

# **NANDHA COLLEGE OF TECHNOLOGY**

## **ERODE- 638 052**



### **DEPARTMENT OF INFORMATION TECHNOLOGY**

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### ***ASSIGNMENT / CASE STUDY REPORT – I***

### **ADVERSARIAL SEARCH**

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# **ADVERSARIAL SEARCH**

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## **1.INTRODUCTION:**

Adversarial search is a search, where we examine the problem which arises when we try to plan ahead of the world and other agents are planning against us. In previous topics, we have studied the search strategies which are only associated with a single agent that aims to find the solution which is often expressed in the form of a sequence of actions. But, there might be some situations where more than one agent is searching for the solution in the same search space, and this situation usually occurs in game playing. The environment with more than one agent is termed as multi-agent environment, in which each agent is an opponent of other agent and playing against each other. Each agent needs to consider the action of other agent and effect of that action on their performance. So, Searches in which two or more players with conflicting goals are trying to explore the same search space for the solution, are called adversarial searches, often known as Games. Games are modeled as a Search problem and heuristic evaluation function, and hence are the two main factors which help to model and solve games in AI.

## 2. Game tree:

A game tree is a tree where nodes of the tree are the game states and Edges of the tree are the moves by players. Game tree involves initial state, actions function, and result Function.

Example: Tic-Tac-Toe game tree:

The following figure is showing part of the game-tree for tic-tac-toe game. Following are some key points of the game:

- There are two players MAX and MIN.
- Players have an alternate turn and start with MAX.
- MAX maximizes the result of the game tree
- MIN minimizes the result.



### 3.ADVERSARIAL SEARCH:

Adversarial search is a search, where we examine the problem which arises when we try to plan ahead of the world and other agents are planning against us.

- ❖ In previous topics, we have studied the search strategies which are only associated with a single agent that aims to find the solution which often expressed in the form of a sequence of actions.
- ❖ But, there might be some situations where more than one agent is searching for the solution in the same search space, and this situation usually occurs in game playing.
- ❖ The environment with more than one agent is termed as multi-agent environment, in which each agent is an opponent of other agent and playing against each other. Each agent needs to consider the action of other agent and effect of that action on their performance.
- ❖ So, Searches in which two or more players with conflicting goals are trying to explore the same search space for the solution, are called adversarial searches, often known as Games.
- ❖ Games are modeled as a Search problem and heuristic evaluation function, and these are the two main factors which help to model and solve games in AI.

**Perfect information:** A game with the perfect information is that in which agents can look into the complete board. Agents have all the information about the game, and they can see each other moves also. Examples are Chess, Checkers, Go, etc.

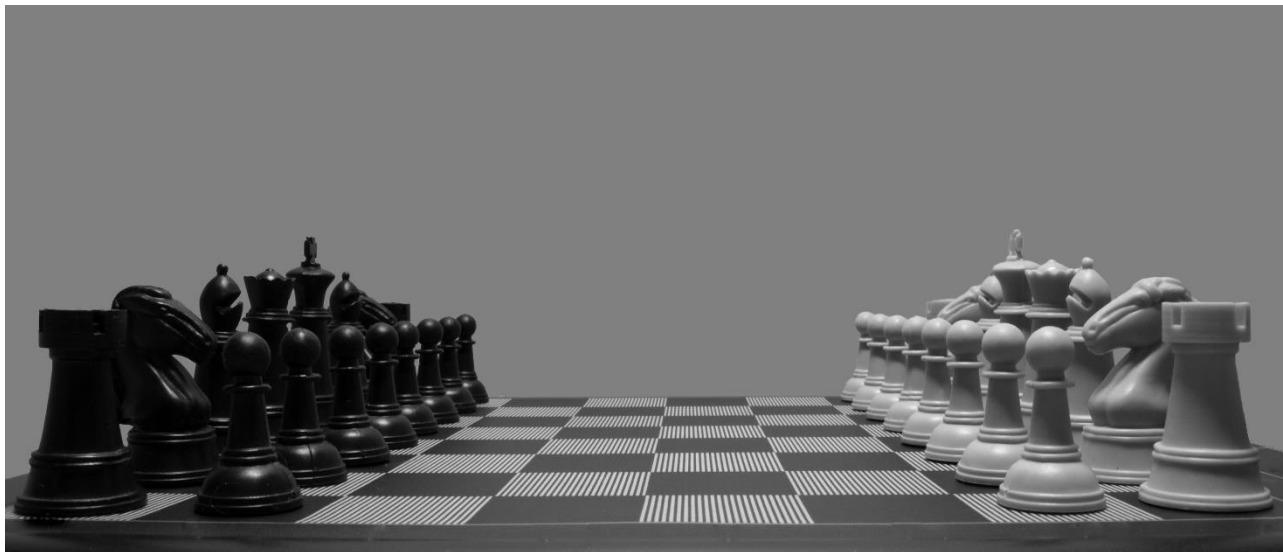
**Imperfect information:** If in a game agents do not have all information about the game and not aware with what's going on, such type of games are called the game with imperfect information, such as tic-tac-toe, Battleship, blind, Bridge, etc.

**Deterministic games:** Deterministic games are those games which follow a strict pattern and set of rules for the games, and there is no randomness associated with them. Examples are chess, Checkers, Go, tic-tac-toe, etc.

**Non-deterministic games:** Non-deterministic are those games which have various unpredictable events and has a factor of chance or luck. This factor of chance or luck is introduced by either dice or cards. These are random, and each action response is not fixed. Such games are also called as stochastic games.

Example: Backgammon, Monopoly, Poker, etc.

<b>Deterministic</b>	<b>Chance Moves</b>
<b>Perfect information</b>	Chess, Checkers, go, Othello Backgammon, monopoly
<b>Imperfect information</b>	Battleships, blind, tic-tac-toe Bridge, poker, scrabble, nuclear war



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- ❖ Perfect information: A game with the perfect information is that in which agents can look into the complete board. Agents have all the information about the game, and they can see each other moves also. Examples are Chess, Checkers, Go, etc.
- ❖ Imperfect information: If in a game agents do not have all information about the game and not aware with what's going on, such type of games are called the game with imperfect information, such as tic-tac-toe, Battleship, blind, Bridge, etc.

#### **4.FORMALIZATION OF THE PROBLEM:**

A game can be defined as a type of search in AI which can be formalized of the following elements:

- ❖ Initial state: It specifies how the game is set up at the start.
- ❖ Player(s): It specifies which player has moved in the state space.
- ❖ Action(s): It returns the set of legal moves in state space.
- ❖ Result(s, a): It is the transition model, which specifies the result of moves in the state space.
- ❖ Terminal-Test(s): Terminal test is true if the game is over, else it is false at any case. The state where the game ends is called terminal states.
- ❖ Utility(s, p): A utility function gives the final numeric value for a game that ends in terminal states s for player p. It is also called payoff function. For Chess, the outcomes are a win, loss, or draw and its payoff values are +1, 0, ½. And for tic-tac-toe, utility values are +1, -1, and 0.

#### **5.IMPORTANCE FEATURES OF ADVERSARIAL SEARCH:**

Adversarial searches have some features which make them unique as compared to the conventional techniques used in searches. There are certain features that can be observed in adversarial searches and with the help of this one can determine how such features make things more interesting and important in our case.

- The game in which adversarial searches have been used must have been a two-player game.

- The two-player game must have been in such a way that the game should have been played in the form of turn-taking. As we have observed in chess, ludo, Poker, etc.
- The information provided should have been perfect otherwise it becomes impossible for the model or the system to determine a strategy and to give a decision based on the results.
- The rules must have been precise. Formal should have been used in order to get better results.
- The actions must have been in a smaller number. This can increase the accuracy with better optimization.

While keeping the above factors in mind can help in developing the game more interesting. In this way, there are certain different advantages as well while adding adversarial searches in a two-player kind of game. These benefits are as follows.

- The game becomes more competitive and becomes hard to solve.
- Some games come under the luck of chance like in the dice games these games become very interesting as every time rolling some dice gives a different number and each number corresponds to a different and exciting move.
- Using this search technique can make the games so fast that with the help of which games become more interesting and competitive.





## 6.CONCLUSION:

In artificial intelligence, deep learning, machine learning, and computer vision, adversarial search is basically a kind of search in which one can trace the movement of an enemy or opponent. The step which arises the problem for the user or the user or the agent doesn't want that specific step task to be carried out. Such searches are important in chess, business strategy tools, trading kind of websites, and war-based games where there are AI agents. In an adversarial search, the user can change the current state but has no control over the next stage. The next state control is in the hands of the opponent and is unpredictable.

