Game Playing

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finish, assign the utility to player.

Games in Artificial Intelligence

Why has game playing been a focus of AI?

- Games have well-defined rules, which can be implemented in programs
- Interfaces required are usually simple
- Many human expert exist to assist in the developing of the programs.
- Games provide a structured task where in success or failure can be measured with least effort.
- They did not require large amount of knowledge.

Game playing

- The term Game means a sort of conflict in which an individuals or groups (known as players) participate.
- Game theory denotes strategy for game.
- Grow a search tree
- Only one player move at each turn
- At the leaf position, when the game is

Chess For Example

Two-player games

Usual conditions:

- *Each player has a global view of the board*
- *Zero-sum game: any gain for one player is a loss for the other*

Major components of a game playing program

Two major components

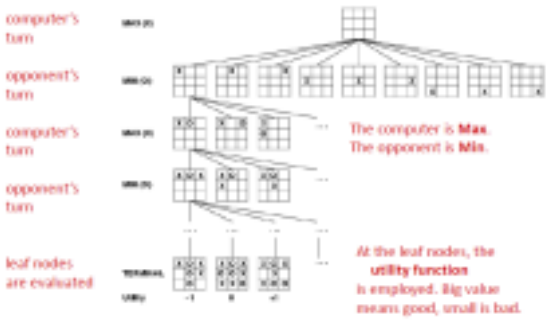
- **Plausible move generator:** plausible move generator is used to generate the set of possible successor positions.
- **Static evaluation function generator (utility function):** based on heuristics, this generates the static evaluation function value for each and every move that is being made. The static evaluation function gives a snapshot of a particular move.

- The average branching factor is around 35
- In average game, each player might make 5 moves.
- So in order to examine the complete game tree,
  we would have to examine 35 ^100 positions.

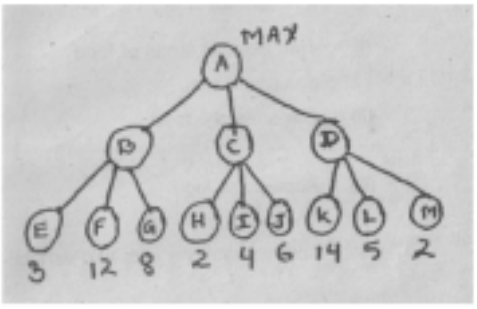
Game playing strategies

- Minimax strategy
- Alpha-Beta Pruning

Game Tree



Example 1: Prune this tree

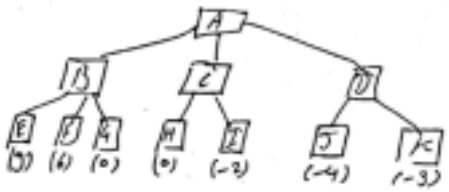


Example 2: Considering the following game tree search space

•What node would not be needed to be examined using alpha-beta pruning technique?

Example 3: Considering the following game tree search space

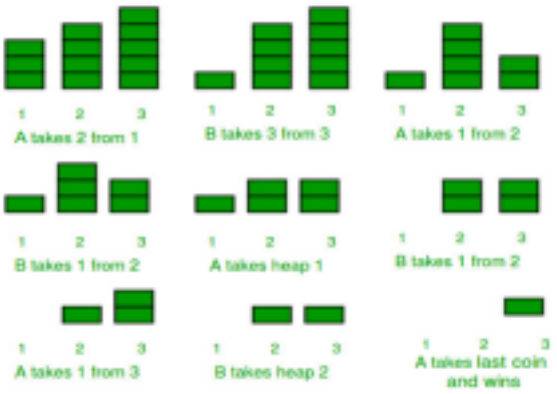
– What nodes should not be needed to be examined using alpha-beta pruning technique?



Tic tac toe

8		6
5	4	7
2	3	1

	1	2
3	4	5
6	7	8



NIM Game

- *Given a number of piles in which each pile contains some numbers of stones/coins. In each turn, a player can choose only one pile and remove any number of stones (at least one) from that pile. The player who cannot move is considered to lose the game (i.e., one who take the last stone is the winner). ”*

Take-Stones Game Playing

An example game is given below for n = 7:

```
Player 1: 3
Player 2: 6
Player 1: 2
Player 2: 4
Player 1: 1
Player 2: 7
Winner: Player 2
```

Game Rules

The game starts with n stones numbered 1, 2, 3, ..., n. Players take turns removing one of the remaining numbered stones. At a given turn there are some restrictions on which numbers (i.e., stones) are legal candidates to be taken. The restrictions are:

- At the first move, the first player must choose an odd-numbered stone that is strictly less than n/2. For example, if n = 7 (n/2 = 3.5), the legal numbers for the first move are 1 and 3. If n = 6 (n/2 = 3), the only legal number for the first move is 1.
- At subsequent moves, players alternate turns. The stone number that a player can take must be a **multiple or factor** of the last move (note: 1 is a factor of all other numbers). Also, this number may **not** be one of those that has already been taken. After a stone is taken, the number is saved as the new last move. If a player **cannot** take a stone, he/she loses the game.

A working example: Grundy's game

- Given a set of coins, a player takes a set and divides it into two unequal sets. The player who cannot do uneven split, looses.
- What is a state? Moves? Goal?

Grundy's game - special case of nim

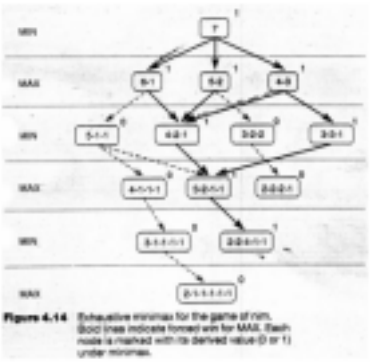


Figure 4.14 Exhaustive minimax for the game of nim. Bold lines indicate forced win for MAX. Each node is marked with its derived value (0 or 1) under minimax.