ARTIFICIAL INTELLIGENCE
Lecture Notes

Unit-V

Robotics &
Philosophical Foundations

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Unit – IV

ROBOTICS & PHILOSOPHICAL FOUNDATIONS

JNTUA SYLLABUS
Unit - V: Robotics: Introduction, Robot Hardware, Robotic Perception, Planning to move, planning uncertain movements, Moving, Robotic software architectures, application domains

Philosophical foundations: Weak AI, Strong AI, Ethics and Risks of AI, Agent Components, Agent Architectures, Are we going in the right direction, What if AI does succeed.

CONTENTS

Unit –V
ROBOTICS

5.1 ROBOTICS

- Robotics is a branch of technology that deals with physical robots.
- Robotics is the intersection of Science, Engineering and Technology.
- Robotics is the engineering discipline dealing with the design, construction, and operation of robots.
- Robotics is a branch of AI which is the combination of Electronics Engineering, Mechanical Engineering & Computer Science Engineering.
- Robotics is a domain in AI which deals with study of creating intelligent and efficient robots.

5.2 ROBOT

- A robot is the product of the Robotics field, where programmable machines are built that can assist humans or mimic human actions.
- Robots are programmable machines that are usually able to carry out a series of actions.
- AI Robots are the artificial agents acting in the real world environment.
- There are three important factors which constitute a robot:
    - Robots interact with the physical world via sensors and actuators.
    - Robots are programmable.
    - Robots are usually autonomous or semi-autonomous.
- A simple Collaborative Robot (COBOT) is the example of a non-intelligent robot.
- Example of COBOT: Industrial Robot can pick up an object and place it elsewhere. It will then continue to pick and place objects in exactly the same way until it is turned off. This is an autonomous function because the robot does not require any human input after it has been programmed. The task does not require any intelligence because it will never change what it is doing.

5.3 TYPES OF ROBOT

Generally there are five types of Robot

1. Pre programmed Robots
2. Humanoid Robots
3. Autonomous Robots
4. Teleoperated Robots
5. Augmenting Robots

1. **Pre programmed Robots**
    - Pre-programmed robots operate in a controlled environment where they do simple, repetitive tasks.
    - Example: **Manipulator** or Mechanical arm on an automotive assembly line. The arm serves one function — to weld a door to the car, to insert a certain part into the engine, etc., and its job is to perform that task longer, faster and more efficiently than a human.
2. **Humanoid Robots**
    - These robots look like humans and mimic human behavior. These robots usually perform human-like activities (like running, jumping and carrying objects).
    - Examples: Hanson Robotics' SOPHIA , Boston Dynamics' ATLAS.
3. **Autonomous Robots**
    - These robots operate independently of human operators. These robots are usually designed to carry out tasks in open environments that do not require human supervision.
    - Example: Mars Rover robot, Mobile robots like Cleaning Bots (Roomba Vacuum cleaner), Lawn Trimming Bots, Hospitality Bots, Autonomous Drones , Autonomous underwater vehicles, Medical Assistant Bots etc.,
4. **Teleoperated Robots**
    - These robots are semi-autonomous bots that use a wireless network to enable human control from a safe distance. These robots usually work in extreme geographical conditions, weather, circumstances, etc.
    - Example: Human-controlled submarines used to fix underwater pipe leaks, Unmanned Air Vehicles(UAV) like Drones used to detect landmines.
5. **Augmenting Robots**
    - Augmenting robots either enhance current human capabilities or replace the capabilities a human may have lost. The field of robotics for human augmentation is a field where science fiction could become reality very soon.
    - Examples: robotic prosthetic limbs or exoskeletons used to lift hefty weights.

5.4 ROBOT HARDWARE / COMPONENTS OF AI ROBOT

- The main components of a robotic system are
    1. CPU
    2. Sensors
    3. Actuators
    4. End-effectors
    5. Power supply
    6. A program

1. Central Processing Unit(CPU)

- The CPU acts as the "brain" of the robot.
- Human brain decides what to do and how to react to the world based on feedback from five senses.
- A robot's CPU does the same thing based on data collected by devices called sensors.

2. Sensors

- Sensors are the powerhouse of a robot's feedback mechanism.
- They act like "eyes" and "ears" to the help the robot in taking the surrounding information.
- Some of the sensors include:

  SONAR sensors (sound navigation and ranging), LIDAR sensor (light detection and ranging), Light sensors, Sound sensors, Temperature sensors, Contact sensors, Distance sensors, Proximity sensors, Pressure sensors, Positioning sensors(GPS).

  Sensors can be of two types:

  a. Passive sensors – true observers such as cameras
  b. Active sensors – send energy to the environment, like SONAR
- The robot's CPU interprets signals from these sensors and adjusts its actions accordingly.
- Cameras feed in visual information, then an AI process called machine vision analyzes the video footage to recognize objects, guiding the robot.
- Some robots even have touch, taste and smell.

3. Actuators

- If sensors are the eyes and ears of the robot, its actuators function like muscles.
- Actuators are small motors attached directly to the structure of the robot that facilitate movement.
- Some of them are:
    - Hydraulic – uses oil to facilitate movement.
    - Penumatic – uses air to facilitate movement.
    - Electric – uses electric current and magnets to facilitate movement.

- The simplest robots consist of an arm with a tool attached for a particular task.
- More advanced robots may move around on wheels.
- Humanoid robots have arms and legs that mimic human movement.

4. End Effectors

- In order to carry out assigned tasks, robots are equipped with tools called "effectors" or "end effectors".
- These are the tools that perform the actual work and interact with the environment.
- Some of them are:
    - Industrial robots may have interchangeable tools such as welding torches, secrewdrivers, pain sprayers.
    - Mobile robots sent to other planets or bomb disposal robots have universal grippers that mimic the function of the human hand.

5. Power Supply

- Most robots get their energy from electricity.
- Stationary robots in factories receive use A.C power.
- Mobile Robots are usually powered with D.C power/Batteries.
- Space robots or Satellites are designed to collect solar power.

6. A Program

- A robot's programming is not a physical component ,but it's still essential part of the system.
- The program within a robot provides the logic that drives the robot.
- The latest robotic technology uses machine learning (reinforcement learning) ,which mimics how human learns.

5.5 ROBOTIC PERCEPTION

- Perception is the process by which robots map sensor measurements into internal representations of the environment.
- Perception is difficult because sensors are noisy, and the environment is partially observable, unpredictable, and often dynamic.
- In other words, robots have all the problems of "state estimation".
- Good internal representations for robots have three properties:
    - they contain enough information to make good decisions,
    - they are structured so that they can be updated efficiently, and
    - they are natural in the physical world.

5.5.1 Simultaneous Localization And Mapping(SLAM)

- SLAM is the computational problem of constructing or updating a map of an unknown environment while simultaneously keeping track of a robot's location within it.
- Knowledge about where things are is the main thing while interacting with environment.
- For example, robot manipulators must know the location of objects they seek to manipulate, navigating robots must know where they are to find their way around.
- Intelligent systems interpret raw data according to probabilistic models and using contextual information that gives meaning to the raw data.
    - **Understanding = Raw data + Probabilistic models +context**

5.5.2 Other types of Perception

- Robots also perceive the temperature, odors, acoustic signals, and so on.
- Many of these quantities can be estimated using conditional probability distribution models.
- These models characterize the variables over time.
- The trend in robotics is clearly towards representations with well-defined semantics.

5.5.3 Machine learning in robot perception

- Machine learning plays an important role in robot perception.
- This is particularly the case when a pre-defined internal information is not available with the robot.
- Supervised learning or Unsupervised learning or Reinforcement learning approaches can be utilized.
- Another machine learning technique enables robots to continuously adapt to broad changes in sensor measurements. This is known as **Adaptive Perception.**
- Adaptive perception techniques enable robots to adjust to changes.

- Example: A self driving car identifies road (stripes representation) and separates the road from grass(plain texture) in the perception. By any chance if it enters in the grass zone it will find a way on the grass (i.e., immediately the grass zone is converted in to stripes representation)

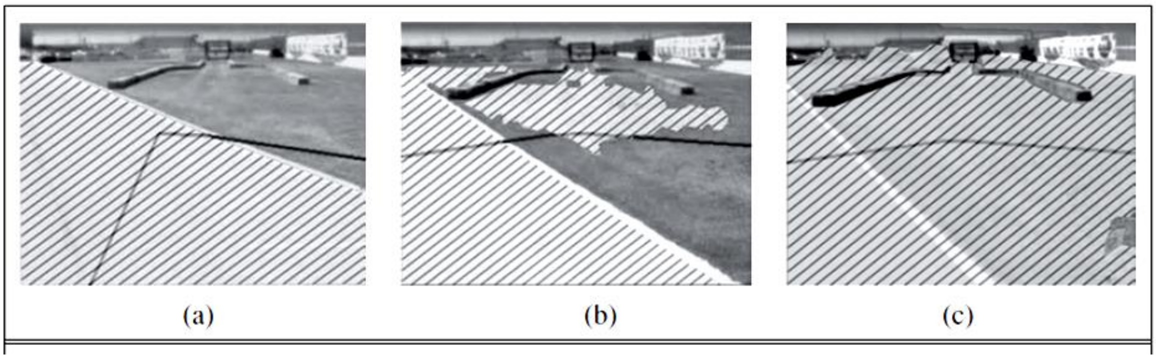


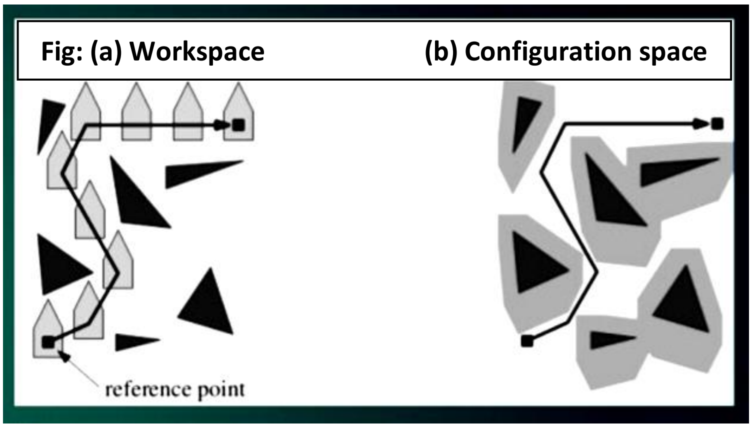
Fig : Sequence of "drivable surface" – In (a) only the road is classified as drivable (striped area). The V-shaped dark line shows where the vehicle is heading. In (b) the vehicle is commanded to drive off the road, onto a grassy surface, and the classifier is beginning to classify some of the grass as drivable. In (c) the vehicle has updated its model of drivable surface to correspond to grass as well as road.

5.6 PLANNING TO MOVE (NAVIGATION & MOTION PLANNING)

- The planning is about decision making tasks performed by the robots or computer programs to achieve a specific goal.
- Planning is arranging a sequence of actions to achieve a goal.
- Motion planning, also path planning is a computational problem to find a the valid sequences that moves the object from the ***source to destination***.
- Any kind of robot wants to move in the physical space.
- Example: A mobile robot movement inside a building-It should execute this task while avoiding walls and not falling down stairs. A motion planning algorithm would take a description of these tasks as input, and produce the speed and turning commands sent to the robot's wheels
- ***Types of motion:***
  Point-to-point: deliver robot to target location.
  Complaint motion: move while in contact to an obstacle(robot pushing a box, a robot manipulator that screws in a light bulb)
  Some of the aspects considered in Motion planning are:
  1. Configuration space & Work space
  2. Cell decomposition methods
  3. Skeletonization methods

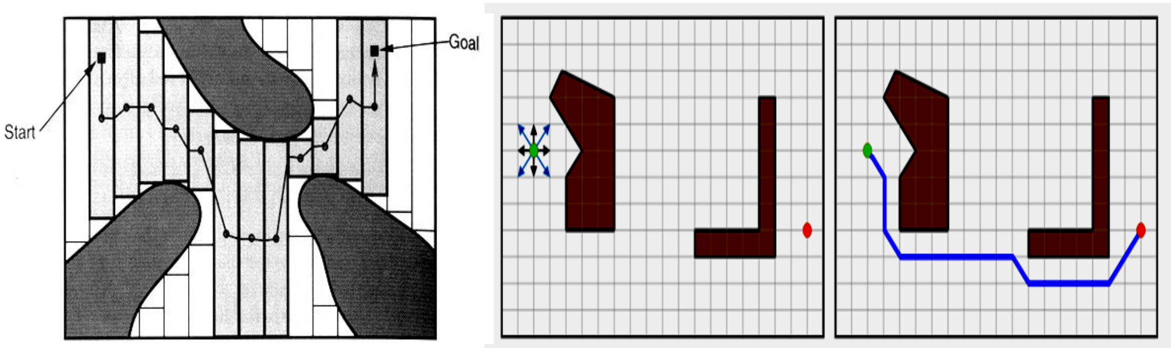
5.6.1 Configuration space & Work space

- Workspace -It is the set of points that can be reached by its end-effectors.The workspace of a robot is the space in which the mechanism is working.
- Configuration space- It is the space of possible positions the robot may attain. A path of robot maps to a curve in the “configuration space” or “C-space”.



5.6.2 Cell decomposition methods

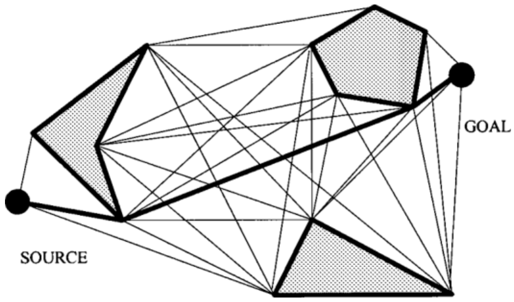
- The main approach to path planning uses cell decomposition.
- Breaking the continuous space into finite number of cells is known cell decomposition.
- It decomposes the workspace into free space and obstacle cells.
- Within free space, the robot can move freely.



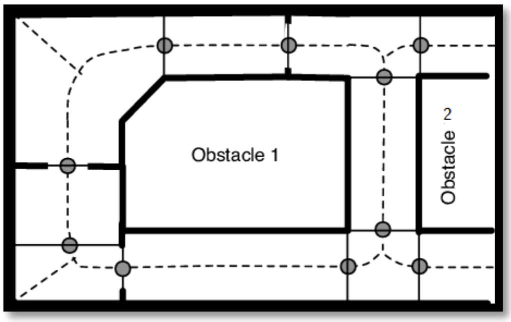
5.6.3 Skeletonization methods

- The path-planning algorithms are based on the idea of skeletonization.
- These algorithms reduce the robot’s free space to a one-dimensional representation.
- This makes planning problem is easier.
- This dimensional representation is called a **skeleton** of the configuration space.
- The path of the robot lies along the skeleton.

- ***Skeletonization methods:***
- ***1. Visibility graphs*** – This graph for the configuration space consists of edges joining all pairs of vertices that can see each other.



- **2. *Voronoi diagrams*** - The Voronoi graph is the set of points equidistant to two or more obstacles in configuration space.



- ***3. Probabilistic roadmap*** – This is a skeletonization approach that offers more possible routes, and thus deals better with wide-open spaces.

  This is a motion planning in robotics, which solves the problem of determining a path between a starting point of the robot and a goal point while avoiding collisions.

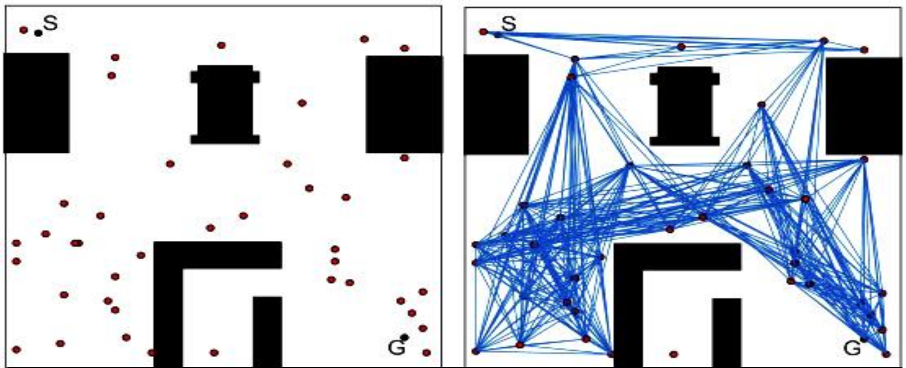


Fig: (a) Sampled nodes (b) Feasible edges between any two nodes

5.7 PLANNING UNCERTAIN MOVEMENTS

- In robotics, uncertainty is the main problem.
- Uncertainty arises from partial observable conditions and stochastic (random) nature of the environment.
- Errors can also arise from the use of approximation algorithms.
- Most of today's robots use deterministic algorithms for decision making, such as the path-planning algorithms.
- It is common practice to extract the **most likely state** from the probability distribution produced by the state estimation algorithm.
- This approach is purely computational.
- In fact, when the environment model changes over time, many robots will plan the paths online during plan execution.
- This is known as ***"online re-planning technique"***
- If the robot faces uncertainty, it can be best modeled as a **Markov decision process (MDP).**
- The solution of MDP gives an optimal policy.
- This policy tells the robot what to do in every possible state.
- In robotics, policies are called **navigation functions**.
- Most of the present day Robots use Reinforcement learning methods to handle the concept of uncertainty.
- Some of the approaches are :
  - ✓ 1.Passive Reinforcement Learning
    - a)Direct Utility Estimation
    - b)Adaptive Dynamic programming
    - c)Temporal Difference learning.
  - ✓ 2.Active Reinforcement Learning
    - a)ADP with exploration function
    - b)Q- Learning
    - c)SARSA (State-Action-Reward-Stage-Action)

5.8 MOVING

- In Robotics, after the path planning, Robotic movement is the main aspect.
- A robot can simply follow any path as per the algorithm, but in the real World, this is not the case.
- Robots have inertia and cannot execute random paths.
- In most cases, the robot gets to exert forces rather than identify positions.
- Following are the some of the methods for calculating these forces.

  1. ***Dynamics and Control***
  2. ***Reactive Control***
  3. ***Reinforcement learning control***

5.8.1 Dynamics and Control

- Kinematic model – It studies the motion of robot mechanism regardless of forces.
- Dynamic model –It studies the motion of robot mechanism under the action of forces.
- Studies of motion include displacement, velocity, acceleration & time.
- The movement of robot arms and other actuators causes the robot to vibrate violently. This is mainly due to the inertia of the components.

5.8.2 Reactive Control

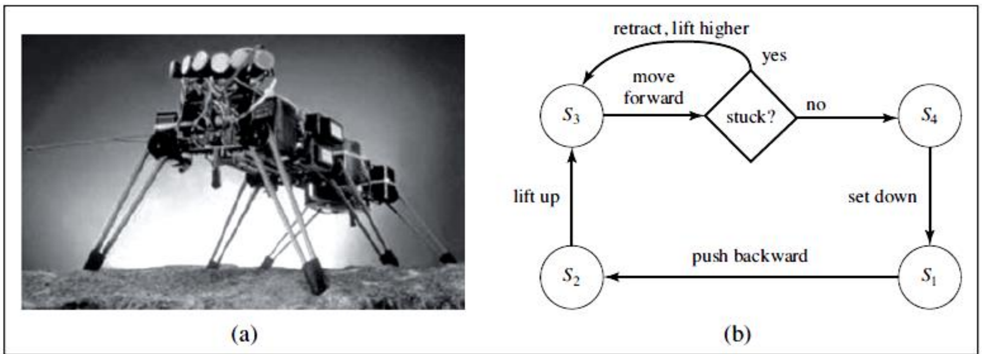
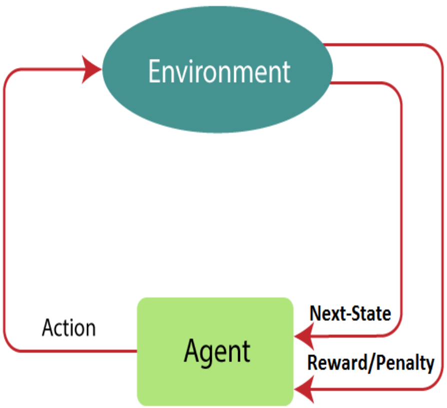
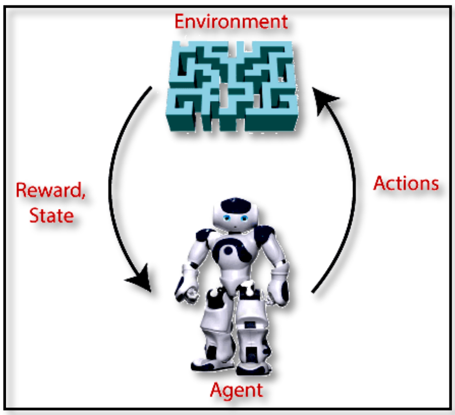


Fig: (a) Hexapod Robot (b) if a leg is stuck during the forward swinging, it reacts to sensor feedback. i.e., it will be lifted.

- Most of the robots are designed in such a way that, it follows ***simple reflex agent*** architecture using reactive control.
- Simple reflex agent - take decisions on the basis of the current percepts.
- In the above example, a six-legged robot is designed to walk on the rough surfaces.
- The robot's sensors follow a set of rules like, lift the leg a small height and move it forward, if the leg encounters an obstacle.

5.8.3 Reinforcement learning control





- Advanced robotic mechanisms follow Reinforcement Learning Control.
- Reinforcement Learning is a feedback-based Machine learning technique in which an agent (Robot) interacts with its environment by producing actions.
- In Reinforcement Learning, the agent learns automatically using feedbacks without any labeled data.
- The control of the robot is based on the ***policy search*** form of Reinforcement Learning.
- RL solves a specific type of problem where decision making is sequential, and the goal is long-term, such as **,** ***robotics****,* ***Self driving cars, self navigating vacuum cleaner e****tc.,*

5.9 ROBOTIC SOFTWARE ARCHITECTURES

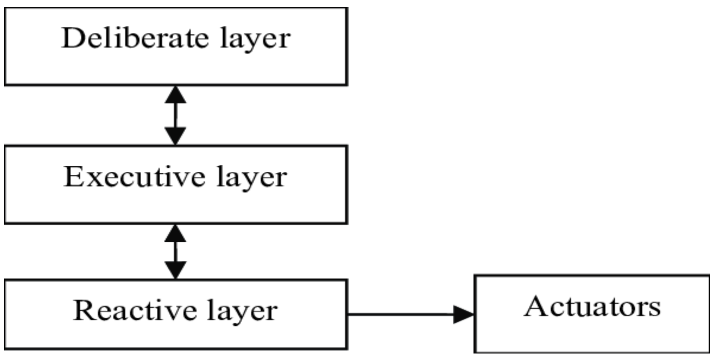
- A methodology for structuring algorithms is called software architecture.
- Architecture includes languages and tools for writing programs.
- The software architectures for robotics must decide how to combine reactive control and model-based deliberative planning.
- Most robot architectures use reactive techniques at the lower levels of control and deliberative techniques at the higher levels.
- Architectures that combine reactive and deliberate techniques are called ***"hybrid architectures".***
- There are two types of software architectures

1. Three-layer architecture

2. Pipeline architecture

5.9.1 Three –layer architecture

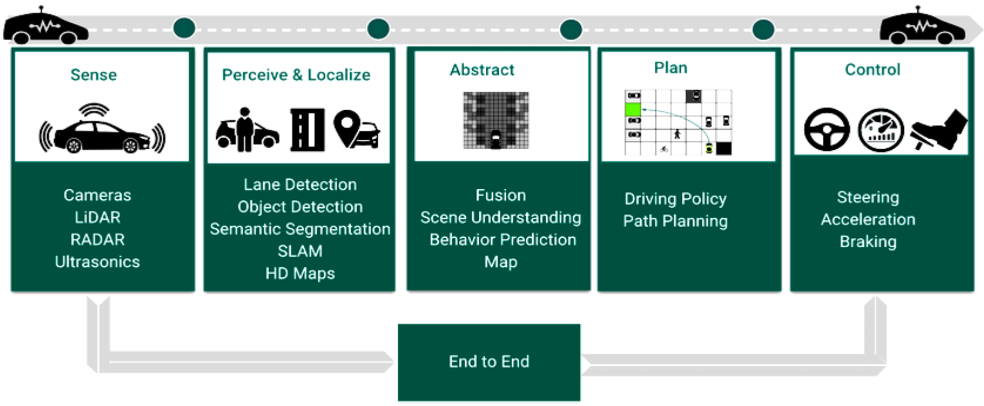
- The most popular hybrid architecture is the three-layer architecture.
- It consists of a reactive layer, an executive layer, and a deliberative layer.
- Some of the robot software systems may have additional layers, such as user interface layers that control the interaction with people.



1. Reactive layer
    - It provides low level control to the robot.
    - It characterized by sensor-action loop.
    - Its decision cycle is in the order of milliseconds.
2. Executive layer
    - This is also known as sequencing layer.
    - This layer serves as a bond between reactive layer and deliberative layer.
    - It accepts directives by the deliberative layer, and sequences them for the reactive layer. Decision cycles at the executive layer are usually in the order of a second.
3. Deliberative layer
    - This is also known as planning layer.
    - It generates global solutions to complex tasks using planning.
    - Because of the computational complexity involved in generating such solutions, its decision cycle is often in the order of minutes.
    - It uses models for decision making.

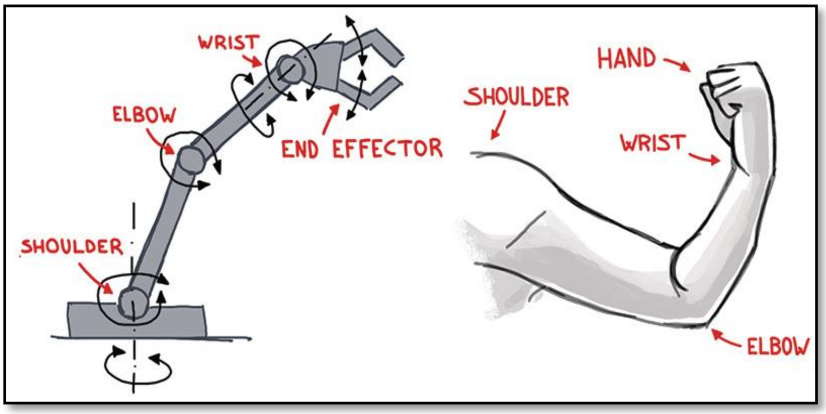
5.9.2 Pipeline architecture

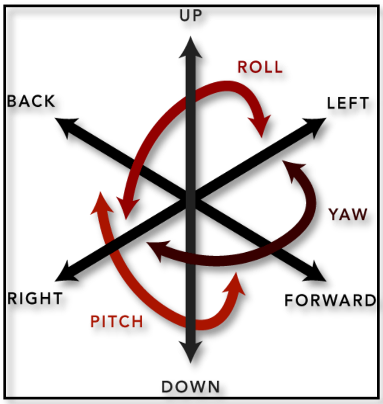
- Pipeline architecture is similar to the human brain
- It executes multiple processes in parallel.
- Some of the modules in this architecture resemble those in the three-layer architecture.
- This type of architecture is used to control an autonomous car.
- Data enters this pipeline at the **sensor interface layer**.
- The **perception layer** then updates the robot's internal models of the environment based on this data.
- Next, these models are handed to the **planning and control layer**, which adjusts the robot's internal plans and turns them into actual controls for the robot.
- Those are then communicated back to the vehicle through the **vehicle interface layer**(display of various indicators on car dashboard)



5.10 DEGREES OF FREEDOM (DOF)

- The DOF of a robot typically refer to the number of movable joints of a robot.





- DOF - one joint one degree of freedom.
- Simple robot arm– 3 degrees of freedom; X,Y,Z axis
- Modern robot arm – 6 degrees of freedom: X,Y,Z, Roll, Pitch, Yaw
- In order to completely define an objects location in space, at least six degrees of freedom must be defined; x, y, z location, and its orientation, or roll, pitch and yaw.

5.11 APPLICATION DOMAINS OF ROBOTICS

1. **Industrial robots** - Material handling, Assembly, Painting, Welding.
2. **Service robots** - autonomous vacuum cleaners, lawn mowers, golf caddies, robotic kiosk, Surveillance.
3. **Medical robots** - Surgical assistants.
4. **Humanoid robots** - Hanson Robotics' SOPHIA , Boston Dynamics' ATLAS.
5. **Exploration robots** – Space mission, under water exploration.
6. **Transportation robots** – Self driving cars like TESLA autonomous car.
7. **Agriculture robots** – Crop harvesting Robots, Weeding Robots.
8. **Hazardous environment robots** - cleaning up nuclear waste, Defusing bombs, clearing minefields on land and at sea.
9. **Logistic robots** – Mobile automated guided vehicles in warehouses to transport goods.
10. **Defense robots** – Flying robot drones

PHILOSOPHICAL FOUNDATIONS

5.12 WEAK AI: CAN MACHINES ACT INTELLIGENTLY?

- Weak AI is generally developed or used for specific application domains.
- This is also known as Narrow AI.
- This is the first stage of AI (***Machine Learning***)
- This is the only kind and most common form of AI that exists today.
- Weak AI operates within a limited context.
- This is a simulation of human intelligence.
- Weak AI is programmed to assist humans with a single task or a specific task.
- By definition, they have narrow capabilities like recommending a product in e-commerce websites like Amazon/ Flipkart or predicting weather etc.,
- Some things they can do:
  - Computer Vision – Face recognition from a large set.
  - Robotics – Autonomous car.
  - Natural Language Processing – Simple Machine Translation.
  - Speech Recognition – Speech to Text, Text to Speech.
  - Games – Grand master level in chess etc.,
- Examples : Google search, Google Maps, Speech recognition, Image recognition on Facebook, Playing Chess in system, Personal digital assistants (Apple's Siri, OK google , Alexa), Autonomous Vehicles like TESLA Cars, Google's DeepMind, Sophia Robot.

5.13 STRONG AI: CAN MACHINES REALLY THINK?

- Strong AI is a type of intelligence which could perform any intellectual task with efficiency like human.
- This is also known as General AI.
- This is the second stage of AI (***Machine Intelligence***)
- Strong AI is still a theoretical concept which is under research and presently there is no such system exists.
- Strong AI has a human level of cognitive function such as reasoning.
- Strong AI has the ability of the programme to perform a different kind of tasks just like a humane does.
- Today's AI certainly imitates intelligent human behavior like never before. But AI can never be the same as human intelligence.
- Examples : Advanced Robotics (Expecting)

5.14 COMPARISON OF WEAK AI & STRONG AI

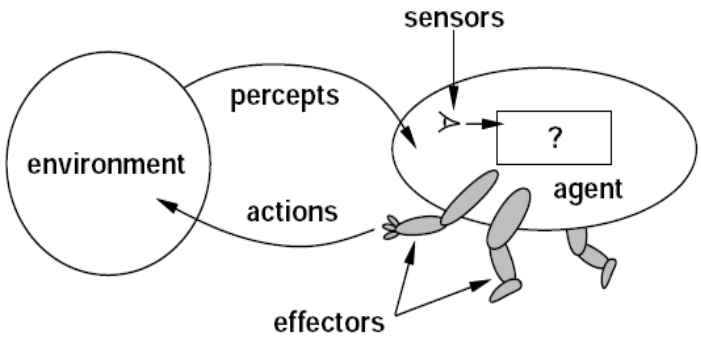
S.No.	Weak AI	Strong AI
1	This is also known as Narrow AI.	This is also known as General AI.
2	This is the first stage of AI- Machine Learning	This is the second stage of AI - Machine Intelligence
3	Good at specific tasks.	Incredible human level intelligence.
4	Performs repetitive tasks.	Performs multiple tasks.
5	Limited ability.	Unlimited abilities.
6	Can't self program.	Can self program.
7	Fixed domain models provided by programmers.	Self learns and reasons its operating environment.
8	Learns from structured data/or from thousand of labeled examples.	Learns from unstructured data/or from few examples.
9	The machine can just simulate the human behavior.	The machine actually has a mind of its own andcan take decisions.
10	Examples – Present AI Computer Chess, Alexa, Siri, etc.,	Examples – Future AI? Advanced Robotics

5.15 THE ETHICS AND RISKS OF AI

- Ethics studies ethical behavior, investigating "what is good and bad", "what is right and wrong" and aims at the establishment of rules of morality and good life.
- Ethics develops and studies the following.
  - Moral principles.
  - Values.
  - Rules and regulations.
  - Rules of conduct.
  - Ethical practices.
- AI technologies solve many real-life problems but they create serious ethical concerns and legal challenges related to:
  - ✓ Protection of privacy
  - ✓ Data security
  - ✓ Data usability
  - ✓ Trust
  - ✓ Safety etc.,

- Some of the ethical challenges of AI include :
  - Lack of transparency of AI tools - AI decisions are not always reasonable to humans.
  - AI is not neutral – AI based decisions are susceptible to inaccuracies, unfair outcomes.
  - Surveillance practices for data gathering and privacy of users.
  - New concerns for fairness and risk for Human Rights and other fundamental values.
- There are six potential threats to society posed by AI and related technology.
  1. People might lose their jobs to automation.
  2. People might have too much (or too little) leisure time.
  3. People might lose their sense of being unique.
  4. AI systems might be used toward undesirable ends.
  5. The use of AI systems might result in a loss of accountability.
  6. The success of AI might mean the end of the human race.

5.16 AGENT COMPONENTS



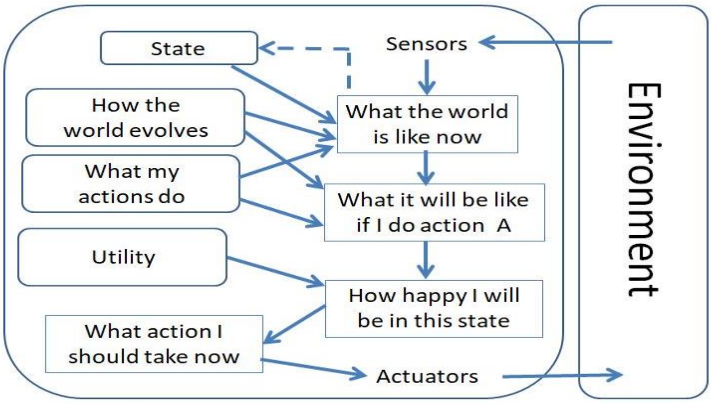
- An AI system can be defined as the study of the rational agent and its environment.
- The agents sense the environment through sensors and act on their environment through actuators.
- *Definition: "An intelligent agent can be anything which perceives its environment through sensors and act upon that environment through actuators or effectors".*
- In simple, an agent senses the environment and takes actions autonomously in order to achieve goals.
- An agent runs in the cycle of ***perceiving, thinking and acting***.

- **Interaction with the environment through sensors and actuators**:
  - **Sensor:** Sensor is a device which detects the change in the environment and sends the information to other electronic devices. An agent observes its environment through sensors. A Sensor can be IR sensor, Voice sensor etc.,
  - **Actuators:** Actuators are the component of machines that converts energy into motion. The actuators are only responsible for moving and controlling a system. An actuator can be an electric motor, gears, rails, etc.
  - **Effectors:** Effectors are the devices which affect the environment. Effectors can be legs, wheels, arms, fingers, wings, fins, and display screen.
- **Keeping track of the state of the world**:
  - This is one of the core capabilities required for an intelligent agent.
  - It requires both perception and updating of internal representations.
- **Learning:**
  - Learning in an agent can be formulated as inductive learning of the functions that constitute various components of the agent.
  - This learning can be supervised, unsupervised, or reinforcement learning.

5.17 AGENT ARCHITECTURES

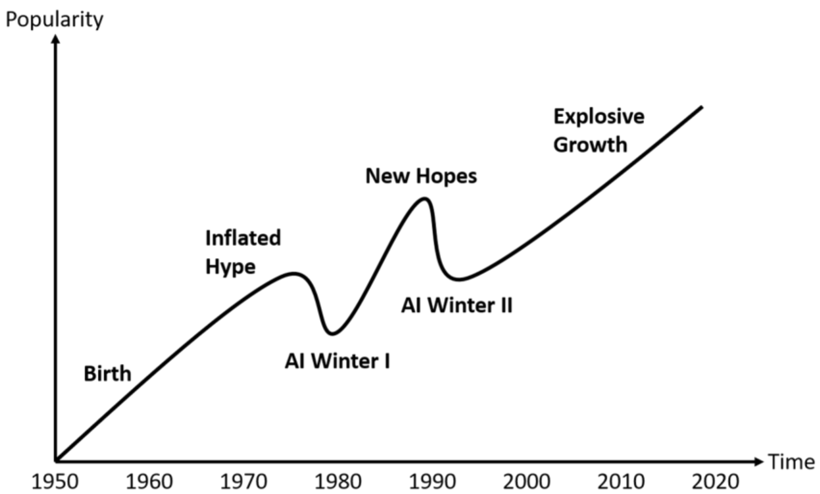
- The structure of an intelligent agent is a combination of architecture and agent program. It can be viewed as
  - ***Intelligent Agent = Architecture + Agent Program***
- The architecture is the combination of sensors & actuators.
- If the program is going to recommend actions like “walk”, the architecture should have “legs”.
- Intelligent agents are grouped in to five classes based on their degree of perceived intelligence and capability. All these agents can improve their performance and generate better action over the time.
- ***Types of Agent Program***
  1. Simple reflex agent
  2. Model based reflex agent
  3. Goal based agent
  4. Utility based agent
  5. Learning agent
- Reflex model is required for immediate responses, whereas other models allow the agent to plan ahead.
- A complete agent must be able to do all the actions simultaneously.

- Present agents will have all the above five models in the architecture.
- This is known as **hybrid architecture.**
- Most of the agents follow utility based agent's architecture.



- Utility-based agent act based not only goals but also the best way to achieve the goal.
- The Utility-based agent is useful when there are multiple possible alternatives, and an agent has to choose in order to perform the best action.
- The utility function maps each state to a real number to check how efficiently each action achieves the goals.

5.18 ARE WE GOING IN THE RIGHT DIRECTION?



- In 1956, Mr. John McCarthy coined the term "Artificial Intelligence"
- AI is a field of science that aims to enable machines to replicate the capabilities of the human mind.
- AI pioneers believed at the time that in short time, "machines will be capable of doing any work a man can do." But it didn't happen.
- Contemporary AI working like a human mind is still a topic for debate.

- Although AI has been around for decades, it is still the early days of implementing this transformative technology in practical ways.
- AI is actively shaping how we live, learn, communicate, and consume.
- For decades, AI scientists and researchers have been trying to recreate the logic and functionalities of the human brain.
- Today, we've reached a point where artificial intelligence algorithms can solve very complicated problems, and in many cases with speed and accuracy that is far superior to those of humans.
- In the past few years, deep learning algorithms have helped bring great advances to fields such as cancer diagnosis, self-driving cars, face and voice recognition, online translation and more.
- AI is impacting the future of every industry and every human being.
- AI has acted as the main driver of emerging technologies like big data, cloud computing, robotics and IoT, and it will continue to act as a technological innovator in the near future.
- Researchers in AI predicted that "human level machine intelligence" has a 50 percent chance of occurring within 45 years and a 10 percent chance of occurring within 9 years.
- There is an incredible amount of opportunity ahead as AI's adoption expands.

5.19 WHAT IF AI DOES SUCCEED?

- Medium-level successes in AI would affect all kinds of people in their daily lives.
- AI has been at work behind the scenes - for example, in automatically approving or denying credit card transactions for every purchase made on the Web, but it is not visible to the consumer.
- Machine learning can be used in major financial decisions and analyses, including share price predictions, trading, loan risk assessments etc.,
- AI can be used in medicine to detect problems in the patient's body.
- AI can also be used in agriculture to predict most efficient harvest times.
- Computer vision perceptions can be used for surveillance and tracking.
- AI is used in telecom, satellite and GPS.
- Companies across industries are adopting AI to scale up and improve their business operations.
- Advances in Deep Learning are helping drive the business success from e-commerce to national security.
- Data is the most important ingredient to a successful recipe of an AI model.

- A large-scale success in AI would change the lives of a majority of humankind.
- AI systems could threaten human autonomy, self-determination, privacy and even survival.
- Ethical issues of AI should be considered to overcome the above threats.
- AI has made great progress in its short history, but the final sentence given by Alan Turing (1950) is still valid today:

"We can see only a short distance ahead,
but we can see that much remains to be done."

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"There is no reason and no way that a human mind can keep up with an artificial intelligence machine by 2035."

- **Gray Scott,** a Futurist, Techno-Philosopher and the World's leading expert in the field of emerging technology.

Question Bank

UNIT – V: ROBOTICS & PHILOSOPHICAL FOUNDATIONS

2 Marks Questions

1. What is the difference between Robotics and Robot?
2. What is autonomous robot?
3. What is the difference between sensor & actuator?
4. What are "end-effectors"?
5. What is robotic perception?
6. What is SLAM in robotics?
7. What is adaptive perception in robotics?
8. What is the difference between configuration space and work space?
9. Explain reactive control in robotics.
10. What is DOF in robotics?
11. List out three layers in three layer architecture.
12. What is pipeline architecture?
13. What is Weak AI? Give the examples
14. "Today's AI is not Strong AI". Justify the statement.
15. Explain agent components.

Essay Questions

1. What is a Robot? Explain various types of Robot with suitable examples.
2. Explain robot hardware components.
3. What is a sensor? Explain various types of sensor.
4. What is an actuator? Explain various types of actuator.
5. Explain the concept of robotic perception.
6. With suitable examples, explain planning to move in robotics.
7. Explain various skeletonization methods in robotics.
8. How robots plan for uncertain movements in path planning? Explain.
9. Explain various types of robot software architectures.
10. Explain applications of robot in various fields.
11. Give the differences between Weak AI and Strong AI.
12. Explain ethics and risks of AI.
13. What is agent architecture? Explain.
14. Is AI is going in the right direction? Explain.
15. What is AI does succeed? Explain with suitable examples.