

## COMP 2280 Winter 2022 - Lab 5

**Due date: April 22, 2022**

### Resources

- The standard ASCII table.
- See the sample program “keyinteg.asm” in Module 11. **Modify the sample program to complete this lab.**

### Question 1

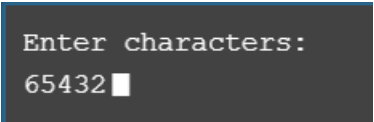
Implement a keyboard Interrupt Service Routine (ISR) that takes the character typed on the keyboard and counts and displays the number of 0-bits in the character. There can be no more than 8 0-bits in an ASCII character.

Hint: Each character is stored in a 16-bit word, but only the 8 least significant bits are used to hold an ASCII character.

For example:

- If the user types the character A, 6 is displayed on the monitor.
- If the user types the character F, 5 is displayed on the monitor.
- If the user types the character G, 4 is displayed on the monitor.
- If the user types the character g, 3 is displayed on the monitor.
- If the user types the character w, 2 is displayed on the monitor.

Use polling to update the display — you are not allowed to use a TRAP instruction for output. You do not need to output the actual character, only the number



```
Enter characters:
65432█
```

There are a few things that you need to keep in mind when implementing your main program:

- You must define and setup the stack for use in the ISR .
- Display a prompt such as 'Enter characters:' to let the user know that input is needed.
- You need to set up your addresses for referencing the device registers as shown in class (as shown in the sample program. See the module 11 for details.).
- You must initialize the interrupt vector table with the address of your ISR. The keyboard interrupt is at location x0180.

**Simulator:** Don't forget to change your simulator setting to “Ignore privileged mode” to do this lab. Otherwise, you will not be able to access the privileged memory locations.