# OOP Advanced Exam – The Tank Game

### Overview

The Tank Game is a competition between vehicles. The competition needs to be automated with a software program. **Stoyan** tried to write some code, but he is not very good and he left bugs here and there. You must finish the job.

### Tasks

#### Task 1: Business Logic

**Stoyan** tried to write some code before you, but he is clumsy, so he left some bugs in the application… But he somehow managed to write the BaseVehicle and TankBattleOperatorclasses and all interfaces right.

Your first task is to find and fix all bugs.

#### Task 2: Input / Output

#### Task 3: Reflection

You need to refactor the given factories and implement new ones. Factories must use reflection, so it will be easy for us to follow the Open/Closed Principle. You are required to implement two factories:

* PartFactory
* VehicleFactory

Your task is to implement these factories in such a way that it will be easy to extend the number of concrete types of each entity.

Also, make sure that if you add a new method in the manager class, you won't have to change the ProcessInput method in the CommandInterpreter class.

NOTE: Make sure you reference the Calling Assembly, instead of the Executing Assembly, since the code that’s going to be calling your factories in the tests depends on this!

No static factories are allowed!

#### Task 4: Unit Testing

Like you saw at the beginning, there is а class, which does not need refactoring - BaseVehicle**.** This is the class, against which you need to **write unit tests**. In your skeleton, you are provided with a **perfectly working** BaseVehicle, but it still needs to be **tested**, because in **Judge**, we have prepared some **bugs**, and you need to catch them in your unit tests.

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

Note: The BaseVehicle you need to test is in the **global namespace**, as are any entities, which it depends on, so **remove any using statements** pointing towards any entities and controllers before submitting your code.

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

### Skeleton

You are allowed to change the **internal** and **private logic** of the **classes** that have been given to you.   
In other words, you can change the **body code** and the **definitions** of the **private members** in whatever   
way you like.

However. . .

You are **NOT ALLOWED** to **CHANGE** the **Interfaces** that have been provided by the **skeleton** in **ANY way**.   
You are **NOT ALLOWED** to **ADD** more **PUBLIC LOGIC**, than the **one**, **provided** by the **Interfaces**, **ASIDE FROM** the ToString() method.

### Guidelines

* Upload **only the** TheTankGameproject in every problem **except** **Unit Tests**. For **Unit Tests**, upload **only the** TheTankGame.Tests **project** with **all using statements pointing to TheTankGame removed**.
* **Do not modify the interfaces or their namespaces!**
* 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** or **properties** in the concrete class than the interface has defined!
* Make sure you have **no public fields** anywhere.

Below, you will find a detailed description of all entities and their methods.

### Structure

The structure of the software circles around Vehicles and Parts.

#### Vehicles

The Vehicles are initialized with:

* Model – a **string**.
* Weight – a **floating-point number**.
* Price – a **decimal number**.
* Attack – an **integer**.
* Defense – an **integer**.
* HitPoints – an **integer**.

There are generally 2 types of Vehicles.

##### Vanguard

A tank-like land vehicle.

##### Revenger

A jet-like aerial vehicle.

#### Parts

The Parts are initialized with:

* Model – a **string**.
* Weight – a **floating-point number**.
* Price – a **decimal number**.

There are generally 3 types of Parts.

##### ArsenalPart

The ArsenalPart is initialized with an additional property:

* AttackModifier – an **integer**.

##### ShellPart

The ShellPart is initialized with an additional property:

* DefenseModifier – an **integer**.

##### EndurancePart

The EndurancePart is initialized with an additional property:

* HitPointsModifier – an **integer**.

#### Assembler

The Assembler contains 3 collections – 1 for the **ArsenalParts**,1 for the **ShellParts**, and 1 for the **EnduranceParts**.

The class exposes **3 methods** for adding Parts – one for the **ArsenalParts,** one for the **ShellParts**, and one for the **EnduranceParts**.

The class also exposes **3 methods** for **extracting** the **total stat modification** each type of parts gives to the **Vehicle**.

#### BattleOperator

The BattleOperator class exposes **1 method** for **handling Battles** – the method **accepts 2 Vehicle**s and initiates a Battle between them, ultimately **resulting** in a **winner**. The winner’s model is **returned** as **result** of the **method**.

The 2 Vehicles fight in turns with the **first given Vehicle** being the **first 1** to **attack**.

**First**, the **attacker attacks**, **then**, the **target attacks back**. Each turn they lose **hitPoints**, due to the attack, by the following formula:

receivingVehicleHitPoints -= (attackingVehicleAttack - (receivingVehicleDefense + (receivingVehicleWeight / 2)))

As you see the **Defense** and **Weight** of the receivingVehicle **reduce** the **attack damage** of the attackingVehicle, which is a normal tactic.

The process of exchanging attacks continues, until one’s **hitPoints** is **lower than** or **equal** to **0**.

### Functionality

The functionality of the software involves adding Vehicles, adding Parts to the Vehicles, and so on. As you see the Vehicles and Parts are the main entities of the program. The model is the **property** that will **identify** them. The **model** will also, always be **unique** in the input.

In **some** of the **commands**, you’ll receive models which may refer to a Vehicle and a Part. You must check what is the object with that model, and process the command depending on the result.

Each Vehicle has an Assembler, in which it **stores** its Parts.   
The business logic of the program involves: adding vehicles and parts, inspecting vehicles and parts, fighting between vehicles.

Check below, each section, and the functionality it describes.

#### Vehicles

The Vehicles are the main actors in the business logic. They have **stats** which **define** their **power**. Those **stats** can be **upgraded** by **adding parts** to them, which is done through the Assembler.

**Battles** are triggered **between 2 Vehicles**. The **resulting winner** of the battle, should **stay** in the data, while the loser should be **removed**.

Battles are controlled by the BattleOperator. When 2 Vehicles are passed to the BattleOperator, it **returns** the model of the **winning vehicle**. You should consider that in your logic.

#### Parts

The Parts have no business logic around themselves. They are just **data models**.

#### Commands

There are several commands which are given from the user input, in order to control the program.   
Here you can see how they are formed.

The **parameters** will be given in the **EXACT ORDER**, as the one **specified below**.   
You can see the exact input format in the **Input section**.

**Each** **command** will **generate an output** **result**, which you must **print**.  
You can see the exact output format in the **Output section**.

##### Vehicle Command

**Parameters** – **type** (string), **model** (string), **weight** (double), **price** (decimal), **attack** (integer), **defense** (integer), **hitPoints** (integer).

Creates a Vehicle of the **given type**, with the **given model**.   
The type will either be “Vanguard” or “Revenger”.

##### Part Command

**Parameters** – **vehicleModel** (string), **type** (string), **model** (string), **weight** (double), **price** (decimal), **additionalParameter** (integer).

Creates a Part of the **given type** with the **given model** and **adds** it to the Assembler of the **Vehicle** with the **given vehicleModel**.

The type will either be “Arsenal”, “Shell” or “Endurance”.

Depending on the Part type, the additionalParameter will be set to a different property:

* If it’s an ArsenalPart the **additionalParameter** will be set ot the attackModifier.
* If it’s a ShellPart the **additionalParameter** will be set ot the defenseModifier.
* If it’s an EndurancePart the **additionalParameter** will be set ot the hitPointsModifier.

##### Inspect Command

**Parameters** – **model** (string)

Brings data about the **Vehicle** or the **Part** with the **given model**, providing **detailed** **information** about it.

##### Battle Command

**Parameters** – **vehicle1Model** (string), **vehicle2Model** (string)

Initiates a battle between **2 Vehicles**. You should **pass** the **2 parameters** to the BattleOperator, and when you get the **resulting winner**, you should **remove** the **loser** from the **data**.

##### Terminate

**Exits** the program. Prints **detailed information** about the **current state** of the system.

### Input

The input consists of several commands which will be given in the format, specified below: :

* Vehicle {vehicleType} {model} {weight} {price} {attack} {defense} {hitPoints}
* Part {vehicleModel} {partType} {model} {weight} {price} {additionalParameter}
* Inspect {model}
* Battle {vehicle1Model} {vehicle2Model}
* Terminate

### Output

Each of the commands generates **output**. Here are the **output formats** of each command:

* Vehicle Command – creates a Vehicle of the given type, with the given model. Prints the following result:

**Created {type} Vehicle – {model}**

* Part Command – adds a Part of the given type, with the given model to a specified Vehicle.

**Added {partType} - {partModel} to Vehicle - {vehicleModel}**

* Inspect command – provides **detailed** **information** about a **Vehicle** or a **Part**, in one of the following formats:

|  |  |
| --- | --- |
| Vehicle | Part |
| {vehicleType} – {vehicleModel}  Total Weight: {totalWeight}  Total Price: {totalPrice}  Attack: {totalAttack}  Defense: {totalDefense}  HitPoints: {totalHitPoints}  Parts: {part1Model}, {part2Model}... | {partType} Part – {partModel}  +{additionalParamValue} {additionalParam} |

Because of the fact, that the **Part** is not particular, the additionalParameter should either be “**Attack**”, “**Defense**”, “**HitPoints**”.

In case **there** **are no Parts** for the Vehicle, print “Parts: None”.

The totalWeight and totalPrice must be printed to the **3rd digit** **after** the **decimal point**.

* + The **Parts** in the output should be **ordered** by **order** of **input**.
* Battle command – The command should return as output the winner in the following format:

**{vehicle1Model} versus {vehicle2Model} -> {winnerModel} Wins! Flawless Victory!**

* Terminate command – Terminates the program; **prints** detailed statistics about the whole system. The format, in which the statistics should be printed is:

Remaining Vehicles: {vehicle1Model}, {vehicle2Model}...  
Defeated Vehicles: {defeatedVehicle1Model}, {defeatedVehicle2Model}...  
Currently Used Parts: {countOfCurrentlyUsedParts}

* + Remaining Vehicles are all Vehicles that **have not been** defeated in a battle.
  + Defeated Vehicles are all Vehicles that **have been** defeated in a battle.
  + Currently Used Parts is the **amount** of **parts** used by the Remaining Vehicles. (Exclude those from the Defeated Vehicles).
  + In case there are no Remaining Vehicles or Defeated Vehicles print “None”.
  + **All data** in the output should be **ordered** by **order** of **input**.

### Constrains

* All **integers** in the input will be in **range [0, 800.000.000]**.
* All **floating-point numbers** in the input will be in **range [0, 1.000.000.000]**.
* All **strings** in the input may contain **any ASCII character**, except **space** (‘ ‘).
* All **input lines** will be **absolutely valid**.
* There will be **no** non-existent **models** or **types** in the input.

### Examples

|  |  |
| --- | --- |
| **Input** | **Output** |
| Vehicle Vanguard SA-203 100 300 1000 450 2000  Vehicle Revenger AKU 1000 1000 1000 1000 1000  Part SA-203 Arsenal Cannon-KA2 300 500 450  Part AKU Shell Shields-PI1 200 1000 750  Inspect SA-203  Inspect AKU  Terminate | Created Vanguard Vehicle - SA-203  Created Revenger Vehicle - AKU  Added Arsenal - Cannon-KA2 to Vehicle - SA-203  Added Shell - Shields-PI1 to Vehicle - AKU  Vanguard - SA-203  Total Weight: 400.000  Total Price: 800.000  Attack: 1450  Defense: 450  HitPoints: 2000  Parts: Cannon-KA2  Revenger - AKU  Total Weight: 1200.000  Total Price: 2000.000  Attack: 1000  Defense: 1750  HitPoints: 1000  Parts: Shields-PI1  Remaining Vehicles: SA-203, AKU  Defeated Vehicles: None  Currently Used Parts: 2 |
| Vehicle Revenger Destroyer-2U 1500 100000 9500 5000 15000  Vehicle Revenger Falcon-303 750 55000 4500 2000 6500  Vehicle Vanguard Rhino-CE 3000 85000 2000 4000 20000  Part Destroyer-2U Arsenal Cannon-X 1000 50000 5000  Part Destroyer-2U Arsenal Cannon-Y 1000 50000 5000  Part Rhino-CE Shell Shield-EX 2000 45000 3000  Battle Destroyer-2U Rhino-CE  Inspect Destroyer-2U  Terminate | Created Revenger Vehicle - Destroyer-2U  Created Revenger Vehicle - Falcon-303  Created Vanguard Vehicle - Rhino-CE  Added Arsenal - Cannon-X to Vehicle - Destroyer-2U  Added Arsenal - Cannon-Y to Vehicle - Destroyer-2U  Added Shell - Shield-EX to Vehicle - Rhino-CE  Destroyer-2U versus Rhino-CE -> Destroyer-2U Wins! Flawless Victory!  Revenger - Destroyer-2U  Total Weight: 3500.000  Total Price: 200000.000  Attack: 19500  Defense: 5000  HitPoints: 15000  Parts: Cannon-X, Cannon-Y  Remaining Vehicles: Destroyer-2U, Falcon-303  Defeated Vehicles: Rhino-CE  Currently Used Parts: 2 |