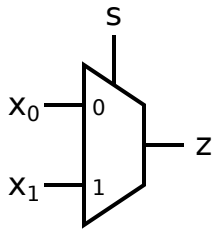
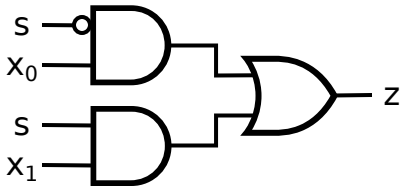
Name: _____ Computing ID: _____

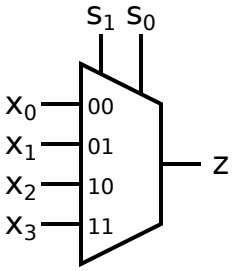
Recall that a 2-input mux



can be built from basic gates:



Consider this 4-input mux:



Draw the basic gates needed to build it:

Let S(x) be the set of bits set in integer x; for example, S(13) would be {0, 2, 3} because 13, or 0b1101, has the 2^0, 2^2, and 2^3 bits set.

Write code bitwise expressions that set variables a through through f such that the following expressions are true. The first one is done for you.

S(a) = S(x) ∪ S(y)

a = x | y

S(b) = S(x) ∩ S(y)

b =

S(c) = S(x) \ S(y)

c =

S(d) = S(x) ∪ {7}

d =

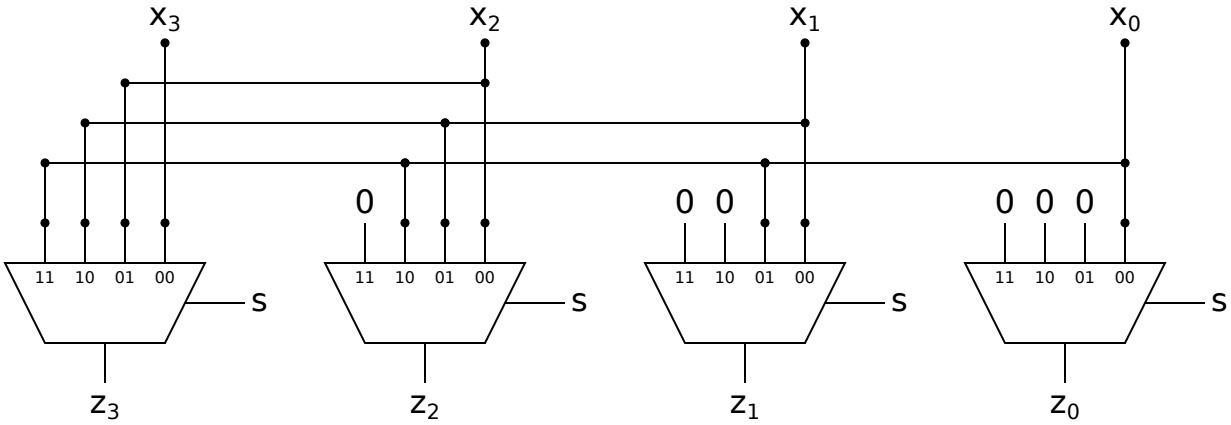
S(e) = S(x) \ {7}

e =

$$f = \begin{cases} 1 & \text{if } 8 \in S(x) \\ 0 & \text{otherwise} \end{cases}$$

f =

The following circuit implements a 4-bit left-shift, z = x << s. Dots are used to show where wires join as opposed to crossing over each other without touching.



Complete the following diagram to implement sign-extending right-shift, z = x >> s. Use dots, etc, similarly to the example diagram above.