Artificial Intelligence & Machine Learning

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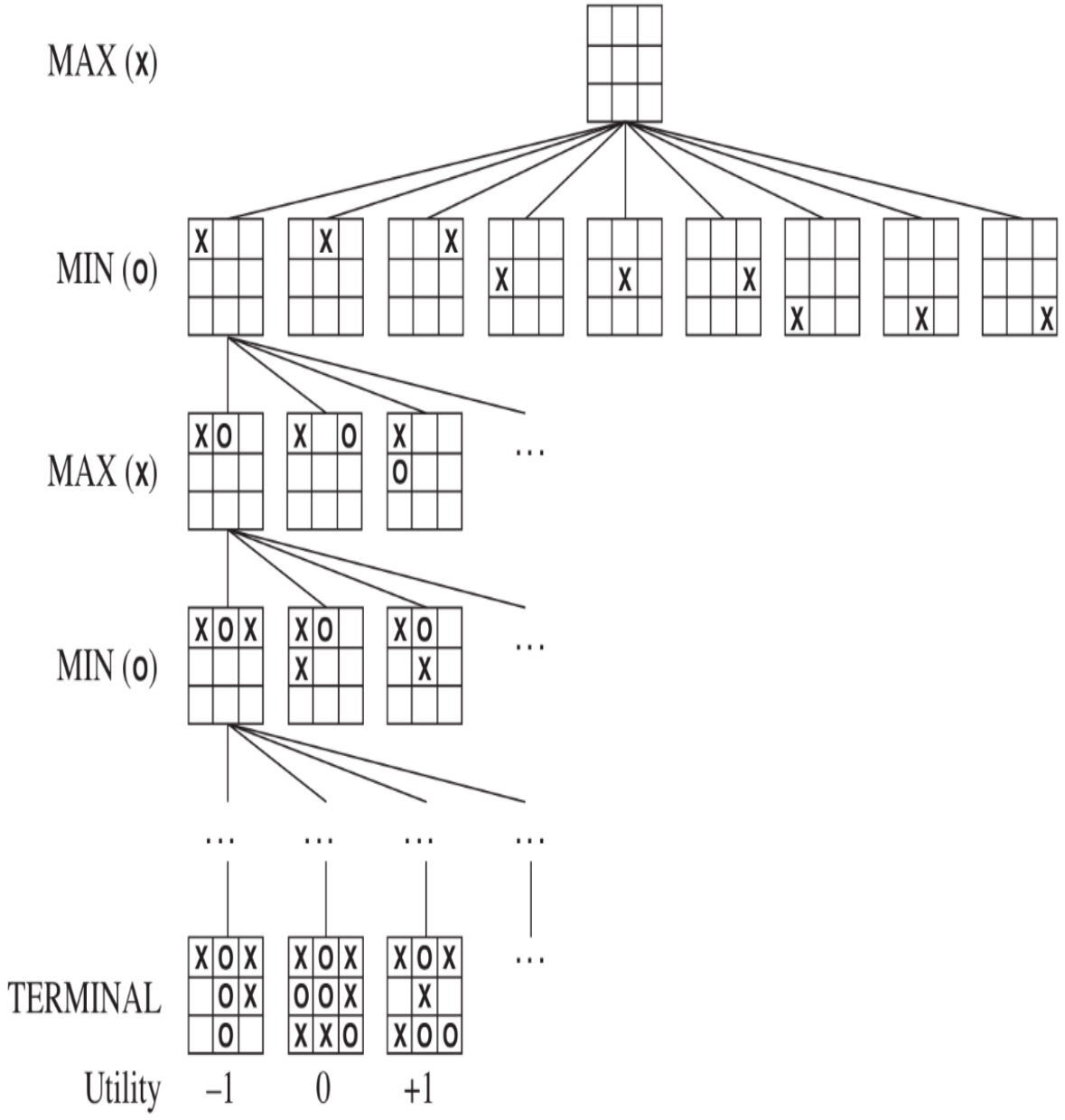
Lecture 7

Game

A game is a search problem with the following components:

- S_0 : The initial state, which specifies how the game is set up at the start.
- PLAYER(s): Defines which player has the move in a state.
- ACTIONS(s): Returns the set of legal moves in a state.
- RESULT(s, a): The transition model, which defines the result of a move.
- TERMINAL-TEST(s): A terminal test, which is true when the game is over and false otherwise. States where the game has ended are called terminal states.
- UTILITY (s, p): A utility function (also called an objective function or payoff function), defines the final numeric value for a game that ends in terminal state s for a player p. In chess, the outcome is a win, loss, or draw, with values $+1$, 0, or $1/2$. A zero-sum game is defined as one where the total payoff to all players is the same for every instance of the game.

Game tree



Minimax algorithm

function MINIMAX-DECISION(state) returns an action
  return arg $max_{a \in ACTIONS(s)}$ MIN -VALUE(RESULT(state,a))

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function MAX-VALUE(state) returns a utility value
  if TERMINAL-TEST(state) then return UTILITY(state)
  v $\leftarrow$ -∞
  for each a in ACTIONS (state) do
    v $\leftarrow$ MAX(v , MIN-VALUE(RESULT(s,a)))
  return v

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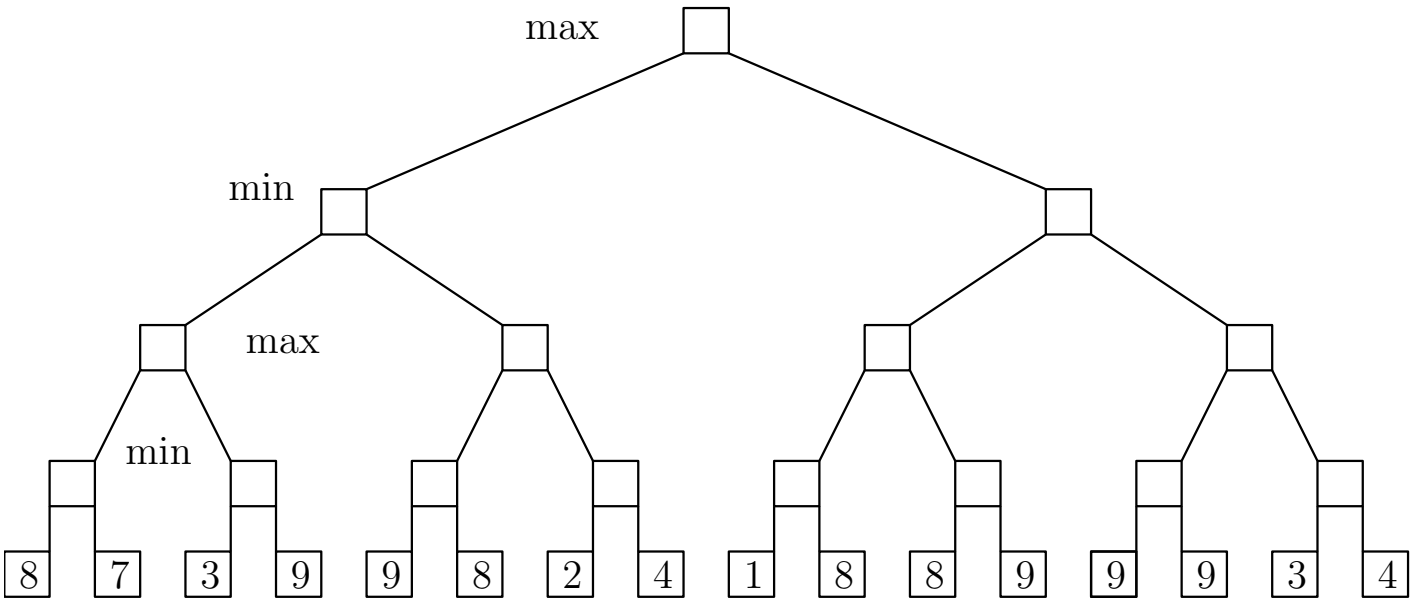
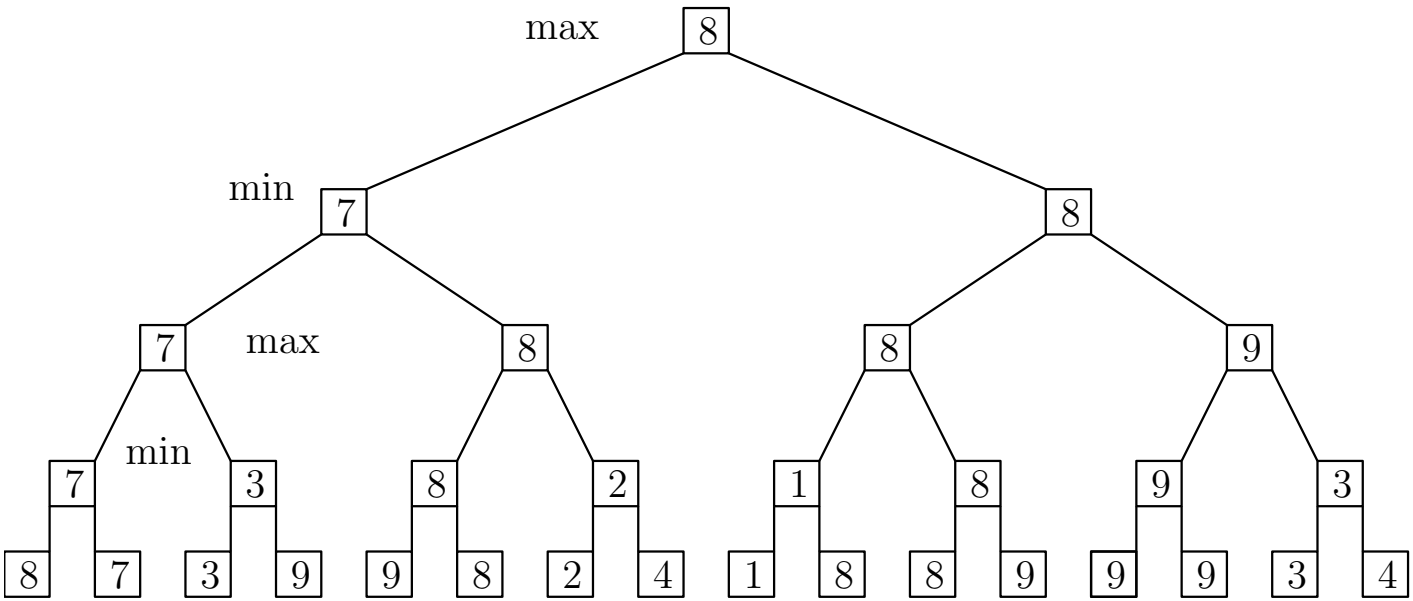
function MIN-VALUE(state) returns a utility value
  if TERMINAL-TEST(state) then return UTILITY(state)
  v $\leftarrow\infty$
  for each a in ACTIONS (state) do
    v $\leftarrow$ MIN(v , MAX-VALUE(RESULT(s,a)))
  return v

Minimax algorithm



Minimax algorithm



Alpha-beta Pruning