Assignment 1: KingSheep

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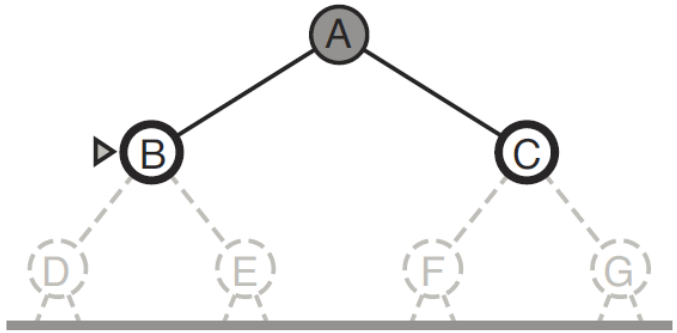
Search Strategy: basics

- Alpha-beta prune
  - For better pruning, it is desired to select the best action first

- Iterative deepening depth first search
  - Cons: recalculation of nodes (small overhead)
  - Pros: provide good ordering for the next iteration



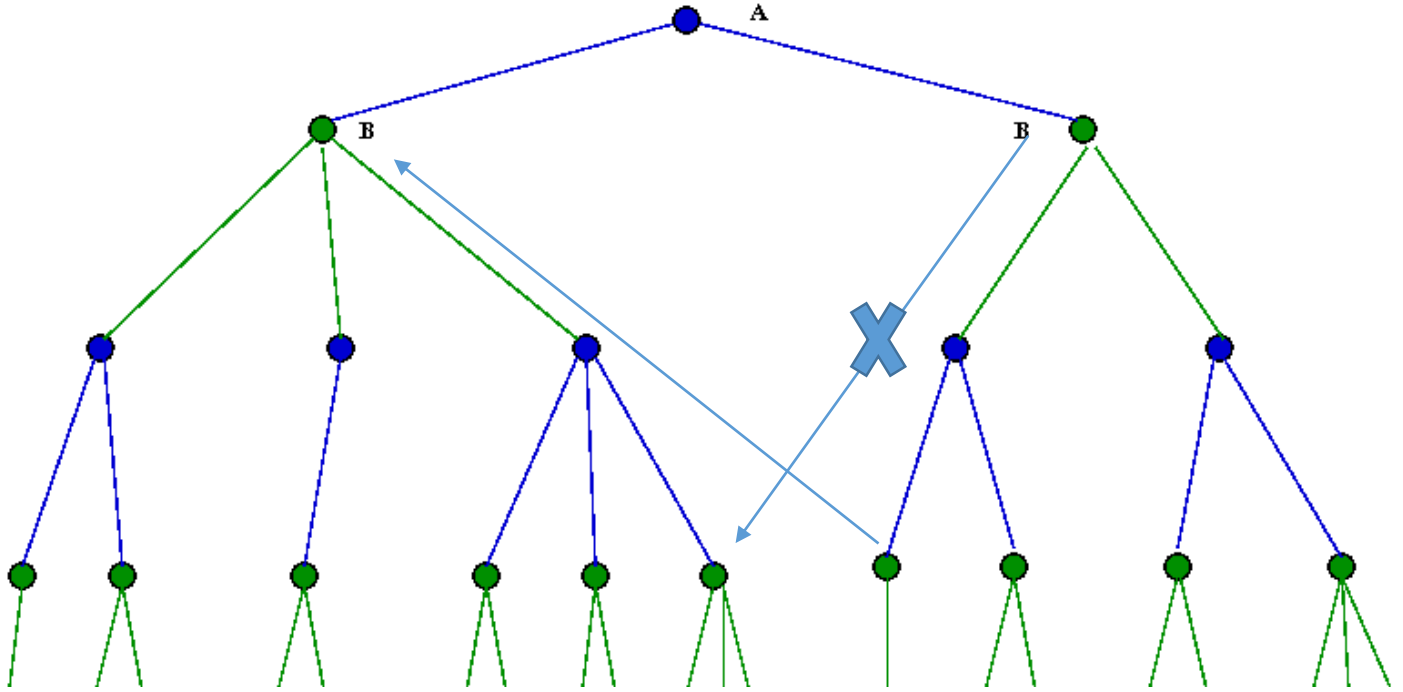
For the next iteration, depth-limit depth first search is first performed on the best node from B and C.

Search Strategy: transposition table

Avoid the duplicate exploration of the same game status

- When should transposition happen?
  - Only when the visited node have explored more layers than the exploration limit of the current node

- Is the visited node pruned or not? The node value can be
  - Upper bound
  - Lower bound
  - Exact value



Search Strategy: transposition table

Implementation: as a hash table

- Use the map as a string hash key
- Each element stores **node value**, **value type** (upperbound,lowerbound or exact value), **best action** and **explored depth**

Save to the transposition table:

- Prune+Max node: lowerbound
- Prune+Min node: upperbound
- Else: exact value

Query from the transposition table:

- lowerbound value: update alpha
- upperbound value: update beta
- Exact value: return the node value directly

Heuristics

- Food Heuristics: sheep towards food square s

$$h_f(s) = \frac{d(s, sheep_{self}) - d(s, sheep_{enemy})}{d(s, sheep_{self}) + d(s, sheep_{enemy})} * val(s)$$

- Sheep heuristics: catch the enemy sheep ($val(sheep) = 10$)

$$h_s = \frac{d_{max} - d(wolf_{self}, sheep_{enemy})}{d_{max}} * val(sheep)$$

- Total heuristics:

$$h = \sum_s h_f(s) + h_s$$