

# 08.71.35 Uppbygging tölva (English exam)

Final exam  
2001

December 17th

Time: 13<sup>30</sup>-16<sup>30</sup>

All *written* materials and a calculator are allowed.

1. [15%] We are designing a 16-bit IEEE floating point format (i.e. a hidden bit, exponent on Excess form, etc.) What is the most number of bits and the least number of bits that can be used for the exponent part, so that the format still complies with the IEEE standard for denormalized numbers, +/??, etc.? Justify your answer. What is the largest and smallest normalized number in each case?

2. [15%] a) Multiply the binary numbers 010010 and 011110 with the modified Booth algorithm.

b) Why can the pairs +1, +1 and -1, -1 never come up when grouping the bit pairs in the modified Booth algorithm?

3. [15%] Describe what the following pieces of assembly code do. Note that the former piece can be far away from the second one. Describe in particular the purpose of the register BX and the purpose of the latter piece of code.

```
        lea    bx, aft
        mov    ax, 5
        jmp    fa
aft:    mov    utk, ax
```

. . .

```
fa:    push   cx
        shl   ax, 1
        mov   cx, ax
        shl   ax, 1
        shl   ax, 1
        add   ax, cx
        pop   cx
        jmp   bx
```

4. [20%] Write a function in 16-bit x86 assembly language that transposes a matrix. Below is a C++/Java program that transposes the matrix A:

```
for(i=0; i<N; i++)
  for(j=i+1; j<M; j++) {
    int t = A[i][j];
    A[i][j] = A[j][i];
    A[j][i] = t;
  }
```

}

Assume that the function will get a pointer to `A[0][0]` in the register `SI`, and the values for `N` in `CX` and `M` in `DX`. The function has to preserve all the registers.

**5. [20%]** Below is a function that calculates the color of a point  $(ca, cb)$  of the Mandelbrot set. Translate the function to IA-32 assembly language that executes inline in Visual C++. You do not have to translate the function header or the definitions of `a` and `b`. You can decide if you translate the `return`-statement, but the function has to return the correct value in any case.

```
int Mandel(double ca, double cb)
{
    double a = 0.0;
    double b = 0.0;

    for( int i=0; i<100; i++ ) {
        a = a*a - b*b + ca;
        b = 2.0*a*b + cb;
        if( a*a + b*b > 4.0 )
            break;
    }

    return i;
}
```

**6. [15%]** A specific hard disk is 80GB. It has 2 platters, with all sides used. There are several zones on each platter with different number of sectors per track. The zone with the most number of sectors per track has 882 sectors. Each sector contains 512 bytes.

- a) Given that the maximum transfer rate is 433Mb/sec, what is the rotation speed of the disk?
- b) If it takes 1.2 msec to move the disk head between adjacent tracks, what is the maximum sustained transfer rate in the zone with the most number of sectors? If you couldn't solve part a), then you can use any typical value for rotation speed here.
- c) Which would improve the sustained transfer rate more: *i*) improving the speed of the read head from 1.2 msec to 0.8 msec or *ii*) increasing the rotation speed of the disk by 10%? You can use any value for the rotation speed if you couldn't solve part a).