Lab 5

Data Structures
C++ for C Coders

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bubble sort
insertion sort
quicksort
selection sort
#if

Lab 05:

1. Working with sort algorithms:
   - Bubble sort, Insertion sort, Selection sort, Quicksort
2. Handling multiple source files, include files, and external functions.
3. Creating header file (#include file)
4. Using a macro "`#if`", "`#else`" and "`#endif`"
5. Files provided
   - `bubble.cpp, insertion.cpp, selection.cpp, quicksort.cpp`
   - `sort.cpp`
   - `sortx.exe, sortx`

Lab 05: Step 1 – Learn sort algorithms

In this lab, we would like to write a program that works like **sortx.exe**.

1. Run **sortx.exe** provided in this lab and experience how it works.

2. Each file shown below contains one specific sort algorithm.
   - bubble.cpp, insertion.cpp, quicksort.cpp, selection.cpp

3. Build and run each file separately.
   - Study the algorithms by your own and understand how each algorithm works.

4. Build and run the source file with **-DDEBUG** may help you trace the code.
   - For example, the following commands show you compiling without or with -DDEBUG.

   ```
   $ g++ bubble.cpp -o sort
   $ g++ bubble.cpp -o sort –DDEBUG
   ```

Lab 05: Step 2 – Create print_list.cpp

- Now we would like to build one executable **`sort.exe`** that uses all those sort functions and **`print_list()`** function defined in separate files.
- Take a look at **`sort.cpp`**
  - This is a skeleton file provided.
  - Your code should go in this file.
- Create **`print_list.cpp`**
  - Create this external file that contrains **`printlist()`** function.
  - Copy **`print_list()`** from one of sort files into its own file named `print_list.cpp`.
  - Add a prototype for **`print_list()`** in **`sort.cpp`.**

Lab 05: Step 3 – Create sort.h

- Create **`nowic/include/sort.h`** file that contains all four sort function prototypes.
- The head file such as **`sort.h`** must begin and end with a macro to prevent it from duplicated inclusion. For example,

```
#ifndef SORT_H
#define SORT_H

// declare the function prototypes for sort.h
void bubbleSort(int *list, int n);
...
...

// This is the end of the header guard
#endif
```

Lab 05: Step 4 – Edit sort.cpp

- In **`sort.cpp`**, we want to invoke sort functions as defined in four sort files. Then, we need to **exclude** **`main()`** and **`print_list()`** in those files. Otherwise, it causes errors because of a multiply defined functions.
- In each sort file, set the macro **`#if 0`**.
  This will actually exclude all codes between **`#if 0`** and **`#endif`** from compiling.
- Add the following line to in **`sort.cpp`**.
  - **`#include "sort.h"`**

Lab 05: Step 5 – Build the executable, sort.exe

- Let us suppose we place source files and include folders as shown below:
  - `~/nowic/include/sort.h`
  - `~/nowic/src/bubble.cpp, insertion.cpp, quicksort.cpp, selection.cpp, print_list.cpp`

- The following command line would not work since it cannot find `sort.h`.

```
$ g++ sort.cpp bubble.cpp insertion.cpp quicksort.cpp selection.cpp
print_list.cpp -o sort
```

- Use `-Idir` option such that the compiler looks for header files in ***dir*** folder. `../` goes up by one level, `../../` by two levels in the tree folder structure.

```
$ g++ sort.cpp bubble.cpp insertion.cpp quicksort.cpp selection.cpp
print_list.cpp -I../include -o sort
```

Lab 05: Sample run without -DDEBUG

```
$ g++ sort.cpp bubble.cpp insertion.cpp quicksort.cpp selection.cpp
print_list.cpp -I../../include -o sort
```

may be different depending on your folder structure

```
$ ./sort
b for bubble, i for insertion, q for quick, s for selection
Enter an algorithm to sort(x to exit): q
UNSORTED(10):
3 4 1 7 0 9 6 5 2 8
SORTED(10):
0 1 2 3 4 5 6 7 8 9
b for bubble, i for insertion, q for quick, s for selection
Enter an algorithm to sort(x to exit): x
```

Lab 05: Sample run with -DDEBUG

```
  $ g++ sort.cpp bubble.cpp selection.cpp insertion.cpp quicksort.cpp print_list.cpp -I../../include -o
sort -DDEBUG
  $ ./sort
  b for bubble, i for insertion, q for quick, s for selection
  Enter an algorithm to sort(x to exit): b
  UNSORTED(10):
  3 4 1 7 0 9 6 5 2 8
  BUBBLE SORTING...
  3 1 4 0 7 6 5 2 8 9
  1 3 0 4 6 5 2 7 8 9
  1 0 3 4 5 2 6 7 8 9
  0 1 3 4 2 5 6 7 8 9
  0 1 3 2 4 5 6 7 8 9
  0 1 2 3 4 5 6 7 8 9
  0 1 2 3 4 5 6 7 8 9
  0 1 2 3 4 5 6 7 8 9
  0 1 2 3 4 5 6 7 8 9
  SORTED(10):
  0 1 2 3 4 5 6 7 8 9
  b for bubble, i for insertion, q for quick, s for selection
  Enter an algorithm to sort(x to exit):
```

may be different depending on your folder structure

Lab 05:

- Files to submit:
  - **`sort.h, print_list.cpp, sort.cpp`**
- Due:
  - 11:55 pm, on the day of this lecture
- Grade:
  - 1.0

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