Due Date: End of class on Monday, April 25, 2016

Name: .................................................
1. (20 points)

A certain program offers 48 courses. Bitlist REQUIRED (6 bytes) show which of these are required by majors to graduate.

Suppose array STUDENT contains a bitlist indicating the course passed by a particular major.

Write code to create bitlist REMAINING showing the courses the student still needs to pass in order to graduate.
2. (25 points)

Subroutine bitcount, see course home page, takes an integer parameter and returns the number of 1’s in the binary representation of that integer.

Write Pep/8 assembly language that takes the array REMAINING from Question 1 and outputs the number of courses that the student still need to pass in order to graduate.
3. (30 points)

Assignment was to write a subroutine MAXMIN that took as parameters a pointer to an array and a count of elements and return the value of the largest and smallest elements in the array. For example if we have

```
T: .word 8
   .word 5
   .word 4
   .word 1
   .word -5
   .word 6
```

Then the following code should output -5 and 8

```
subsp 8,i
lda T,i
sta 0,s
lda 6,i
sta 2,s
call MAXMIN
deco 4,s
deco 6,s
addsp 8,i
```

A student’s solution to this assignment is the following. Identify the errors

```
MAXMIN:   lda 0,i
          sta 6,s
          sta 8,s
          ldx 0,i
loop:     addx 1,i
          cpx 2,s
          brge end
          lda 2,sxf
          cpa 6,s
          brgt skip
          sta 6,s
skip:     cpa 8,s
          brgt skip2
          sta 8,s
skip2:    br loop
end:      ret0
```
4. (25 points)

Consider the following grammar for arithmetic expressions.

\[
\begin{align*}
E & \rightarrow E + T \mid E - T \mid T \\
T & \rightarrow T * F \mid T / F \mid F \\
F & \rightarrow (E) \mid a \mid b
\end{align*}
\]

For each of the following expressions, indicate if is in the language described by this grammar and, if it is, draw the syntax tree.

a. \((a + b)(a - b)\)
b. \(-a + b\)
c. \(a + b * b\)
d. \(b * (a - b)\)
e. \((-a) * b\)