PROGRAM 3

CSCI/CMPE 2333 Fall 2016 Due December 6, 2016

The problem of finding all right-angle triangles for which the legs and the hypotenuse are integers leads to the Diophantine equation

$$z^2 = x^2 + y^2$$

Its solutions, called Pythagorean triples, can be represented by the formulae

$$x = u^2 - v^2$$

$$y = 2uv$$

$$z = u^2 + v^2$$

where u and v are arbitrary positive integers. Using arbitrary values for u and v can produce Pythagorean triples which are multiples of each other. For example,

u = 2, v = 1 ==> x = 3, y = 4, z = 5
u = 3, v = 1 ==> x = 8, y = 6, z = 10

Notice that the second triple (8, 6, 10) is just a rearrangement of twice the first triple (3, 4, 5).

To eliminate these multiples and generate unique Pythagorean triples, restrictions are placed on u and v. They are:

if u is even/odd, v must be odd/even
u and v must be relatively prime (their greatest common divisor (gcd) is 1)

The following algorithm does this:

```
U = 2
REPEAT
    IF   U is even
         V = 1
    ELSE
         V = 2
    ENDIF
    REPEAT
         IF   gcd(U, V) = 1
              triple(U, V)
         V = V + 2
    UNTIL   V > U
    U = U + 1
UNTIL   U = 10
```

(cont'd on back)

```
procedure triple(U, V)
    X = U*U - V*V
    Y = 2*U*V
    Z = U*U + V*V
    IF   X > Y
           swap X and Y
    ENDIF
    write out X, Y, Z
    RETURN
```

An efficient technique for finding the greatest common divisor (gcd) is due to a Greek mathematician named Euclid (ca. 300 BC). To find the gcd of two numbers, A and B, do the following:

```
WHILE   B > 0
     A = A mod B          (the remainder from A/B)
     swap A and B
ENDWHILE
GCD = A
```

Write an assembly language program which finds Pythagorean triples using the above algorithm. There is no input to your program. Your output should be a list of the triples displayed on the screen, one triple per line.

Implement the TRIPLE and GCD routines as procedures called TRIPLE and GCD. Use registers EAX and EBX to pass U and V to the procedures, and pass the gcd back in register EAX (the procedure TRIPLE does not pass anything back). The procedures should protect all registers used.

NOTE: The procedures TRIPLE and GCD should NOT reference the values U and V stored in the main procedure! That is, use registers to pass parameters.

You may assume that all values are unsigned integers.

Hand in:
1) A documented listing of your program
2) The output of your program