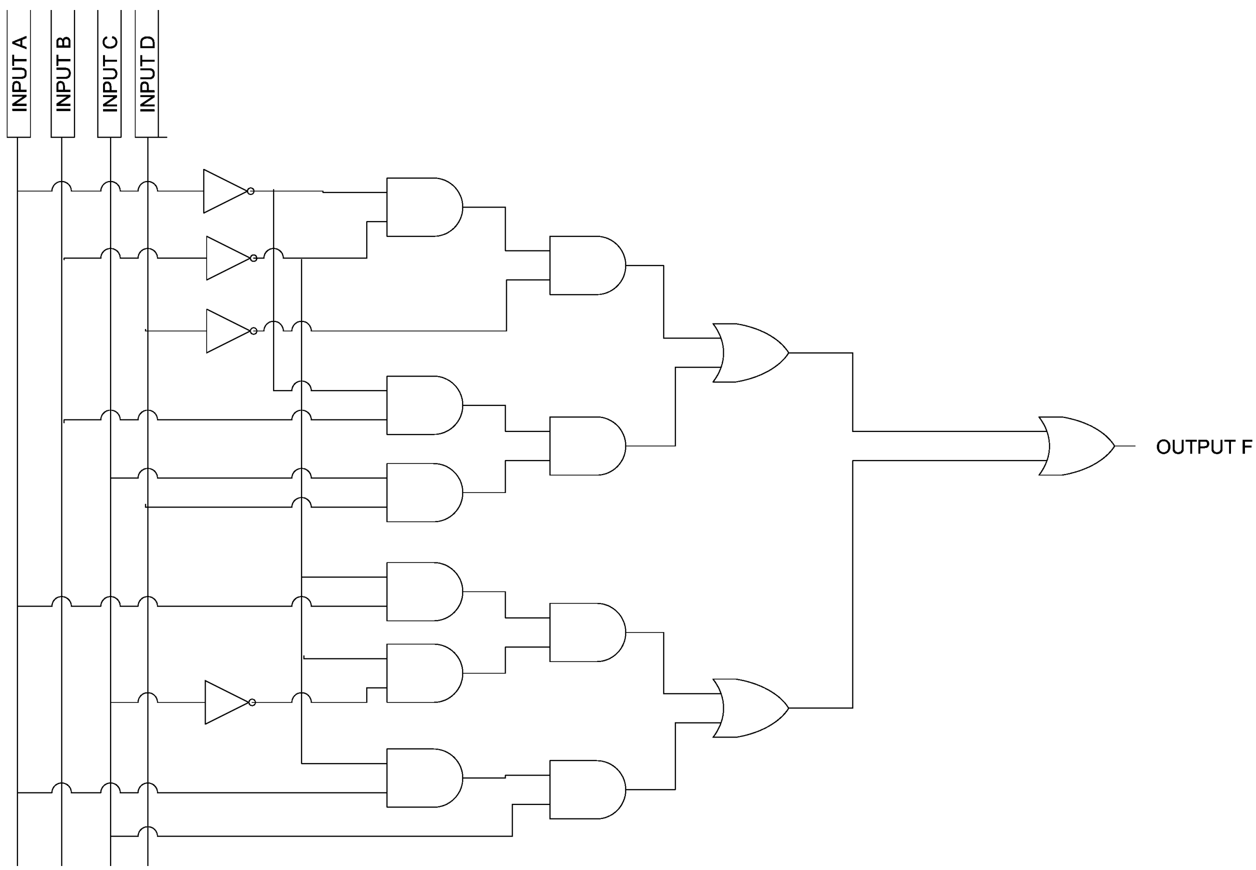
*All the normal rules apply:* *Due next class, work on separate paper, start early, show your work, label everything, specify units, circle answers.*

1. For the following logic functions, construct a truth table for the expression, draw a Karnaugh map from the table, and derive a reduced equation from the K-map (reduce to simplest possible form).
    a. F = A'BC' + ABC + ABC' + BC'
    b. F = A'B'C' + A'B'C + A'BC' + AB'
    c. F = A'B'C'D + A'BC'D + A'BCD' + A'BCD + AB'C'D + AB'CD' + ABC'D

2. For the following diagram:
    a. Determine the output function F (be careful, the rest of the problem requires accuracy here).
    b. Use a truth table and k-map to reduce the function.
    c. Draw a fully-labeled circuit diagram for the reduced expression.
    d. Quantify the difference between the new and original circuits - how many logic gates were saved, how many IC's were saved, and how many time delays (gate levels) were eliminated?



3. A rocket ship is preparing to launch. The system which enables the launch has three status levels, Red, Yellow, and Green. The system has four inputs:

   A: Mission control ready switch (1 = ready, 0 = not ready)

   B: Pilot OK indicator (1= pilot ok, 0 = pilot not ok)

   C: Launch pad motion detector (1 = motion detected, 0 = no motion detected)

   D. Engine ignition detector (1 = engines ignited, 0 = engines dead)

   The ship is clear for takeoff if all of the following conditions are met: Mission control is ready, the pilot is OK, there is no motion on the launch pad, engines are ignited. Launch status should be red if two or less of the above conditions are met. Status is yellow if exactly three of the conditions are met. Green status comes only when the rocket is clear for takeoff.

   Represent each status level with a fully reduced logic function. Hint: You can think of this as three separate problems – one for each status level. For each level, create a truth table, reduce with a k-map and derive the reduced function from the k-map. You should end up with three functions in the end, such as $F_{red}$, $F_{yellow}$, and $F_{green}$

4. A lawn watering system has four inputs: a soil moisture sensor which outputs a HI signal when there is low moisture in the soil; an anemometer which outputs a HI signal if the wind is above a preset threshold; a photoelectric sensor outputs HI in the presence of daylight; and a manual override switch which outputs HI when engaged.

   The system will turn on the sprinklers if ALL of the following conditions are met: soil moisture content is low, wind is below the preset threshold, it is night time. The sprinklers will also turn on regardless of the above conditions if the manual override switch is engaged and the wind is below threshold.

   Design the four-input system such that when the conditions above are met, the final output F is HI when the sprinklers should turn on and LO otherwise. Define your variables, assign a value to each variable's condition, create a truth table, construct a k-map to reduce the output equation, and draw a fully-labeled circuit diagram complete with pin assignments for the devices. You may use 74HC08, 74HC32, and 74HC04 chips in your circuit.