

Maths 1261 Quiz 5 answers Friday 6/12/13

(it is ok to collaborate)

(1) Complete the routine `product ( )` below.

```
typedef struct { double re, im; } COMPLEX;
COMPLEX * zero_complex ( )
{ /* as in lecture */ }
COMPLEX * product ( COMPLEX * a, COMPLEX * b )
{ ... }
```

Answer

```
COMPLEX * product ( COMPLEX * a, COMPLEX *b )
{
    COMPLEX * c = zero_complex ( );
    c->re = a->re * b->re - a->im * b->im;
    c->im = a->re * b->im + a->im * b->re;
    return c;
}
```

(2) Simulate the routine `xxx ( n )` below, with $n=4$. What does it do in general, given $n \geq 0$?

```
int xxx( int n )
{
    int x;

    if ( n == 0 )
        return 0;
    else
    {
        x = xxx ( n-1 );
        return x + 2 * n - 1;
    }
}
```

Answer

```
xxx
n 4   x ?
xxx
n 3   x ?
xxx
n 2   x ?
xxx
```

```

        n 1 x ?
xxx
        n 0 x ?
return 0
        n 1 x 0
return 0 + 2 - 1
        n 2 x 1
return 1 + 4 - 1
        n 3 x 4
return 4 + 6 -5
        n 4 x 9
return 16

```

(3) Simulate the program below. What $yyy(n)$ does in general is still unknown.

```

void yyy( int n )
{
    printf("%d\n", n);
    if ( n > 1 )
        if ( n%2 == 0 )
            yyy ( n/2 );
        else
            yyy ( 3*n + 1 );
}

main()
{
    yyy (10);
}

```

Answer

```

yyy 10
n 10
prints 10
yyy 5
n 5
prints 5
yyy 16
n 16
prints 16
yyy 8
n 8
prints 8
yyy 4
n 4

```

```

        prints 4
    yyy 2
        n 2
        prints 2
        yyy 1
        return from yyy(1)
    return from yyy(2)
return from yyy(4)
return from yyy(8)
return from yyy(16)
return from yyy(5)
return from yyy(10)

```

(4) Simulate the following program. What does $zzz(n)$ do in general, given $n \geq 1$?

```

int zzz (int n)
{
    static int w = 0;
    if ( n > 1 )
    {
        ++ w;
        zzz ( n/2 );
    }
    else
        return w;
}
main()
{
    printf("zzz(19)=%d\n", zzz(19));
}

```

```

main
  calls zzz(19)
  zzz
    n 19                                w 0
                                         w 1
    zzz (9)
    zzz
      n 9                                w 1
                                         w 2
      zzz (4)
      n 4                                w 2
                                         w 3
      zzz (2)
      n 2                                w 3

```

w 4

```
    zzz (1)
    return 4
    return 4
    return 4
    return 4
    return 4
    prints
zzz(19)=4
```

In general, given $n \geq 1$, $zzz(n)$ returns $\lfloor \log_2 n \rfloor$.

(5) Say what gets printed, explaining why.

- (i) `printf("%f\n", ((double) 'J' - 'A')/('e'-'a'));`
 - (ii) `printf("%d\n", (int)(char) 200);`
 - (iii) `printf("%d\n", (int)(unsigned char) 200);`
 - (iv) `printf("%c\n", '0' + 3);`
 - (v) `printf("%c\n", 'a' + 'H' - 'A');`
-

Answer.

- (i) 2.250000
The numerator is 9.0 and the denominator 4.
 - (ii) -56
Sign extension means that 8-bit numbers from 128 to 255 are treated as negative, and they would be in the negative range from -128 to -1 , and a negative number x in that range is encoded as $256+x$. In particular -56 is encoded as 200 and 200 converts to -56 .
 - (iii) 200 With unsigned char, there is no sign extension.
 - (iv) 3 In ASCII, digits '0', '1', etc are adjacent.
 - (v) h In ASCII, the distance from 'a' to 'h' equals the distance from 'A' to 'H'.
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