# C# OOP Demo Exam - 04 August 2019

## Motocross World Championship MXGP

## Overview

The FIM (Fédération Internationale de Motocyclisme) Motocross World Championship (MXGP) is the one of the biggest motocross champoinship ever. You love to ride motorcycles and you are the biggest fan on MXGP and for that reason, MXGP hired you to create platform for storing information about riders, motorcycles and races.

## Setup

* Upload **only the** MXGPpackage in every problem **except** **Unit Tests**
* **Do not modify the classes, interfaces or their packages**
* Use **strong cohesion** and **loose coupling**
* **Use inheritance and the provided interfaces wherever possible**
  + This includes **constructors**, **method parameters** and **return types**
* **Do not** violate your **interface** **implementations** by adding **more public methods** in the concrete class than the interface has defined
* Make sure you have **no public fields** anywhere

## Task 1: Structure (50 points)

You are given **8** interfaces, and you have to implement their functionality in the **correct classes**.

It is not required to implement your structure with Engine, CommandHandler, ConsoleReader, ConsoleWriter and enc. It's good practice but it's not required.

There are **3** types of entities and 3 repositories in the application: **Motorcycle, Rider, Race and Repository**:

### Motorcycle

Motorcycle is a **base class** for any **type of motorcycle** and it **should not be able to be instantiated**.

#### Data

* **Model** – string
  + If the model **is null, whitespace or less than 4 symbols,** throw an **ArgumentException** with message **"Model {model} cannot be less than 4 symbols."**
  + All models are unique
* **HorsePower** – int
  + **Every type** of motorcycle has different range of valid horsepower. If the horsepower is not in the valid range**,** throw an **ArgumentException** with message **"Invalid horse power: {horsepower}."**
* **CubicCentimeters** – double
  + **Every type** of motorcycle has different cubic centimeters.

#### Behavior

##### double CalculateRacePoints(int laps)

The CalculateRacePoints calculates the race points in the concrete race with this formula:

cubic centimeters / horsepower \* laps

#### Constructor

A **Motorcycle** should take the following values upon initialization:

string model, int horsePower, double cubicCentimeters

#### Child Classes

There are several concrete types of **Motorcycles**:

##### PowerMotorcycle

The **cubic centimeters** for this type of motorcycle are 450. Minimum **horsepower** is 70 and maximum **horsepower** is 100.

If you receive horsepower which is not in the given range throw ArgumentException with message **"Invalid horse power: {horsepower}."**.

##### SpeedMotorcycle

The **cubic centimeters** for this type of motorcycle are 125. Minimum **horsepower** is 50 and maximum **horsepower** is 69.

If you receive horsepower which is not in the given range throw ArgumentException with message **"Invalid horse power: {horsepower}."**.

### Rider

#### Data

* **Name** – string
  + If the name **is null, empty** or less than **5 symbols** throw an ArgumentException with message **"Name {name} cannot be less than 5 symbols."**
  + **All names are unique**
* **Motorcycle** – Motorcycle
* **NumberOfWins** – int
* CanParticipate **–** bool
  + Default behaviour is false
  + Rider can participate in race, **ONLY** if he has motorcycle (motorcycle is not null)

#### Behavior

##### void AddMotorcycle(Motorcycle motorcycle)

This method adds a motorcycle to the rider. If the motorcycle null, throw **Argument**NullException with message **"****Motorcycle cannot be null."**.

If motorcycle is not null, save it and after that rider can participate to race.

##### void WinRace()

When rider win race, number of wins should be increased.

#### Constructor

A Ridershould take the following values upon initialization:

string name

### Race

#### Data

* Name – string
  + If the name **is null, empty** or less than **5 symbols** throw an ArgumentException with message **"Name {name} cannot be less than 5 symbols."**
  + All names are unique
* Laps – int
  + Throws ArgumentException with message **"****Laps cannot be less than 1."**, if the laps are less than **1**.
* Riders – A **c**ollection of **riders**

#### Behavior

##### void AddRider(Rider rider)

This method adds a rider to the race if the rider is valid. If a rider is not valid, throw an exception with the appropriate message.

Exceptions are:

* If a rider is **null** throw an **Argument**NullException with message **"****Rider cannot be null."**
* If a rider **cannot** participate in the race (the rider doesn't own a motorcycle) throw an ArgumentException with message **"****Rider {rider name} could not participate in race."**
* If the rider already **exists** in the race throw an ArgumentNullException with message:  
  **"****Rider {rider name} is already added in {race name} race."**

### Repository

The repository holds information about the entity.

#### Data

* Models – A **collection of T (entity)**

#### Behavior

**void Add(T model)**

Adds an entity in the collection.

**bool Remove(T model)**

Removes an entity from the collection.

**T GetByName(string name)**

Returns an entity with that name.

**Collection<T> GetAll()**

Returns all entities (unmodifiable)

#### Child Classes

Create **MotorcycleRepository**, **RiderRepository** and **RaceRepository** repositories.

## Task 2: Business Logic (150 points)

### The Controller Class

The business logic of the program should be concentrated around several **commands**. You are given interfaces, which you have to implement in the correct classes.

**Note: The** ChampionshipController **class SHOULD NOT handle exceptions! The tests are designed to expect exceptions, not messages!**

**Note: The** ChampionshipController **class SHOULD HAVE empty constructor!**

The first interface is **I**ChampionshipController. You must implement a ChampionshipControllerclass, which implements the interface and implements all of its methods. The given methods should have the following logic:

### Commands

There are several commands, which control the business logic of the application. They are stated below.

#### CreateRider Command

##### Parameters

* **riderName** – **string**

##### Functionality

Creates a rider with the given name and adds it to the appropriate repository.

The method should **return** the following message:

****"********Rider {name} is created."****

**If a rider with the given name already exists in the rider repository, throw** an ArgumentException **with message**"Rider {name} is already created."

#### CreateMotorcycle Command

##### Parameters

* type - string
* model - string
* horsePower - int

##### Functionality

Create a **motorcycle** with the provided **model** and **horsepower** and add it to the repository. There are two types of motorcycles: **"SpeedMotorcycle"** and **"PowerMotorcycle".**

If the **motorcycle** already exists in the appropriate repository throw an ArgumentException with following message:

"Motorcycle {model} is already created."

If the motorcycle is successfully created, the method should **return** the following message:

"{"SpeedMotorcycle"/ "PowerMotorcycle"} {model} is created."

#### AddMotorcycleToRider Command

##### Parameters

* riderName – String
* motorcycleModel - String

##### Functionality

Gives the motorcycle with given name to the rider with given name (if exists).

If the rider **does not exist** in rider repository, throw InvalidOperationException with message

* "Rider {name} could not be found."

If the motorcycle **does not exist** in motorcycle repository, throw InvalidOperationException with message

* "Motorcycle {name} could not be found."

If everything is successful you should add the motorcycle to the rider and return the following message:

* "Rider {rider name} received motorcycle {motorcycle name}."

#### AddRiderToRace Command

##### Parameters

* raceName – string
* riderName - string

##### Functionality

Adds a rider to the race.

If the race **does not exist** in the race repository, throw an InvalidOperationException with message:

* "Race {name} could not be found."

If the rider **does not exist** in the rider repository, throw an InvalidOperationException with message:

* "Rider {name} could not be found."

If everything is successful, you should add the rider to the race and return the following message:

* "Rider {rider name} added in {race name} race."

#### CreateRace Command

##### Parameters

* name – string
* laps – int

##### Functionality

Creates a race with the given name and laps and adds it to the race repository.

If the race with the given name already **exists**, throw an InvalidOperationException with message:

* "Race {name} is already created."

If everything is successful you should return the following message:

* "Race {name} is created."

#### StartRace Command

##### Parameters

* raceName – string

##### Functionality

This method is the biggest deal. If everything is valid, you should **arrange** all riders and then return the three fastest riders. To do this you should sort all riders in **descending** order by the result of CalculateRacePoints method in the motorcycle object. At the end, if everything is valid **remove** this race from race repository.

If the race **does not exist** in race repository, throw an InvalidOperationException with message:

* "Race {name} could not be found."

If the participants in the race are less than **3**, throw an InvalidOperationException with message:

* "Race {race name} cannot start with less than 3 participants."

If everything is successful, you should return the following message:

* "Rider {first rider name} wins {race name} race."  
  "Rider {second rider name} is second in {race name} race."  
  "Rider {third rider name} is third in {race name} race."

#### End Command

**Exit** the program.

### Input / Output

You are provided with one interface, which will help with the correct execution process of your program. The interface is **I**Engine and the class implementing this interface should read the input and when the program finishes, this class should print the output.

#### Input

Below, you can see the **format** in which **each command** will be given in the input:

* **CreateRider** **{name}**
* **CreateMotorcycle** **{motorcycle type} {model} {horsepower}**
* **AddMotorcycleToRider {rider name} {motorcycle name}**
* **AddRiderToRace {race name} {rider name}**
* **CreateRace {name} {laps}**
* **StartRace {race name}**
* **End**

#### Output

Print the output from each command when issued. If an exception is thrown during any of the commands' execution, print the exception message.

#### Examples

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| **Input** |
| CreateRider Michael  CreateRider Peter  CreateMotorcycle Speed Honda 60  CreateMotorcycle Power Suziki 80  CreateMotorcycle Power Yamaha 70  CreateRace Loket 2  AddMotorcycleToRider Michael Honda  AddMotorcycleToRider Peter Suziki  AddMotorcycleToRider Michael Yamaha  StartRace Loket  AddRiderToRace Loket Michael  AddRiderToRace Loket Peter  StartRace Loket  CreateRider Brian  AddRiderToRace Loket Brian  CreateMotorcycle Speed KTM-SX 55  AddMotorcycleToRider Brian KTM-SX  AddRiderToRace Loket Brian  StartRace Loket  End |
| **Output** |
| Rider Michael is created.  Rider Peter is created.  SpeedMotorcycle Honda is created.  PowerMotorcycle Suziki is created.  PowerMotorcycle Yamaha is created.  Race Loket is created.  Rider Michael received motorcycle Honda.  Rider Peter received motorcycle Suziki.  Rider Michael received motorcycle Yamaha.  Race Loket cannot start with less than 3 participants.  Rider Michael added in Loket race.  Rider Peter added in Loket race.  Race Loket cannot start with less than 3 participants.  Rider Brian is created.  Rider Brian could not participate in race.  SpeedMotorcycle KTM-SX is created.  Rider Brian received motorcycle KTM-SX.  Rider Brian added in Loket race.  Rider Michael wins Loket race.  Rider Peter is second in Loket race.  Rider Brian is third in Loket race. |

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| **Input** |
| CreateRider Kevin  CreateRider Kevin  CreateRider Jose  CreateMotorcycle Speed KTM-SX-F 100  CreateMotorcycle Power KTM 100  CreateMotorcycle Power KTM-SX-F 100  CreateMotorcycle Power KTM-SX-F 100  StartRace Imola  CreateRace Imola 4  AddRiderToRace Lommel Kevin  AddRiderToRace Imola Jose  AddRiderToRace Imola Kevin  AddMotorcycleToRider Kevin KTM-SX-F  AddRiderToRace Imola Kevin  CreateMotorcycle Speed Honda 60  CreateMotorcycle Power Suziki 80  CreateMotorcycle Power Yamaha 70  CreateRace Loket 2  CreateRider Michael  CreateRider Peter  AddMotorcycleToRider Michael Honda  AddMotorcycleToRider Peter Suziki  AddRiderToRace Imola Michael  AddRiderToRace Imola Peter  StartRace Imola  End |
| **Output** |
| Rider Kevin is created.  Rider Kevin is already created.  Name Jose cannot be less than 5 symbols.  Invalid horse power: 100.  Model KTM cannot be less than 4 symbols.  PowerMotorcycle KTM-SX-F is created.  Motorcycle KTM-SX-F is already created.  Race Imola could not be found.  Race Imola is created.  Race Lommel could not be found.  Rider Jose could not be found.  Rider Kevin could not participate in race.  Rider Kevin received motorcycle KTM-SX-F.  Rider Kevin added in Imola race.  SpeedMotorcycle Honda is created.  PowerMotorcycle Suziki is created.  PowerMotorcycle Yamaha is created.  Race Loket is created.  Rider Michael is created.  Rider Peter is created.  Rider Michael received motorcycle Honda.  Rider Peter received motorcycle Suziki.  Rider Michael added in Imola race.  Rider Peter added in Imola race.  Rider Peter wins Imola race.  Rider Kevin is second in Imola race.  Rider Michael is third in Imola race. |

## Task 3: Unit Tests (100 points)

You will receive a skeleton with **RaceEntry, UnitMotorcycle** and **UnitRider** classes inside. The class will have some methods, properties, fields and one constructor, which are working properly. You are **NOT ALLOWED** to change any class. Cover the whole class (**RaceEntry**) with unit tests to make sure that the class is working as intended.

You are provided with a **unit test project** in the **project skeleton**. **DO NOT modify its NuGet packages**.

Note: The TheRace you need to test is in the **global namespace**, so **remove any using statements,** pointing towards the namespace TheRace.

Do **NOT** use **Mocking** in your unit tests!