEMBLED) from Luz 07:21 (07:51) to
MilanoCentrale 08:39 (09:09)  delay (00:30) speed = 0 km/h is
now assembled, arriving at the platform at 07:41

07:41 Train [87] (READY) from Luz 07:21 (07:51) to
MilanoCentrale 08:39 (09:09)  delay (00:30) speed = 0 km/h is
now at the platform, departing at 07:51

07:51 Train [87] (RUNNING) from Luz 07:21 (07:51) to
MilanoCentrale 08:39 (08:39)  delay (00:00) speed = 195 km/h
has left the platform, traveling at speed 195 (195)

08:39 Train [87] (ARRIVED) from Luz 07:21 (07:51) to
MilanoCentrale 08:39 (08:39)  delay (00:00) speed = 195 km/h
has arrived at the platform, disassembly at 08:59

08:59 Train [87] (FINISHED) from Luz 07:21 (07:51) to
MilanoCentrale 08:39 (08:39)  delay (00:00) speed = 195 km/h
is now disassembled.
```

- For the grade C (and also D and E), the simulation shows that 9 trains never left their departure station because they remained in the INCOMPLETE state

  Trains: 32, 81, 82, 87, 91, 94, 97, 121 and 127

Option > 3

Train menu

1. Search train by number
2. Search train by vehicle id
3. *Show all trains*
4. Change log level [Low]
0. Return

Option > 4

Station menu

1. *Show station names*
2. show station by name
3. *Show all stations*
4. Change log level [Low]
0. Return

Option > 5

Vehicle menu

1. Show vehicle by id
2. *Show all vehicles*
3. Change log level [Low]
0. Return

Note : In the Vehicle menu we can implement:

e) User option for getting the current location of a vehicle given its id.
f) User option for getting a history of the movements of a chosen vehicle so far at any point in the simulation.

Project submission:

The compressed file you will hand in should contain:

- Source code

- If you are using Visual Studio you can send the source files and the project file <project name> .vcxproj.
- If you are using Linux or Mac, you must send the source files and a **makefile**.(test your makefile if it is working properly before you send it)

- The data files used

- The report in pdf format (Please follow the report requirements carefully stated in the project description)

Good Luck!
Awais