6th Sem (IT)

18/2

Adversarial Search / Game playing /

Scope of AI-Games

Competitive environments in which the agents goals are in Conflicting give rise to adversarial search problems often known as games.

(Multi-agent Environment)

Techniques for choosing a good move when the time is limited.

* Pruning

Pruning allow us to ignore portions of the search tree that make no difference to the final choice and the heuristic evaluation functions allow us to approximate the true utility of a state without doing a complete search

. Games with two players Max and Min where Max moves first (take turns until the game is over)

A game as a search problem with the following elements.

→ So : Initial State

→ 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) : transitional model which defines the result of a move.

→ TERMINAL-TEST (s) : A terminal test is true when the game is over and false otherwise.

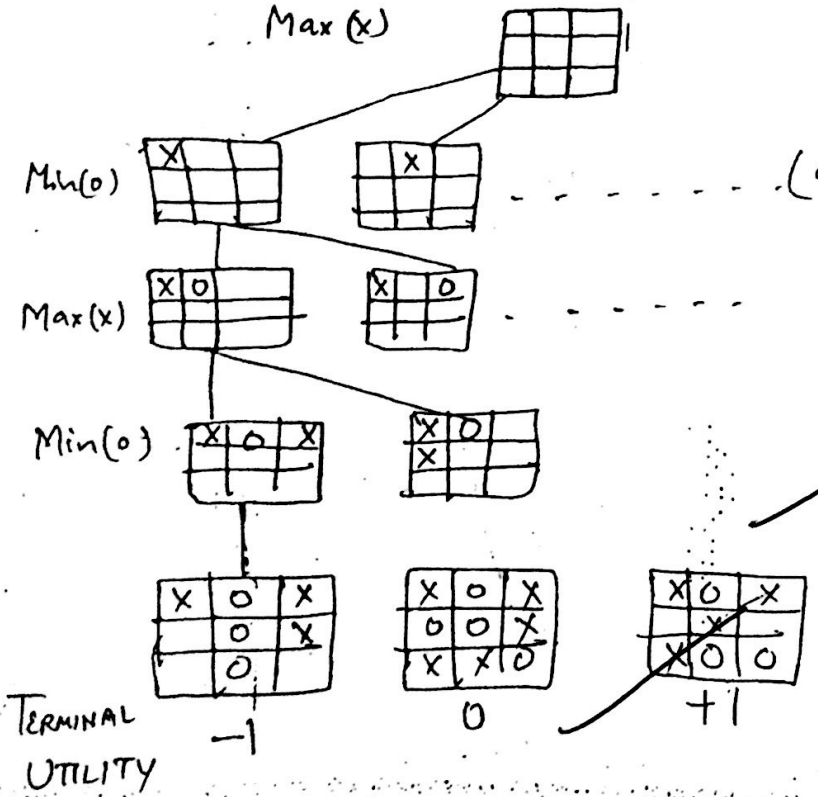
States where game has ended is called terminal States

→ UTILITY (S,P): A utility function / objective function or payoff function defines the final numeric value for a game that ends in terminal state S for a player P.

A Zero-Sum game is defined as one where the total payoff to all players is the sum of every instance of the game. Chess is Zero-Sum because every game has payoff of either 0+1, 1+0 or $\frac{1}{2}+\frac{1}{2}$ "Constant Sum" would have been a better term.

In Tic-Tac-Toe
9! = 362,880 terminal nodes

Inchess 10^{40} nodes



MINIMAX ALGORITHM ... { The minimax value of a node is the utility value (for Max) of being in the corresponding state, assuming that both players play optimally from there to the end of the game.

* The minimax value of a terminal state is just its utility.

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 returns UTILITY (State)
$V \leftarrow -\infty$
for each a in ACTIONS (state) do
$V \leftarrow$ MAX (V, MIN-VALUE (RESULT (S, a)))
return V

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

V is a vector for utility Value

Optimal decisions in Multiplayer Games

Issues in multiplayer Games

→ We need to replace a single Value for each node with a Vector of values.
for example in a three player game with players A, B and C, a Vector (V_A, V_B, V_C) is associated with each node.

→ The Best move is marked as the root.

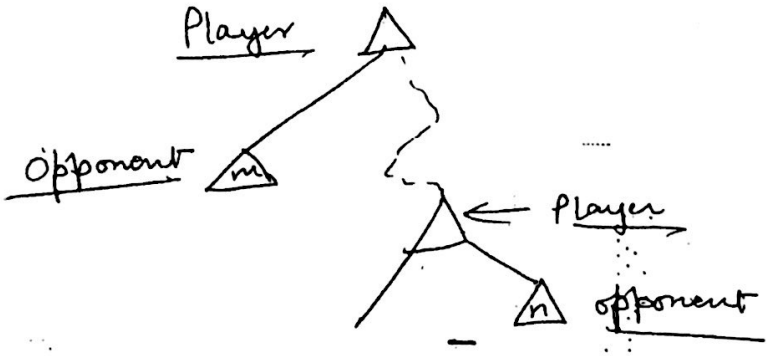
ALPHA - BETA PRUNING

The Problem with MINIMAX Search is that the number of game states it has to examine is exponential in the depth of the tree.

We can't eliminate the exponent but it turns out we can effectively cut it in half

alpha beta Pruning is applied to MINIMAX Tree.

→ Can be applied to trees of any depth
→ Prune entire subtrees rather than just leafs.



if m is better than ~~for~~ n for player., we will never get to in play.

α = the Value of the best (highest-Value) choice we have found so far at any choice point along the path for MAX.

β = the Value of the best (i.e lowest-Value) choice we have found so far, at any choice point along the path for MIN.

Move ordering

α-β pruning is highly dependent on the order in which the states are examined.

Try best-first

Cutting off search

Modification of Alpha_Beta Search.

Call heuristic evaluation function.

QUIESCENCE → The evaluation function should be applied only to positions that are quiescent.

{unlikely to exhibit wild swings in the value in nearby future}

Non quiescent positions can be expanded further until quiescent positions are reached.

HORIZON EFFECT :— It arises when the program is facing an opponent's move that causes serious damage and is ultimately unavoidable but can be temporarily avoided by delaying tactics.

SINGULAR EXTENSION } one strategy to mitigate the horizon effect is singular extension. ; A move that is "clearly better" than all other moves in a given position.

Forward Pruning

It is also possible to do forward pruning, meaning that some moves at a given node are pruned immediately without further consideration.

Scanned by CamScanner

Stochastic Games

Many unpredictable external events can put us in certain positions.
Many games mimic this unpredictability by including a random
element, such as throwing a dice.

We call these as stochastic games.

Natural Language Processing

Expert System

An Expert System utilizes human knowledge captured in a Computer to solve problems that ordinarily require human intelligence

Expert System / knowledge base Expert System / knowledge assistants.

General Purpose problem Solver

Procedure deployed by Newell & Simon from their logic theory machine.
*(A Predecessor to ES)

GPS tries to workout the steps needed to change Certain initial situation in Various ways.

Step 1
- → Statement of Preconditions
- → operators for preconditions needs to be true before applied
- → postConditions that will be true after the operator has been used.

GPS find out operators that reduce the difference between a goal and Current State.

Expert Systems (DENDRAL & MYCIN)

DENDRAL

- → First Expert System (By Standard university in 1960)
- → Designed to analyse mass Spectra
- → Analyse nature of molecules tested.
- → DENDRAL didnot Contain rules.
- → Uses heuristic knowledge obtained from experienced chemists to help Constrain the Problem.

features of DENDRAL

→ Knowledge Representation: (Production rules and algorithms)

→ Reasoning: (forward chaining)

→ Heuristic knowledge: uses a variation of DFS called Generate and test.

→ Dialogue / Explaination (user can supply information and the system can request)

Another Expert System (MYCIN)

→ By Standard University

→ Expert System for treating blood infections

→ MYCIN Explains the reasoning for diagnosis and recommendation for further treatment

→ MYCIN Uses appro 500 Production rules

features of MYCIN

{All same as that of DENDRAL}

* Expert System Vs Problem Solving Sys:

- Expert System → Problem related expertise is encoded structures only but not encoded in ...
- Problem Solving Sys encoded in ...

The General Architecture of an expert System involves two principal Components:

→ A Problem dependent Set of data declarations (knowledge base)

→ A Problem independent program Called inference Engine.

Expert System

* → Set of Programs that main manipulate Encoded knowledge to solve problems in a specialized domain

Application domain of Expert Systems includes

aerospace, military operations, finance, banking, metereology, Geology, Geographies etc.

Expert Sources Can be

→ Specialists of domain
→ journals
→ Texts
→ Databases
→

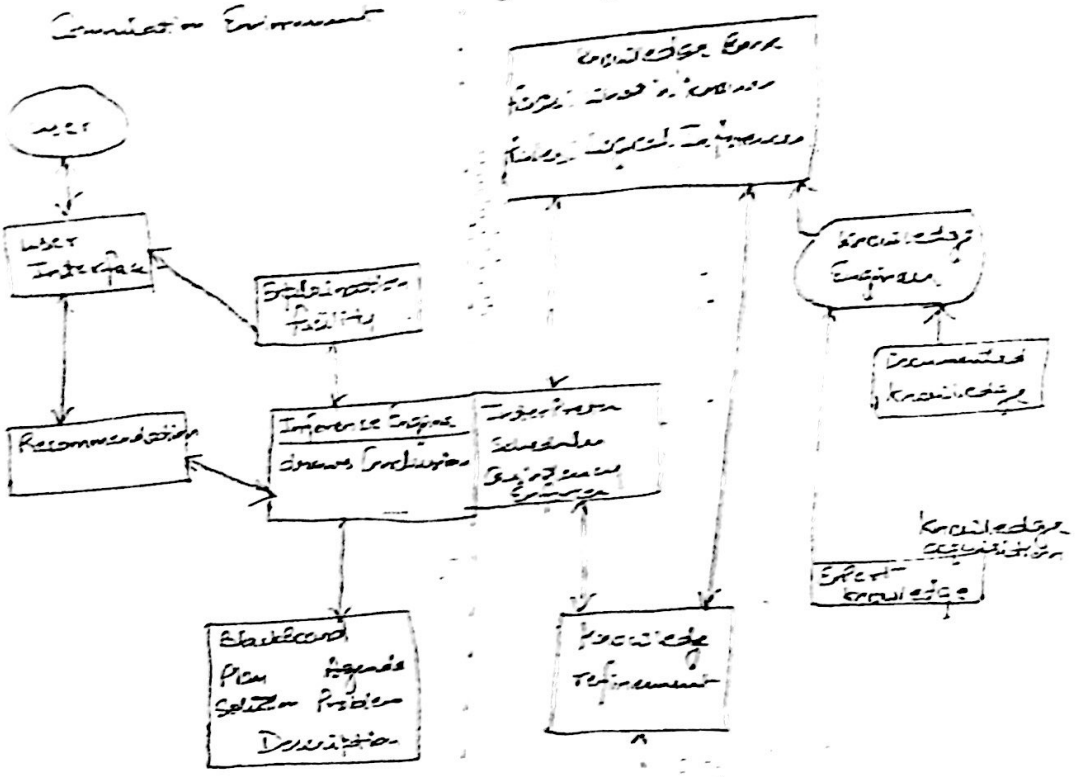
Expert System Architecture

→ Types of knowledge for an expert System Arch.

↳ Theories about the problem area.

↳ Rules and procedures regarding the General problem area.

↳ heuristics (of what to do in a given problem situation)



fuzzy logic
Can be able to draw conclusions other than true / false.

Genetic algorithms → Applied to many large scale scheduling problem and even to produce future structures of computers.

Advantages / disadvantages of Expert Systems

Advantages

↳ Provides consistent answers for repetitive decisions.

- Handle routine tasks requiring routine levels of information
- Encourage organizations to clarify the logic of their decision making
- Never forgets to ask a question as a human might

Disadvantages

- Lacks common sense needed in some decision making.
- Cannot make corrective responses as human expert would in unusual circumstances
- Domain Expert not always able to explain their logic & reasoning.
- Errors may occur in the knowledge base and lead to wrong decisions.

Features of Expert Systems

- Backward chaining
- Coping with Uncertainity
- forward chaining
- Data representation
- User interfaces etc