# Objects and Classes Advanced – Exercise

This document defines the lab for the ["C++ OOP" course @ Software University](https://softuni.bg/trainings/3659/cpp-oop-july-2022). Please submit your solutions (source code) to all below-described problems in [Judge](https://judge.softuni.org/Contests/3075/Objects-and-Classes-Advanced-Exercise).

Write C++ code for solving the tasks on the following pages.

Any code files that are part of the task are provided under the folder **Skeleton**.

Please follow the exact instructions on uploading the solutions for each task.

## Car

You are given a program in a CarMain.cppfile that reads and creates constobjects of class Car, which has the following attributes:

* Brand (string)
* Model (string)
* Year (int)

The program reads input and writes output to the console, using the Car class and getters for the above-mentioned attributes.

Your task is to study the code in CarMain.cpp and implement the Car class in Car.h (which is #include-d by CarMain.cpp), so that CarMain.cpp compiles successfully and accomplishes the task described. Your Car.h file should resemble the following:

|  |
| --- |
| **Car.h** |
| #ifndef CAR\_H  #define CAR\_H  // Place your code here  #endif // !CAR\_H |

You should submit a single .zip file for this task, containing ONLY the Car.h file. The Judge system has a copy of the other files and will compile them, along with your file, in the same directory.

### Examples

|  |  |
| --- | --- |
| **Input** | **Output** |
| Volkswagen  Golf  2015 | Brand -> Volkswagen  Model -> Golf  Year -> 2015 |

## Sum Of Vectors

You are given a program in a Main**.cpp** file that reads:

* How many couples of data do you have
* Elements data 1
* Elements data 2

The number of couples is an integer, the datas are strings.

With the couples in the data vectors, you have to create a new vector with the concatenation of the previous 2 vectors’ data.

Write a function that does the concatenation

Your task is to study the code in **Main.cpp** and implement the **SumOfVectors** function in **SumOfVectors.h** (which is **#include**-d by **Main.cpp**), so that **Main.cpp** compiles successfully and accomplishes the task described. Your SumOfVectors**.h** file should resemble the following:

|  |
| --- |
| **SumOfVectors.h** |
| #ifndef SUMOFVECTORS\_H  #define SUMOFVECTORS\_H  // Place your code here  #endif // !SUMOFVECTORS\_H |

You should submit a single **.zip** file for this task, containing ONLY the **SumOfVectors.h** file. The Judge system has a copy of the other files and will compile them, along with your file, in the same directory.

**Examples**

|  |  |
| --- | --- |
| **Input** | **Output** |
| 2  Ivan  Dragan 22 23 | Ivan 22  Dragan 23 |
| 1  Polya Pavlova | Polya Pavlova |

## Operators

You are given code for a program that reads a specified number of lines from the console, and then formats them in the following way:

* It prepends two lines of characters before the lines from the input
* It then places each of the original lines prefixing it with its number (starting from 1) followed by ". "
* It then appends a line of characters at the end

The program does all this (you don’t have to do input, output, or determine line numbers), but it uses operators which aren’t defined in the C++ language.

Your task is to study the code in OperatorsMain.cpp and implement the necessary operators in Operators.h (which is #include-d by OperatorsMain.cpp), so that OperatorsMain.cpp compiles successfully and accomplishes the task described. Your Operators.h file should resemble the following:

|  |
| --- |
| **Operators.h** |
| #ifndef OPERATORS\_H  #define OPERATORS\_H  #include <ostream>  #include <vector>  #include <string>  #include <sstream>  // Place your code here  #endif // !OPERATORS\_H |

You should submit a single .zip file for this task, containing ONLY the Operators.h file. The Judge system has a copy of the other files and will compile them, along with your file, in the same directory.

### Examples

|  |  |
| --- | --- |
| **Input** | **Output** |
| 2  hello  c++ operators | Formatted Lines  ----------------  1. hello (5)  2. c++ operators (13)  ---------------- |

## Resources

You are given code for a program that reads information about Resources (links to Presentations, Demos, or Videos) in the SoftUni Learning system *(well, ok, not the real system, but at least this one won’t break the links…)* and then sorts them by their id, and also prints how many of each type of resource there was in the input.

Each Resource has the following properties:

* An integer id
* A ResourceType – one of Presentation, Demo, or Video
* A string representing the link to the resource

The code for the program is in the ResourcesMain.cpp and it uses a Resource class, which it expects to be defined in a file named "Resource.h" in the same directory.

Your task is to study the ResourcesMain.cpp file and the ResourceType.h file, and to create the Resource.h file and implement the Resource class in such a way that the program correctly reads the input, orders it by id, prints it as lines on the output (each Resource output line should have the same format as the matching Resource input line) and then prints the number of Resources of each type.

Your Resource.h file should resemble the following:

|  |
| --- |
| **Resource.h** |
| #ifndef RESOURCE\_H  #define RESOURCE\_H  #include "ResourceType.h"  // Place your code here  #endif // !RESOURCE\_H |

You should submit a single .zip file for this task, containing ONLY the Resource.h file. The Judge system has a copy of the other files and will compile them, along with your file, in the same directory.

### Examples

|  |
| --- |
| **Input** |
| 4  255 Demo http://kottakoa.com  42 Presentation http://theanswertolifetheuniverseandeverything.com  13 Demo http://example.com  69 Video http://yeahyouwish.com |
| **Output** |
| ... by id:  13 Demo http://example.com  42 Presentation http://theanswertolifetheuniverseandeverything.com  69 Video http://yeahyouwish.com  255 Demo http://kottakoa.com  ... by type:  Presentation: 1  Demo: 2  Video: 1 |

## Lectures

You are given code similar to **Task 4 – Resources**, however, this time the main() code uses a Lecture object (the class for which should be defined in a Lecture.h file) to store and organize the resources. It also uses several operators to do that and iterates the Resources in the Lecture through a range-based for loop (*hint: the Lecture class will need to begin() and end() methods which return iterators*).

Another difference is that in this task, there can be two Resource objects in the input which have different link**s** but have the same id. This indicates that the Resource has been changed – i.e. if a Resource with the same id is encountered **multiple times**, only keep its version appearing **latest** in the input.

The program’s output should be the same as in **Task 4** – the resources ordered by id, followed by the number of occurrences of each ResourceType, ordered Presentation (if non-zero), then Demos (if non-zero), and last Video (if non-zero).

Your task is to study the code, figure out what operators and classes you need to implement, search the Web for concepts you aren’t familiar with, and submit the files necessary for the program to compile and run successfully.

You should submit a single .zip file for this task, containing ONLY the files YOU created. The Judge system has a copy of the other files and will compile them, along with your file, in the same directory.

### Examples

|  |
| --- |
| **Input** |
| 6  42 Presentation http://thisiswillberenamed.com  255 Demo http://kottakoa.com  42 Presentation http://theanswertolifetheuniverseandeverything.com  13 Demo http://this.will.also.be.renamed.com  13 Demo http://example.com  69 Video http://yeahyouwish.com |
| **Output** |
| ... by id:  13 Demo http://example.com  42 Presentation http://theanswertolifetheuniverseandeverything.com  69 Video http://yeahyouwish.com  255 Demo http://kottakoa.com  ... by type:  Presentation: 1  Demo: 2  Video: 1 |

|  |
| --- |
| **Input** |
| 6  42 Demo http://thisiswillberenamed.com  255 Demo http://kottakoa.com  42 Demo http://theanswertolifetheuniverseandeverything.com  13 Demo http://this.will.also.be.renamed.com  13 Demo http://example.com  69 Video http://yeahyouwish.com |
| **Output** |
| ... by id:  13 Demo http://example.com  42 Demo http://theanswertolifetheuniverseandeverything.com  69 Video http://yeahyouwish.com  255 Demo http://kottakoa.com  ... by type:  Demo: 3  Video: 1 |

## Memory Allocator\* (excluded from homework)

Your task is to write a simple memory allocator, which does not introduce a memory leak. You are given the main() function, which reads two values (as integer numbers) of memory followed by N command lines.

* The first integer value indicates the size of your memory allocator (in the range [0, INT\_MAX] inclusive).
* The second integer value indicates the number of following command lines (N) you need to process and execute (in the range [0, INT\_MAX] inclusive).
* The next **N** lines of indicating the command that you should process and execute.

The commands have the following syntax:

* "Allocate INDEX";
* "Deallocate INDEX";
* "Idle”;

Where INDEX can be any integer in the range (in the range [0, INT\_MAX] inclusive);

Keep in mind that INDEX may not be in present in your memory allocator boundaries.

You should implement the functions **executeCommand()** and **printResult()** in another .cpp file. (For example MemoryAllocator.cpp)

For each executed command in the **executeCommand()** – you should print a status message depending on the received **ErrorCode** in **printResult()**. Every call to **printResult()** should end with a **newline**.

You should print:

* For successful allocation/deallocation (not introducing memory leak or crashing the problem) – "**command** - success"
* For preventing a memory leak – "**command** - memory leak prevented, will not make allocation"
* For preventing a system crash – "**command** - system crash prevented, will skip this deallocation"
* For receiving an index that is not in the bound of your memory allocator – "**command** – out of bound"
* For receiving an "Idle" – "**command** - this exam is a piece of cake! Where is the OOP already?!?"
  + Where "**command**" is the exact same string that is passed to the function.

Your task is to study the code and implement the function so that the code accomplishes the task described.

You should submit a single .zip file for this task, containing **ONLY** the files you created.

The Judge system has a copy of the other files and will compile them, along with your file, in the same directory.

### Restrictions

You are free to implement another function/functions that are used internally by the **executeCommand()** and **printResult().**

### Examples

|  |  |
| --- | --- |
| **Input** | **Output** |
| 5 2  Allocate 3  Deallocate 3 | Allocate 3 - success  Deallocate 3 - success |
| 2 4  Deallocate 21  Allocate 1  Idle  Allocate 1 | Deallocate 21 - out of bound  Allocate 1 - success  Idle - this exam is a piece of cake! Where is the OOP already?!?  Allocate 1 - memory leak prevented, will not make allocation |
| 8 4  Allocate 2  Deallocate 2  Deallocate 2  Allocate 2 | Allocate 2 - success  Deallocate 2 - success  Deallocate 2 - system crash prevented, will skip this deallocation  Allocate 2 - success |

## Bytes Parsing\* (excluded from homework)

Your task is to write program, which reads/represents/parses numbers out of contiguous array of bytes in memory into C++ primitive data type numbers. You are given the main() function, which reads two string values (as whole rows) of memory.

* The first string value indicates your command buffer. The buffer may only contain the letters ‘s’, ‘i’, ‘l’ (in any order and in any number of occurrences);
* ‘s’ – stands for ‘short’ C++ primitive data type;
* ‘i’ – stands for ‘integer’ C++ primitive data type;
* ‘l’ – stands for ‘long long’ C++ primitive data type;
* The second string value contains your data buffer (as a single row of data).

Each character of the second string will be in the range **[0, 9]** inclusive;

After the read from the console an -= ‘0’ operation is performed on each char so the remaining value is the actual integer value from 0 to 9;

Keep in mind that the command buffer may contain commands, which you have no data for in your data buffer. When you reach such a case -> simply ignore the rest of the commands from the command buffer.

You should implement the functions **parseData()** and **printResult()** in another .cpp file. (For example BytesParsing.cpp)

Keep in mind that the Judge system has a 64bit Little-endian architecture so:

* sizeof(short) is 2 bytes;
* sizeof(int) is 4 bytes;
* sizeof(long long) is 8 bytes;

#### Example:

command - "sil"

bufferData – "10200030000000"

* First parsed number is ‘short’ and first 2 bytes “[0-1]” are represented as an ‘short’;
* Second parsed number is ‘int’ and next 4 bytes from index [2-5] are represented as an ‘int’;
* Third parsed number is ‘long long’ and next 8 bytes from index [6-13] are represented as an ‘long long’;

The result is “1 2 3”

#### Example 2:

command - "silll"

bufferData – "10200030000"

The result is "**1 2 Warning, buffer underflow detected**"

The data buffer does not have enough information about all the listed commands. All the parsed numbers so far are printed first.

As a result of **parseData()** – you should print a status message depending on the received **ErrorCode** in **printResult()** followed by a **newline**.

You should print:

* For successful allocation parsing – all parsed numbers are divided by **whitespace** (the last number should also have whitespace before the newline);
* For partial parsing (more requested commands than actual data to parse) – all **successfully** parsed numbers so far divided by **whitespace** followed by "Warning, buffer underflow detected" (the last number should also have whitespace before the "Warning part");
* For preventing an empty command buffer or data buffer – "No input provided";

Your task is to study the code and implement the function so that the code accomplishes the task described.

You should submit a single .zip file for this task, containing **ONLY** the files you created.

The Judge system has a copy of the other files and will compile them, along with your file, in the same directory.

### Restrictions

You are free to implement another function/functions that are used internally by the **parseData()** and **printResult().**

The command buffer and data buffer size will be in the range **[0, SIZE\_T\_MAX]** inclusive;

Note: ‘size\_t’ and ‘unsigned long long integer’ are the same thing;

### Examples

|  |  |
| --- | --- |
| **Input** | **Output** |
| ss  2002 | 2 512 |
| is  11110 | 16843009 Warning, buffer underflow detected |
| sil  900200003000000 | 9 512 196608 |