1. (20 points) Binary addition
   (a) (5 points) Compute the following longhand binary addition:
   \[
   \begin{array}{c}
   1011 \\
   + 0101 \\
   \end{array}
   \]
   (b) (5 points) What is the decimal representation of \(1011_2\)?
   (c) (5 points) What is the decimal representation of \(0101_2\)?
   (d) (5 points) What is the decimal representation of the sum you computed in part 1(a) above?

2. (20 points) Hex addition.
   (a) (5 points) Compute the following longhand hex addition:
   \[
   \begin{array}{c}
   \text{DEAD} \\
   + \text{BEEF} \\
   \end{array}
   \]
   (b) (5 points) Convert the hex number 0xDEAD to binary.
   (c) (5 points) How many bits do we need to represent the hex number 0xDEAD in binary?
   (d) (5 points) Is 0xDEAD a positive or negative number in 2’s complement representation? How do you know?

3. (20 points) Binary bitwise logic
   (a) (5 points) Compute the following longhand binary exclusive OR:
   \[
   \begin{array}{c}
   101100 \\
   \oplus 010100 \\
   \end{array}
   \]
(b) (5 points) Compute the following longhand **binary** AND:

\[
\begin{array}{ccccccc}
1 & 0 & 1 & 1 & 1 & 1 \\
& & 0 & 1 & 0 & 1 & 0 \\
\hline
& & 0 & 1 & 0 & 1 & 0 \\
\end{array}
\]

(c) (5 points) Compute the following longhand **hex** AND:

\[
\begin{array}{cccccccc}
D & E & A & D \\
& & 0 & 3 & F & F \\
\hline
& & 0 & 3 & F & F \\
\end{array}
\]

(d) (5 points) Is the output of the hex AND operation in part 3(c) above a positive or negative number in 2’s complement representation? How do you know?

4. (20 points) Bit shifts
   (a) (5 points) Compute \(1000 \ 0101_2 >> 3\)

(b) (5 points) What is the decimal representation of \(1000 \ 0101_2\)?

(c) (5 points) What is the decimal representation of the result of part a above?

(d) (5 points) Write out the operation being performed in part 4(a) above in terms of a decimal multiplication or division and calculate the result of the multiplication/division. *Hint: should be the same as the result of the bit shift*