Study Guide: Unit 1

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September 30, 2021
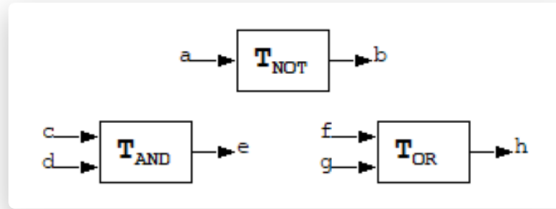
Figure 1: Turing Machines

1. You are given the following three simple Turing Machines that implement the logic operations NOT, AND, and OR, and their connections are labeled with the letters a through h. Refer to Figure 1. Connect these simple machines to form the logical function exactly as shown below (no simplifying the function): ((NOT 1) AND 2) OR 3

   ○ input 1 connects to c
   ○ e connects to g
   ○ input 1 connects to a
   ○ input 3 connects to c
   ○ h connects to a
   ○ input 2 connects to d
   ○ b connects to c

2. Assume each choice below shows the addition of two 6-bit fixed-point binary integers. Mark every choice that results in overflow.

   ○ 0111.10 + 0000.11
   ○ 1010.10 + 1101.01
   ○ 0011.01 + 0100.10
   ○ 1110.10 + 0001.10
   ○ 1010.10 + 1100.00

3. Assume each integer shown below is in base 10. Use 7 bits to show each integer in the representation listed. If it is *not* possible to show the integer in the representation listed, answer "xxxxxxx".

   (a) 0 in signed magnitude.
   (b) -22 in 2's complement.
   (c) 37 in 2's complement.
   (d) -44 in unsigned.

4. Convert 1.75_{10} to its equivalent in IEEE 754 32-bit floating point representation. Be careful when entering your 32-bit answer.

5. Assume each choice below shows the addition of two 4-bit 2's complement binary integers. Mark every choice that results in overflow. FYI: Be certain; Canvas deducts points for incorrect choices.

   ○ 1011 + 1100
   ○ 0111+0010
   ○ 1011+1010
   ○ 1110 + 1010

○ 0110 + 1010

6. Consider the following 10-bit fixed-point binary value 0111011.011; what is its value in bae 10 with three digits of precision after the decimal point?

7. Assume that there are 220 books in a library. If every book is to be assigned a unique bit pattern, what is the minimum number of bits required to do this? Additionally, what are the number of books that can be added to the library without requiring additional bits for each book's unique bit pattern?

8. Determine if each of the following pairs of logical expressions are equivalent. HINT: For each pair, use a truth table to show that for all combinations of inputs (i.e., for X only 0,1; for X and Y 00,01,10,11) both expressions produce the same results.

   (a) NOT(NOT(NOT(X))) = NOT(X) ARE equivalent

   (b) NOT(X OR Y) = NOT(X) AND NOT(Y) ARE equivalent

9. Assume each value below shows an integer in 2's complement representation in 2,4,8 and 16 bits length. Convert each binary number to decimal.

   (a) 11

   (b) 1010

   (c) 10100111

   (d) 1101010011011001

10. Convert 61543_{10} to its equivalent in unsigned integer format shown in hex(e.g., A27E) rather than binary.

11. You are given the following partial ASCII table of characters. (Just look up a table online, you're allowed to for this one). Which one of the following is NOT the correct 8 bit ASCII representation of the 3 character emoji?

   ○ >:P is 00111110 00111010 01110000

   ○ :-(is 00111010 00101101 00101000

   ○ :$\hat{)}$ is 00111010 01011110 00101001

   ○ ;-] is 00111011 00101101 01011101

12. Which one of the logical calculations below takes 8-bit binary input X and clears to 0 its bits at odd positions leaving its bits at even positions unchanged, Recall, the left most bit is at position 7, which is an odd bit, and the rightmost bit iis at position 0, which is an even bit.

   ○ X AND 01010101

   ○ X OR 01010101

   ○ X OR 10101010

   ○ X AND 10101010

13. Let X = 010101, Y = 001100 and Z = 101010. What is the result of (X OR (NOT Y)) AND Z?

14. Consider the following IEEE 754 32-bit floating point value

$$01001111\ 01001000\ 00000000\ 00000000.$$

Is its sign positive or negative?
What is its exponent's value in base 10?
Enter the fraction part's value in base 10 in the format 0.XXXX where X is a digit.

15. Name a task you enjoy doing. Describe several high-level steps to complete that task. Next, take ach of these steps and break them down into detailed steps.