Homework Lecture 4

3.1
Show the results of adding the following pairs of five-bit twos complement numbers and indicate whether or not overflow occurs for each case.

```
  1 0 1 1 0
+ 1 0 1 1 1
-----------
```

```
  1 1 1 1 0
+ 1 1 1 0 1
-----------
```

```
  1 1 1 1 1
+ 0 1 1 1 1
-----------
```

3.3
Add the following twos complement and ones complement binary numbers as indicated. For each case, indicate if there is overflow.

Two's complement

```
  1 0 1 1.1 0 1
+ 0 1 1 1.0 1 1
---------------
```

One's complement

```
  1 0 1 1.1 0 1
+ 0 1 1 1.0 1 1
---------------
```

3.4
Show the process of serial unsigned multiplication for 1010 (multiplicand) and multiplied by 0101 (multiplier).
In the lecture hardware for a sequential unsigned multiplier is given. So for this example the intermediate steps (content of the registers after each step).

Exercise 1
The IEEE FP standard 754 also defines a "double precision" floating point number system. Properties:

- total number of bits 64
- sign: single bit (left most bit)
- exponent: 11 bits, excess 1023 code, all zero and all one is used for special numbers.
- fraction field 52 bits. A hidden bit is used (not included in the 52 bits). Point is right of hidden bit.

For the normalized numbers:

a) Max decimal value of the mantissa (M_{max})
b) Min decimal value of the mantissa (M_{min})
c) Max decimal value of the exponent (E_{max})
d) Min decimal value of the exponent (E_{min})
e) Largest positive decimal value that can be representend (V_{max})
f) Smallest positive decimal value that can be represented (V_{min})