1. Define the following terms (18%):
   (a) software-defined networking  (b) virtual memory  (c) bandwidth
   (d) spoofing  (e) pipelining (f) strong typing
2. Convert \(-53.71875\) to IEEE single-precision format. (6%)
3. Suppose a 32-bit instruction takes the following format:

   \[
   \begin{array}{cc|cc|c}
   \text{opcode} & \text{Dst register} & \text{Src1 register} & \text{Src2 register} & \text{immediate} \\
   \end{array}
   \]

   If there are 823 opcodes and 16 registers, what is the range of value that can be represented by the immediate? (6%)
4. What is a bootstrap program, and where is it stored? (6%)
5. Each of the boxes in the following figure is a full-adder circuit. What is the output of the logic circuit? (Please write down the values of S3, S2, S1, and S0) (8%)

6. Given the following transistor-level circuit:
   (a) Give the Boolean expression for \(Z\) in terms of \(A\) and \(B\). (4%)
   (b) Draw the gate-level circuit for \(Z\) using 2-input AND/OR gates and NOT gates. (4%)

7. Compare and contrast an assembler, a compiler, and an interpreter. (6%)
8. What is the worst bottleneck in a computer system? (4%)
9. Name and describe three disk scheduling algorithms. (6%)
10. What is big data and how do we use it? (6%)
11. What are the four necessary pieces of information needed to build a queuing system? (8%)
12. What is a firewall, and what does it accomplish? (6%)
13. Describe how Android uses a unique virtual machine for running Java programs. (6%)
14. What is a loopback and when is it used? (6%)