Lecture 22
Artificial Intelligence

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Robots

Robotic systems

- Programmable device doing complex actions automatically with speed & precision
- Robot Institute of America defines robot: “A robot is a programmable, multi-functional manipulator designed to move material, parts, tools, or specialized devices through variable programmed motions for the performance of a variety of tasks.”
  - virtual artificial agent
  - Guided by computer program or electronic circuitry

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Robotic systems

- ASSOCIATION OF ROBOTICS There are many robotics association in world
  - JIRA (Japan industrial robotics association)
  - WRO (world robotic Olympiad)
  - RIA (robotics institute of America)
  - IFR (international federation of robotics)
  - CRIA (China Robot Industry Alliance)
  - IEEE robot & automation society

CLASSIFICATION OF ROBOTICS:

- JIRA has created a robot classification system.
  - i. Manual Robot
  - ii. Fixed Sequence robot
  - iii. Variable sequence robot
  - iv. Numerical robot
  - v. Playback robot
  - vi. Intelligent robot

CLASSIFICATION OF ROBOTICS:

- MANUAL ROBOT:
  - This type of robot has multiple degrees of freedom, but all of its actions are performed under the direct control of an operator.

- FIXED SEQUENCE ROBOT:
  - This type of robot repeats a fixed sequence of actions without needing to be controlled by an operator e.g cart picking robot

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CLASSIFICATION OF ROBOTICS:

- VARIABLE SEQUENCE ROBOT
  - This type of robot is similar to class 2, except that the sequence of actions can be reprogrammed easily allowing it to be quickly adapted to perform new tasks
- PLAYBACK ROBOT
  - This type of robot is first guided through a sequence of actions by an operator, then repeats the same actions automatically. playback robot with point to point control
- NUMERICAL ROBOT
  - This type of robot moves through a sequence of actions, which it receives in the form of numerical data.
- INTELLIGENT ROBOT
  - A robot that senses its environment and responds to changes in it in order to continue performing its function.

CLASSIFICATION OF ROBOTICS:

- LAWS OF ROBOTICS
  - A robot may not injure a human being or, by failing to act, allow a human being to come to harm.
  - A robot must obey orders given to it by human beings, except where carrying out those orders would break the First Law.
  - A robot must protect its own existence, as long as the things it does to protect itself do not break the First or Second Law

CLASSIFICATION OF ROBOTICS:

- IDEAL TASKS Tasks which are:
- Dangerous
  - Space exploration
  - chemical spill cleanup
  - disarming bombs
  - disaster cleanup
- Boring and/or repetitive
  - Welding car frames
  - part pick and place
  - manufacturing parts.
- High precision or high speed
  - Electronics testing ,Surgery etc

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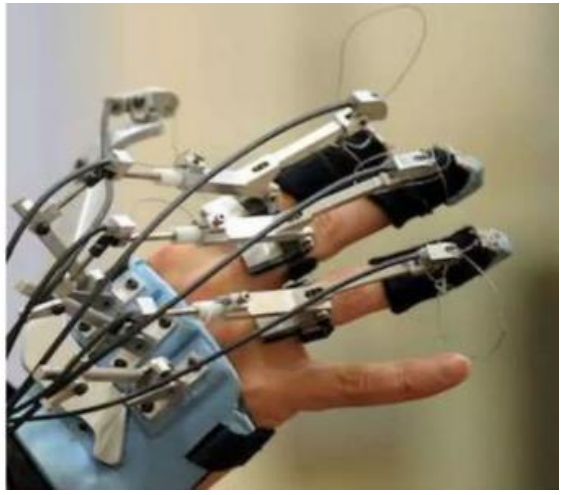
ROBOTS:

- Medical robots:
- There are three types
  - 1.Surgical Robots
  - 2.Rehabilitation Robots
  - 3.Pharmacy Automation



- MILITARY ROBOTS
  - Robots that are use in Military for Bomb Disposal, Transportation, Reconnaissance Drones, Rescue, attacking

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CLASSIFICATION OF ROBOTICS:

- Some of the key benefits of robots in industry and society in general are:
  - Robots can perform many tasks more quickly, safely, accurately and cheaply than human workers.
  - Robots can work continuously for long periods of time without fatigue or boredom.
  - A robot can use sensors to gather information about its environment that is not detectable using the human senses.
  - Robots can be equipped with capabilities beyond those of humans, in terms of speed, force and / or accuracy.
  - Robots can work in uncomfortable environments.

CLASSIFICATION OF ROBOTICS:

- Robotic Path Planning
  - Robotic path planning is trying to answer a different - instead of removing or adding material to fabricate an object, robotic path planning determines how an object can navigate through a space with known or unknown obstacles while minimizing collisions.

CLASSIFICATION OF ROBOTICS:

- Robotic Path Planning
  - Robots are either given, or implicitly build, a mapped representation of their surrounding space.
  - This map can be saved as a discrete approximations with chunks of equal size (like a grid map) or differing sizes (like a topological map, for example road-maps). Continuous map approximations can also be stored by defining inner and outer boundaries as polygons and paths around boundaries as a sequence of real valued points.
  - Although continuous maps have clear memory advantages, discrete maps are most common in robotic path planning because they map well to graph representations which have a rich history of search and optimization algorithms with simple computation complexity.

ROBOTICS:

- Robotic Path Planning: **Tree search algorithms:**
  - Once a space is represented as a graph, there are classic shortest-path graph algorithms that can guarantee the shortest path is found, if given unlimited computation time and resources
  - Dijkstra's algorithm:
  - Dijsktra's algorithm creates a set of "visited" and "unvisited" nodes. An initial starting node is assigned a distance of zero and all other node's distance values are set to infinity.
  - Then, each neighbor is visited and it's distance from the current node is determined, if the distance is less than the previously defined distance value, then the value is updated.
  - Once all neighboring values are updated, the algorithm moves the current node of the "visited" set and repeats the process of the next neighboring node with the shortest distance value. The algorithm continues until all nodes have been moved from "unvisited" to "visited".

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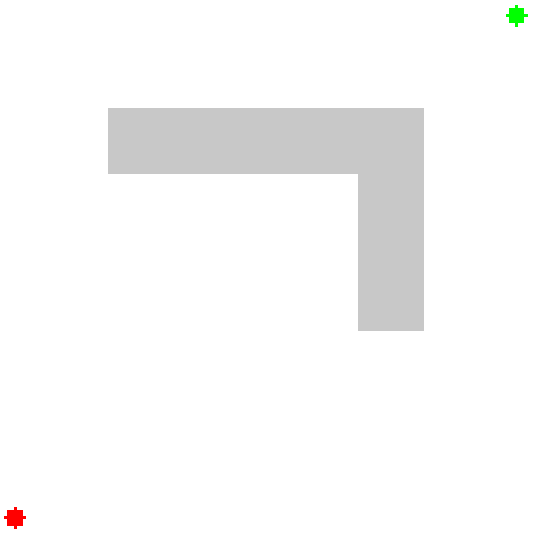

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ROBOTICS:

- Robotic Path Planning: **Tree search algorithms:**
- **A*:**
- A* is another path-finding algorithm that extends Dijkstra's algorithm by adding heuristics to stop certain unnecessary nodes from being searched.
- This is done by weighting the cost values of each node distance by their euclidean distance from the desired endpoint. Therefore, only paths that are headed generally in the correct direction will be evaluated.

ROBOTICS:

- Robotic Path Planning: **Tree search algorithms:**
- **Rapidly-exploring random trees (RRT):**
  - RRT quickly searches a space by randomly expanding a a space-filling tree until the desired target point is found.
- **Machine Learning path planning**
- Machine learning methods are the latest development for determining robotic path planning.
- Reinforcement learning using Markov Decision Processes or deep neural networks can allow robots to modify their policy as it receives feedback on its environment.

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ROBOTICS:

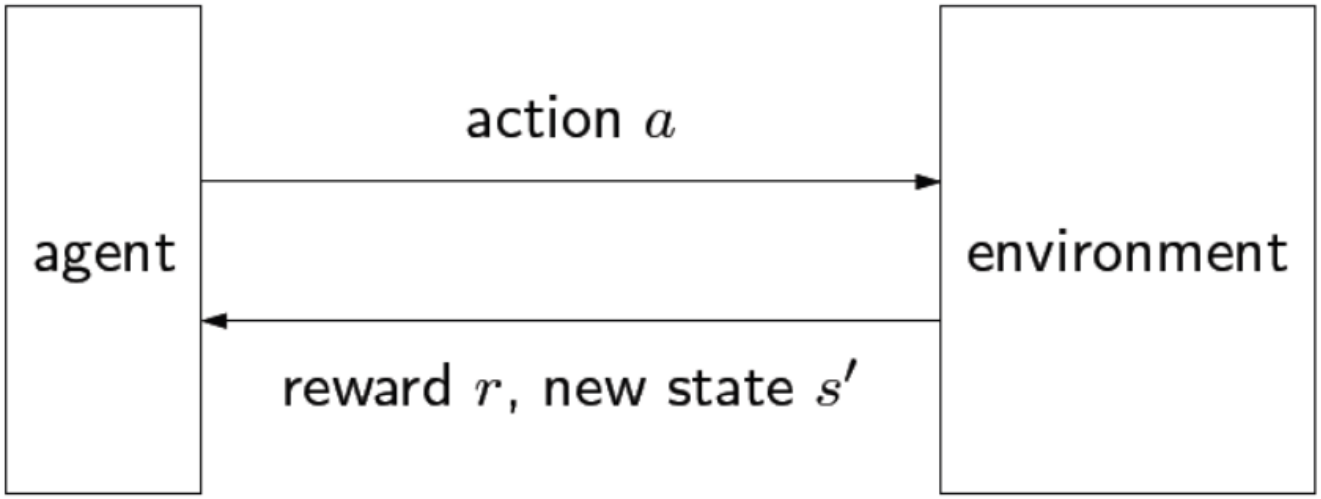
- Robotic Path Planning: **Tree search algorithms:**
- **Reinforcement learning:**
- Rewards or punishments.
- For example, the lack of a tip at the end of the journey gives the taxi agent an indication that it did something wrong.
- The two points for a win at the end of a chess game tells the agent it did something right.
- Reinforcement learning allows an agent to learn how to behave from past successes and failures.

ROBOTICS:

- Robotic Path Planning: **Tree search algorithms:**
- **Reinforcement learning:**
- The agent needs to know that something good has happened when it (accidentally) checkmates the opponent, and that something bad has happened when it is checkmated or vice versa, if the game is suicide chess.
- This kind of feedback is called reward, or reinforcement
- In games like chess, the reinforcement is received only at the end of the game. In other environments, the rewards come more frequently. In ping-pong, each point scored can be considered a reward; when learning to crawl, any forward motion is an achievement.

ROBOTICS:

- RL frame work



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