# Object-Oriented Programming – Practical Exam

## Problem 1 – War Machines

In a war machine virtual factory there are two types of **machines**: **tanks** and **fighters**. Each machine has **name**,**pilot**, **health points**, **attack points**, **defense points** and **attack targets**. Each pilot has **name** and **machines** he **engages**. Pilots make status **reports** on all machines they engage. One machine can be **engaged** by one pilot at a time. **Tanks** have **defense mode** which can be turned **on** and **off**. **Fighters** have stealth mode which can be turned **on** and **off**.

### Design the Class Hierarchy

Your **task** is to **design an object-oriented class hierarchy** to model the war machines factory, machines and pilots **using the best practices for object-oriented design (OOD) and object-oriented programming (OOP)**. Avoid duplicated code though abstraction, inheritance, and polymorphism and encapsulate correctly all fields.

You are given few C# **interfaces** that you should **obligatory** implement and use as a basis of your code:

|  |
| --- |
| namespace WarMachines.Interfaces  {  public interface IPilot  {  string Name { get; set; }  void AddMachine(IMachine machine);  string Report();  }  public interface IMachine  {  string Name { get; set; }  IPilot Pilot { get; set; }  double HealthPoints { get; set; }  double AttackPoints { get; }  double DefensePoints { get; }  IList<string> Targets { get; }  void Attack(string target);  string ToString();  }  public interface ITank : IMachine  {  bool DefenseMode { get; }  void ToggleDefenseMode();  }  public interface IFighter : IMachine  {  bool StealthMode { get; }  void ToggleStealthMode();  }  public interface IMachineFactory  {  IPilot HirePilot(string name);  ITank ManufactureTank(string name, double attackPoints, double defensePoints);  IFighter ManufactureFighter(string name, double attackPoints,  double defensePoints, bool stealthMode);  }  } |

All your machines should implement IMachine. Pilots should implement IPilot. Tanks and fighter courses should implement ITank and IFighter respectively. Machines and pilots should be created only through the IMachineFactory interface implemented by a class named MachineFactory. Tank’s initial health points are always 100 and fighter’s initial health points are always 200. Tank’s defense mode adds 30 defense points to the initial ones and removes 40 attack points from the initial ones. By default tanks’ defense mode is turned on. Fighters in stealth mode can be attacked only by other fighters.

The IPilot.Report() method returns the information about a pilot in the following form:

|  |
| --- |
| ***(pilot name)* – *(number of machines/”no”)* *(“machine”/”machines”)***  **- *(machine name)***  **\*Type: *(“Tank”/”Fighter”)***  **\*Health: *(machine health points)***  **\*Attack: *(machine attack points)***  **\*Defense: *(machine defense points)***  **\*Targets: *(machine target names/”None” – comma separated)***  **\*Defense: *(“ON”/”OFF” – when applicable)***  **- *(machine name)***  **\*Type: *(machine type)***  **\*Health: *(machine health points)***  **\*Attack: *(machine attack points)***  **\*Defense: *(machine defense points)***  **\*Targets: *(machine target names/”None” – comma separated)***  **\*Stealth: *(“ON”/”OFF” – when applicable)*** |

Look into the example below to get better understanding of the printing format.

The listed machines added to a certain pilot (though the AddMachine(…) method) should be ordered by health points then by name. If the pilot has no machines added, print **“no machines”**. If the pilot has **1** machine, print **“1 machine”** and list it. It is allowed to add the same machine more than once. Machine’s targets are separated by “, “ (comma + space). If a machine does not have targets, print **“None”**. All double type fields should be printed “**as is**”, without any formatting or rounding.

The IMachine.ToString() method returns the information about a course in the following form:

|  |
| --- |
| **- *(machine name)***  **\*Type: *(“Tank”/”Fighter”)***  **\*Health: *(machine health points)***  **\*Attack: *(machine attack points)***  **\*Defense: *(machine defense points)***  **\*Targets: *(machine target names/”None” – comma separated)***  **\*Defense: *(“ON”/”OFF” – when applicable)***  **\*Stealth: *(“ON”/”OFF” – when applicable)*** |

The Type is either “Tank“ or “Fighter”. The defense and stealth are only shown when applicable and should print “**ON**” or “**OFF**” depending on their state. The attack targets added to a certain machine (though the Attack(…) method) should appear in the order of their addition. It is allowed to attack one machine (thus adding it) more than once. If the machine has no targets added to it, print “**None**”. Do not print , (comma) at the line end. All double type fields should be printed “**as is**”, without any formatting or rounding.

All properties in the above interfaces are mandatory (cannot be null or empty). Keep in mind that a machine can be manufactured without a pilot but **cannot** be engaged with **null** pilot afterwards.

If a null value is passed to some mandatory property, your program should throw a proper exception.

### Additional Notes

To simplify your work you are given a virtual war machines factory execution engine that executes a sequence of commands read from the console using the classes and interfaces in your project (see the file WarMachinesSkeleton.rar). Please put your classes in namespace **WarMachines.Machines**. Implement the **MachineFactory** class in the namespace **WarMachines.Engine**.

You are only **allowed to write classes**. You are **not allowed to modify the existing interfaces and classes except the MachineFactory class**.

Current implemented commands the engine supports are:

* **HirePilot (name)** – adds a pilot with given name. Duplicate names are not allowed. As a result the command returns “**Pilot (name) hired**”.
* **Report (name)** – searches for a hired pilot with given name and returns the **IPilot.Report()** method result.
* **ManufactureTank (name) (attack) (defense)** – creates a tank with given name, attack and defense points. Duplicate names are not allowed. Initial health points are always 100. Initial defense mode is turned on. As a result the command returns “**Tank (name) manufactured - attack: (attack); defense: (defense)**”.
* **DefenseMode (name)** – searches for tank with given name and toggles its defense mode. As a result the command returns “**Tank (name) toggled defense mode**”.
* **ManufactureFighter (name) (attack) (defense) (stealth)** – creates a fighter with given name, attack and defense points. Duplicate names are not allowed. Initial health points are always 200. As a result the command returns **“Fighter (name) manufactured - attack: (attack); defense: (defense); stealth: (ON/OFF)”**
* **StealthMode (name)** - searches for fighter with given name and toggles its stealth mode. As a result the command returns “**Fighter (name) toggled stealth mode**”.
* **Engage (pilot-name) (machine-name)** – searches for a pilot and machine by given names, adds the machine to the pilot’s list of machines and initialises the machine’s pilot. As a result the command returns “**Pilot (pilot-name) engaged machine (machine-name)**”.
* **Attack (attacking-machine-name) (defending-machine-name)** – searches for two machines by given names and the first one attacks the second one if it is possible. As a result the command returns “**Machine (defending-machine-name) was attacked by machine (attacking-machine-name) - current health: (defending-machine-health).**

In case of invalid operation or error, the engine returns appropriate text messages.

### Sample Input

|  |
| --- |
| **HirePilot John**  **HirePilot Nelson**  **Report Bender**  **ManufactureTank T-72 100 100**  **ManufactureFighter Kingcobra 150 90 StealthON**  **Report John**  **Engage John T-72**  **Engage John Kingcobra**  **Report John**  **Report Nelson**  **Engage Nelson T-72**  **Engage Nelson Kingcobra**  **ManufactureFighter Boeing 180 90 StealthOFF**  **Engage Nelson Boeing**  **Attack T-72 Kingcobra**  **Attack T-72 Boeing**  **DefenseMode T-72**  **DefenseMode Kingcobra**  **DefenseMode Boeing**  **Attack T-72 Kingcobra**  **Attack T-72 Boeing**  **StealthMode Kingcobra**  **StealthMode Boeing**  **StealthMode T-72**  **Attack Kingcobra T-72**  **Attack Boeing T-72**  **Report Nelson**  **Report John** |

### Sample Output

|  |
| --- |
| **Pilot John hired**  **Pilot Nelson hired**  **Pilot Bender could not be found**  **Tank T-72 manufactured - attack: 100; defense: 100**  **Fighter Kingcobra manufactured - attack: 150; defense: 90; stealth: ON**  **John - no machines**  **Pilot John engaged machine T-72**  **Pilot John engaged machine Kingcobra**  **John - 2 machines**  **- T-72**  **\*Type: Tank**  **\*Health: 100**  **\*Attack: 60**  **\*Defense: 130**  **\*Targets: None**  **\*Defense: ON**  **- Kingcobra**  **\*Type: Fighter**  **\*Health: 200**  **\*Attack: 150**  **\*Defense: 90**  **\*Targets: None**  **\*Stealth: ON**  **Nelson - no machines**  **Machine T-72 is already occupied**  **Machine Kingcobra is already occupied**  **Fighter Boeing manufactured - attack: 180; defense: 90; stealth: OFF**  **Pilot Nelson engaged machine Boeing**  **Tank T-72 cannot attack stealth fighter Kingcobra**  **Machine Boeing was attacked by machine T-72 - current health: 200**  **Tank T-72 toggled defense mode**  **Machine Kingcobra does not support this operation**  **Machine Boeing does not support this operation**  **Tank T-72 cannot attack stealth fighter Kingcobra**  **Machine Boeing was attacked by machine T-72 - current health: 190**  **Fighter Kingcobra toggled stealth mode**  **Fighter Boeing toggled stealth mode**  **Machine T-72 does not support this operation**  **Machine T-72 was attacked by machine Kingcobra - current health: 50**  **Machine T-72 was attacked by machine Boeing - current health: 0**  **Nelson - 1 machine**  **- Boeing**  **\*Type: Fighter**  **\*Health: 190**  **\*Attack: 180**  **\*Defense: 90**  **\*Targets: T-72**  **\*Stealth: ON**  **John - 2 machines**  **- T-72**  **\*Type: Tank**  **\*Health: 0**  **\*Attack: 100**  **\*Defense: 100**  **\*Targets: Boeing, Boeing**  **\*Defense: OFF**  **- Kingcobra**  **\*Type: Fighter**  **\*Health: 200**  **\*Attack: 150**  **\*Defense: 90**  **\*Targets: T-72**  **\*Stealth: OFF** |