CSC258 Computer Organization Lab 1

1   An animal lover *a* , a bird *b* , a cat *c* , and a dog *d* are all on the west bank of a river, indicated by *a=b=c=d=⊥* . The animal lover needs to transport the bird, cat, and dog to the east bank, indicated by *a=b=c=d=⊤* . The boat can carry the animal lover and at most one other thing (bird or cat or dog), so several trips are necessary. If the bird and cat are left together (without the animal lover), the cat will eat the bird. If the cat and dog are left together (without the animal lover), the dog will eat the cat.

(a)   Write the value table (truth table) for a function *danger* that has value ⊤ if something is in danger of being eaten, and ⊥ if all is well.

(b)   Write function *danger* in max of mins (sum of products, disjunction of conjunctions, DNF) form.

(c)   Write the simplest expression you can for *danger* .

(d)   Construct a circuit for *danger* . Use a switch for each input, and an LED for the output.

(e)   Using the circuit, show how the animal lover can transport the bird, cat, and dog from the west bank to the east bank safely. To make one move, flip switch *a* and at most one of *b* , *c* , or *d* ; if you do flip one of *b* , *c* , or *d* , it must be in the same direction as *a* . After each move, check that the result is safe.

2   Three couples are on the west bank of a river, indicated by *h0=h1=h2=w0=w1=w2=⊥* . They all need to cross the river to the east bank, indicated by *h0=h1=h2=w0=w1=w2=⊤* . The boat carries at least one person and at most two people each crossing, so several trips are necessary. If the husband of one couple is without his wife, and the wife of another couple is without her husband, on the same side of the river at the same time, there will be hanky-panky. Hanky-panky happens on a riverbank, not in the boat.

(a)   Write the simplest expression you can for function *hankypanky* .

(b)   Construct a circuit for *hankypanky* . Use a switch for each input, and an LED for the output.

(c)   Using the circuit, show how the couples can cross the river without any hanky-panky.