

資料結構與程式設計

(Data Structure and Programming)

107 學年上學期複選必修課程 901 31900

Homework #1 (Due: 9:00pm, Tuesday, **Sep 18, 2018**)

[Note]

- (i) You need to submit this homework in order to get the 授權碼 to register the course.
 - (ii) Although the deadline is on Tuesday Sep. 18, which is the second week of the semester, you are advised to submit it at your earliest convenience in order to get the 授權碼 earlier. The headcount is limited to 190.
 - (iii) TA or instructor will quickly go over your submission of homework and grade it ASAP. Plagiarism will be checked. You must pass the plagiarism check and have a “reasonable” submission in order to qualify for the 授權碼. (Note) “Reasonable” is a qualitative judgment, not a quantitative measurement, meaning that you should not turn in blank homework or something that is not abide by our requirements. Homework score is not a final decision factor for 授權碼.
 - (iv) Please do pay attention to the homework submission rules at the end of this document. Failure to follow the rules will result in disqualification of getting 授權碼.
 - (v) It is very likely you are NOT familiar with some advanced C++ features required in this homework. For example, dynamic array, operator overloading, or even header file / multiple files, etc. Nevertheless, “self-learning” by researching on the internet and then figuring out the solution is one of the key spirit in this course. You need to get used to it in order to enjoy (a.k.a. survive in) the class.
 - (vi) If you find it very difficult in finishing this homework, you may consider NOT to take this course as the followed homework assignments will become much tougher.
 - (vii) The copyright of these homework problems belongs to the author, Prof. Chung-Yang (Ric) Huang, in National Taiwan University (NTU). These problems are used for the class “Data Structure and Programming” in NTU only. Use in any form without the permission of the author will be treated as violation of the copyright law. For permission requests, send e-mail to cyhuang@ntu.edu.tw addressed “Attention: Use of DSnP problems”.
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1. In this course, we require that all the homework be done in a Linux compatible programming environment (e.g. Ubuntu, Mac OS X, etc). Therefore, we would like to make sure you have it before the class starts.

There are several ways to obtain a Linux compatible environment, for example: (i) Have a computer that runs Linux OS, (ii) Have a dual-boot computer that you can choose to boot Linux when powering it on, (iii) Install a virtual machine (e.g. VirtualBox) on a non-Linux environment (e.g. Windows) and then install the Linux OS on the virtual machine, (iv) Remotely login (i.e. telnet or ssh) to a Linux workstation (e.g. some server in your lab), or (v) Use “terminal” on Mac, etc.

In this problem, we will check if you have “g++” installed and if it supports C++11. please follow the steps below, screenshot your “terminal”, rename and save the file under the p1 directory.

(i) In terminal, execute “cd p1” // change directory to “p1”

(ii) Type “make” // it will evoke the “Makefile”

If it is executed correctly, you should see:

```
Compile success!!  
program tested successfully !!  
compiler check pass !!
```

If you see any problem on C++11 compatibility or g++ compiler, fix it before you move on.

(iii) Screenshot your terminal, and save the screenshot as “p1.xxx”, where “xxx” is the file extension of the image (e.g. p1.jpg).

(iv) Make sure “p1.xxx” is stored properly under the p1 directory.

Feel free to mosaic parts of the screenshot if you have any security concern.

Execute the above steps in the same terminal so that the screenshot can be fitted into a single image file.

2. In this problem, you are asked to read in a “.json” file and perform some operations and/or statistics on its data.

A JSON file is a lightweight data-interchange format. It is easy for humans to read and write, and it is easy for machines to parse and generate. It is based on a subset of the [JavaScript Programming Language, Standard ECMA-262 3rd Edition - December 1999](#). Please refer to [JSON official site](#) for its complete spec.

However, in this homework, to simplify the task, we will set the following limitations on our test JSON file format:

- ✓ Each file will contain one and only one JSON object.
- ✓ Each JSON object is enclosed by opening and closing curly braces ‘{’ and ‘}’ located in the begin and end of the file, respectively, each in one line. No extra characters, except perhaps white spaces (e.g. ‘ ’, ‘\t’, ‘\b’, ‘\r’, ‘\n’), are in these two lines.
- ✓ Within the curly braces is(are) zero, one, or more element(s). Each element is a key-value pair, where the key is of type “string” and is enclosed by double

quote " ", and the value is a positive or negative C++ integer (i.e. type "int"). No object, array, string, or Boolean value will appear in our testcases.

- ✓ Key is composed of English letters (i.e. a-z, A-Z), digits (i.e. 0-9), and underline symbol (i.e. '_'). No other character is allowed. The length of the key is virtually unlimited. However, it should be able to read in as a C++ "string".
- ✓ Key cannot be empty nor white-space string.
- ✓ At least a white space is inserted between the key and the column symbol ':', and between the column symbol ':' and the value.
- ✓ Each element, except for the last one, is followed by a comma ','.
- ✓ White spaces appeared outside the key string are ignored.

Valid examples of JSON files in this homework are like:

[Example-1]

```
{
    "Ric" : 100,
    "John" : 50
}
```

[Example-2]

```
{
"aa" : 3 ,
    "bbb" : 4
}
```

[Example-3]

```
{
    "asf" : -123,
    "qQ"   : 88 ,
    "j"    : 0
}
```

[Example-4]

```
{

}
```

A JSON file generator is provided in the director “hw2/jsonGen” for you to generate JSON testcases. Simply type “make json” in “hw2” directory and you will get a generator called “jgen”. Execute “jgen” followed by a number (i.e. the number of elements) and you will see a randomly generated JSON file on the screen (stdout). Use redirect operator ‘>’ to save the output to a file (e.g. ./jgen 100 > 100.json). Please note that the generated JSON file contains keys of length smaller than 10 and with lower-case letters only, and its values are between -999 to 999. Please refer to the above rules/limitations for our real testcases.

You can assume that our testcases are all syntactically correct. You don’t need to handle format errors.

Implement the following sub-problems using C++ in the subdirectory “p2” and write your codes in the files as specified in each sub-problem. To compile the codes, type “make” under “p2” directory to evoke “Makefile” to generate the executable “p2Run”. In principle, you don’t need to create new “.h” or “.cpp” files. However, if you intend to do so, please make sure you understand how to incorporate the new files into the Makefile and the executable can be successfully generated by “make”.

Under the success of compilation, type “./p2Run” to run the program.

We also provide reference programs for both Linux and Mac environments as “p2Run-linux” and “p2Run-mac” under the “ref” director, respectively. You should run them to compare their outputs with your results.

- (a) Define the *main()* function in “p2Main.cpp” and declare a JSON object “Json json” in it.

In the beginning, your program should prompt the message to ask for the input of the .json file.

```
Please enter the file name: test1.json
```

Once the .json file is properly read in, print the message (change the filename accordingly):

```
File "test1.json" was read in successfully.
```

and you should see “Enter command: ” on the screen waiting for the user to enter any of the commands as defined in sub-problems (c) – (f). Since we assume that there is no syntax error in the .json file, there is no need to handle the parsing error. Therefore, if your program does not halt and print out the above message, it is definitely something wrong in your code.

(Hint) Suggested readings: iostream, fstream, string

- (b) Define class `Json` and class `JsonElem` in the file “p2Json.h” to represent the data of a JSON object and its elements, respectively. Since the number of elements in a JSON object is not known in the beginning and may increase with the “ADD” command later, please use dynamic array “`vector<JsonElem>`” to record the elements. That is,

```
class Json {
public:
    // TODO: define constructor & member functions on your own
    bool read(const string&);
```

```
private:
    vector<JsonElem> _obj; // DO NOT change this definition.
                           // Use it to store JSON elements.
};
```

And for each element, define string and int as its data members:

```
class JsonElem {
public:
    // TODO: define constructor & member functions on your own
    JsonElem() {}
    JsonElem(const string& k, int v): _key(k), _value(v) {}

    friend ostream& operator << (ostream&, const JsonElem&);

private:
    string _key; // DO NOT change this definition.
               // Use it to store key.
    int _value; // DO NOT change this definition.
               // Use it to store value.
};
```

(Hint) Suggested readings: class / constructor, dynamic array, return by reference, operator overloading, const method/variable

For the commands in sub-problems (c) – (f) below, implement them as member functions of class `Json` and name them as “print()”, “add()”... etc. accordingly. Evoke them in “p2Main.cpp” such as `json.print()`. Note that the commands are case sensitive (all uppercase letters) and you don’t need to handle errors when parsing the commands/options.

- (c) The command “PRINT” prints the entire JSON object. For example, for the example “test1.json” in the hw2 directory, you should see:

```
{
  "Ric" : 100,
  "John" : 50
}
```

Note that each element is printed in a row with indentation of 2 space characters in the beginning, followed by the key (enclosed by double quote " "), a space character, a colon symbol, a space character, and the value. Put a comma ‘,’ after the value if it is not the last element. For ease of grading, please DO NOT put any extra white space anywhere in the printout.

- (d) The commands “SUM”, “AVE”, “MAX”, and “MIN” compute the summation, average, maximum, and minimum of the values of different elements in the JSON object. Clearly, there will be NO argument for these commands.

For example, for the example “test3.json” in the hw2 directory, you should see:

```
Enter command: SUM
The summation of the values is: -35.
Enter command: AVE
The average of the values is: -11.7.
Enter command: MAX
The maximum element is: { "qQ" : 88 }.
Enter command: MIN
```

The minimum element is: { "asf" : -123 }.

For the AVE command, compute and round the result up to the first decimal digit (Use fixed and setprecision(1) to format the printing).

If there is no element in the JSON object, you should report:

Error: No element found!!

- (e) The command “ADD” adds a new element (i.e. key-value pair) to the JSON object. The added key and value are provided as arguments to this command and are separated by space(s).

For example ---

```
ADD Mary 70 // add a new element "Mary" : 70
```

Nothing will be printed for this command. Use “PRINT” command to check the result.

Please note that the added element affects the JSON object in your program only. It will not change (i.e. write back to) the read-in file.

- (f) The command “EXIT” exits the program.

Notes: Please pay attention to the homework rules below and announcements on the website/FB page. Failure to abide by the rules may result in deduction of your homework score.

[Homework Rules]

1. Name your files as specified in each problem. Put all your files and in a directory named “yourID_hw1”, where “yourID” is your school ID in lower case and numbers (e.g. b05901888_hw1). Compress the directory by the command (on Linux or Mac Terminal):

```
tar zcvf yourID_hw1.tgz yourID_hw1
```

You should remove the executable and object files (if any) before submission to reduce the file size (e.g. type “make clean” under p2).

2. Submit your homework through ftp. The instruction of ftp will be sent out separately in a few days.
3. Any update, problem fix, and announcement will be posted on FaceBook group NTU_DSnP: <https://www.facebook.com/groups/NTUDSnP/>. Please follow it closely. If you are a registered student and would like to join the group, please go there and click “Join”.