# OOP Basics Exam Preparation – System Split

You have been given the task to gather statistics about The System. The System is a network of components, connected together to build something which functions logically, but you don’t need to know that. You need to build a program which processes statistics about The System.

### Overview

The System consists, mainly, of two types of components – **Hardware** and **Software** components.

Hardware components have a **name**, a **type**, a **maximum capacity** and a **maximum memory**.

There are **2** **types** of Hardware components:

* **Power Hardware** – decreases **75%** of its given **capacity**, and increases its **memory** by **75%**.
* **Heavy Hardware** – decreases **25%** of its given **memory** and **doubles** its given **capacity**.

Software components have a **name**, a **type**, **capacity** **consumption** and **memory** **consumption**.

* **Express Software** – **doubles** its given **memory** **consumption**.
* **Light Software** – **increases** its given **capacity consumption** by **50%** and **decreases** its given **memory consumption** by **50%.**

**Example:** If a **Power Hardware** has **150 given capacity**, his capacity will be – **75%** from **150** =  
**150 – ((150 \* 3) / 4) =   
150 – (450 / 4) =   
150 – 112 = 38  
Note** that you are working with **INTEGERS**.

Software components are **stored on Hardware components**. Each Software component **takes up** aspecific amount of **capacity** and a specific amount of **memory** from the **Hardware**, in order to function properly. When registered, a Software component is stored on a **specified Hardware Component**.

There are several main commands you should configure in order for your program to function as needed.

### Task 1: Classes and Encapsulation - 40 points

You need to have the following classes:

**Component** - a common class for all components, that have **name** and **type**

* Constructors:
  + **String name**, **String type**
* Methods:
  + **String getName()**
  + **String getType()**
  + **int getCapacity()**
  + **int getMemory()**

**HardwareComponent** - a common class for all hardware components

* Methods:
  + **void registerSoftwareComponent(SoftwareComponent softwareComponent)**

**SoftwareComponent** - a common class for all software components

**PowerHardwareComponent**, **HeavyHardwareComponent**, **ExpressSoftwareComponent**, **LightSoftwareComponent** - classes representing power and heavy hardware, express and light software components

* Constructors:
  + **String name**, **int capacity**, **int memory**

Ensure proper encapsulation of all data.

### Task 2: Hierarchy and Polymorphism - 20 points

You need to implement proper hierarchy for classes.

### Task 3: Application Logic - 20 points

The functionality of System Split is interpreted through commands. You need a class that handles commands.

**TheSystem** – stores information about the whole system and handles commands.

It should have the following functionality:

* **void registerPowerHardware(String name, int capacity, int memory)**
* **void registerHeavyHardware(String name, int capacity, int memory)**
* **void registerExpressSoftware(String hardwareComponentName, String name, int capacity, int memory)**
* **void registerLightSoftware(String hardwareComponentName, String name, int capacity, int memory)**
* **void releaseSoftwareComponent(String hardwareComponentName, String softwareComponentName)**
* **String analyze()**
* **String split()**

### Commands

* **RegisterPowerHardware(name, capacity, memory)**
* **RegisterHeavyHardware(name, capacity, memory)**
  + Registers a Hardware component of the **specified type** on The System with the given **name**, **capacity**, and **memory**.
* **RegisterExpressSoftware(hardwareComponentName, name, capacity, memory)**
* **RegisterLightSoftware(hardwareComponentName, name, capacity, memory)**
  + Registers a Software component of the **specified type** on the given Hardware component, with the  
    given **name**. The Software Component **takes up** from the **hardware’s capacity and memory** – the given **capacity** and **memory**.
  + If the given Hardware component **does NOT exist** in The System, the command should do nothing.
  + If the given Hardware component **does** **NOT** **have enough capacity** or **memory** to contain the Software component, the command should do nothing.
* **ReleaseSoftwareComponent(hardwareComponentName, softwareComponentName)**
  + **Destroys** the Software Component with the given **name**, from the Hardware Component with the given **name**.
  + In case there is **NO** such **Hardware Component**, in **The System**, the command should do nothing.
  + In case there is **NO** such **Software Component**, on the given **Hardware Component**, the command should do nothing.
* **Analyze()**
  + Shows statistics about the **components currently** in **The System** in the following format:  
    **“System Analysis**

**Hardware Components: {countOfHardwareComponents}**

**Software Components: {countOfSoftwareComponents}**

**Total Operational Memory: {totalOperationalMemoryInUse} / {maximumMemory}**

**Total Capacity Taken: {totalCapacityTaken} / {maximumCapacity}”**

* + The total operational memory in use and total capacity taken is calculated from all the Software components **currently** in **The System**. You must also print the **maximum** **memory** and **capacity** **available** from all the Hardware Components **currently** in **The System**.
* **System Split**
  + This command **finalizes** the work of the program, and prints information about the whole System.
  + The System is split, and all of the Hardware components are to be printed **one by one**.
  + The format of printing is the following:

**“Hardware Component – {componentName}**

**Express Software Components: {countOfExpressSoftwareComponents}**

**Light Software Components: {countOfLightSoftwareComponents}**

**Memory Usage: {memoryUsed} / {maximumMemory}**

**Capacity Usage: {capacityUsed} / {maximumCapacity}**

**Type: {Power/Heavy}**

**Software Components: {softwareComponent1, softwareComponent2…}”**

* + **Power Hardware Components** must be printed **before** the **Heavy Hardware Components**.
  + When printing **the** **Software Components**, print **only their names**.
  + In case the Hardware component **does not have any** Software Components, print “**None**”.
  + The general **order of output** for all of the components is – **by order of entrance**.

### Task 4: Input / Output - 30 points

### Input

* The input will come in the **form of commands**, in the format – specified above.
* The input will consist **only** of the commands specified above.
* The input ends when you receive the command **“System Split”**.

### Output

* The only output you must print is the one specified for the **Analyze** command, and the **final output**.
* All of the output must be exactly in the format specified above.

### Constraints

* The names of the components will be strings, and will consist of English alphabet letters and digits.
* The **names** of the **Hardware Components** will **always** be **unique**.
* The **names** of the **Software Components** will be unique **for every Hardware Component**.
* The memory and capacity of each component will be integer numbers in range [0, 231 - 1].
* The type of a Hardware Component can be **“Power”**or **“Heavy”**.
* The type of a Software Component can be **“Express”** or **“Light”**.
* There will be **NO** invalid input commands.
* Allowed time/memory: 250ms / 32MB.

### Examples

|  |  |
| --- | --- |
| **Input** | **Output** |
| **RegisterPowerHardware(HDD, 200, 200)**  **RegisterHeavyHardware(SSD, 400, 400)**  **RegisterLightSoftware(HDD, Test, 0, 10)**  **RegisterExpressSoftware(HDD, Test2, 100, 100)**  **RegisterExpressSoftware(HDD, Test3, 50, 100)**  **RegisterLightSoftware(SSD, Windows, 20, 50)**  **RegisterExpressSoftware(SSD, Linux, 50, 100)**  **RegisterLightSoftware(SSD, Unix, 20, 50)**  **Analyze()**  **ReleaseSoftwareComponent(SSD, Linux)**  **System Split** | **System Analysis**  **Hardware Components: 2**  **Software Components: 0**  **Total Operational Memory: 0 / 650**  **Total Capacity Taken: 0 / 850**  **System Analysis**  **Hardware Components: 2**  **Software Components: 5**  **Total Operational Memory: 455 / 650**  **Total Capacity Taken: 160 / 850**  **Hardware Component - HDD**  **Express Software Components - 1**  **Light Software Components - 1**  **Memory Usage: 205 / 350**  **Capacity Usage: 50 / 50**  **Type: Power**  **Software Components: Test, Test3**  **Hardware Component - SSD**  **Express Software Components - 0**  **Light Software Components - 2**  **Memory Usage: 50 / 300**  **Capacity Usage: 60 / 800**  **Type: Heavy**  **Software Components: Windows, Unix** |

### BONUS TASK: Dump Analysis - 20 points

There is also a bonus task for you to implement in your program.

The System is hyper-dynamic – it is constantly changing its infrastructure. **Addition** and **removal** of components are frequent actions. For data safety reasons, The System contains a **Dump**. The Dump **contains all elements** that are **temporarily deleted**, so they can be **restored** if needed. If, however, the temporarily deleted components are **deleted from The Dump itself**, restoring them would be **impossible**.

* **Dump(hardwareComponentName)**
  + Removes from **The System** the Hardware component with the given **name**, and throws it **into The Dump**, along with all of its Software components.
  + Dumped units **do NOT take** any **memory** or **capacity** on The System.
  + In case there is no component with the **given name** in The System, the command should do nothing.
* **Restore(hardwareComponentName)**
  + Restores the given Hardware component, from **The Dump**, to **The System**.
  + In case there is **NO** such component in The Dump, the command should do nothing.
* **Destroy(hardwareComponentName)**
  + Removes the given Hardware component from **The Dump**. After this action the component should no longer exist.
  + In case there is **NO** such component **in The Dump**, the command should do nothing.
* **DumpAnalyze()**
  + Shows statistics about the whole Dump in the following format:  
    **“Dump Analysis**

**Power Hardware Components: {countOfPowerHardwareComponents}**

**Heavy Hardware Components: {countOfHeavyHardwareComponents}**

**Express Software Components: {countOfExpressSoftwareComponents}**

**Light Software Components: {countOfLightSoftwareComponents}**

**Total Dumped Memory: {totalDumpedMemory}**

**Total Dumped Capacity: {totalDumpedCapacity}”**

* + The dumped memory, capacity, and is calculated from all the components, currently **in The Dump**.

|  |  |
| --- | --- |
| **Input** | **Output** |
| **RegisterPowerHardware(HDD, 300, 250)**  **RegisterHeavyHardware(SSD, 600, 1200)**  **RegisterExpressSoftware(HDD, Test1, 1, 1)**  **RegisterExpressSoftware(HDD, Test2, 1, 1)**  **RegisterExpressSoftware(HDD, Test3, 1, 1)**  **RegisterLightSoftware(SSD, Test1, 5, 10)**  **RegisterLightSoftware(SSD, Test2, 5, 10)**  **Dump(HDD)**  **Dump(SSD)**  **Analyze()**  **DumpAnalyze()**  **System Split** | **System Analysis**  **Hardware Components: 0**  **Software Components: 0**  **Total Operational Memory: 0 / 0**  **Total Capacity Taken: 0 / 0**  **Dump Analysis**  **Power Hardware Components: 1**  **Heavy Hardware Components: 1**  **Express Software Components: 3**  **Light Software Components: 2**  **Total Dumped Memory: 16**  **Total Dumped Capacity: 17** |

|  |  |
| --- | --- |
| **Input** | **Output** |
| **RegisterPowerHardware(CPU, 150, 235)**  **RegisterHeavyHardware(RAM, 450, 750)**  **RegisterExpressSoftware(CPU, ALU2, 10, 0)**  **Dump(CPU)**  **Analyze()**  **Restore(CPU)**  **Analyze()**  **Dump(CPU)**  **Destroy(CPU)**  **RegisterPowerHardware(SSD, 3000, 5000)**  **RegisterExpressSoftware(SSD, Windows, 400, 1750)**  **RegisterExpressSoftware(SSD, Skype, 50, 200)**  **RegisterExpressSoftware(SSD, Linux, 250, 300)**  **Analyze()**  **System Split** | **System Analysis**  **Hardware Components: 1**  **Software Components: 0**  **Total Operational Memory: 0 / 563**  **Total Capacity Taken: 0 / 900**  **System Analysis**  **Hardware Components: 2**  **Software Components: 1**  **Total Operational Memory: 0 / 974**  **Total Capacity Taken: 10 / 938**  **System Analysis**  **Hardware Components: 2**  **Software Components: 3**  **Total Operational Memory: 4500 / 9313**  **Total Capacity Taken: 700 / 1650**  **Hardware Component - SSD**  **Express Software Components - 3**  **Light Software Components - 0**  **Memory Usage: 4500 / 8750**  **Capacity Usage: 700 / 750**  **Type: Power**  **Software Components: Windows, Skype, Linux**  **Hardware Component - RAM**  **Express Software Components - 0**  **Light Software Components - 0**  **Memory Usage: 0 / 563**  **Capacity Usage: 0 / 900**  **Type: Heavy**  **Software Components: None** |