

*Midterm solutions*

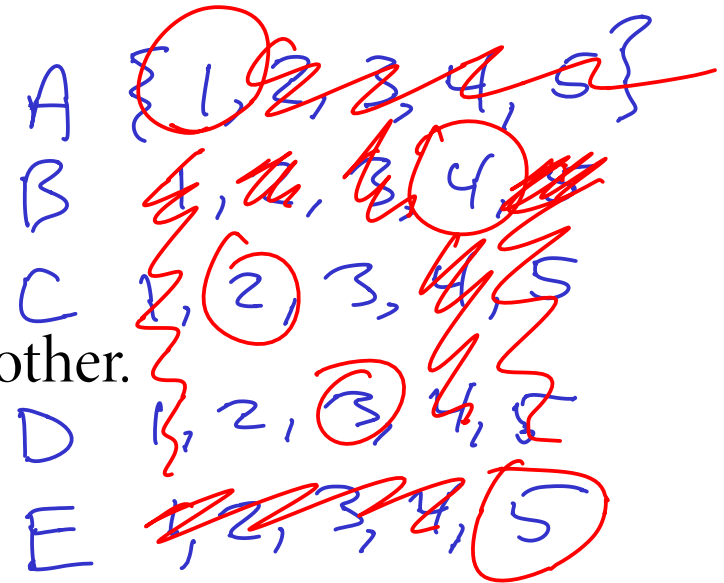
1. For each statement below, fill in the blank with the *best* term from the following list. Some terms might be used more than once; some might not be used at all.

- A\* search • breadth-first search • depth-first search • graph
- heuristic • minimax • modus ponens • prolog • zero sum

- (a) zero sum describes a game in which the gain of one player is balanced exactly by the loss of the other player.
- (b) A\* is an example of an *informed* path-finding algorithm.
- (c) prolog is a programming language based on predicate logic.
- (d) A(n) heuristic is a technique for making an educated guess about the value of a particular state.

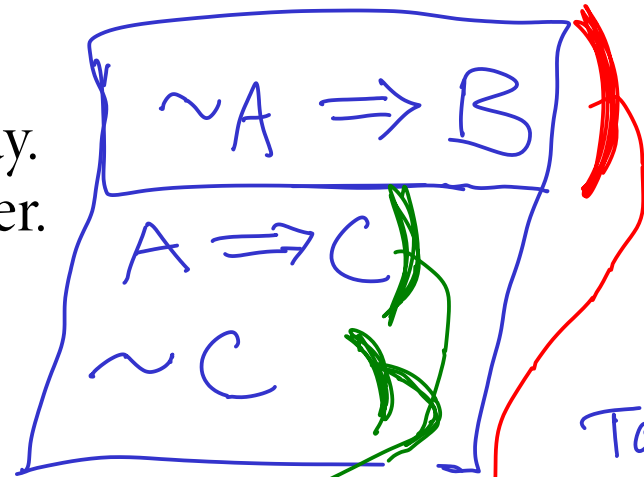
2. Imagine that 5 colleagues are going out for lunch. There are five chairs around a circular table. Find a seating assignment consistent with all of the following constraints:

- (a) No two people can share the same chair.
- (b) Alice must sit in chair #1.
- (c) Bob cannot sit next to Alice.
- (d) Carol and David should sit next to one another.
- (e) Ella must sit in chair #5.



3. I have class every day except Tuesday.  
 On Tuesday, we have sushi for dinner.  
 We're not having sushi today.

A: It's Tuesday  
 B: I have class  
 C: Having sushi



$\sim A$

B

Tollens:

$$\frac{P \Rightarrow Q \quad \sim Q}{\sim P}$$

$\sim P$

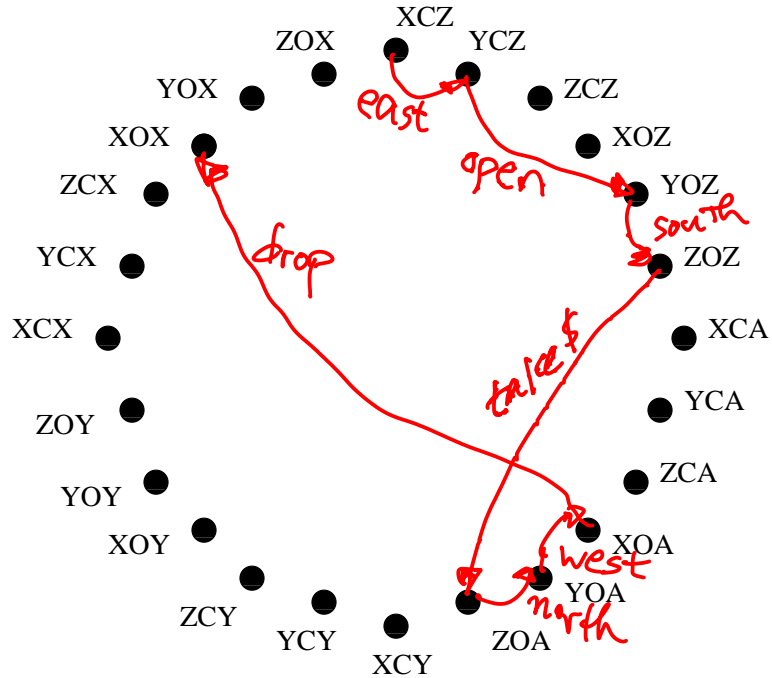
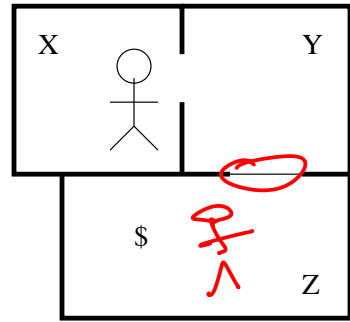
Ponens:

$$\frac{P \Rightarrow Q \quad P}{Q}$$

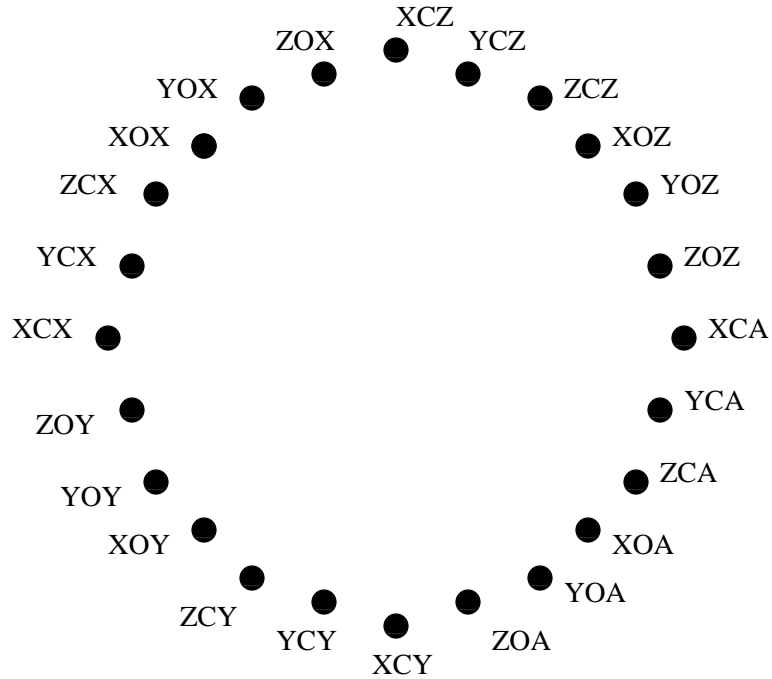
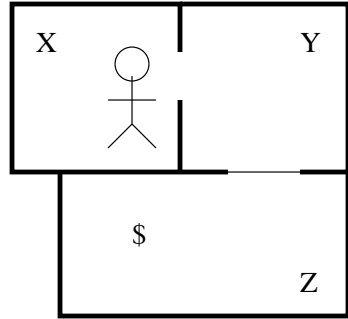
Q

4.

- (a) Trace a complete path from the start state XCZ to the goal state XOX.  
(This corresponds to fetching the treasure, carrying it back to room X, and dropping it there.)



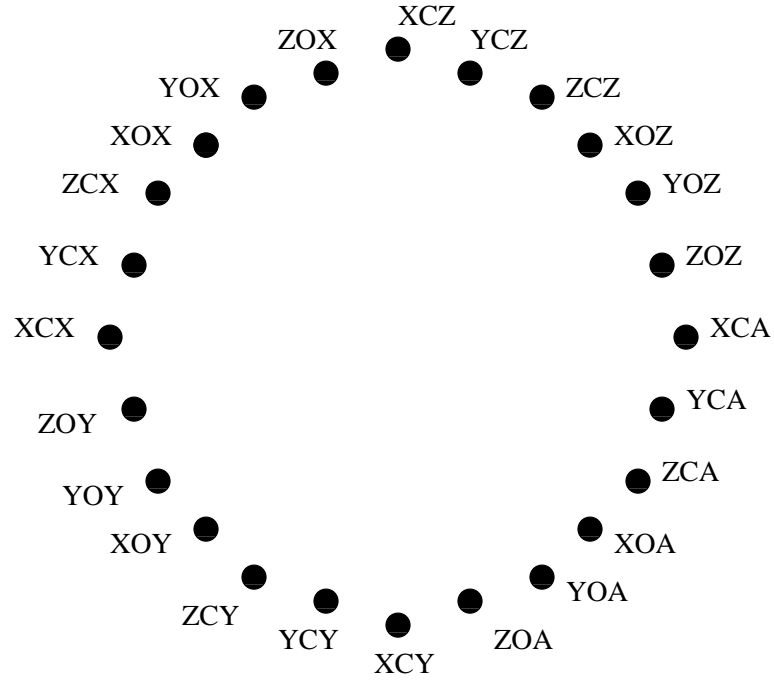
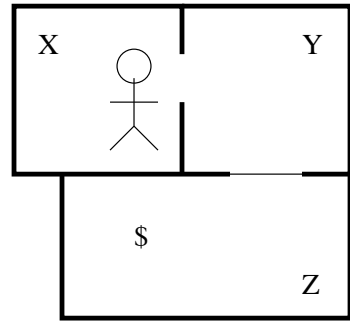
(b) Trace a complete path from the start state  $XCZ$  to the goal state  $XCX$ .  
(Same as above, but this time you close the door again after leaving room  $Z$ .)



(c) In your own words, describe the meaning of the state ZCY.

The adventurer is in room Z, the treasure is in room Y, and the door between Z and Y is closed.

(d) Trace a complete path from the start state XCZ to the state ZCY.





(e) We can represent the state of this world with three components:

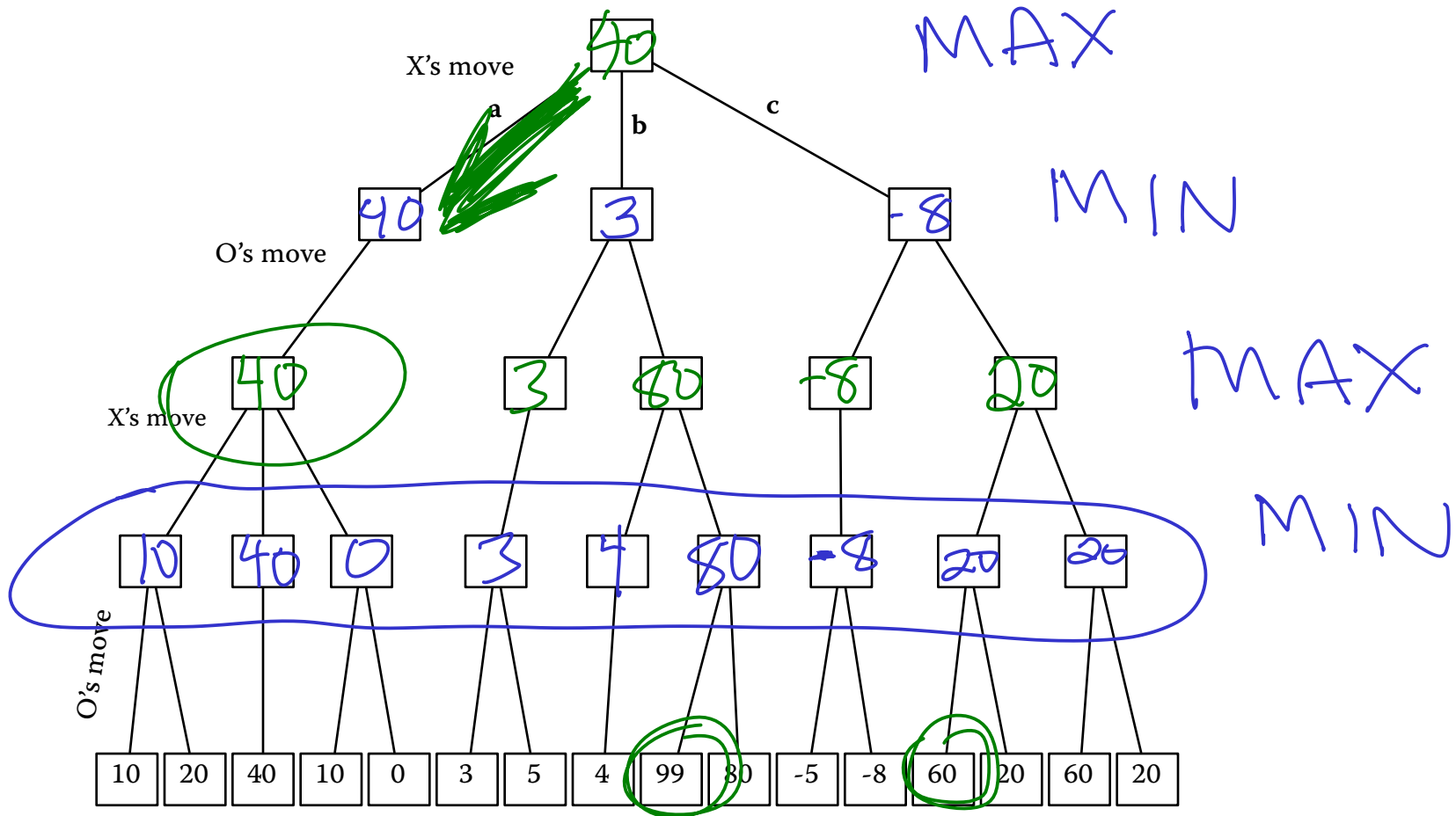
- the room containing the adventurer (X, Y, or Z);  $W$  4
- the status of the door (O for open, or C for closed); and 2
- the room containing the treasure (X, Y, Z, or A if the adventurer is carrying it).  $W$  5

That produces a total of 24 states ( $3 \times 2 \times 4$ ).

How many states would there be if we added another room,  $W$ , to the west of X?

$$4 \cdot 2 \cdot 5 = 40$$

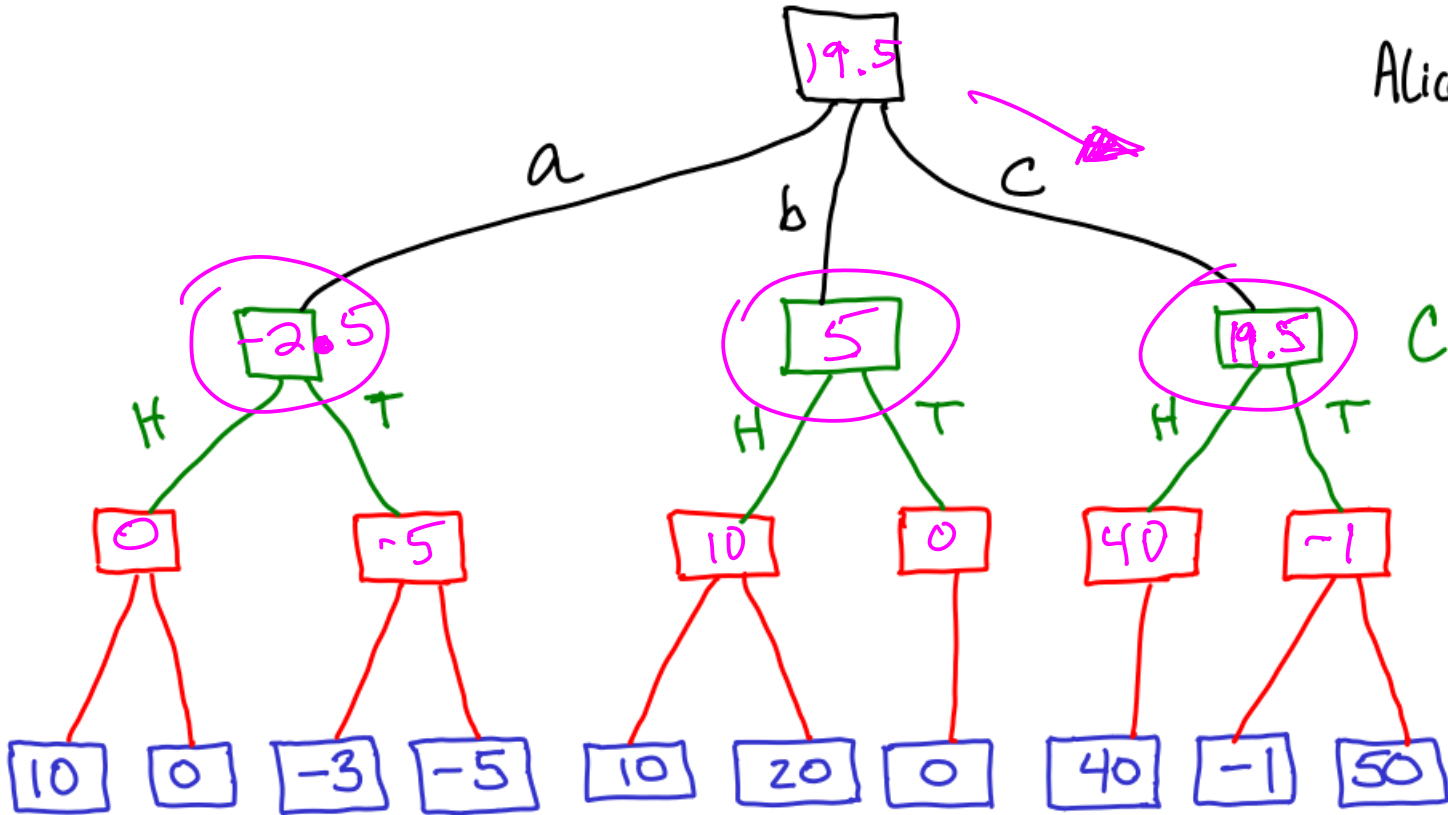
5.



6.

# Expected values

$$\begin{array}{l} H \quad \$10 \cdot \frac{1}{2} = 5 \\ T \quad \$20 \cdot \frac{1}{2} = 10 \\ \hline 15 \end{array}$$

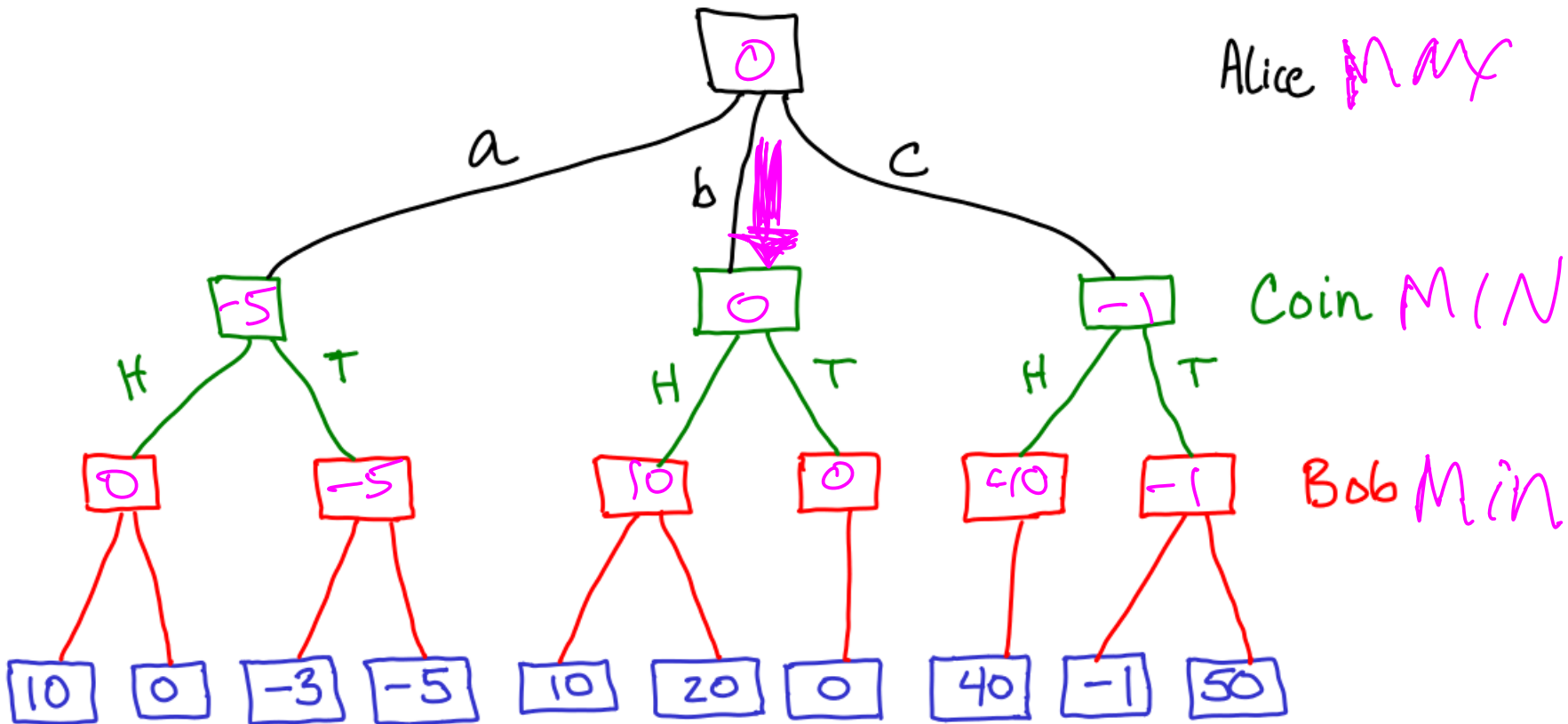


Alice MAX

Coin

Bob MIN

# Worst case



ABC-XYZ

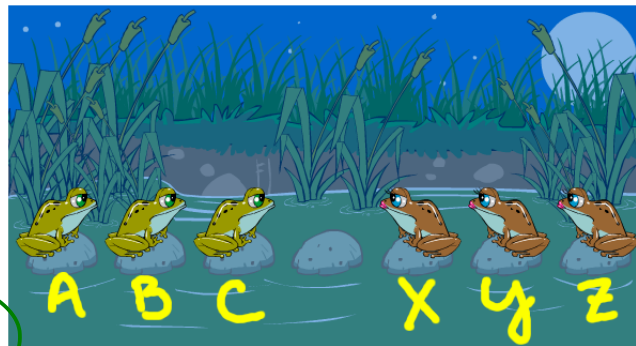
ABCX-YZ

X hops

C hops

B jump

Y jump



hop  
jump

AB-CXYZ

A-CBXYZ

ABCYX-Z

A jump

B hop

X jump

A hop

Z hop

(dead) BACXYZ

A-BCXYZ  
AIBXC-YZ

-ACBXYZ

dead end

ABCYXZ -  
dead end

7.

