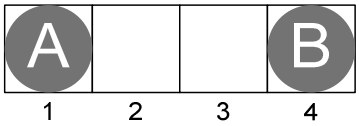
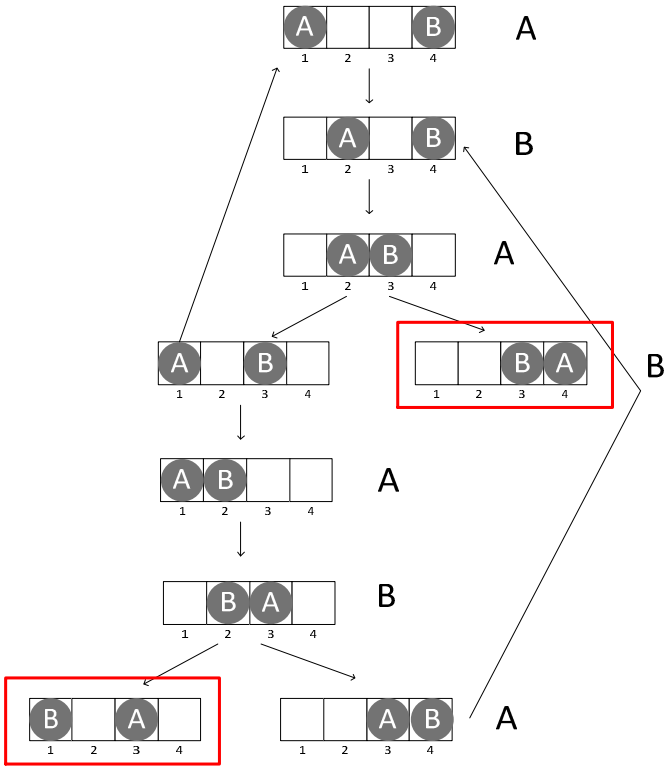
AI Course Fall HT 2/2015:
Exercise 2: Game Search and Constraint Problems

Task 5: MINIMAX



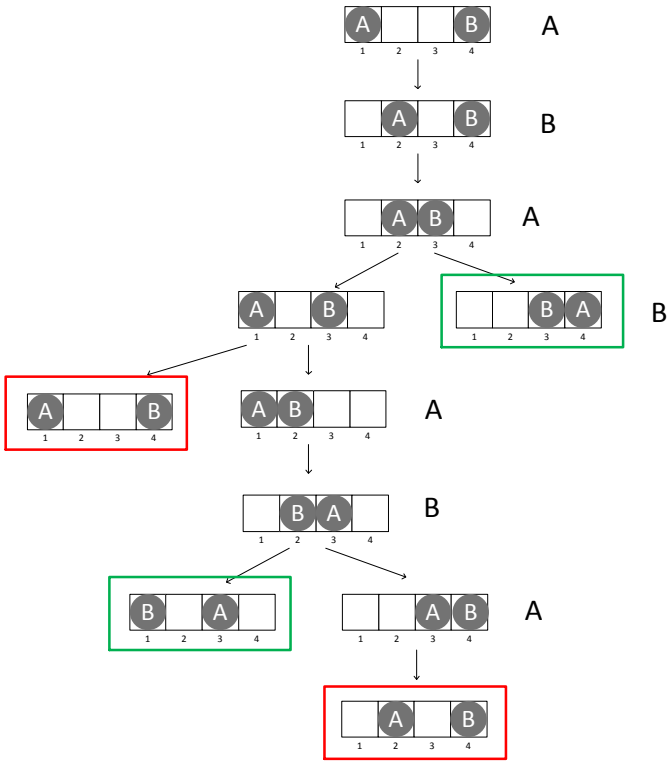
Consider the following game: The start position is as depicted above. Player A moves first, then the players take turns. Every Player must move his/her token to an open adjacent space in either direction. If the opponent occupies a neighboring cell and if there is an open space behind, a player may jump over its opponent. The player may also move back to its old position). The game ends, when one player has reached the opposite end of the board. This player wins and gets +1, the looser gets -1.

a) Draw the game search tree/graph and add the utilities of the leaf states.



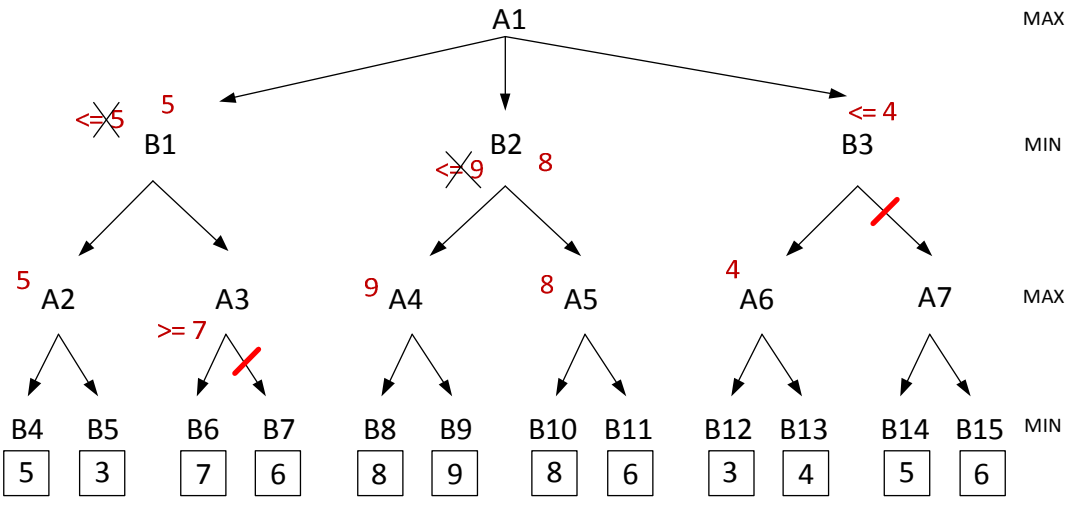
b) Propagate MINIMAX values. The game tree contains loops - how would you handle loops states with in this scenario?

We identify the loopy states and give them a "intermediate" value – something 0. Then we can handle the MINIMAX. As it is an intermediate value and there are others so we will not go into the loopy branches



Task 6: MINIMAX with Alpha-Beta Pruning

Consider the following game tree. Use Alpha-Beta-Pruning to determine the next action. How many nodes did you spare expanding?



3 leave nodes and 1 intermediate – could have been better, if we would have started with B2...

Task 7: Constraint Satisfaction: The Zebra Puzzle

Consider the following logic puzzle: In five houses, each with a different color, live five persons of different nationalities, each of whom prefers a different brand of candy, a different drink and a different pet. Given the following facts, the questions to answer are "Where does the Zebra live and in which house do they drink water"?

The Englishman lives in the red house.
The Spaniard owns the dog.
The Norwegian lives in the first house on the left.
The green house is immediately to the right of the ivory house.
The man who eats Hershey bars lives in the house next to the man with the fox.
KitKats are eaten in the yellow house.
The Norwegian lives next to the blue house.
The Smarties eater owns snails.
The Snickers eater drinks orange juice.
The Ukrainian drinks tea.
The Japanese eats Milky Ways.
Kitkats are eaten in a house next to the house where the horse is kept.
Coffee is drunk in the green house.
Milk is drunk in the middle house.

Formulate this problem as a Constraint Satisfaction Problem. **(You do not need to solve it, just identify what are the variables, their domains and how based on that you can formulate the constraints)**

The "Zebra Puzzle" can be represented as a CSP by introducing a variable for each color, pet, drink, country, and cigarette brand (a total of 25 variables). The value of each variable is a number from 1 to 5 indicating the house number. **This is a good representation because it easy to represent all the constraints given in the problem definition this way**.

Color Variables:
Red ∈ {1,2,3,4,5}
Green ∈ {1,2,3,4,5}
Yellow ∈ {1,2,3,4,5}
Ivory ∈ {1,2,3,4,5}
Blue ∈ {1,2,3,4,5}

Pet Variables
Dog ∈ {1,2,3,4,5}
Snails ∈ {1,2,3,4,5}
Horse ∈ {1,2,3,4,5}
Fox ∈ {1,2,3,4,5}
Zebra (?)∈ {1,2,3,4,5}

Drink-Variables
Orange Juice ∈ {1,2,3,4,5}
Tea ∈ {1,2,3,4,5}
Coffee ∈ {1,2,3,4,5}
Milk ∈ {1,2,3,4,5}
Water (?)∈ {1,2,3,4,5}

Nationality
English ∈ {1,2,3,4,5}
Spanish ∈ {1,2,3,4,5}
Norwegian ∈ {1,2,3,4,5}
Japanise ∈ {1,2,3,4,5}
Ukrainian ∈ {1,2,3,4,5}

Sweets
Hershey Bars ∈ {1,2,3,4,5}
Smarties ∈ {1,2,3,4,5}
Snickers ∈ {1,2,3,4,5}
Milky Ways ∈ {1,2,3,4,5}
Kitkats ∈ {1,2,3,4,5}

The Constraints:

English = Red
Spanish = Dog
Norwegian = 1
Green = Ivory+1
Hershey=Fox+1 or Fox-1
Kitkats = Yellow
Norwegian=Blue+1 or Blue-1
Smarties = Snails
Snickers = Orange Juice
Ukranian = Tee
Japanes = MilkyWay
Kitkats = Horse+1 or Horse-1
Coffee = Green
Milk = 3

Often people start with an object-oriented point of view – the houses fit together and have a number of attributes that are related to each other given the constraints. But in such a case, formulating the constraints in a way that a computer can use them is quite hard.
