

# **Tic-Tac-Toe**

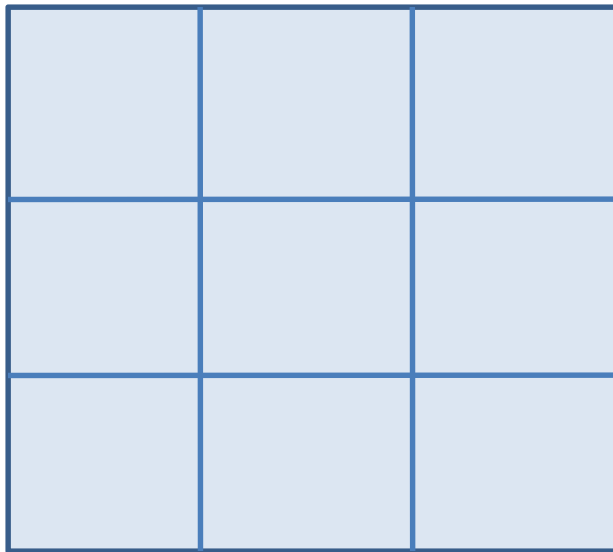
## **Non-AI and AI technique**

Dr. Priyadarshan Dhabe,  
Ph.D (IIT Bombay)

# How to play tic-tac-toe?

Players	Symbol
P1	X
P2	O

**Initial Board**



Turn of P1- will put one X in any blank cell

Turn of P2- will put one O in any blank cell

P1 & P2- Play alternate turns

Winning position-

P1- will try to put all X in any row, column or diagonal

P2- will try to put all O's in any row, column or diagonal

Max Turns-9

# How to play tic-tac-toe?

o		
	o	
		o

Winning position of P2

	x	
	x	
	x	

Winning position of P1

# How to play tic-tac-toe using Computer ?

- Either P1 or P2 will be played by computer
- Computer can use two Techniques to play this game by
  - Non-AI technique
  - AI technique

# Representation of board position in computer memory

1. Using 3x 3 Matrix

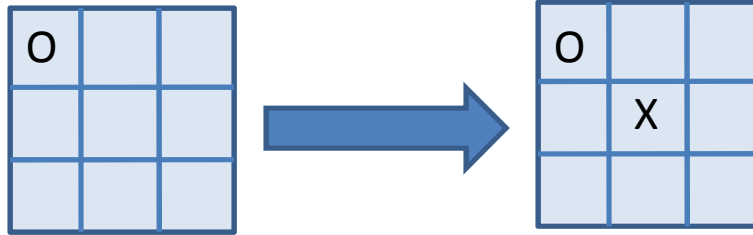
0	1	2
3	4	5
6	7	8

2. Using 9 element vector

0	1	2	3	4	5	6	7	8
---	---	---	---	---	---	---	---	---

# Non-AI technique

- Using rules



For calculations use following values to represent

- **Blank**- 0 (Zero)
- **X**- 1 (one)
- **O**-2 (Two)

O		
	X	

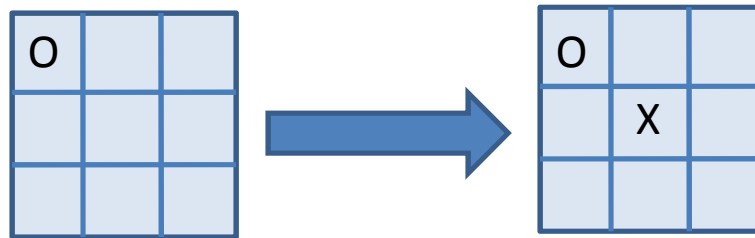
2	0	0
0	1	0
0	0	0

**Vector representation**

2	0	0	0	1	0	0	0	0
---	---	---	---	---	---	---	---	---

# Non-AI technique

- System will prepare a rule base of  $3^9$  rules like



Each 9 element vector is considered as base 3 number to provide an **index** in rule base

2	0	0	0	1	0	0	0	0
---	---	---	---	---	---	---	---	---

$$\begin{aligned} index &= 2x3^8 + 0x3^7 + 0x3^6 + 0x3^5 + 1x3^4 + 0x3^3 + 0x3^2 + 0x3^1 + 0x3^0 \\ &= 2x3^8 + 1x3^4 = 2x6561 + 1x81 = 13203 < 3^9 = \mathbf{19683} \end{aligned}$$

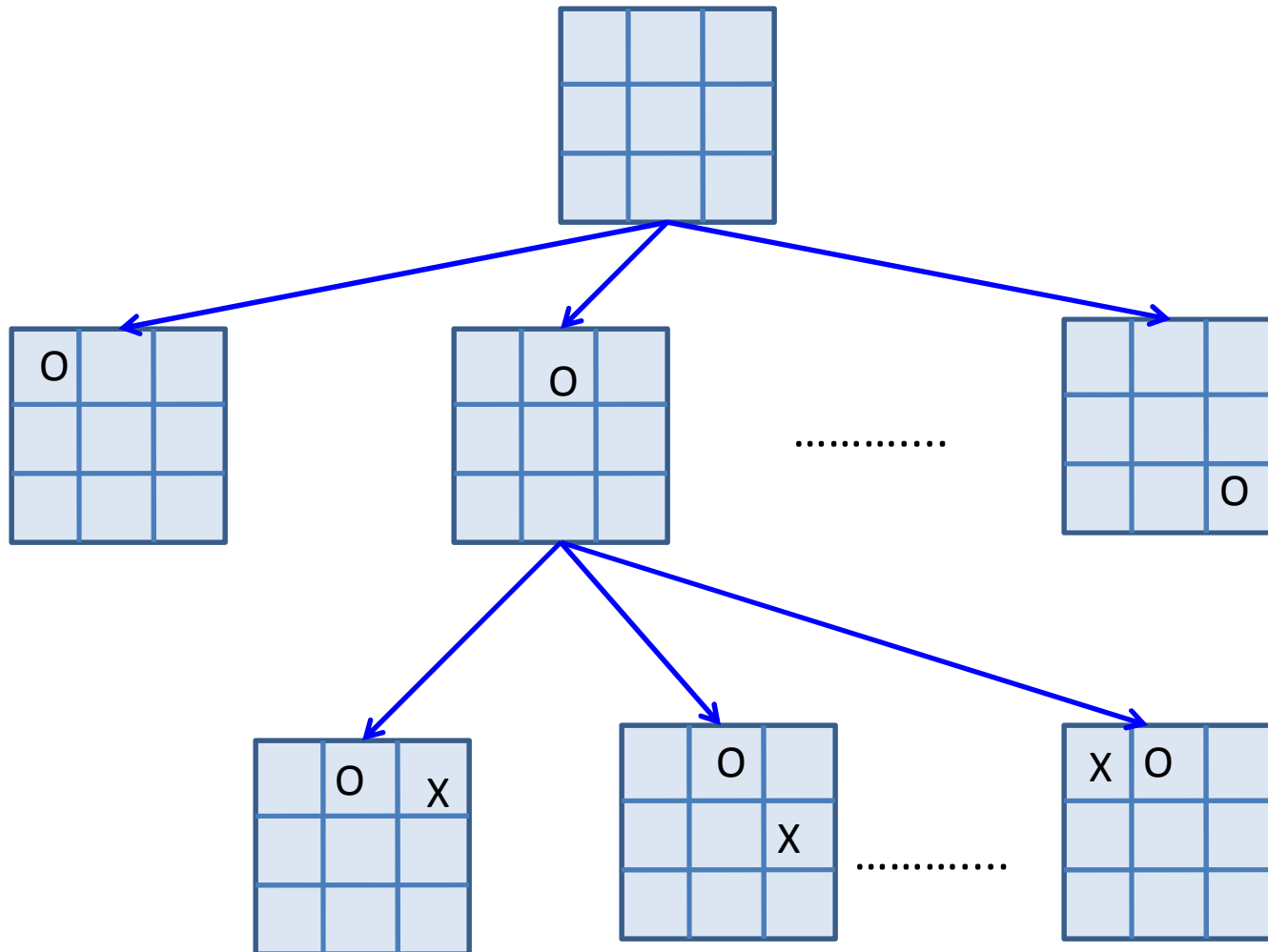
# Non-AI technique

- How to use index?

Index	Vector V
1	[000,000,000]
$3^9$	[.....]



# Tic-Tac-Toe game tree



# Tic-Tac-Toe AI technique

## Design two functions

1. Possible move generator
2. Node evaluator

- How to select the best possible move?- using scores

Winning- 60

Blocking- 50

Else- No of rows+ cols+ diagonals blocked from winning our opponent

# Possible move generator

X	O	
O		O
	X	

X-2

O-1

Next Turn X

2	1	0	1	0	1	0	2	0
---	---	---	---	---	---	---	---	---

## 4 X 9 element matrix

2	1	2	1	0	1	0	2	0
2	1	0	1	2	1	0	2	0
2	1	0	1	0	1	2	2	0
2	1	0	1	0	1	0	2	2

Find all possible moves from the given state and choose best one if it is turn of player X

X	O	
O		O
	X	

- 50,3, 3,3

Find all possible moves from the given state and  
choose best one if it is turn of player O

X	O	
O	X	O
	X	