# C# OOP Basics Exam Preparation I –

# Need For Speed

The Speed Rush has been around for many years. The thrill of racing with insane speeds, and the risk of winning or losing a lot of money, is the main reason for the racers’ … Need For Speed.

### Overview

You have a task to write a software program, which will create a virtual model of the cars, races and their development.

### Task I : Structure

The main structure of the program should include the following elements:

#### Cars

A basic car has the following properties: a **brand** (**string**), a **model** (**string**), an **yearOfProduction** (**int**), **horsepower** (**int**), **acceleration** (**int**), **suspension** (**int**), and **durability** (**int**).

Each different type of car adds to those properties. Here are the types:

* PerformanceCar – a car made for racing. Might be a little ugly, but it is a rocket inside.
  + Has **addOns** (**Collection of strings**). (by default – **empty**)
  + **Increases** its given **horsepower** by **50%**.
  + **Decreases** its given **suspension** by **25%**.
* ShowCar – a car made for showing off. Looking cool out there, bro.
  + Has **stars** (**int**). (by default – **0**)

#### Races

The basic race has the following properties: **length** (**int**), **route** (**string**), a **prizePool** (**int**), and **participants** (**Collection of Cars**),

* CasualRace – just a normal race. Several beasts’ warfare, spreading their roars throughout the roads.
* DragRace – a drag race. An engine fray. The ideal gear shifting will be the winner in this.
* DriftRace – a drift race. Don’t you wish your girlfriend was drifty like me.

#### Garage

* Garage – The Garage is that place where all the cars stay, when they are not racing. The Garage also provides the ability to **modify** parked car
  + Has **parkedCars** (**Collection of Cars**).

#### Constructors

Implement all **class constructors**, with the **parameters** in the **EXACT** **given order** and the **EXACT given types**.

#### String Representation

Implement ToString() methods for every Car class. You can see the requirements in the **Output** **Section** below.

### Task II: Business Logic

#### The Controller Class

The business logic of the program should be concentrated around several commands. Implement a class called CarManager, which will hold the **main functionality**, represented by these **methods**:

* void Register(int id, string type, string brand, string model, int yearOfProduction, int horsepower, int acceleration, int suspension, int durability)
* string Check(int id)
* void Open(int id, string type, int length, string route, int prizePool)
* void Participate(int carId, int raceId)
* string Start(int id)
* void Park(int id)
* void Unpark(int id)
* void Tune(int tuneIndex, string addOn)

#### Commands

The commands in the **CarManager class** should represent the **functionality** to the input commands of the user. Here are the **input commands** you need to accept from the **user input**.

* **register {id} {type} {brand} {model} {year} {horsepower} {acceleration} {suspension} {durability}**
  + **REGISTERS** a car of the **given type**, with the **given** **id**, and the **given** **stats**.
  + The **car type** will be either “**Performance**” or “**Show**”.
* **check {id}**
  + **CHECKS details** about the **car** with the **given id**.
  + **RETURNS** a **string** **representation** of the **car**.
* **open {id} {type} {length} {route} {prizePool}**
  + **OPENS** a race of the **given type**, with the **given id**, and **stats**.
  + The **race type** will be either “**Casual**”, “**Drag**” or “**Drift**”.
* **participate {carId} {raceId}**
  + **ADDS** a car as a **participant** in the **given race**.
  + Once added, a car **CANNOT** **turn down** a **race** or be **REMOVED** from it.
* **start {raceId}**
  + **INITIATES** the **race** with the **given id**.
  + **RETURNS** detailedinformation about the **race result**.
* **park {carId}**
  + **PARKS** a car by a **given id** in the garage.
* **unpark {carId}**
  + **UNPARKS** the carwiththe **given id** from the garage.
* **tune {tuneIndex} {tuneAddOn}**
  + **Tunes** the **currently parked CARS** with the **given** **index** and the given **add-on**.
  + You should **increase** a car’s **horsepower** by the **given index**, and the **suspension**, by **HALF** of the **given index.**
    - **150 tuneIndex** = **150** **increase** in the **horsepower** and **75 increase** in **suspension**.
  + If the car is a **ShowCar** it should increase its **stars** by the **given tuneIndex**.
  + Upon tuning, a **PerformanceCar** adds the **given** **add-on** to its **collection** of **add-ons**.

#### Functionality

**Cars** and **Races** are the **main entities** in the program’s functionality. They have no suitable way to be **ACCESSED**, which is why, upon registration, they are **given** an **Id**. The Id will be a simple integer. There is **NO need** for **Cars** and **Races** to know their **Ids**. The **CarManager** is the one that **controls** the **main logic**, which is why it is the **only class** which needs to know of **every car** and **race’s** **id**.

When you register a car, you store it in such a way, so that you can **access** it **by id**. You can then make the car participate in a race, or select it in the garage. There are several **RULES** that you must follow:

1. Once a car has been **ADDED** as a **participant** in a race, it **CANNOT** be **PARKED** in the garage, **UNTIL** the race is **OVER**.
   * **IGNORE** any attempt to park a racer car.
2. A car, which has been **PARKED** in the garage, **CANNOT** participate in a race.
   * **IGNORE** any attempt to include a parked car in a race.
3. **IGNORE** any attempt to **TUNE** cars, when there are **NO PARKED** cars in the garage.
4. **SINGLE** car **CAN** participate in **MANY** races.
5. A race **CANNOT** start without **ANY** participants.
6. A race **CAN** start with **LESS** than **three participants**.

**Performance points** **(PP)** determine every race’s winners. **PP** are either **Overall Performance**, **Engine Performance** or **Suspension Performance**. Here are the different **formulas**:

* A CasualRace determines its **winners** based on their **Overall Performance** (**OP**) (in **DESCENDING** order). **Overall Performance**, of **EACH CAR**, is calculated by the following formula:  
  (horsepower / acceleration) + (suspension + durability)
* A DragRace determines its **winners** based on their **Engine Performance** (**EP**) (in **DESCENDING** order). **Engine** **Performance**, of **EACH CAR**, is calculated by the following formula:  
  (horsepower / acceleration)
* A DriftRace determines its **winners** based on their **Suspension Performance** (**SP**) (in **DESCENDING** order). **Suspension** **Performance**, of **EACH CAR**, is calculated by the following formula:  
  (suspension + durability)

Depending on the different TYPE of RACE, different type of POINTS are calculated for the racers. In the end all points are presented as Performance Points (in the OUTPUT).

When you **OPEN** a race, you register it – this provides the functionality to **add participants** to it.   
When you **START** a race, the winners are calculated immediately, **PRINTED** as **output**, and the race becomes **CLOSED** (you **CANNOT** add any more **participants** in it, and you **CANNOT** start it again).

If **TWO** cars have the **SAME** result, participant **registered before the other** comes **FIRST**.

The **1st place** winner takes **50 %** of the race’s **prize pool**.

The **2nd place** winner takes **30 %** of the race’s **prize pool**.

The **3rd place** winner takes **20 %** of the race’s **prize pool**.

You need to take in account **ONLY** the **FIRST 3** players, **AFTER** you’ve ordered them in **descending order**, by the **corresponding criteria**.

In case a race has **LESS** than **3 participants**, you should print **only** **them**, as **winners**. The **prizes** remain the **SAME**.

In case a race has **NO** participants, you should print “**Cannot start the race with zero participants.**”, and **IGNORE** the command.

### Task III: I / O (Input / Output)

#### Input

* The input will come in the form of commands, in the format specified above.
* The input sequence ends when you receive the command “**Cops Are Here**”.

#### Output

Two elements generate output in the program’s functionality:

* The “**check**” command should **RETURN** a **String representation** of the **CAR** with the **GIVEN ID**:
  + “{brand} {model} {yearOfProduction}
  + {horsepower} HP, 100 m/h in {acceleration} s
  + {suspension} Suspension force, {durability} Durability”
  + If the car is a **PerformanceCar**, you must print “Add-ons: {add-ons}”, on the **last line** – **each** **add-on** **separated** by a **comma** and a **space** “**,** “. In case there are **NO** add-ons, print “**None**”.
  + If the car is a **ShowCar**, you must print “{stars} \*”, on the **last line**.
* The “**start**” command should **RETURN** a **String representation** the **RACE** with the **GIVEN ID**:
  + “{route} - {length}
  + 1. {brand} {model} {performancePoints}PP - ${moneyWon}
  + 2. {brand} {model} {performancePoints}PP - ${moneyWon}
  + 3. {brand} {model} {performancePoints}PP - ${moneyWon}”
  + **1**, **2** and **3** – being the **1st**, **2nd** and **3rd** participants (the **winners**).
  + **If** there are **LESS** than **3** participants, print as much as there are.
  + In case there are **NO** participants, print “**Cannot start the race with zero participants.**”, and **IGNORE** the command.

#### Constrains

* **All integers** in the input will be in **range [0, 100000]**.
* **All strings** in the input may consist of **any ASCII character**, except **SPACE**
  + So that the input is easily processed.
* There will be **NO invalid** input lines, or **invalid** (**non-existent**) Ids.
* Note that throughout the program, you are working **ONLY** with **INTEGERS**.
  + Each **mathematical** or **logical action** performed on **numeric data**, should be performed between **INTEGERS**.
* Note: **50%** of **X** is **EQUAL** to **(X \* 50) / 100**.
* **Note**: **Decrease** means **DECREASE… 100** **decreased** by **25%** = **100 – (100 \* 25) / 100 = 100 – 25 = 75**.

#### Examples

|  |  |
| --- | --- |
| **Input** | **Output** |
| register 1 Performance BMV M92 2013 300 4 150 75  register 2 Show Maserati Levante 2015 400 6 250 100  register 3 Performance Nissan GT-R 2017 550 4 300 100  register 4 Performance McLaren P1 2016 650 2 400 200  register 5 Performance Trabant 601 1988 2000 1 10000 1000  open 1 Drag 10 BeverlyHills 50000  open 3 Casual 20 NewYork 100000  participate 1 1  participate 2 1  participate 3 1  participate 4 1  participate 5 1  participate 1 3  participate 2 3  participate 3 3  check 5  start 1  start 3  Cops Are Here | Trabant 601 1988  3000 HP, 100 m/h in 1 s  7500 Suspension force, 1000 Durability  Add-ons: None  BeverlyHills - 10  1. Trabant 601 3000PP - $25000  2. McLaren P1 487PP - $15000  3. Nissan GT-R 206PP - $10000  NewYork - 20  1. Trabant 601 11500PP - $50000  2. McLaren P1 987PP - $30000  3. Nissan GT-R 531PP - $20000 |
| register 3 Show Porsche Carrera 2017 550 4 300 100  register 4 Performance McLaren P1 2016 650 2 400 200  register 5 Performance Trabant 601 1988 2000 1 10000 1000  open 1 Casual 20 Manhattan 100000  open 2 Drag 14 Washington 100000  participate 5 1  participate 5 2  park 3  park 4  park 5  start 2  tune 150 Turbo  tune 100 Nitrous  tune 50 Tires  participate 3 1  check 3  check 4  unpark 4  participate 4 1  start 1  Cops Are Here | Washington - 14  1. Trabant 601 3000PP - $50000  Porsche Carrera 2017  850 HP, 100 m/h in 4 s  450 Suspension force, 100 Durability  300 \*  McLaren P1 2016  1275 HP, 100 m/h in 2 s  450 Suspension force, 200 Durability  Add-ons: Turbo, Nitrous, Tires  Manhattan - 20  1. Trabant 601 11500PP - $50000  2. McLaren P1 1287PP - $30000 |

### Task IV: Bonus

The modern racers like different types of races. If you are really good at writing software, then your employers would like to hire you for some more work.

Your task is to implement classes for **2** extra **SPECIAL** **races**:

* TimeLimitRace
  + Is **INITIALIZED** with an **EXTRA PARAMETER – goldTime** (**int**).
* CircuitRace
  + Is **INITIALIZED** with an **EXTRA PARAMETER – laps** (**int**).

Both races, have an extra parameter, aside from the **normal races**. The parameter is received, **from** the **user input** as last parameter, when **OPENING** one of these **types** of **races**.

#### Logic

The TimeLimitRace can only have **1 participant**. **ANY** attempt to **add more participants** to it should be **IGNORED**.  
The participant has a **Time Performance** (**TP**), which is calculated by the following formula:

raceLength \* ((participantHorsepower / 100) \* participantAcceleration)

Depending on the Time Performance, the player earns “**Gold**”, “**Silver**” or “**Bronze**” time:

* **TP** <= **raceGoldTime** – Racer has earned **Gold** Time and earns **100%** of the **prizePool**.
* **TP** <= **raceGoldTime** + **15** – Racer has earned **Silver** Time and earns **50%** of the **prizePool**.
* **TP** > **raceGoldTime** + **15** – Racer has earned **Bronze** Time and earns **30%** of the **prizePool**.

The **String representation** of the TimeLimitRace is in the following format:

* “{route} – {length}
* {participantBrand} {participantModel} – {participantTimePerformance} s.
* {participantEarnedTime} Time, ${wonPrize}.”

The CircuitRace is almost like a normal race, with the difference that it has **laps** and **4 winners** in **total**. The winners are **determined** by **Overall Performance** (**OP**) like in CasualRace.

* **1st** place earns **40%** of the **prizePool.**
* **2nd** place earns **30%** of the **prizePool.**
* **3rd** place earns **20%** of the **prizePool.**
* **4th** place earns **10%** of the **prizePool**.

The special thing about this race is … That **EVERY** lap **DECREASES** the **DURABILITY** of **EACH** participant by (**length** **\*** **length**). The **String representation** of the CircuitRace is in the following format:

* “{route} - {length \* laps}
* 1. {brand} {model} {performancePoints}PP - ${moneyWon}
* 2. {brand} {model} {performancePoints}PP - ${moneyWon}
* 3. {brand} {model} {performancePoints}PP - ${moneyWon}
* 4. {brand} {model} {performancePoints}PP - ${moneyWon}”

#### Examples

|  |  |
| --- | --- |
| **Input** | **Output** |
| register 1 Performance Mitsubishi Lancer-Evo 2010 400 5 200 100  register 2 Performance Nissan Z370 2012 500 4 300 200  register 3 Show BMW i8-Spyder 2016 600 3 400 300  register 4 Performance Lamborghini Aventador 2017 1000 2 500 300  register 5 Show Ford Mustang-Shelby 1970 400 5 700 200  open 1 Circuit 10 SofiaStreets 100000 5  open 2 Circuit 2 SofiaAirport 10000 2  participate 1 1  participate 2 1  participate 3 1  participate 4 1  participate 5 1  start 1  check 1  check 2  check 3  check 4  check 5  Cops Are Here | SofiaStreets - 50  1. Lamborghini Aventador 925PP - $40000  2. Ford Mustang-Shelby 480PP - $30000  3. BMW i8-Spyder 400PP - $20000  4. Nissan Z370 112PP - $10000  Mitsubishi Lancer-Evo 2010  600 HP, 100 m/h in 5 s  150 Suspension force, -400 Durability  Add-ons: None  Nissan Z370 2012  750 HP, 100 m/h in 4 s  225 Suspension force, -300 Durability  Add-ons: None  BMW i8-Spyder 2016  600 HP, 100 m/h in 3 s  400 Suspension force, -200 Durability  0 \*  Lamborghini Aventador 2017  1500 HP, 100 m/h in 2 s  375 Suspension force, -200 Durability  Add-ons: None  Ford Mustang-Shelby 1970  400 HP, 100 m/h in 5 s  700 Suspension force, -300 Durability  0 \* |
| register 1 Performance Mitsubishi Lancer-Evo 2010 400 5 200 100  register 4 Performance Lamborghini Aventador 2017 1000 2 500 300  park 4  tune 1000 Turbo  unpark 4  open 1 TimeLimit 5 SofiaAirport 100000 260  open 2 TimeLimit 5 Malibu 10000 240  start 1  participate 4 1  participate 1 1  participate 4 2  start 1  start 2  Cops Are Here | Cannot start the race with zero participants.  SofiaAirport - 5  Lamborghini Aventador - 250 s.  Gold Time, $100000.  Malibu - 5  Lamborghini Aventador - 250 s.  Silver Time, $5000. |