**Exercise: Working with Abstraction**

This document defines the **exercise assignments** for the ["C# HYPERLINK "https://softuni.bg/opencourses/csharp-oop"OOP HYPERLINK "https://softuni.bg/opencourses/csharp-oop"" course @ Software University](https://softuni.bg/opencourses/csharp-oop).

You can check your solutions here: [https://judge.softuni.bg/Contests/Working-with-Abstraction-Exercise](https://judge.softuni.bg/Contests/1496/Working-with-Abstraction-Exercise)

Your job is to download [source code](https://softuni.bg/downloads/svn/csharp-fundamentals/2018-Jan/CSharp-OOP-Basics/02.%20CSharp-OOP-Basics-Working-with-Abstraction/02.%20CSharp-OOP-Basics-Working-with-Abstraction-Exercises-Resources.zip) and **refactor** it.

* **Raw Data**

Write a program that tracks **cars** and their **cargo**. Define a class **Car** that holds an information about **model, engine, cargo** and a **collection of exactly 4 tires**. The **engine**, **cargo** and **tire** shouldbe **separate classes**. Create a **constructor** that receives all of the information about the **Car** and creates and **initializes** its inner **components** (**engine**, **cargo** and **tires**).

On the first line of input, you will receive a number **N** - the number of cars you have. On each of the next **N** lines, you will receive an information about each car in the format:

"**{model} {engineSpeed} {enginePower} {cargoWeight} {cargoType} {tire1Pressure} {tire1Age} {tire2Pressure} {tire2Age} {tire3Pressure} {tire3Age} {tire4Pressure} {tire4Age}"**

The **speed**, **power**, **weight** and **tire age** are **integers** and **tire** **pressure** is a **double.**

After the **N** lines, you will receive a single line with one of the following commands:

* "**fragile**" - print all cars whose **cargo** is **"fragile"** with **a tire**, whose **pressure is** **< 1**
* "**flamable**" - print all of the cars, whose **cargo** is **"flamable"** and have **engine power > 250**

The cars should be printed in order of appearing in the input.

**Examples**

|  |  |
| --- | --- |
| **Input** | **Output** |
| 2  ChevroletAstro 200 180 1000 fragile 1.3 1 1.5 2 1.4 2 1.7 4  Citroen2CV 190 165 1200 fragile 0.9 3 0.85 2 0.95 2 1.1 1  fragile | Citroen2CV |
| 4  ChevroletExpress 215 255 1200 flamable 2.5 1 2.4 2 2.7 1 2.8 1  ChevroletAstro 210 230 1000 flamable 2 1 1.9 2 1.7 3 2.1 1  DaciaDokker 230 275 1400 flamable 2.2 1 2.3 1 2.4 1 2 1  Citroen2CV 190 165 1200 fragile 0.8 3 0.85 2 0.7 5 0.95 2  flamable | ChevroletExpress  DaciaDokker |

* **Cars Salesman**

**You are given the problem and the solution of this task. Refactor it by reusing the base constructors in the classes.**

Define two classes **Car** and **Engine.**

**Car** has the following properties:

* **Model**
* **Engine**
* **Weight**
* **Color**

**Engine** has the following properties:

* **Model**
* **Power**
* **Displacement**
* **Efficiency**

A Car's **weight** and **color** and its Engine's **displacement** and **efficiency** are **optional**.

On the first line, you will read a number **N,** which will specify how many lines of engines you will receive. On each of the next **N** lines, you will receive information about an **Engine** in the following format:

**"{model} {power} {displacement} {efficiency}"**

After the lines with engines, you will receive a number **M**. On each of the next **M** lines, an information about a **Car** will follow in the format:

**"{model} {engine} {weight} {color}"**

The engine will be the **model of an existing** **Engine**. When creating the object for a **Car**, you should keep a **reference to the real engine** in it, instead of just the engine's model.

**Note:** that the optional properties **might be missing** from the formats.

Your task is to **print** all the **cars** in the order they were received and their information in the format defined bellow. If any of the optional fields are missing, print "**n/a**" in its place:

**{CarModel}:  
 {EngineModel}:  
 Power: {EnginePower}  
 Displacement: {EngineDisplacement}  
 Efficiency: {EngineEfficiency}  
 Weight: {CarWeight}  
 Color: {CarColor}**

**Bonus\***

Override the classes'  **ToString()** methods to have a reusable way of displaying the objects.

**Examples**

|  |  |
| --- | --- |
| **Input** | **Output** |
| 2  V8-101 220 50  V4-33 140 28 B  3  FordFocus V4-33 1300 Silver  FordMustang V8-101  VolkswagenGolf V4-33 Orange | FordFocus:  V4-33:  Power: 140  Displacement: 28  Efficiency: B  Weight: 1300  Color: Silver  FordMustang:  V8-101:  Power: 220  Displacement: 50  Efficiency: n/a  Weight: n/a  Color: n/a  VolkswagenGolf:  V4-33:  Power: 140  Displacement: 28  Efficiency: B  Weight: n/a  Color: Orange |
| 4  DSL-10 280 B  V7-55 200 35  DSL-13 305 55 A+  V7-54 190 30 D  4  FordMondeo DSL-13 Purple  VolkswagenPolo V7-54 1200 Yellow  VolkswagenPassat DSL-10 1375 Blue  FordFusion DSL-13 | FordMondeo:  DSL-13:  Power: 305  Displacement: 55  Efficiency: A+  Weight: n/a  Color: Purple  VolkswagenPolo:  V7-54:  Power: 190  Displacement: 30  Efficiency: D  Weight: 1200  Color: Yellow  VolkswagenPassat:  DSL-10:  Power: 280  Displacement: n/a  Efficiency: B  Weight: 1375  Color: Blue  FordFusion:  DSL-13:  Power: 305  Displacement: 55  Efficiency: A+  Weight: n/a  Color: n/a |

* **Jedi Galaxy**

**Rework the following solutions in order to avoid repeating code, increase readability and improve performance.**

Ivo's galaxy is represented as a two-dimensional array. You will receive **two** integers, separated by a space, which represent the two dimensional array - the first being the rows and the second being the columns. Every cell in the matrix is a star that has a value. Ivo starts at the given **row** and **col**. He can move only on the diagonal **from the lowest left to the upper right**, and **adds** to his score **all** the **stars** (values) from the cells he **passes through**. Unfortunately, there is always an Evil power that tries to prevent his success.

Evil power starts at the given **row** and **col** and instantly **destroys** **all stars** on the **opposite** diagonal - **from lowest right to the upper left.** Ivo **adds** the values only of the stars that are **not** **destroyed** by the evil power.

Then, you must fill the two dimensional array with increasing integers starting from 0, and continuing on every row, like this:

first row: 0, 1, 2… m

second row: n+1, n+2, n+3… n + n.

**Example:**

Ivo starts with coordinates **row = 5**, **col = -1**. He must collect all stars with value **[20, 16, 12, 8, 4]**. Evil starts with coordinates **row = 5**, **col = 5**. The Evil **destroys** all stars in range **[24, 18, 12, 6, 0]**. The star with value **12** is the **cross** **point** for Ivo and The Evil, so Ivo **skips** the stars and **collects** only these who are not in the evil range.



You will also receive multiple pairs of commands in the form of 2 integers separated by a single space. The first two integers will represent Ivo's start coordinates. The second one will represent the Evil Power's start coordinates.

The input ends when you receive the command "**Let the Force be with you**". When that happens, you must print the value of all stars that Ivo has collected successfully.

**Input**

* On the first line, you will receive the number N, M -> the dimensions of the matrix. You must then fill the matrix according to these dimensions.
* On the next several lines you will begin receiving 2 integers separated by a single **space**, which represent Ivo's row and col. On the next line you will receive the Evil Power's coordinates.
* There will always be **at least 2 lines** of input to represent at least 1 path of Ivo and the Evil force.
* When you receive the command, "**Let the Force be with you**" the input ends.

**Output**

* The output is simple. Print the sum of the values from all stars that Ivo has collected.

**Constraints**

* The dimensions of the matrix will be integers in the range [5, 2000].
* The given rows will be valid integers in the range [0, 2000].
* The given columns will be valid integers in the range [-231 + 1, 231 - 1].

|  |  |
| --- | --- |
| **Input** | **Output** |
| 5 5  5 -1  5 5  Let the Force be with you | 48 |
| 5 5  4 -1  4 5  Let the Force be with you | 29 |

* **Hospital**

Your task will be to prepare an electronic register for a hospital. In the hospital we have different departments:

* **Cardiology**
* [**Oncology**](https://en.wikipedia.org/wiki/Oncology)
* [**Emergency department**](https://en.wikipedia.org/wiki/Emergency_department)
* **etc.**

Each department has **20** rooms for patients and **each room has 3 beds**. When a new patient goes in the hospital, he/she is placed on the first free bed in the department. If there are no free beds, the patient should go in another hospital. Of course, in every hospital there are doctors. Each doctor can have patients in a different department. You will receive an information about the patients in the format **{Department} {Doctor} {Patient}**

After the **"Output"** command, you will receive some other commands about what kind of output you need to print. The commands are:

* **{Department}** - You need to **print all patients** in this department in the **order of receiving**.
* **{Department} {Room}** - You need to **print all patients** in this room in **alphabetical order**.
* **{Doctor}** - You need to **print all patients** for this doctor in **alphabetical order.**

The program ends when you receive command **"End"**.

**Input**

On the first lines you will receive info for the hospital, department, doctors and patients in the following format:

**{Department} {Doctor} {Patient}**

When you read the **"Output"** line you will get one or more commands telling you what you need to print

Keep reading commands for printing untill you reach the command **"End"**.

**Output**

* **{Department}** - print all patients in this department in order of receiving on a new line
* **{Department} {Room}** - print all patients in this room in alphabetical order each on new line
* **{Doctor}** - print all patients that are healed from doctor in alphabetical order on new line

**Constraints**

* **{Department}** - single word with length **1 < n < 100**
* **{Doctor}** - name and surname, both with length **1 < n < 20**
* **{Patient}** - unique name with length **1 < n < 20**
* **{Room}** - integer **1 <= n <= 20**
* Time limit: 0.3 sec. Memory limit: 16 MB.

**Examples**

|  |  |
| --- | --- |
| **Input** | **Output** |
| Cardiology Petar Petrov Ventsi  Oncology Ivaylo Kenov Valio  Emergency Mariq Mircheva Simo  Cardiology Genka Shikerova Simon  Emergency Ivaylo Kenov NuPogodi  Cardiology Gosho Goshov Esmeralda  Oncology Gosho Goshov Cleopatra  Output  Cardiology  End | Ventsi  Simon  Esmeralda |

|  |  |
| --- | --- |
| **Input** | **Output** |
| Cardiology Petar Petrov Ventsi  Oncology Ivaylo Kenov Valio  Emergency Mariq Mircheva Simo  Cardiology Genka Shikerova Simon  Emergency Ivaylo Kenov NuPogodi  Cardiology Gosho Goshov Esmeralda  Oncology Gosho Goshov Cleopatra  Output  Cardiology 1  End | Esmeralda  Simon  Ventsi |

|  |  |
| --- | --- |
| **Input** | **Output** |
| Cardiology Petar Petrov Ventsi  Oncology Ivaylo Kenov Valio  Emergency Mariq Mircheva Simo  Cardiology Genka Shikerova Simon  Emergency Ivaylo Kenov NuPogodi  Cardiology Gosho Goshov Esmeralda  Oncology Gosho Goshov Cleopatra  Output  Ivaylo Kenov  End | NuPogodi  Valio |

* **Greedy Times**

Finally, you have unlocked the safe and reached the treasure! Inside there are all kinds of gems, cash in different currencies and gold bullions. Next to you there is a bag which unfortunately has a limited space. You don't have much time so you need to take as much wealth as possible! But in order to get a bigger amount of the most valuable items, you need to keep the following rules:

* The **gold amount** in your bag should **always** **be** **more** than **or equal** to the **gem** **amount** at **any** time
* The **gem amount** should **always** **be** **more** than **or** **equal** to the **cash** **amount** at **any** time

If you read an **item** which **breaks** one of **these rules** you **should not put** it in the **bag**. You should **always** be careful **not** to **exceed** the overall **bag**'**s capacity,** because it will tear down and you will lose everything! You will receive the **content** **of** the **safe** on a **single line** in the **format** of **item - quantity** pairs, separated by **whitespace**. You need to gather **only** **three** **types** of items:

* Cash - All **three letter** items
* Gem - All **items** which **end** on "**Gem**" (at least 4 symbols)
* Gold - this type has **only one item** with the name - "**Gold**"

Each **item** which **does not** fall **in** one of the **above categories** is **useless** and you should **skip it**. Reading item's **names** should be **CASE-INSENSITIVE**. You should **aggregate** **item's quantities** which have the **same** **name**.

If you've kept the rules you should escape successfully with a bag full of wealth. Now it's time to review what you have managed to get out of the safe. **Print all** the **types** ordered by **total amount** in **descending order**. Inside a type, **order** the **items** first **alphabetically** in **descending** order and **then by** their **amount** in **ascending** order. Use the following format for each type:

**"<{type}> ${total amount}"**

**"##{item} - {amount}"** - each item from this type on new line

**Input**

* On the **first line**, you will receive a **number** which represents the **capacity** of the **bag**
* On the **second line**, you will receive a **sequence** of **item - quantity** pairs

**Output**

* Print **only** the **types** from which you **have items in the bag**, ordered by **Total Amount** in descending order. Inside a type, order the **items** **first** **alphabetically** in **descending** order and **then** by **amount** in **ascending** **order**. Use the following format for each type:

**"<{type}> ${total amount}"**

**"##{item} - {amount}"** - each item on new line

**Constraints**

* The Bag's **max capacity** will **always** be a **positive number**
* All **quantities** will be **positive** **integer** in the range [0 … 2100000000]
* Each item of type **gem** willhave a **name** - **at** **least 4** symbols
* Time limit: 0.1 sec. Memory limit: 16 MB

**Examples**

|  |  |
| --- | --- |
| **Input** | **Output** |
| 150  Gold 28 Rubygem 16 USD 9 GBP 8 | <Gold> $28  ##Gold - 28  <Gem> $16  ##Rubygem - 16  <Cash> $9  ##USD - 9 |
| 24000010  USD 1030 Gold 300000 EmeraldGem 900000 Topazgem 290000 CHF 280000 Gold 10000000 JPN 10000 Rubygem 10000000 KLM 3120010 | <Gold> $10 300 000  ##Gold - 10300000  <Gem> $10 290 000  ##Topazgem - 290 000  ##Rubygem - 10 000 000  <Cash> $3 410 010  ##KLM - 3 120 010  ##JPN - 10 000  ##CHF - 280 000 |
| 80345  RubyGem 70000 JAV 10960 Bau 60000 Gold 80000 | <Gold> $80000  ##Gold - 80000 |

* **Sneaking**

After our hero Sam got the recipe from the first problem, there is another thing he needs to check off from his to-do list. In order to make the recipe even more valuable, he needs to **"**eliminate**"** anyone who possesses the knowledge of it. That person is Sam's sworn enemy - **Nikoladze**. Sam needs to get through a rectangular room of **patrolling** **enemies** until he finally **reaches Nikoladze**.

A standard room looks like this:

|  |  |
| --- | --- |
| **Room** | **Legend** |
| ......N... b......... ..d....... ......d... .....S.... | S Sam, the player character  b/d left/right-facing patrolling enemy  N Nikoladze  . Empty space |

Each turn proceeds as follows:

* **Enemies** move either **left** or **right**, depending on which **direction** they are **facing** (**b** goes **right**, **d** goes **left**)
* If an enemy is standing on the **edge** of the room, he flips his **direction** (from **d** to **b** or from **b** to **d**)
* After that, Sam moves in the **direction** he is instructed to (either **U**/**D**/**L**/**R** or **W**, which means **wait**).
* If **Sam** moves **onto an enemy** (**same row** and **column**), Sam **kills** the enemy and **leaves no trace of him**.
* Otherwise, if an enemy is on the **same row** as Sam, and also **facing** **Sam** (eg. **.b.S.**), the **enemy** **kills Sam**.
* If Sam reaches the **same row** as **Nikoladze**, **Sam** kills **Nikoladze** (replacing him with an **X**)

**Input**

* On the **first line** of input, you will receive n - the **number of rows** the **room** will consist of
* On the next **n lines**, you will receive the **room**, which Sam will have to navigate.
* On the **final line** of input, you will receive a sequence of **directions** - one of (U, D, L, R, W)

**Output**

* If Sam is **killed**, print **"Sam died at {row}, {col}".**
* If Nikoladze is **killed**, print **"Nikoladze killed!"**.
* Then, in both cases, **print** the **final state of the room** on the **console**, with either **Sam** or **Nikoladze**'**s** **symbols** replaced by an **X**.

**Constraints**

* The room will always be **rectangular**.
* There will **always** be enough moves for **Sam** to reach **Nikoladze.**
* There will be **no case** where **Sam** is instructed to move **out of the bounds of the room**.
* There will be **no case** with **two enemies on the same row**.
* There will be **no case** with an **enemy and Nikoladze** standing on the **same row**.
* There will be **no case** where Sam reaches the same **row and column** as **Nikoladze**.

**Examples**

|  |  |  |
| --- | --- | --- |
| **Input** | **Output** | **Comments** |
| 5  ......N...  b.........  ..d.......  ......d...  .....S....  UUUUR | Sam died at 2, 5  ......N...  ...b......  b....X....  ..........  .......... | Turn 1: **Enemies** move, then Sam **steps on** the enemy on the **4th** row.  Turn 2: Enemies move, then Sam moves.  Turn 3: Enemy 2 **turns around**, Sam goes on the same row as him.  Turn 4: Enemy sees Sam and **kills him**. |
| 3  N......  .b.....  ..dS...  WUUU | Nikoladze killed!  X..S...  .......  b...... | Turn 1: Enemies move, Sam waits.  Turn 2: Enemies move, Sam goes **up, steps on an enemy**.  Turn 3: Enemies move, Sam goes **up, kills Nikoladze**. |
| 6  .............  ....S........  .b...........  ...........d.  .............  ....N........  WWWDWWWDDRD | Nikoladze killed!  .............  .............  ............b  d............  .............  ....XS....... | Turn 1/2/3: Enemies **move**, Sam **waits**.  Turn 4: Enemies **move**, Sam goes **down**.  Turn 5/6/7: Enemies **move**, Sam **waits**.  Turn 8/9: Enemies **move**, Sam goes **down**.  Turn 10: Enemies **move**, Sam goes **right**.  Turn 11: Enemies **move**, Sam goes **down** and **kills** Nikoladze. |