EEN118 LAB EIGHT

This week you are going to make an interactive calculator. It doesn't have to be very fancy, just functional. Like the kind you could buy for $10.

1. *A Button*

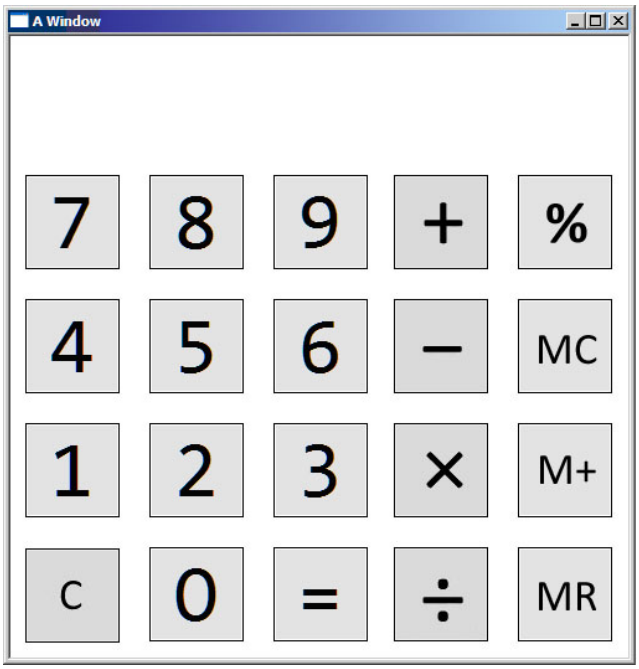
Write a function that will draw a single button, of the sort that might be useful for a calculator. You may have to experiment with the pen position to get the digits properly centred.

The function should be given parameters to tell it the size of the button and what symbol it should contain within it. Shade the button and give it an outline just so that it doesn't look dreadful.

You may like to remember that there is a library function called `set_font_size(`*n*`)`. It selects the font to be used by `write_string` so that it will fit neatly in a box n pixels high. What a coincidence.

2. *Some Buttons*

Now write a function that draws a whole grid of buttons, as they would appear on a calculator. Remember to leave space for a numeric display to be added later.



Plan the positions of your buttons carefully so that they fit neatly within the window. You should define named constants for the window's width and height, and calculate button sizes and positions from those values. Then you will be able to change the size of your calculator at any time, without having to recalculate everything. Eventually you should even make the font size depend on the window size so that it always looks right, but that will require a little experimentation.

Take care to ensure that you have a simple regular calculation for the positions of buttons, otherwise the next step will be unnecessarily complicated.

A note about special characters.

× and ÷ don't appear on the keyboard. In order to type them, you must enter a mysterious key sequence. For the multiplication sign, hold down the ALT key while typing 0 2 1 5 on the numeric keypad. When you release the ALT key, the sign appears. For the division sign, the sequence is 2 4 6 (without the leading zero). You can find all sorts of interesting characters if you look.

3. *Clicking*

The graphics library allows your program to detect mouse clicks. This little snippet of code:

```
wait_for_mouse_click();
const int x = get_click_x(), y = get_click_y();
cout << "Mouse clicked at position (" << x << ", " << y << ")\n";
```

causes a program to wait until the mouse is clicked somewhere within its graphics window, then report the co-ordinates of the pixel that was clicked on. Try it out. Put that in a loop after you've drawn the grid of buttons, and make sure it does what you would expect.

Now the real task is to convert the pixel co-ordinates to something that represents which button (if any) the mouse was clicked within. If you chose the same layout of buttons as I did, and you have a simple calculation for the positions of buttons, this will be easy.

For now, just work out which row and column of buttons the mouse click was in. In the diagram, the "7" button is in row 1 column 1, and the "×" button is in row 3 column 4. Your program should be modified so that a mouse click on the "7" button makes it print "`clicked row 1 column 1`" and a click on the "×" button makes it print "`clicked row 3 column 4`", and so on. Then, don't forget to check that the click was actually inside the square of the button.

4. *What did you click on?*

Now convert that bit of code into a very useful function. Whenever it is called, the function should wait until the mouse is clicked, and work out which row and column of buttons the click corresponds to, exactly as before. After that, it should return as its result a value indicating the label of that button. Perhaps 0 to 9 for the digits, and other numbers for the other symbols.

There is no clever trick to work out for this. Once you know the row and column numbers, the best plan is probably just to have a bunch of `if`s, one for each button, returning the right label. So if the click was on row 2 column 2, this function should return 5.

Put it all in a little program and test it well.

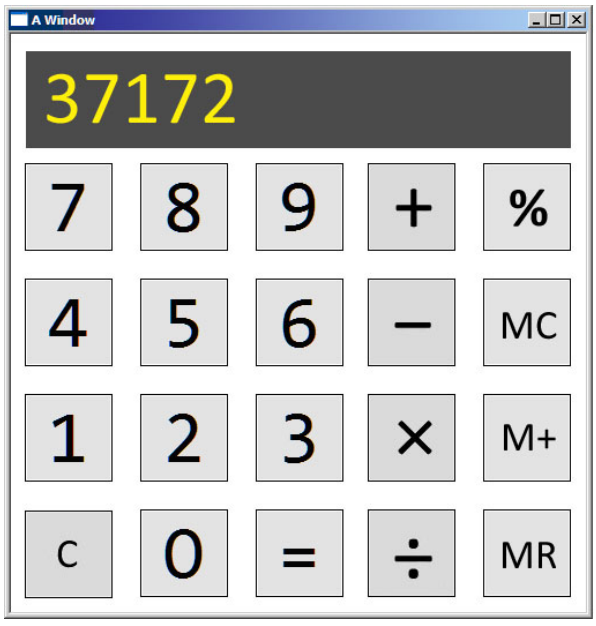
5. *Almost a calculator*

Just for now, ignore all the buttons except for the numeric ones and Clear. As each numeric button is clicked, your program should keep track of the entire number that has been entered (so if "`7`" then "`4`" then "`8`" are clicked, it should have in its mind the `int` value 748).

There is an easy way to do this, and it is one of those situations where a variable can be useful. If your program allows itself to have an int variable that will accumulate a number as it is entered, this plan will work:

start with the variable set to zero.
repeat this loop:
Wait for a button to be pressed.
If it was the "9" button, the multiply the variable by 10 and add 9.
If it was the "8" button, the multiply the variable by 10 and add 8.
If it was the "7" button, the multiply the variable by 10 and add 7,
etc etc etc.
Clear should reset absolutely everything in your program, that will make debugging much easier.
Print the new value of the variable.

6. *Calculators have displays*



There isn't much to say about the display, just make it always show the current value. The library function `write_string` will happily take an int as its parameter.

7. *Finally*

Make the other buttons do their thing.

Get a clear idea of exactly what should happen when each button is pressed. It is not complicated, but unless you think it through first, your program might be. You can keep it restricted to just `int`s, but try to make it into a sturdy product, one that doesn't explode if you try to divide something by zero for instance.

In the diagrams, the `%` sign was intended to represent the modulo operator, like in C++. You can interpret it as a percentage calculator if you want, but I never really got the point of that button.

As far as MC, M+, and MR are concerned, you can be creative if you want. There is no reason why you should have exactly these operations, but we definitely want more than just plus, minus, times, and divide. If you decide to go with these operations, the idea is that there is a separate memory variable that generally has no effect on the display. When you press MC (memory clear), the memory variable is set to zero. If you press M+, whatever number is on the display gets added to the memory variable. If you press MR (memory recall), the display value is set to equal the memory value.

8. *That's it.*

There is extra credit available for good enhancements, such as decimal points and extra function keys. You know what calculators are normally capable of. But extra credit is only given if the basic functionality is working and well designed.