CMPT 295 Assignment 1 Solutions (2%)

1. [3 marks] *Web Submission Test*

   No solution required.

2. [3 marks] *Compilers and Interpreters*

   The special virtual machine is called an *emulator*.

3. [7 marks] *Simulation*

   (a) [2 marks] `(n,result)` $\in \{(0,0),(1,0),(2,1),(3,2),(4,2),(5,2),(6,2),(7,3),(8,4),(9,4),(10,4),(11,4),(12,5),(13,6),(14,6),(15,6)\}$

   (b) [2 marks] The subroutine `mystery` counts the number of `0x6f`'s (i.e., lowercase '`o`'s) in the array `str[0..n-1]`.

   (c) [1.5 marks] `%rcx` is a pointer into the array, and it is decremented on each loop. It points to each character of `str[0..n-1]`, loop by loop, until the beginning of `str` is reached.

   (d) [1.5 marks] `str[]` is scanned in reverse order. In other words, `str[n-1]` is examined first, then `str[n-2]` and so on, until finally `str[0]`. This is clear upon examination of the subroutine: `%rcx` is decremented until equal to `str`, progressing towards low memory, i.e., *backwards*.

4. [7 marks] *Integer Multiplication*

```
# This subroutine multiplies the two unsigned integers in %esi and %edi the
# old-fashioned way: by continual addition.  On each loop, %edi is decremented
# and %esi is added to the result in %eax.

times:
        movl    $0, %eax

loop:
        cmpl    $0, %edi
        jz      endl
        addl    %esi, %eax
        decl    %edi
        jmp     loop

endl:
        ret
```