EEEC10008(515169) S23: Homework 3

Due: 2023/06/06 (Tues.) 23:59

[Instruction]

- Please put your source code files into a folder named StudentID_hw3, then compress the folder to a **zip** file (Ex: 111511000_hw3.zip), and upload the zip files to e3 before the deadline.
- **If the zipped file or the compiled binary name is wrong, your score for this homework is 30% off.**
- **Your programs must be compiled into `./hw3-1` and `./hw3-2` using a single `make` command, so you need to provide a `makefile`.**
- **Your source code files should be able to be compiled and executed on our server.**
- This is what your files may look like

```
TA_Samuel@ICP:~/workspace/spring/hw3$ tree
.
├── Button.cpp
├── Button.h
├── Calculator.cpp
├── Calculator.h
├── hw3-1.cpp
├── hw3-2.cpp
├── Label.cpp
├── Label.h
├── makefile
├── TextInput.cpp
├── TextInput.h
├── utility.h
├── View.cpp
├── View.h
├── Window.cpp
└── Window.h
```

- If you have any questions, please post your questions onto the hw3 forum on E3.
- You can get the provided files from `/home/share/hw3/`.

[Problem 1-1]: GUI in terminal?

The GUI, or graphical user interface, is a form of user interface that allows users to interact with electronic devices through graphical icons and audio indicator such as primary notation, instead of text-based UIs, typed command labels or text navigation. GUIs were introduced in reaction to the perceived steep learning curve of CLIs (command-line interfaces), which require commands to be typed on a computer keyboard.

The actions in a GUI are usually performed through direct manipulation of the graphical elements. Beyond computers, GUIs are used in many handheld mobile devices such as MP3 players, portable media players, gaming devices, smartphones and smaller household, office and industrial controls.

In this problem, you need to implement a simple version of GUI in the terminal, including five

classes (`class Window, class View, class Button, class Label, and class TextInput`). `View` is the basic component of GUI, other components, namely `Button`, `Label`, and `TextInput` are all inherited from `View`. `Window` is used to manage `View`, and contains a vector of `View`.

- ✓ You will use the keyboard to navigate the GUI.
- ✓ To pass the test, your program cannot contain memory leaks. You can use the following command to test for memory leaks.
  - ■ `valgrind <your_executable_file>`
- ✓ File Description
  - ■ You will be given `hw3-1.cpp`, `Window.h, Window.cpp, View.h, Label.h, Button.h, utility.h` and `TextInput.h`.
  - ■ You can get these files from `/home/share/hw3/`.
  - ■ You don't need to modify `utility.h` and `Window::run()` in `Window.cpp`
  - ■ **Do not modify `hw3-1.cpp`,** otherwise you will get 0 points.
  - ■ As for other header files, you can freely add any other member functions you need.
- ✓ You don't need to worry about text exceeding the view edge or other GUI errors.
- ✓ The position of the view indicates the top left corner of the view.
- ✓ You must submit `makefile, hw3-1.cpp, Window.h, View.h, Label.h, Button.h, TextInput.h,` and `Utility.h` these eight files for this problem; however, if you have other program files, you may compress them into the same directory. In this directory, your code will be compiled and executed.
- ✓ Please **write every class in separate files** and write a "`Makefile`" in your directory to compile your code. Your code can be compiled by typing "`make`", and the name of your executable binary should be `hw3-1 and hw3-2`.
- ✓ Demo execution binary `hw3-1_demo` and `hw3-2_demo` are also in `/home/share/hw3/`, you can try them out.
- ✓ Here are the class template and the output. You can reference the comments in header files for more information about what each function does.
- ✓ `Window.h`

```
#ifndef _WINDOW_H_
#define _WINDOW_H_
#include <vector>
#include "utility.h"
using namespace std;
class View;
class Window {
    vector<View*> views;
```

```
    int sizeX;
    int sizeY;
    char** canvas;
    bool exit = false;
    View* selectedView = nullptr;

   public:
    // Consturctor, remember to allocate canvas
    Window(int sizeX = 40, int sizeY = 20);

    // Destructor, remember to deallocate canvas
    ~Window();

    // Add a new view to the window in provided position
    void addView(View* view, int posX, int posY);

    // Set exit to true
    void setExit();

    // Return selectedView
    View* getSelectedView();

    // Render the window, call "system("clear");" first
    void render();

    // Provided in Window.cpp
    void run();

   private:
    // Will be called when arrow key is pressed
    // If selectedView == nullptr, set the first
selectable view in the vector views to selectedView
    // Else set selectedView to the nearest selectable
```

```
view of the current selectedView in the given direction
    void onArrowKeyPress(ArrowKey key);

    // Will be called when normal key is pressed
(alphabet, symbols, backspace)
    // Call onInputKey() of the selected view
    void onNormalKeyPress(char key);

    // Will be called when Enter key is pressed
    // Call onClick() of the selected view
    void onEnterPress();

    // Set the selectedView
    void selectView(View* view);
};
#endif
```

✓ View.h

```
#ifndef _VIEW_H_
#define _VIEW_H_
#include <vector>
using namespace std;
class Window;
class View {
    static vector<View*> views;
   protected:
    int posX;
    int posY;
    int sizeX;
    int sizeY;
    bool selectable;
    char** canvas;
    Window* window = nullptr;
    void (*onClickListener)(View*) = nullptr;
```

```
    void (*onChangeListener)(View*) = nullptr;

   public:
    // Consturctor, remember to allocate canvas
    View(int sizeX, int sizeY);

    // Destructor, remember to deallocate canvas
    ~View();

    // Getters
    int getSizeX();
    int getSizeY();
    bool isSelectable();

    // Return if window->selectedView is same as self
    bool isSelected();

    // Callback function pointers setters
    void setOnClickListener(void (*listener)(View*));
    void setOnChangeListener(void (*listener)(View*));

    // Delete all created View in views, call at the end
of main()
    static void deleteAllView();

   protected:
    // Setters
    void setPos(int posX, int posY);
    void setWindow(Window* window);
    int getPosX();
    int getPosY();

    // Handler: when the view is clicked, call on click
```

```
listener
    virtual void onClick();

    // Handler: when the view is changed, call on change
listener
    virtual void onChange();

    // Handler: When user input to the view
    virtual void onInputKey(char key);

    // Return rendered view canvas
    virtual char** render() = 0;

    // Call window render()
    void rerenderWindow();

   public:
    friend class Window;
};
#endif
```

✓ Label.h

```
#ifndef _LABEL_H_
#define _LABEL_H_
#include <string>
#include "View.h"
#include "utility.h"
using namespace std;
class Label : public View {
    string output;
    Alignment alignment;

   public:
    // Constructor, remeber to set selectable to false
```

```
    Label(int sizeX, int sizeY, string output = "", Alignment
alignment = Alignment::CENTER);


    // Setters: remember to call onChange and rerenderWindow()
when setter is called
    void setOutput(string output);
    void setAlignment(Alignment alignment);


   private:
    // Render the label, need to render text for different
alignment
    char** render();
};


#endif
```

✓ Button.h

```
#ifndef _BUTTON_H_
#define _BUTTON_H_
#include <string>
#include "View.h"
using namespace std;
class Button : public View {
    string text;
   public:
    // Constructor, remeber to set selectable to true
    Button(int sizeX, int sizeY, string text = "");


    // Getter
    string getText();


   private:
    // Handler: When user click the button, call
onChange()
```

```
    void onClick();


    // Render the button, the apperance of the button is
different when selected
    char** render();
};
#endif
```

✓ TextInput.h

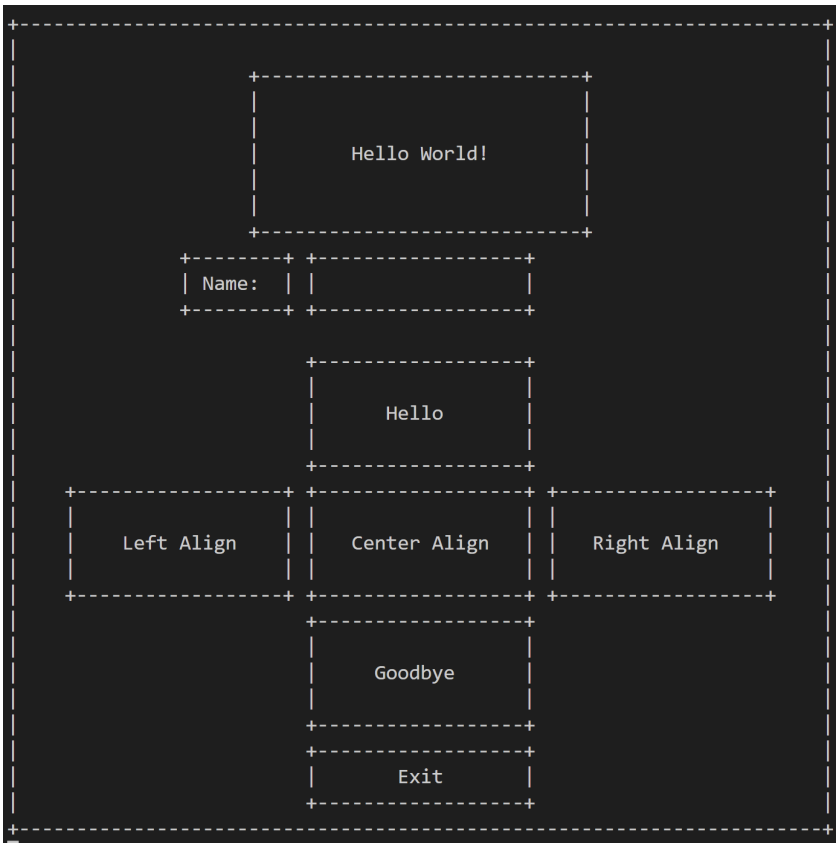
```
#ifndef _TEXTINPUT_H_
#define _TEXTINPUT_H_
#include <string>
#include "View.h"
using namespace std;
class TextInput : public View {
    string input;


   public:
    // Constructor, remeber to set selectable to true
    TextInput(int sizeX, int sizeY, string input = "");


    // Getter
    string getInput();


   private:
    // When the TextInput is selected and the user press
the keyboard, onInputKey() will be called
    void onInputKey(char key);


    // Render the textInput, the apperance of the
textInput is different when selected
    char** render();
};
#endif
```

✓ utility.h

```
#ifndef _UTILITY_H_
#define _UTILITY_H_
// Define Alignment and ArrowKey
// Usage example:  Alignment alignment = Alignment::LEFT;
//                 ArrowKey key = ArrowKey::UP;
enum class Alignment { LEFT, RIGHT, CENTER };
enum class ArrowKey { UP, DOWN, LEFT, RIGHT };
#endif
```

✓ $ make

$ ./hw3-1



Press Arrow Key UP

```
+-----------------------------------------------------------------+
|                                                                 |
|                  +---------------------------+                  |
|                  |                           |                  |
|                  |                           |                  |
|                  |        Hello World!       |                  |
|                  |                           |                  |
|                  |                           |                  |
|                  +---------------------------+                  |
|             +--------+ +==================+                     |
|             | Name:  | [                  ]                     |
|             +--------+ +==================+                     |
|                                                                 |
|                      +------------------+                       |
|                      |                  |                       |
|                      |      Hello       |                       |
|                      |                  |                       |
|                      +------------------+                       |
|    +------------------+ +------------------+ +------------------+    |
|    |                  | |                  | |                  |    |
|    |    Left Align    | |   Center Align   | |   Right Align    |    |
|    |                  | |                  | |                  |    |
|    +------------------+ +------------------+ +------------------+    |
|                      +------------------+                       |
|                      |                  |                       |
|                      |     Goodbye      |                       |
|                      |                  |                       |
|                      +------------------+                       |
|                      +------------------+                       |
|                      |       Exit       |                       |
|                      +------------------+                       |
+-----------------------------------------------------------------+
```

Press “Samuel”

```
+-----------------------------------------------------------------+
|                                                                 |
|                  +---------------------------+                  |
|                  |                           |                  |
|                  |                           |                  |
|                  |        Hello World!       |                  |
|                  |                           |                  |
|                  |                           |                  |
|                  +---------------------------+                  |
|             +--------+ +==================+                     |
|             | Name:  | [Samuel            ]                     |
|             +--------+ +==================+                     |
|                                                                 |
|                      +------------------+                       |
|                      |                  |                       |
|                      |      Hello       |                       |
|                      |                  |                       |
|                      +------------------+                       |
|    +------------------+ +------------------+ +------------------+    |
|    |                  | |                  | |                  |    |
|    |    Left Align    | |   Center Align   | |   Right Align    |    |
|    |                  | |                  | |                  |    |
|    +------------------+ +------------------+ +------------------+    |
|                      +------------------+                       |
|                      |                  |                       |
|                      |     Goodbye      |                       |
|                      |                  |                       |
|                      +------------------+                       |
|                      +------------------+                       |
|                      |       Exit       |                       |
|                      +------------------+                       |
+-----------------------------------------------------------------+
```

Press Arrow Key Down

```
+-------------------------------------------------------------------+
|                                                                   |
|                  +--------------------------+                     |
|                  |                          |                     |
|                  |                          |                     |
|                  |       Hello World!       |                     |
|                  |                          |                     |
|                  |                          |                     |
|                  +--------------------------+                     |
|             +--------+ +------------------+                       |
|             | Name:  | |Samuel            |                       |
|             +--------+ +------------------+                       |
|                                                                   |
|                       +------------------+                        |
|                       |##################|                        |
|                       |######Hello#######|                        |
|                       |##################|                        |
|                       +------------------+                        |
|    +------------------+ +------------------+ +------------------+ |
|    |                  | |                  | |                  | |
|    |    Left Align    | |   Center Align   | |   Right Align    | |
|    |                  | |                  | |                  | |
|    +------------------+ +------------------+ +------------------+ |
|                       +------------------+                        |
|                       |                  |                        |
|                       |     Goodbye      |                        |
|                       |                  |                        |
|                       +------------------+                        |
|                       +------------------+                        |
|                       |       Exit       |                        |
|                       +------------------+                        |
+-------------------------------------------------------------------+
```

Press ENTER

```
+-------------------------------------------------------------------+
|                                                                   |
|                  +--------------------------+                     |
|                  |                          |                     |
|                  |                          |                     |
|                  |      Hello Samuel!       |                     |
|                  |                          |                     |
|                  |                          |                     |
|                  +--------------------------+                     |
|             +--------+ +------------------+                       |
|             | Name:  | |Samuel            |                       |
|             +--------+ +------------------+                       |
|                                                                   |
|                       +------------------+                        |
|                       |##################|                        |
|                       |######Hello#######|                        |
|                       |##################|                        |
|                       +------------------+                        |
|    +------------------+ +------------------+ +------------------+ |
|    |                  | |                  | |                  | |
|    |    Left Align    | |   Center Align   | |   Right Align    | |
|    |                  | |                  | |                  | |
|    +------------------+ +------------------+ +------------------+ |
|                       +------------------+                        |
|                       |                  |                        |
|                       |     Goodbye      |                        |
|                       |                  |                        |
|                       +------------------+                        |
|                       +------------------+                        |
|                       |       Exit       |                        |
|                       +------------------+                        |
+-------------------------------------------------------------------+
```

Press Arrow Key Left

```
+-------------------------------------------------------------------+
|                                                                   |
|                  +---------------------------+                    |
|                  |                           |                    |
|                  |                           |                    |
|                  |       Hello Samuel!       |                    |
|                  |                           |                    |
|                  |                           |                    |
|                  +---------------------------+                    |
|             +--------+ +------------------+                        |
|             | Name:  | |Samuel            |                        |
|             +--------+ +------------------+                        |
|                                                                     |
|                       +------------------+                         |
|                       |                  |                         |
|                       |      Hello       |                         |
|                       |                  |                         |
|                       +------------------+                         |
|    +------------------+ +------------------+ +------------------+  |
|    |##################| |                  | |                  |  |
|    |####Left Align####| |   Center Align   | |   Right Align    |  |
|    |##################| |                  | |                  |  |
|    +------------------+ +------------------+ +------------------+  |
|                       +------------------+                         |
|                       |                  |                         |
|                       |     Goodbye      |                         |
|                       |                  |                         |
|                       +------------------+                         |
|                       +------------------+                         |
|                       |       Exit       |                         |
|                       +------------------+                         |
+-------------------------------------------------------------------+
```

Press ENTER

```
+-------------------------------------------------------------------+
|                                                                   |
|                  +---------------------------+                    |
|                  |                           |                    |
|                  |                           |                    |
|                  |Hello Samuel!              |                    |
|                  |                           |                    |
|                  |                           |                    |
|                  +---------------------------+                    |
|             +--------+ +------------------+                        |
|             | Name:  | |Samuel            |                        |
|             +--------+ +------------------+                        |
|                                                                     |
|                       +------------------+                         |
|                       |                  |                         |
|                       |      Hello       |                         |
|                       |                  |                         |
|                       +------------------+                         |
|    +------------------+ +------------------+ +------------------+  |
|    |##################| |                  | |                  |  |
|    |####Left Align####| |   Center Align   | |   Right Align    |  |
|    |##################| |                  | |                  |  |
|    +------------------+ +------------------+ +------------------+  |
|                       +------------------+                         |
|                       |                  |                         |
|                       |     Goodbye      |                         |
|                       |                  |                         |
|                       +------------------+                         |
|                       +------------------+                         |
|                       |       Exit       |                         |
|                       +------------------+                         |
+-------------------------------------------------------------------+
```

Press Arrow Key Right

```
+-------------------------------------------------------------------+
|                                                                   |
|                  +---------------------------+                    |
|                  |                           |                    |
|                  |                           |                    |
|                  |Hello Samuel!              |                    |
|                  |                           |                    |
|                  |                           |                    |
|                  +---------------------------+                    |
|             +--------+ +------------------+                       |
|             | Name:  | |Samuel            |                       |
|             +--------+ +------------------+                       |
|                                                                   |
|                       +------------------+                        |
|                       |                  |                        |
|                       |      Hello       |                        |
|                       |                  |                        |
|                       +------------------+                        |
|    +------------------+ +------------------+ +------------------+ |
|    |                  | |##################| |                  | |
|    |    Left Align    | |###Center Align###| |   Right Align    | |
|    |                  | |##################| |                  | |
|    +------------------+ +------------------+ +------------------+ |
|                       +------------------+                        |
|                       |                  |                        |
|                       |     Goodbye      |                        |
|                       |                  |                        |
|                       +------------------+                        |
|                       +------------------+                        |
|                       |       Exit       |                        |
|                       +------------------+                        |
+-------------------------------------------------------------------+
```

Press Arrow Key Right

```
+-------------------------------------------------------------------+
|                                                                   |
|                  +---------------------------+                    |
|                  |                           |                    |
|                  |                           |                    |
|                  |Hello Samuel!              |                    |
|                  |                           |                    |
|                  |                           |                    |
|                  +---------------------------+                    |
|             +--------+ +------------------+                       |
|             | Name:  | |Samuel            |                       |
|             +--------+ +------------------+                       |
|                                                                   |
|                       +------------------+                        |
|                       |                  |                        |
|                       |      Hello       |                        |
|                       |                  |                        |
|                       +------------------+                        |
|    +------------------+ +------------------+ +------------------+ |
|    |                  | |                  | |##################| |
|    |    Left Align    | |   Center Align   | |###Right Align####| |
|    |                  | |                  | |##################| |
|    +------------------+ +------------------+ +------------------+ |
|                       +------------------+                        |
|                       |                  |                        |
|                       |     Goodbye      |                        |
|                       |                  |                        |
|                       +------------------+                        |
|                       +------------------+                        |
|                       |       Exit       |                        |
|                       +------------------+                        |
+-------------------------------------------------------------------+
```

Press Enter

```
+-------------------------------------------------------------------+
|                                                                   |
|                  +---------------------------+                    |
|                  |                           |                    |
|                  |                           |                    |
|                  |              Hello Samuel!|                    |
|                  |                           |                    |
|                  |                           |                    |
|                  +---------------------------+                    |
|             +--------+ +------------------+                       |
|             | Name:  | |Samuel            |                       |
|             +--------+ +------------------+                       |
|                                                                   |
|                       +------------------+                        |
|                       |                  |                        |
|                       |      Hello       |                        |
|                       |                  |                        |
|                       +------------------+                        |
|    +------------------+ +------------------+ +------------------+ |
|    |                  | |                  | |##################| |
|    |    Left Align    | |   Center Align   | |###Right Align####| |
|    |                  | |                  | |##################| |
|    +------------------+ +------------------+ +------------------+ |
|                       +------------------+                        |
|                       |                  |                        |
|                       |     Goodbye      |                        |
|                       |                  |                        |
|                       +------------------+                        |
|                       +------------------+                        |
|                       |       Exit       |                        |
|                       +------------------+                        |
+-------------------------------------------------------------------+
```

Press Arrow Key Down

```
+-------------------------------------------------------------------+
|                                                                   |
|                  +---------------------------+                    |
|                  |                           |                    |
|                  |                           |                    |
|                  |              Hello Samuel!|                    |
|                  |                           |                    |
|                  |                           |                    |
|                  +---------------------------+                    |
|             +--------+ +------------------+                       |
|             | Name:  | |Samuel            |                       |
|             +--------+ +------------------+                       |
|                                                                   |
|                       +------------------+                        |
|                       |                  |                        |
|                       |      Hello       |                        |
|                       |                  |                        |
|                       +------------------+                        |
|    +------------------+ +------------------+ +------------------+ |
|    |                  | |                  | |                  | |
|    |    Left Align    | |   Center Align   | |   Right Align    | |
|    |                  | |                  | |                  | |
|    +------------------+ +------------------+ +------------------+ |
|                       +------------------+                        |
|                       |##################|                        |
|                       |#####Goodbye######|                        |
|                       |##################|                        |
|                       +------------------+                        |
|                       +------------------+                        |
|                       |       Exit       |                        |
|                       +------------------+                        |
+-------------------------------------------------------------------+
```

Press Enter

```
+-------------------------------------------------------------------+
|                                                                   |
|                  +---------------------------+                    |
|                  |                           |                    |
|                  |                           |                    |
|                  |            Goodbye Samuel!|                    |
|                  |                           |                    |
|                  |                           |                    |
|                  +---------------------------+                    |
|             +--------+ +------------------+                       |
|             | Name:  | |Samuel            |                       |
|             +--------+ +------------------+                       |
|                                                                   |
|                       +------------------+                        |
|                       |                  |                        |
|                       |      Hello       |                        |
|                       |                  |                        |
|                       +------------------+                        |
|    +------------------+ +------------------+ +------------------+ |
|    |                  | |                  | |                  | |
|    |    Left Align    | |   Center Align   | |   Right Align    | |
|    |                  | |                  | |                  | |
|    +------------------+ +------------------+ +------------------+ |
|                       +------------------+                        |
|                       |##################|                        |
|                       |#####Goodbye######|                        |
|                       |##################|                        |
|                       +------------------+                        |
|                       +------------------+                        |
|                       |       Exit       |                        |
|                       +------------------+                        |
+-------------------------------------------------------------------+
```

Press Down

```
+-------------------------------------------------------------------+
|                                                                   |
|                  +---------------------------+                    |
|                  |                           |                    |
|                  |                           |                    |
|                  |            Goodbye Samuel!|                    |
|                  |                           |                    |
|                  |                           |                    |
|                  +---------------------------+                    |
|             +--------+ +------------------+                       |
|             | Name:  | |Samuel            |                       |
|             +--------+ +------------------+                       |
|                                                                   |
|                       +------------------+                        |
|                       |                  |                        |
|                       |      Hello       |                        |
|                       |                  |                        |
|                       +------------------+                        |
|    +------------------+ +------------------+ +------------------+ |
|    |                  | |                  | |                  | |
|    |    Left Align    | |   Center Align   | |   Right Align    | |
|    |                  | |                  | |                  | |
|    +------------------+ +------------------+ +------------------+ |
|                       +------------------+                        |
|                       |                  |                        |
|                       |     Goodbye      |                        |
|                       |                  |                        |
|                       +------------------+                        |
|                       +------------------+                        |
|                       |#######Exit#######|                        |
|                       +------------------+                        |
+-------------------------------------------------------------------+
```

Press ENTER

```
+-------------------------------------------------------------------+
|                                                                   |
|                  +---------------------------+                    |
|                  |                           |                    |
|                  |                           |                    |
|                  |            Goodbye Samuel!|                    |
|                  |                           |                    |
|                  |                           |                    |
|                  +---------------------------+                    |
|             +--------+ +------------------+                        |
|             | Name:  | |Samuel            |                        |
|             +--------+ +------------------+                        |
|                                                                   |
|                       +------------------+                        |
|                       |                  |                        |
|                       |      Hello       |                        |
|                       |                  |                        |
|                       +------------------+                        |
|    +------------------+ +------------------+ +------------------+  |
|    |                  | |                  | |                  |  |
|    |    Left Align    | |   Center Align   | |   Right Align    |  |
|    |                  | |                  | |                  |  |
|    +------------------+ +------------------+ +------------------+  |
|                       +------------------+                        |
|                       |                  |                        |
|                       |     Goodbye      |                        |
|                       |                  |                        |
|                       +------------------+                        |
|                       +------------------+                        |
|                       |#######Exit#######|                        |
|                       +------------------+                        |
+-------------------------------------------------------------------+
TA_Samuel@ICP:~/workspace/spring/hw3$
```

- ✓ Reference
  - How To Create And Use makefile In C++

    https://www.softwaretestinghelp.com/cpp-makefile-tutorial/

[Problem 3-2]: Calculator

In this problem, you need to use the GUI Library you created in 3-1 to build a simple calculator.

- ✓ To pass the test, your program cannot contain memory leaks. You can use the following command to test for memory leaks.
  - `valgrind <your_executable_file>`
- ✓ File Description
  - You will be given `hw3-2.cpp` and `Calculator.h`. However, you can modify them whatever you want.
  - You can get these files from `/home/share/hw3/`.
  - For GUI Library, you must use the same header and cpp files that you create from hw3-1
- ✓ Please use the same "`Makefile`" for both hw3-1 and hw3-2 to compile your code. Your code from hw3-1 and hw3-2 must be compiled by typing "`make`", and the name of your executable binary should be `hw3-1 and hw3-2`.
- ✓ The calculator has to follow the 'order of operations' rule when calculating math expressions.

I.e. calculate multiplication first, then calculate addition and subtraction later.

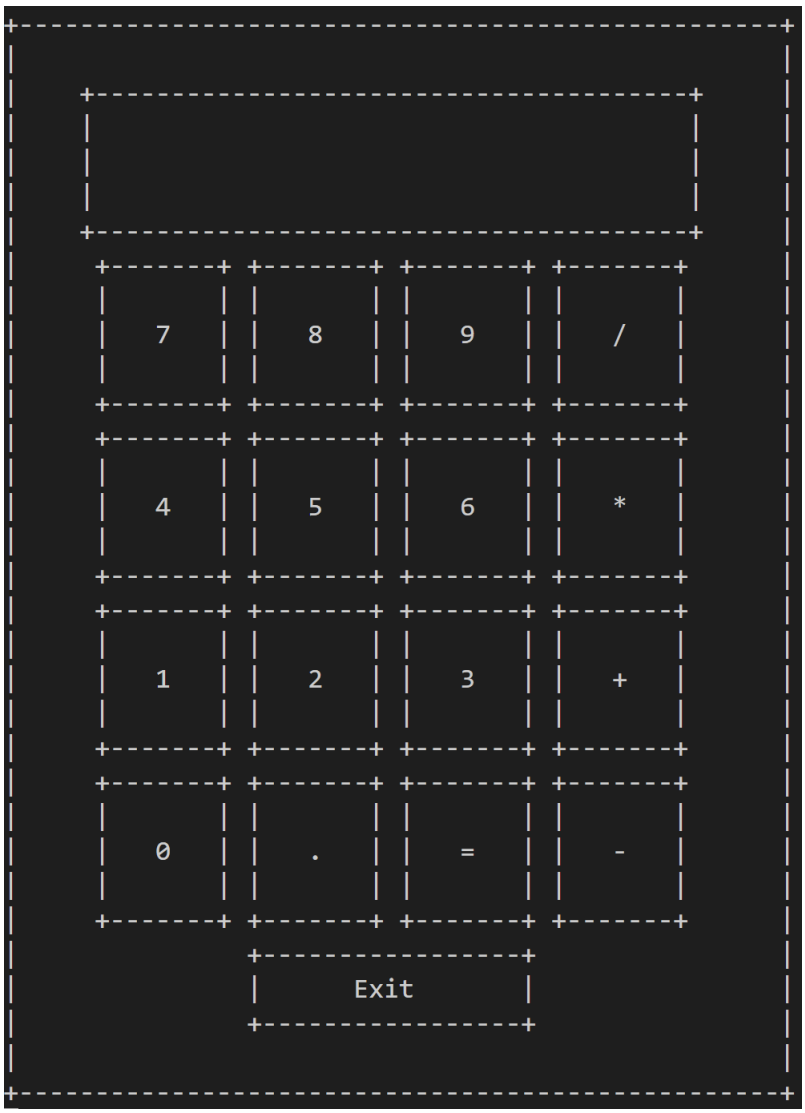
- ✓ Here are the class template and the output. You can reference the comments in header files for more information about what each function does.
- ✓ Calculator.h

```
# #ifndef _CALCULATOR_H_
#define _CALCULATOR_H_
#include "Button.h"
#include "Label.h"
#include "Window.h"
using namespace std;
// You can reference hw3-1.cpp to learn how to use the
gui library you created
class Calculator {
    static Window window;
    static Label* display;
    Button* numButtons[10];
    Button* exitButton;
    Button* dotButton;
    Button* addButton;
    Button* subButton;
    Button* mulButton;
    Button* divButton;
    Button* eqButton;

    static string expression;
   public:
    // Constructor, setup views
    Calculator();

    // Destructor, call View::deleteAllView();
    ~Calculator();

    // Call window.run()
```

```
    void run();


    // Callback static functions
    static void exitWindow(View* view);
    static void pressSymbolButton(View* view);
    static void pressEqualButton(View* view);


   private:
    // Evaluate the expression inputed by buttons
    static double evaluate(string expression);
};
#endif
```

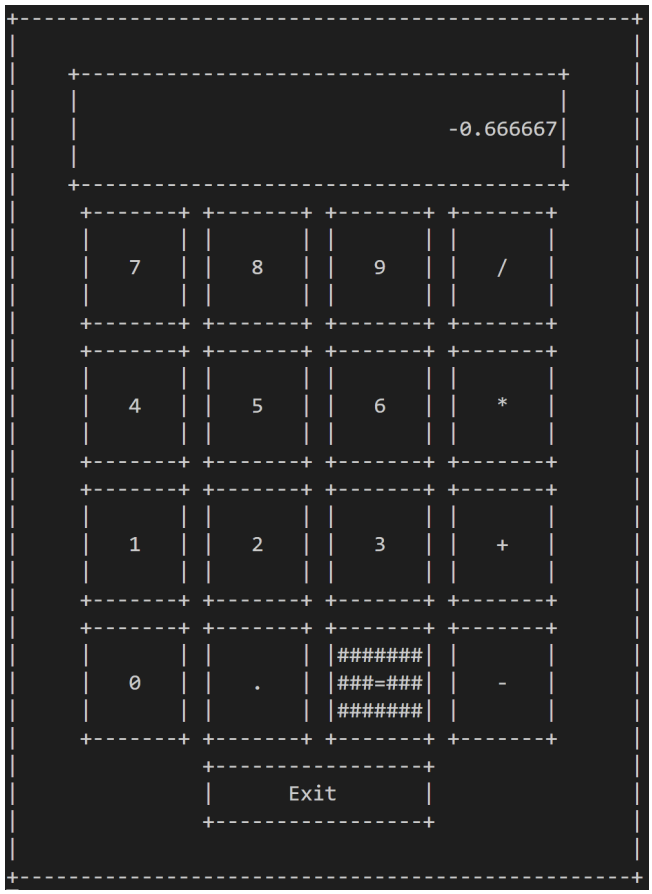
✓ `$ make`

`$ ./hw3-2`

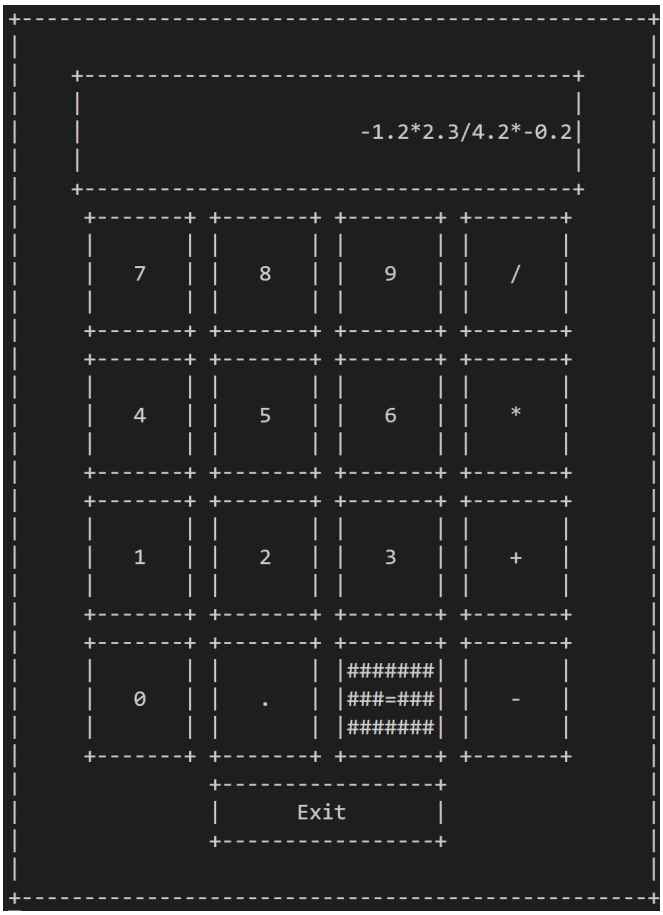


Press Arrow Key to input “3+5*2/3+8-5*3”

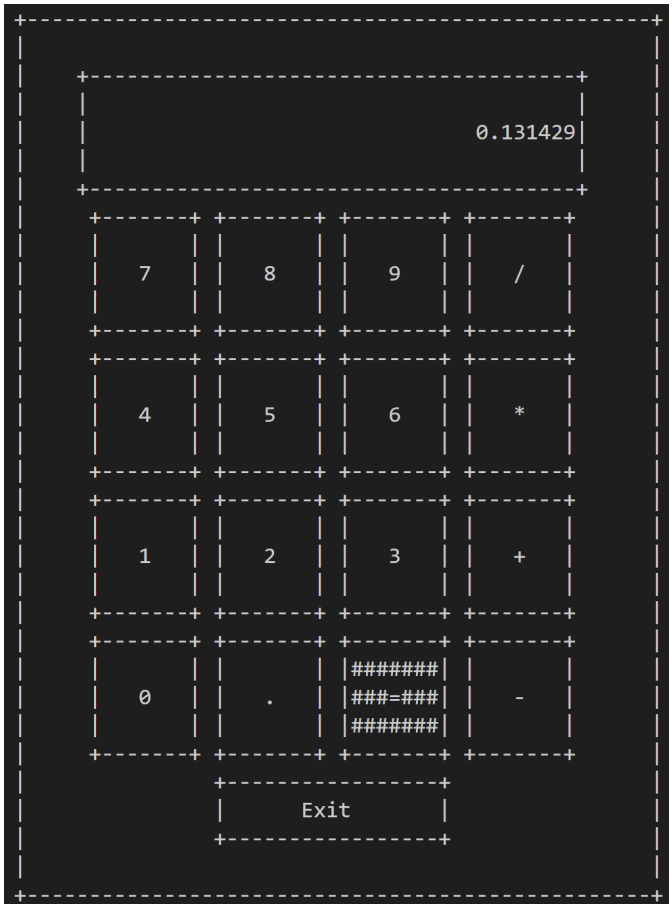
Press Arrow Key to select “=” then press ENTER



Press Arrow Key to input “-1.2*2.3/4.2*-0.2”



Press Arrow Key to select “=” then press ENTER



Press Arrow Key to select “Exit” then press ENTER