COSC-175: Systems-I
Fall 2026
Sample mid-term questions

1. **Demonstrate that NOR is a universal operator**. That is, show that AND, OR, and NOT can all be expressed and implemented using nothing but the NOR operator.

2. **Design and draw a circuit that emits the following repeating sequence**:

   $$00, 01, 00, 10, 00, 11, \ldots$$

   Your circuit should have 2 bits of output, as well as *clock* and *reset* inputs. Every 6 clock cycles should progress through the sequence; upon the next cycle, the circuit should "wrap around" and begin the sequence again. The *reset* should return the circuit to the beginning of the sequence. You may use basic memory devices such as *flip-flops* (which may be aggregated into *registers*).

3. **Show the design of a *comparitor circuit***. That is, assuming two 4-bit inputs, $A = (A_3, A_2, A_1, A_0)$ and $B = (B_3, B_2, B_1, B_0)$, generate three 1-bit outputs that represent, respectively, $A < B$, $A > B$, and $A = B$. Assume that the input values are two's complement integers. Show the logic and the circuit that implements it. You may use individual gates as well as high-level components such as adders, multiplexers, etc., as needed.