

Exercise 7: Basics of computer science, part II

Problem 1: Binary Arithmetic

1. Find the 8-bit two's complement representation of the following integers: -23, -42.
2. Solve using two's complement: $-13 + 52 = ?$.
3. Solve the following expressions in binary representation: $126 \cdot 16 = ?$, $\frac{74}{2} = ?$, $\frac{91}{8} = ?$

Problem 2: Floating Point

1. How many bits are in a standard floating point number? In a double-precision floating point number?
2. Name the different components of a floating point number.
3. Convert the following 32-bit floating point number to a real base-10 number:
1 1000 0001 011 0000 0000 0000 0000.
4. What is the 32-bit floating point representation of 17.75?

Problem 3: Data Representation

The English alphabet has 26 letters. Assuming they occur with equal probabilities:

1. What is the probability P_i of each letter?
2. What is the entropy of the alphabet?
3. If we encode the alphabet in 8 bits code, what is the redundancy?
4. If the redundancy of the alphabet in ASCII is so big, why is 8-bit coding used for it?

Problem 4: SQL Databases

An online forum for discussions about science and medicine has many users, each with his/hers own unique id, username, password, date of joining the forum, date of last message posted and preferred graphical theme. The data is stored in a relational database.

1. Write SQL code to generate the table 'users' which implements the structure above (keyed by user IDs).
2. Write a command to list the data for the first 100 users (i.e. $0 \leq \text{ID} < 100$).
3. The 1,337th user to join was *DMendel*, password 'theMEndel'. He joined on January 30th 2003 and prefers the theme 'Tapirs'. Write a code to add him to the table.
4. *DMendel* wrote a new message. What command should be used to update this information? (assume NOW is a variable storing the current time)
5. User *AnWakefi* decided that he did not like the forum and thus un-registered from it. How would you delete his account?
6. User *mariecur* wishes to see the date of her last post + which theme she is using. How would you implement this query?