

Quiz #8  
Monday, November 13<sup>th</sup>

1. [10 pts] Complete the implementation of the function `CircleArea` that calculates and returns the area of a circle ( $\pi r^2$ ) using Q32 fixed-point reals. Your solution may call the library functions `Q32Ratio` and `Q32Product` as needed, but do not write those functions.

```
// Data type declaration:
typedef int64_t Q32 ;

// Prototypes of library functions:
Q32 Q32Ratio(int32_t top, int32_t btm) ;
Q32 Q32Product(Q32 a, Q32 b) ;
```

```
Q32 CircleArea(Q32 r)
{
    Q32 pi = Q32Ratio(314159, 100000) ;
    Q32 rSquared = Q32Product(r, r) ;
    return Q32Product(pi, rSquared) ;
}
```

2. [10 pts] The following function uses Q32 fixed-point reals to calculate the area of a triangle. Translate it into ARM assembly language:

```
Q32 TriangleArea(Q32 base, Q32 height)
{
    return Q32Product(base, height) >> 1 ;
}
```

```
TriangleArea:
    PUSH    {LR}
    BL      Q32Product
    LSRS    R1,R1,1
    RRX     R0,R0
    POP     {PC}
```

3. [10 pts] Calculate the product  $A \times B = 1002_{10} \times 3004_{10}$  by decomposing the operands into their least and most-significant halves. Give the value of each of the four partial products, indicate which operands were used to produce each partial product, show their relative position for summation, and perform that addition to produce the final result. Do all of your work in decimal.

```
AHI = 1010, ALO = 0210
BHI = 3010, BLO = 0410

AHIBHI:    0300
AHIBLO:     0040
ALOBHI:     0060
ALOBLO:      0008
          -----
          0301000810
```

1. [10 pts] The unsigned product of the two binary integers  $1011_2$  and  $0110_2$  is  $01000010_2$ . Show in clear detail the arithmetic operation(s) and the relative positions of their operands that is required to convert the unsigned product into a signed 2's complement product. Do all of your work in binary.

1011 is negative, so subtract 0110 from the most-significant half of 01000010:

```
  0100 0010
- 0110
-----
  1110 0010
```