

AI-Applications

Unit-2

Applications of AI: Game Playing

- Deep Blue in Chess
- Wumpus world

Deep Blue in Chess

- Deep Blue is the chess machine that defeated then World Chess Champion Garry Kasparov in a six-game match in 1997.
- There were a number of factors that contributed to this success including:
 - a single-chip chess search engine
 - a massively parallel system with multiple levels of parallelism,
 - a strong emphasis on search extensions
 - a complex evaluation function
 - effective use of a Grandmaster game database.

Deep Blue in Chess

- Deep Blue's victory was viewed as a symbolic testament to the rise of artificial intelligence—a victory for machine versus man
- The Deep Blue project (initially called ChipTest) was created by Feng-hsiung Hsu in 1985.
- In 1989 Hsu and other colleagues joined the IBM team to fully develop Deep Blue.
- An early version of Deep Blue played a match against GM Joel Benjamin, who joined the Deep Blue team as a GM consultant afterward.

Deep Blue in Chess

- By the time of the 1997 match
 - Deep Blue's alpha-beta search algorithm (the same type of search that is still used by many conventional computer engines today) along with its custom hardware allowed it to consider up to **200 million positions per second**.
- Deep Blue was dismantled after the 1997 victory, with one of its two racks being displayed at the National Museum of American History and the other at the Computer History Museum.

One of the Deep Blue racks on display at the Computer History Museum.



Wumpus world

- The Wumpus world is a simple world example to illustrate the worth of a knowledge-based agent and to represent knowledge representation.
- It was inspired by a video game **Hunt the Wumpus** by Gregory Yob in 1973.
- The Wumpus world is a cave which has 4/4 rooms connected with passageways.
- So there are total 16 rooms which are connected with each other.
- We have a knowledge-based agent who will go forward in this world.
- The cave has a room with a beast which is called Wumpus, who eats anyone who enters the room.
- Note: Here Wumpus is static and cannot move.

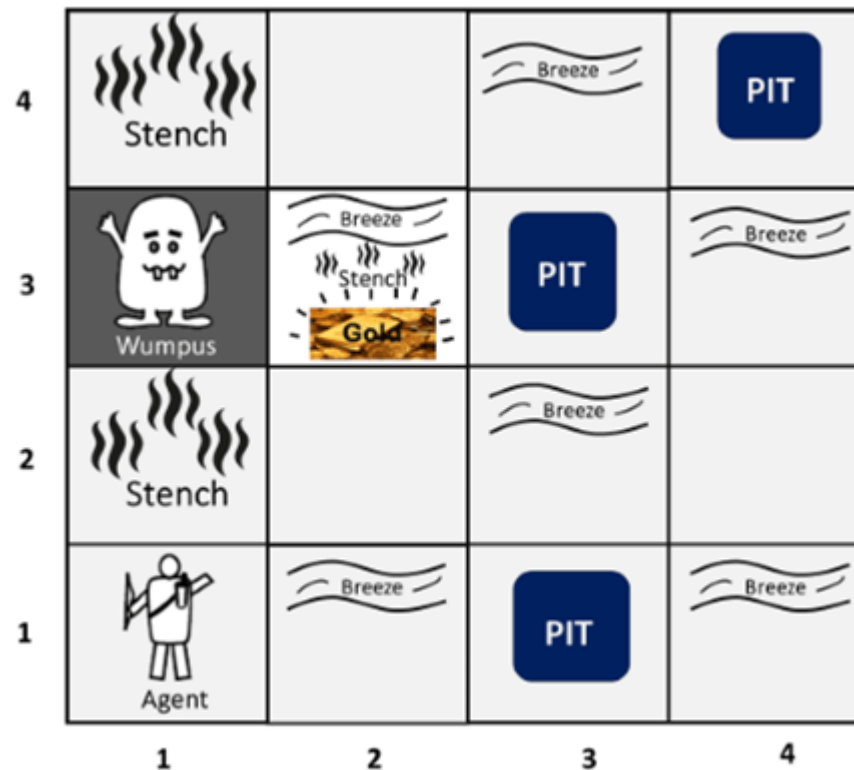
Wumpus world

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- The Wumpus can be shot by the agent, but the agent has a single arrow.
- In the Wumpus world, there are some Pits rooms which are bottomless, and if agent falls in Pits, then he will be stuck there forever.
- The exciting thing with this cave is that in one room there is a possibility of finding a heap of gold.
- So the agent goal is to find the gold and climb out the cave without fallen into Pits or eaten by Wumpus.
- The agent will get a reward if he comes out with gold, and he will get a penalty if eaten by Wumpus or falls in the pit.

Sample diagram for representing the Wumpus world

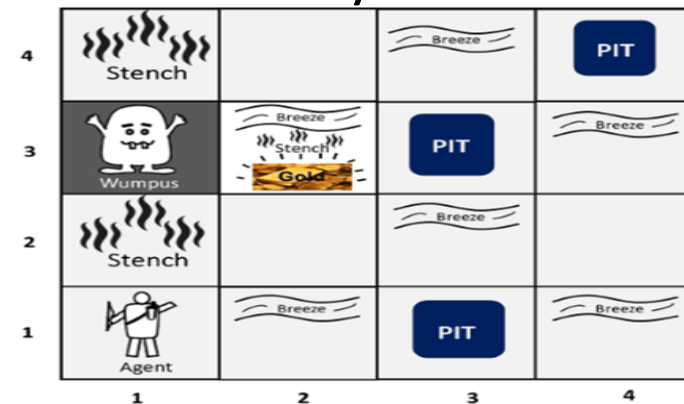
- It is showing some rooms with Pits, one room with Wumpus and one agent at (1, 1) square location of the world.



There are some components which can help the agent to navigate the cave.

- **These components are given as follows:**

- The rooms adjacent to the Wumpus room are smelly, so that it would have some stench.
- The room adjacent to PITs has a breeze, so if the agent reaches near to PIT, then he will perceive the breeze.
- There will be glitter in the room if and only if the room has gold.
- The Wumpus can be killed by the agent if the agent is facing to it, and Wumpus will emit a horrible scream which can be heard anywhere in the cave.

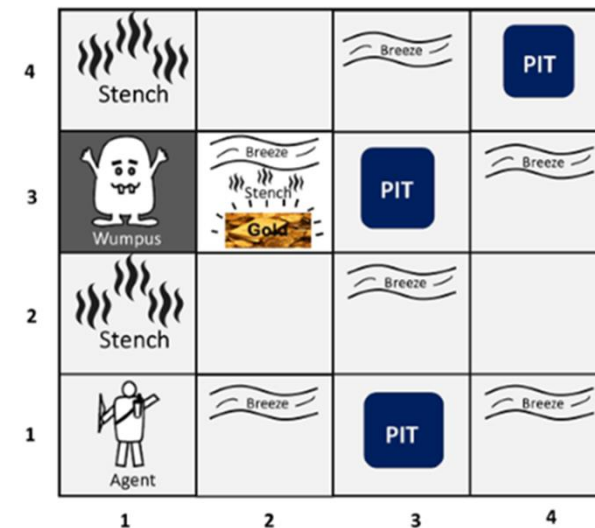


PEAS description of Wumpus world:

- To explain the Wumpus world we have given PEAS description as below:
- Performance measure:
 - +1000 reward points if the agent comes out of the cave with the gold.
 - -1000 points penalty for being eaten by the Wumpus or falling into the pit.
 - -1 for each action, and -10 for using an arrow.
 - The game ends if either agent dies or came out of the cave.

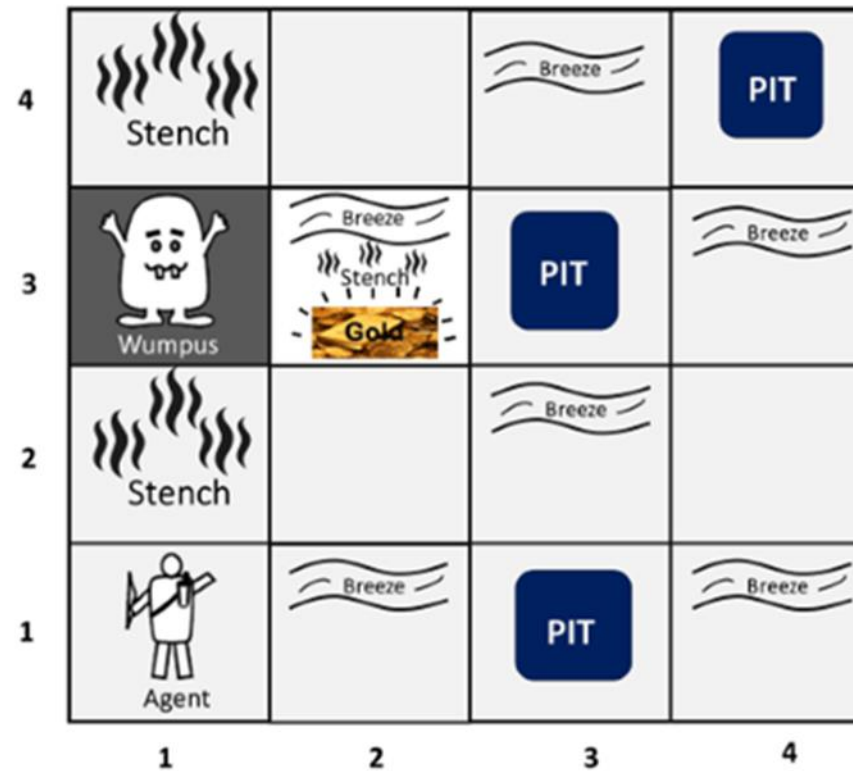
PEAS description of Wumpus world:

- Environment:
 - A 4*4 grid of rooms.
 - The agent initially in room square [1, 1], facing toward the right.
 - Location of Wumpus and gold are chosen randomly except the first square [1,1].
 - Each square of the cave can be a pit with probability 0.2 except the first square.

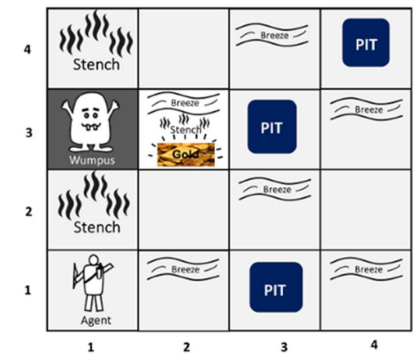


PEAS description of Wumpus world:

- Actuators:
 - Left turn,
 - Right turn
 - Move forward
 - Grab
 - Release
 - Shoot.



Sensors



- The agent will perceive the **stench** if he is in the room adjacent to the Wumpus. (Not diagonally).
- The agent will perceive **breeze** if he is in the room directly adjacent to the Pit.
- The agent will perceive the **glitter** in the room where the gold is present.
- The agent will perceive the **bump** if he walks into a wall.
- When the Wumpus is shot, it emits a horrible **scream** which can be perceived anywhere in the cave.
- These percepts can be represented as five element list, in which we will have different indicators for each sensor.
- Example if agent perceives stench, breeze, but no glitter, no bump, and no scream then it can be represented as:
[Stench, Breeze, None, None, None].

The Wumpus world Properties:

- **Partially observable:** The Wumpus world is partially observable because the agent can only perceive the close environment such as an adjacent room.
- **Deterministic:** It is deterministic, as the result and outcome of the world are already known.
- **Sequential:** The order is important, so it is sequential.
- **Static:** It is static as Wumpus and Pits are not moving.
- **Discrete:** The environment is discrete.
- **One agent:** The environment has a single agent as we have one agent only and Wumpus is not considered as an agent.

Exploring the Wumpus world:

- Now we will explore the Wumpus world and will determine how the agent will find its goal by applying logical reasoning.
- **Agent's First step:**
- Initially, the agent is in the first room or on the square [1,1], and we already know that this room is safe for the agent, so to represent on the below diagram (a) that room is safe we will add symbol OK. Symbol A is used to represent agent, symbol B for the breeze, G for Glitter or gold, V for the visited room, P for pits, W for Wumpus.
- At Room [1,1] agent does not feel any breeze or any Stench which means the adjacent squares are also OK.

1,4	2,4	3,4	4,4
1,3	2,3	3,3	4,3
1,2 ok	2,2	3,2	4,2
1,1 A ok	2,1 ok	3,1	4,1

A = Agent
B = Agent
G = Glitter, Gold
ok = Safe, Square
P = Pit
S = Stench
V = Visited
W = Wumpus

(a)

Room is Safe, No
Stench,
No Breeze

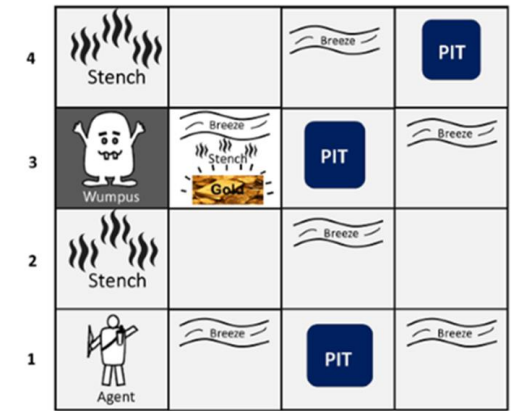
1,4	2,4	3,4	4,4
1,3	2,3	3,3	4,3
1,2 ok	2,2 P?	3,2	4,2
1,1 v ok	2,1 B ok	3,1 P?	4,1

(b)

Perceived Breeze,
Adjacent room is not
Safe Go Back

Agent's second Step:

- Now agent needs to move forward, so it will either move to [1, 2], or [2,1]. Let's suppose agent moves to the room [2, 1], at this room agent perceives some breeze which means Pit is around this room. The pit can be in [3, 1], or [2,2], so we will add symbol P? to say that, is this Pit room?
- Now agent will stop and think and will not make any harmful move. The agent will go back to the [1, 1] room. The room [1,1], and [2,1] are visited by the agent, so we will use symbol V to represent the visited squares.



(a)

Room is Safe, No Stench, No Breeze

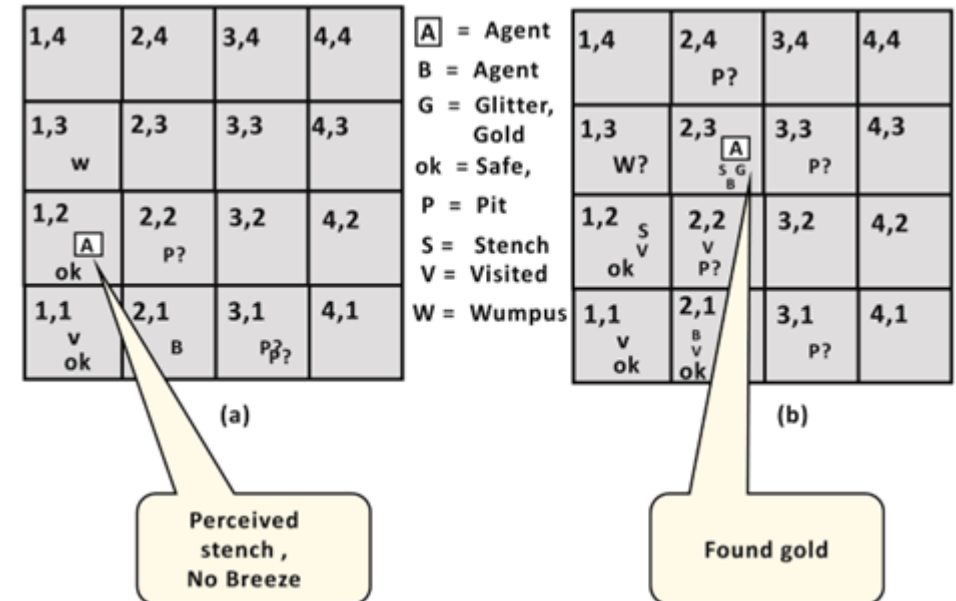
(b)

Perceived Breeze, Adjacent room is not Safe Go Back

Agent's third step:

- At the third step, now agent will move to the room [1,2] which is OK. In the room [1,2] agent perceives a stench which means there must be a Wumpus nearby.
- But Wumpus cannot be in the room [1,1] as by rules of the game, and also not in [2,2] (Agent had not detected any stench when he was at [2,1]).
- Therefore agent infers that Wumpus is in the room [1,3], and in current state, there is no breeze which means in [2,2] there is no Pit and no Wumpus. So it is safe, and we will mark it OK, and the agent moves further in [2,2].

4	Stench		Breeze	PIT
3	Wumpus	Breeze Stench Gold	PIT	Breeze
2	Stench		Breeze	
1	Agent	Breeze	PIT	Breeze
	1	2	3	4



Agent's fourth step:

- At room [2,2], here no stench and no breezes present so let's suppose agent decides to move to [2,3].
- At room [2,3] agent perceives glitter, so it should grab the gold and climb out of the cave.

