Logic Gates: Some Applications

1. An agricultural facility uses 3 tanks for storage and processing. Each tank contains a fluid level sensor. The sensor outputs a logic high voltage (e.g. +5V) only when the tank is less than 10% full (near empty) ; the sensor outputs a logic low otherwise To status of the tanks can be monitored via indicator lights. To monitor the status of the tank via control panel, a green LED should illuminate if none of the tanks is near empty. A red LED should illuminate otherwise. Design the electronics hardware that will accomplish this task. The inputs to the system are the sensor readings; the outputs are the LED illumination state.

Figure 1. Tanks in a pretty field. Image credit: https://www.lipp-system.de/tanks/liquid-storage-tanks/?lang=en

2. We often encounter digital pulses (time varying signals) as inputs to logic gates, shows as A and B below.
    a. What will be the corresponding output X from a NAND gate? Carefully sketch it.
    b. Now assume A and B are input to a XOR gate. Carefully sketch its output

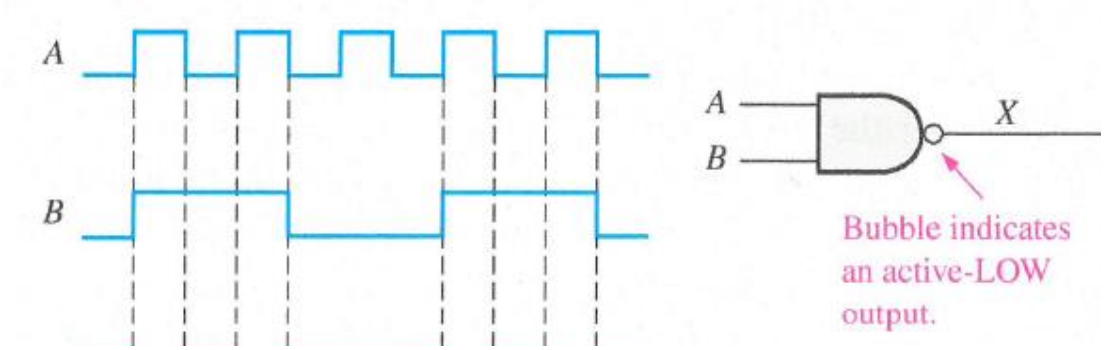

Figure 2. Digital pulse inputs to a logic gate. The regular period of each "clock cycle" is indicated by dotted lines. Image credit: Floyd, Digital Fundamentals 11ed, Pearson publishing

3. An airplane must properly retract landing gear upon take-off and properly deploy it before landing. Assume there is a sensor for each of 3 sets of wheels (1 each under the nose and either wing) that indicates the state of the landing gear. A logical 0 indicates it is retracted; a logical 1 indicates it is properly deployed. Upon approach for landing, the pilots must ascertain the state of the landing gear is properly deployed. A green LED should illuminate if so; otherwise the flight panel should indicate a warning with a red LED. Design the logical circuitry for the airplane's landing gear.

Figure 3. Landing gear on an Air NZ long hauler. Image credit: brittanica.com