CMPT 295: Encoding and Decoding Numbers

1. ENCODING / DECODING

(a) Express the decimal number 114.625 as a base-2 number and as a hexadecimal number.

(b) Consider the following binary sequence: 11000111.

i. What decimal number does this sequence represent if it is interpreted as a base 2 integer?

ii. Can it be interpreted as a BCD encoding? If so, then what number is represented; otherwise explain why it does not represent a valid BCD encoding.

iii. If the binary sequence is chosen from the set of all fixed length codewords of the same length, How many distinct fixed length codewords belong to the set?

iv. An alphabet of 100 symbols is to encoded with a set of fixed length codewords. What is the minimum length of each codeword?

2. **Floating Point Representation**

A floating point representation for real numbers is to be designed, subject to the following constraints:

- A 16 bit format is to be adopted.
- The value zero will be represented by 0000_{16}.
- The representation should accommodate eight significant bits of precision, including a most significant implied '1' bit (except for the representation of zero).
- Exponents in the range (-126 to $+126$) should be accommodated.
- An exponent value of $+127$ will represent overflow.
- An exponent value of -127 will represent underflow.
- The significand field will be interpreted as a sign-magnitude value.
- The exponent will be interpreted as a bias-127 encoded value.

(a) Draw a diagram of the floating point format, indicating the bit positions of the exponent and significant fields.

(b) What real number is represented by the floating point value $BF80_{16}$?

(c) Convert the number -2^{16} into its corresponding 16-bit floating point representation. Express your answer in hexadecimal.

3. **Floating Point Representation**

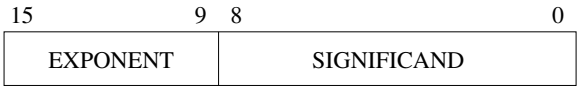
An unsigned floating point format is defined as follows:

(a) What is the 16-bit floating point representation of the decimal number 9.75?

(b) Express your answer as a VHDL hexadecimal constant.

(c) What base-2 value is represented by the floating point encoding `0x8500`?

(d) Suppose that the floating point forma was defined as followst:



i. What is the 16-bit floating point representation of the decimal number 9.75?

ii. Express your answer as a VHDL hexadecimal constant.