Advanced Topics in AI
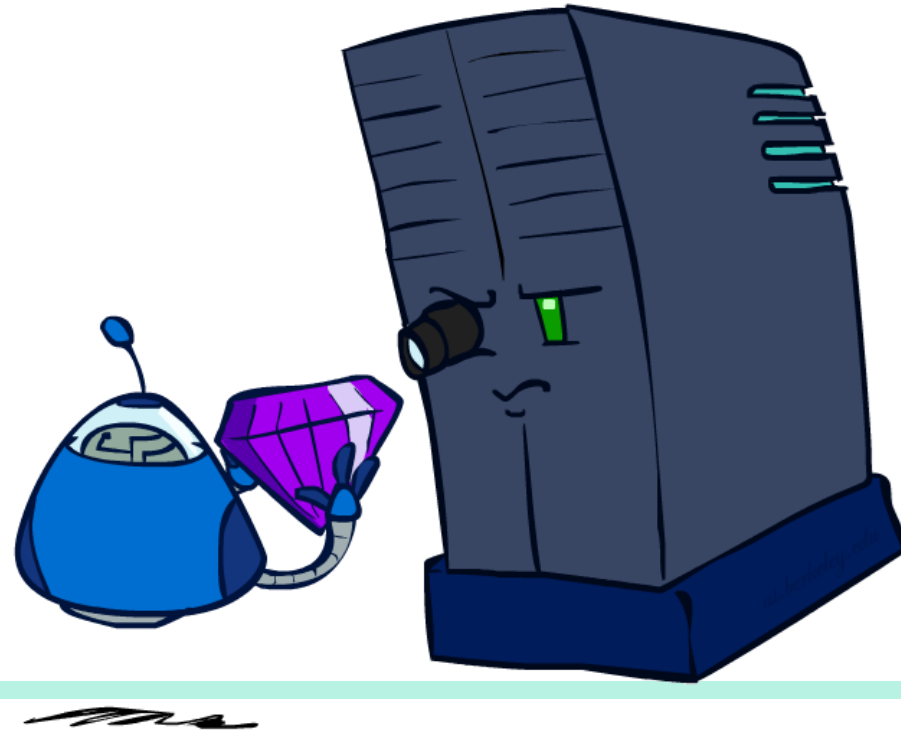
Evaluation functions

Instructor: Prof. Dr. techn. Wolfgang Nejdl

Leibniz University Hannover

Overcoming Resource Limits

Resource Limits

- Problem: In realistic games, cannot search to leaves!

- Solution: Depth-limited search
  - Instead, search only to a limited depth in the tree
  - Replace terminal utilities with an evaluation function for non-terminal positions

max

min
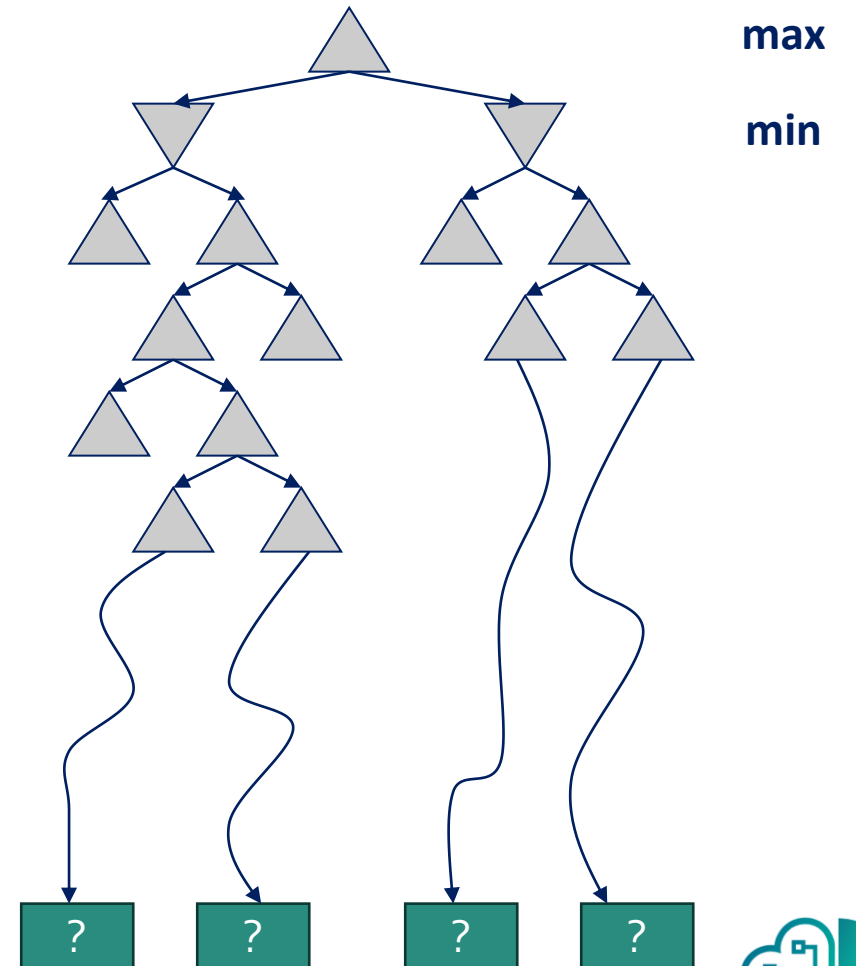
Resource Limits

- Problem: In realistic games, cannot search to leaves!

- Solution: Depth-limited search
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- Example:
  - Suppose we have 100 seconds, can explore 10K nodes / sec
  - So can check 1M nodes per move
  - α-β reaches about depth 8 – decent chess program

- Guarantee of optimal play is gone

- More plies makes a BIG difference

 - Use iterative deepening for an anytime algorithm

max

min
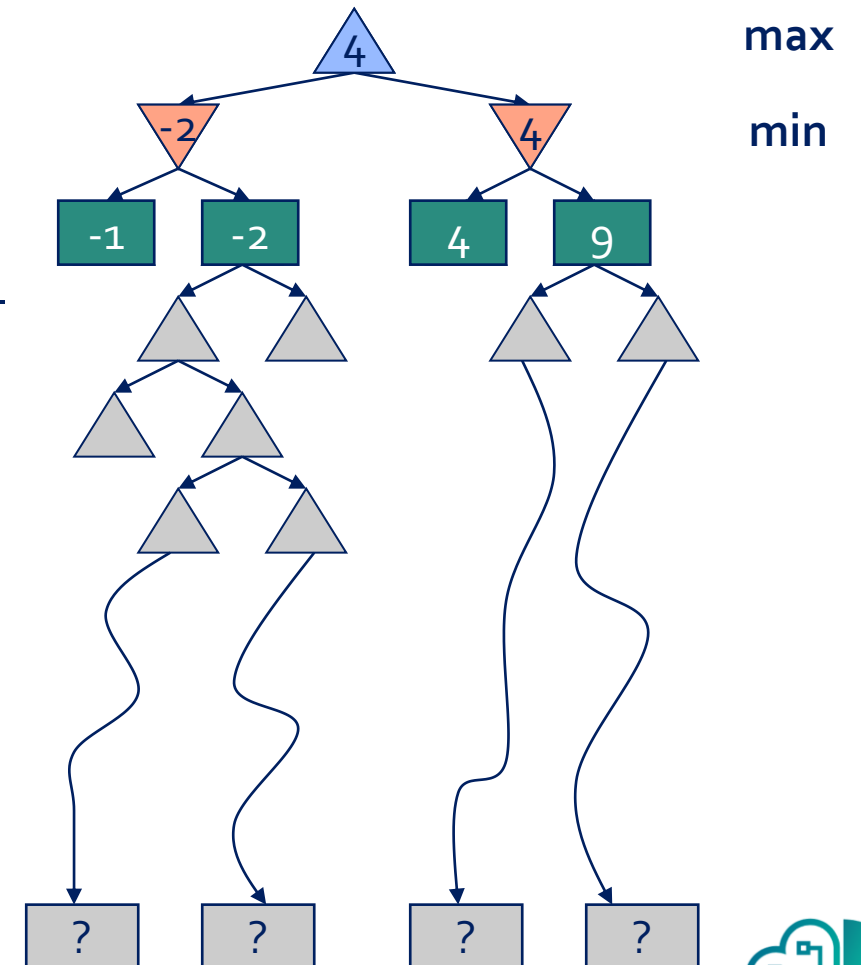
Why Pacman Starves
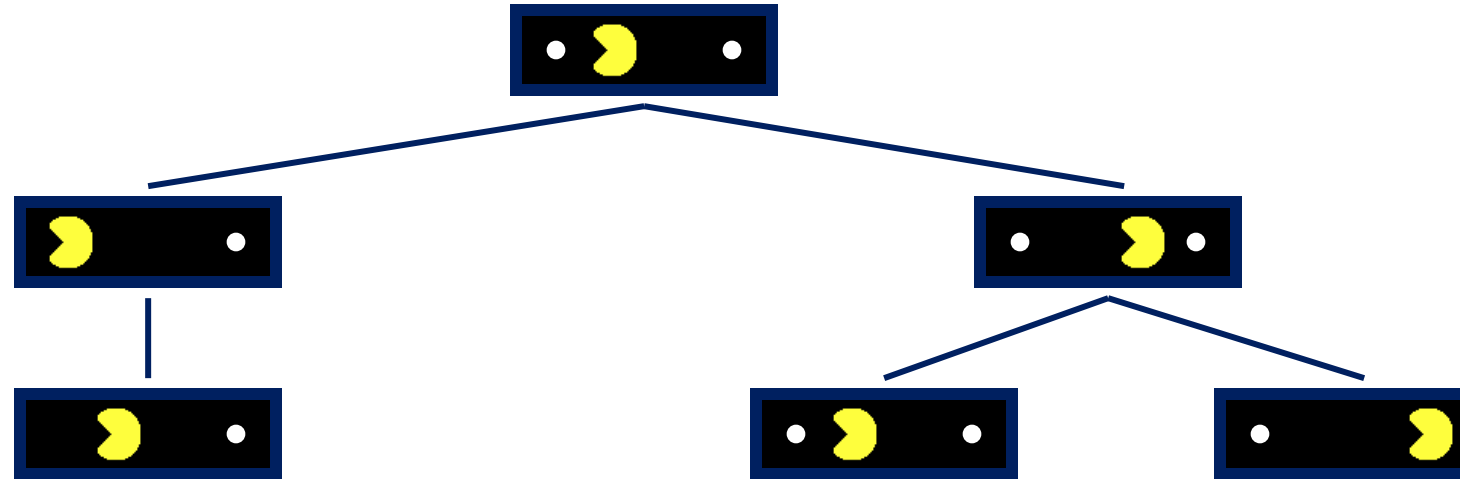
- A danger of replanning agents!
  - He knows his score will go up by eating the dot now
    - (west, east)
  - He knows his score will go up just as much by eating the dot later
    - (east, west)
  - There are no point-scoring opportunities after eating the dot
    - (within the horizon, two here)
  - Therefore, waiting seems just as good as eating:
   - he may go east, then back west in the next round of replanning!

Evaluation Functions

- Evaluation functions score non-terminals in depth-limited search

Black to move

White slightly better

White to move

Black winning
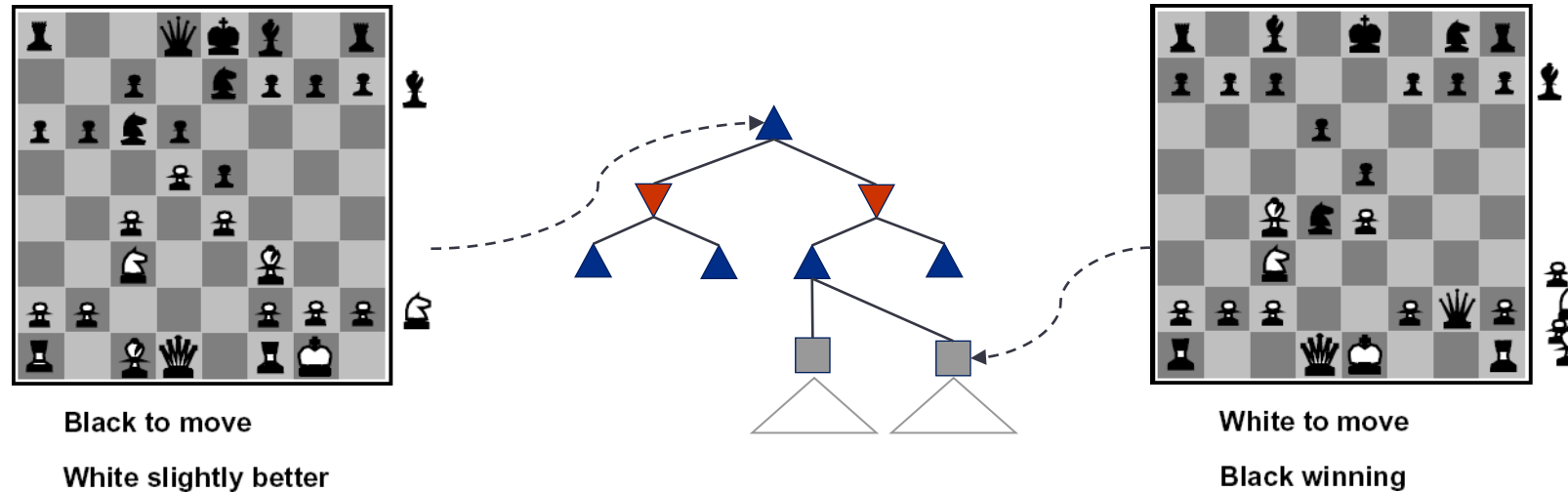
- **Ideal function**: returns the actual minimax value of the position
- **In practice**: typically weighted linear sum of features:
  - $Eval(s) = w_1 f_1(s) + w_2 f_2(s) + \ldots + w_n f_n(s)$
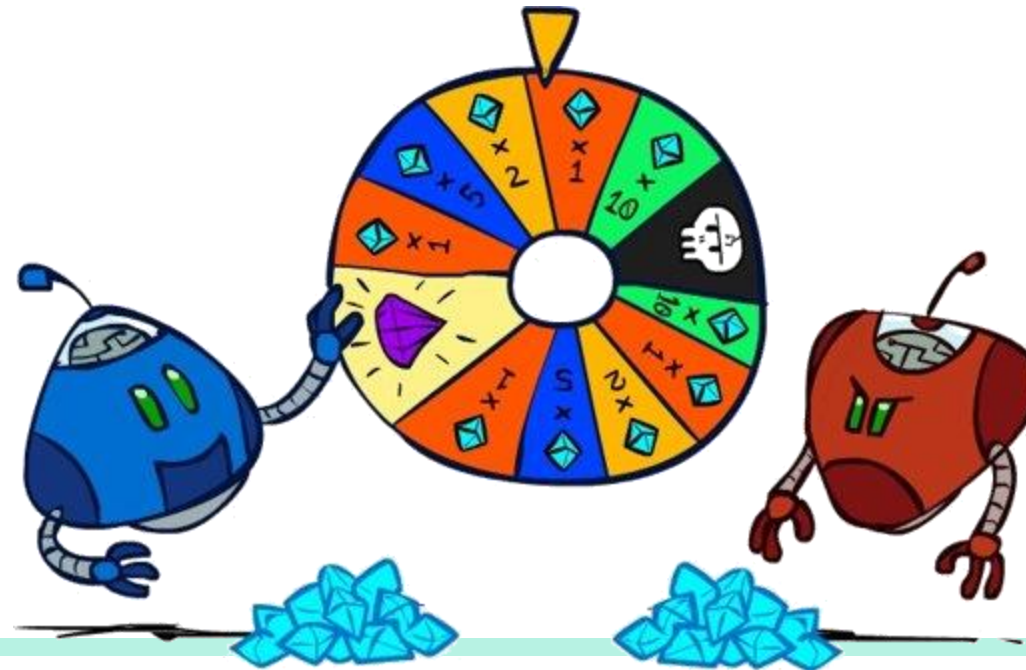 - e.g. f1(s) = (num white queens – num black queens), etc.

Depth Matters

- Evaluation functions are always imperfect

- The deeper in the tree the evaluation function is buried, the less the quality of the evaluation function matters

- An important example of the tradeoff between complexity of features and complexity of computation
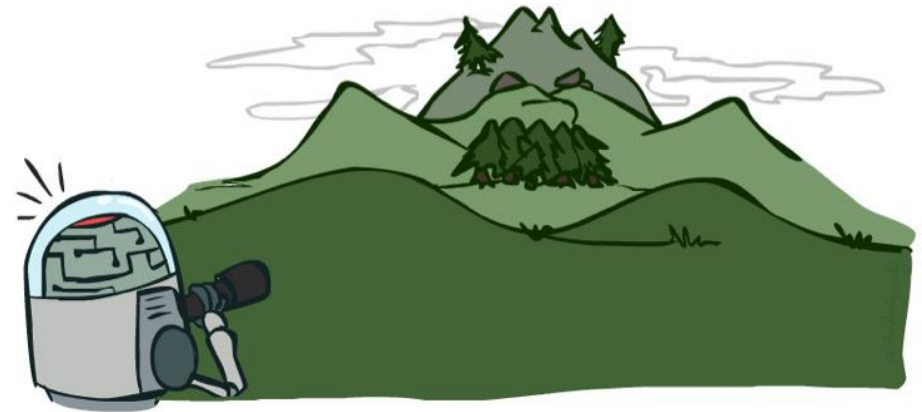
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Next: Uncertainty & Expectimax

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