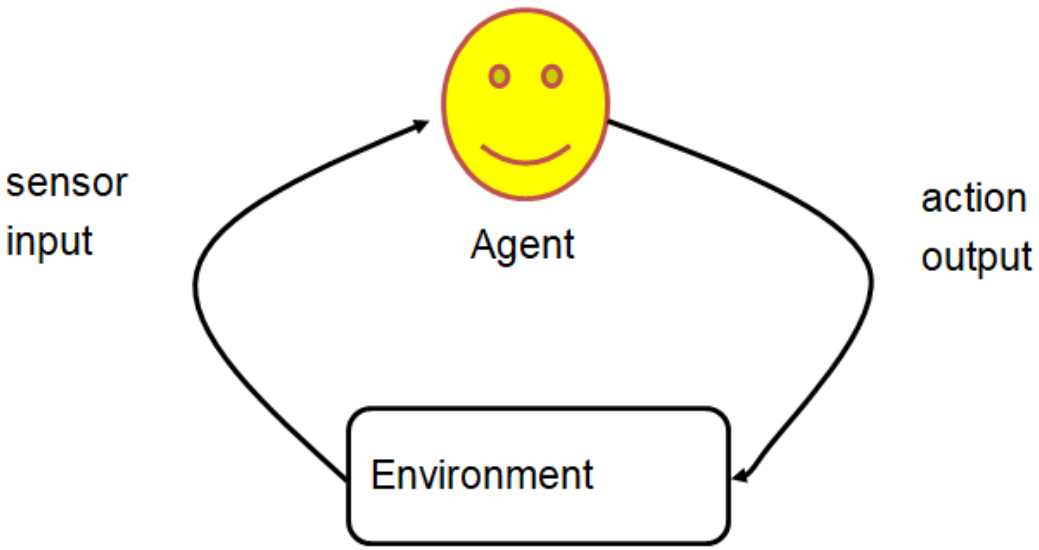
Lecture 2
Artificial Intelligence

Khola Naseem
khola.naseem@uet.edu.pk

Agent:



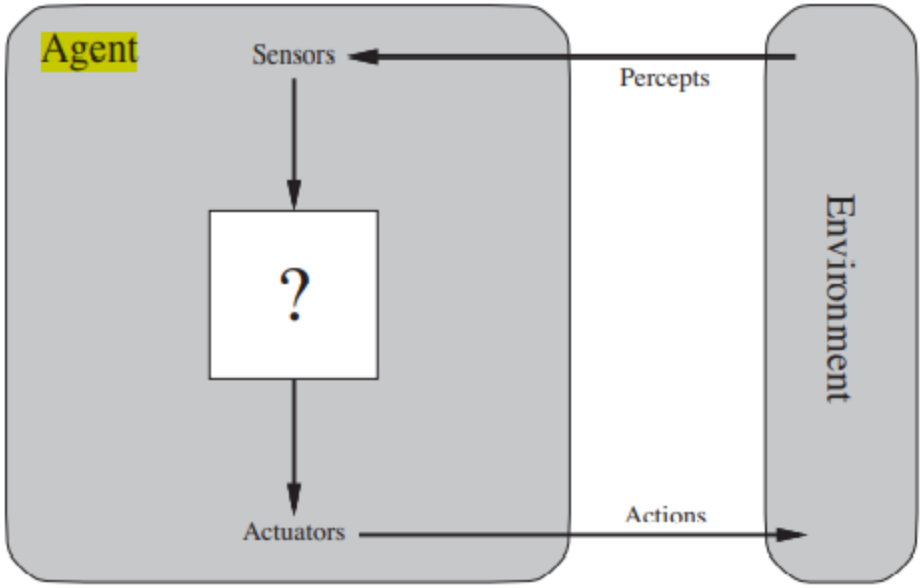
Credit: Khola Naseem

Agent:

Agent

- We define AI as the study of agents that receive percepts from the environment and perform actions.
- An agent is anything that can be viewed as perceiving its environment through sensors and acting upon that environment through actuators

:



Credit: Khola Naseem

Characteristics and Applications of Intelligent Agents

- An agent is an entity which is:
- Situated in some environment.
- Autonomous, in the sense that it can act without direct intervention from humans or other software processes, and controls over its own actions and internal state.
- Flexible which means:
  - Responsive (reactive): agents should perceive their environment and respond to changes that occur in it;
  - Proactive: agents should not simply act in response to their environment, they should be able to exhibit opportunistic, goal-directed behavior and take the initiative when appropriate;
  - Social: agents should be able to interact with humans or other artificial agents

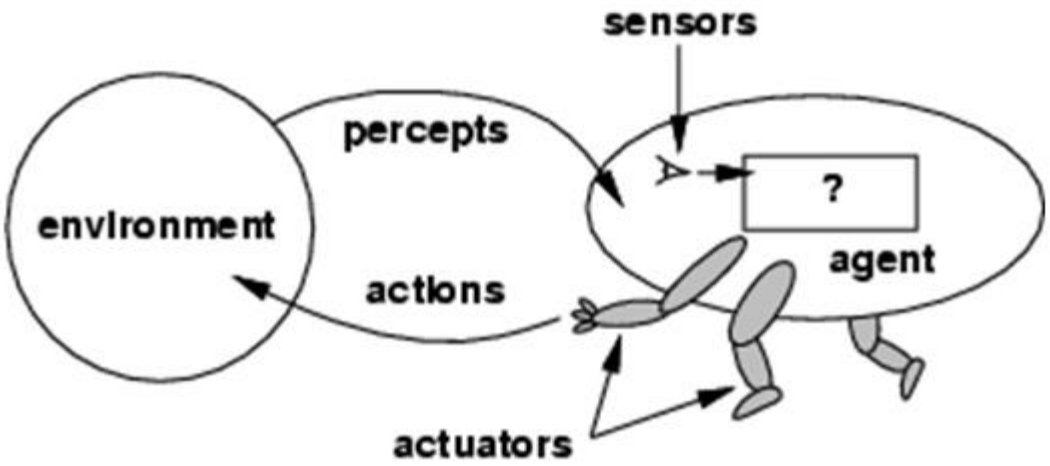
Credit: Khola Naseem

Agent's function maps

Agent

- we say that an agent's behavior is described by the agent function that maps any given percept sequence to an action.

:

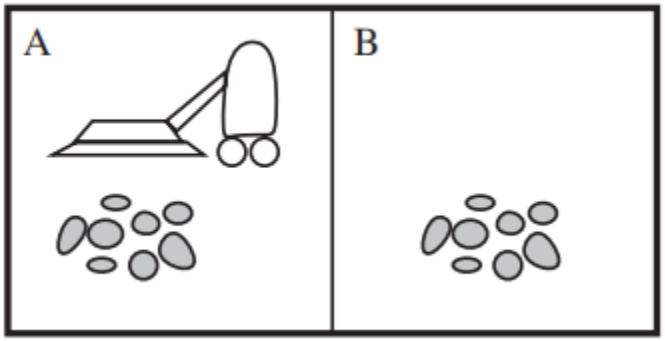


Credit: Khola Naseem

Agent

Agent

- A human agent has eyes, ears, and other organs for sensors and hands, legs, and so on for actuators
- A robotic agent might have cameras and infrared range finders for sensors and various motors for actuators
- A software agent receives keystrokes, file contents, and network packets as sensory inputs and acts on the environment by displaying on the screen, writing files, and sending network packets.



A vacuum-cleaner world with just two locations.

Credit: Khola Naseem

Task environment:

- Before we design an intelligent agent, we must specify its "task environment"

PEAS:

- Performance measure
- Environment
- Actuators
- Sensors

- This sequence of actions causes the environment to go through a sequence of states. If the sequence is desirable, then the agent has performed well. This notion of desirability is captured by a **performance measure.**
- **Example: Taxi driver**
  - Performance measure: safe, fast, comfortable (maximize profits)
  - Environment: roads, other traffic, pedestrians, customers
  - Actuators: Steering wheel (manage direction), accelerator (control speed), brake (slow speed), signal (communicate about turns), horn (ask for path)
  - Sensors: cameras, sonar, speedometer, GPS, accelerometer, engine sensors

PEAS

Agent: Part-picking robot

- Performance measure: Percentage of parts in correct bins
- Environment: Conveyor belt with parts, bins
- Actuators: Jointed arm and hand
- Sensors: Camera, joint angle sensors

Credit: Khola Naseem

PEAS

Agent: Medical diagnosis system

- Performance measure: Healthy patient, minimize costs, lawsuits
- Environment: Patient, hospital, staff
- Actuators: Screen display (questions, tests, diagnoses, treatments, referrals)
- Sensors: Keyboard (entry of symptoms, findings, patient's answers)

Credit: Khola Naseem

PEAS

Agent: Interactive English tutor

- Performance measure: Student's score on test
- Environment: Set of students, testing agency
- Actuators: Display of exercises, suggestions, corrections
- Sensor: Keyboard entry

Credit: Khola Naseem

Types/Structure of agents :

Types of Agents

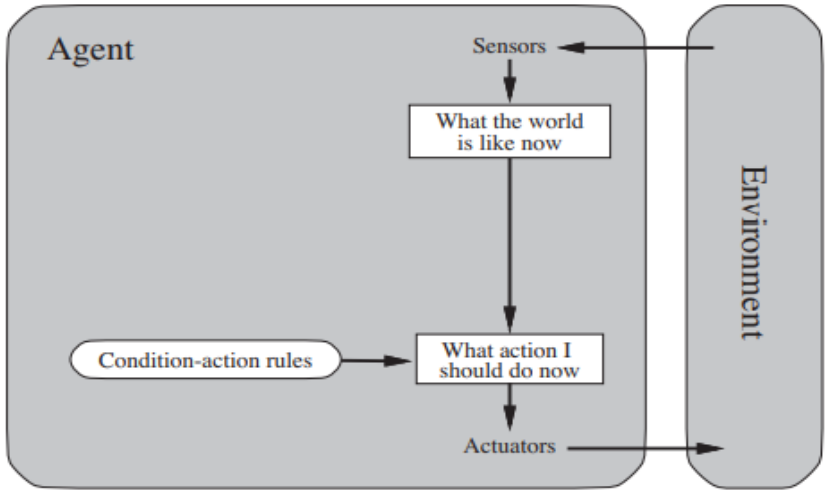
- Agents can be grouped into five classes based on their degree of perceived intelligence and capability :
  - Simple Reflex Agents
  - Model-Based Reflex Agents
  - Goal-Based Agents
  - Utility-Based Agents
  - Learning Agent

:

Types/Structure of agents :

- Simple Reflex Agents
  - Simple reflex agents ignore the rest of the percept history and act only on the basis of the **current percept**.
  - The agent function is based on the **condition-action rule**. A condition-action rule is a rule that maps a state i.e, condition to an action. If the condition is true, then the action is taken, else not.
    - if car-in-front-is-braking then initiate-braking
  - For example, the vacuum agent

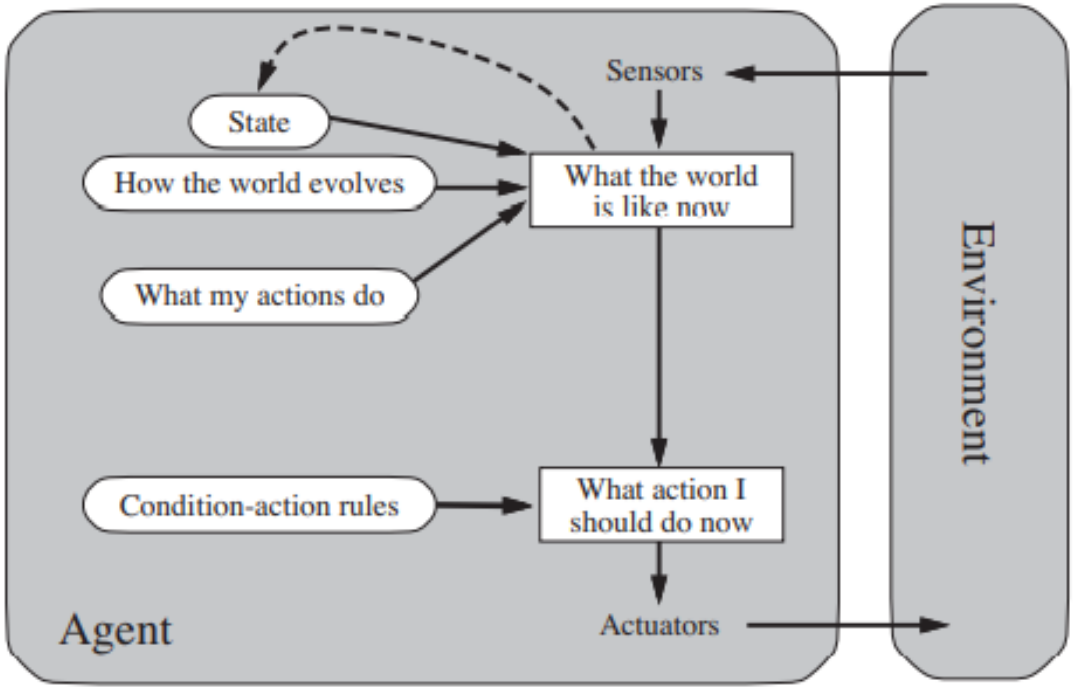
:



Credit: Khola Naseem

Types/Structure of agents :

- **Model-Based Reflex Agents**
  - It works by finding a rule whose condition matches the current situation.
  - The agent has to keep track of the internal state which is adjusted by each percept and that depends on the percept history.



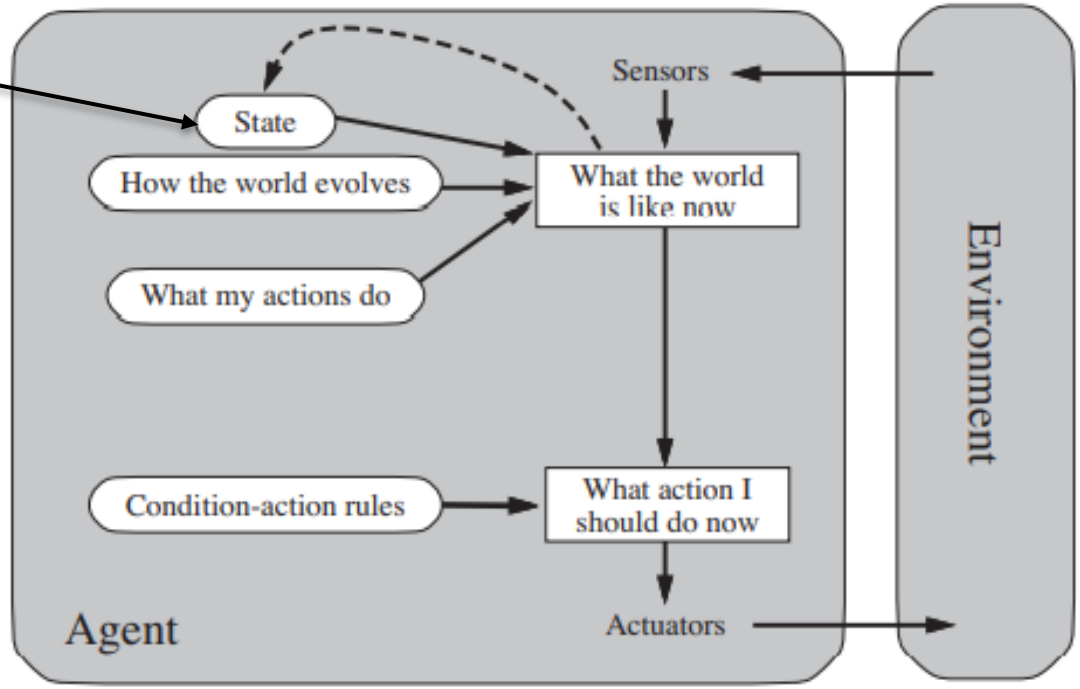
Credit: Khola Naseem

Types/Structure of agents :

- **Model-Based Reflex Agents**

Model the state of the world by: modeling how the world changes how it's actions change the world

description of current world state



- This can work even with partial information
- It's is unclear what to do without a clear goal

Credit: Khola Naseem

Types/Structure of agents :

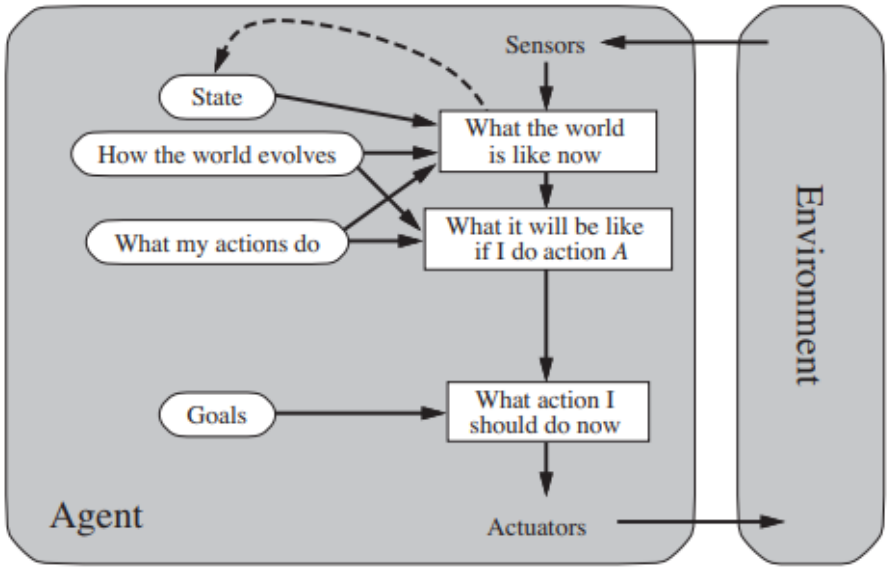
Goal Based agent:

- At a road junction
- These kinds of agents take decisions based on how far they are currently from their goal(description of desirable situations).
- Their every action is intended to reduce its distance from the goal.
- This allows the agent a way to choose among multiple possibilities, selecting the one which reaches a goal state.
- They usually require search and planning. The goal-based agent's behavior can easily be changed.
- More flexible, e.g. Change destination

Types/Structure of agents :

Goal Based agent:

Goals provide reason to prefer one action over the other.
We need to predict the future: we need to plan & search



Credit: Khola Naseem

Types/Structure of agents :

Utility Based agent:

- there are multiple possible alternatives, then to decide which one is best, utility-based agents are used.
- They choose actions based on a preference (utility) for each state.
- Sometimes achieving the desired goal is not enough. We may look for a quicker, safer, cheaper trip to reach a destination. Agent happiness should be taken into consideration.

Types/Structure of agents :

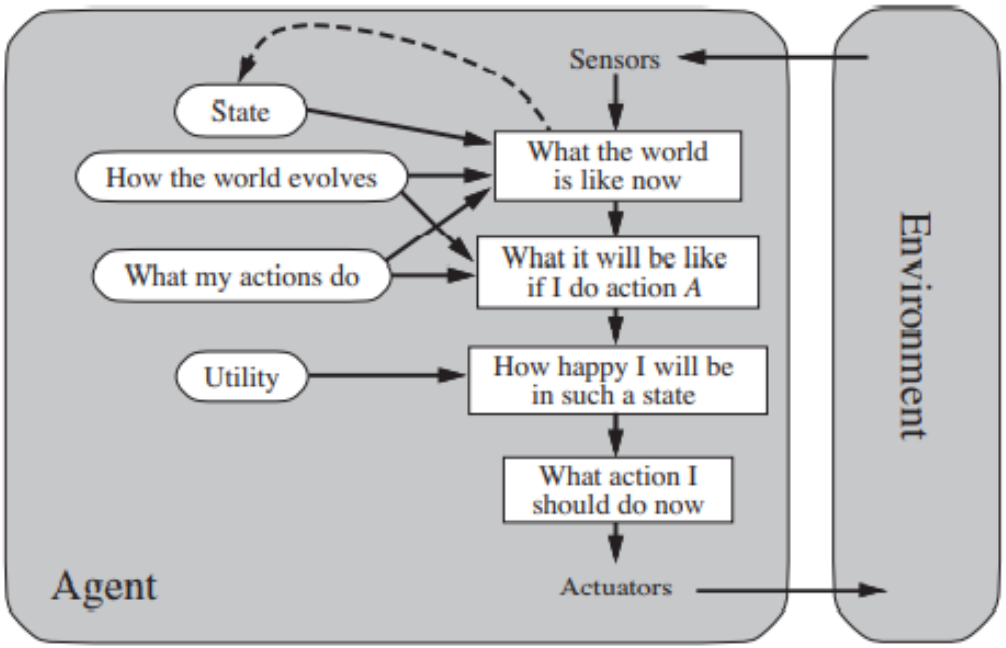
Utility Based agent:

- Utility describes how “happy” the agent is. Because of the uncertainty in the world, a utility agent chooses the action that maximizes the expected utility.
- A utility function maps a state onto a real number which describes the associated degree of happiness
- E.g **texi driver**

Types/Structure of agents :

Utility Based agent:

Some solutions to goal states are better than others.
Which one is best is given by a utility function.
Which combination of goals is preferred?



Credit: Khola Naseem

Types/Structure of agents :

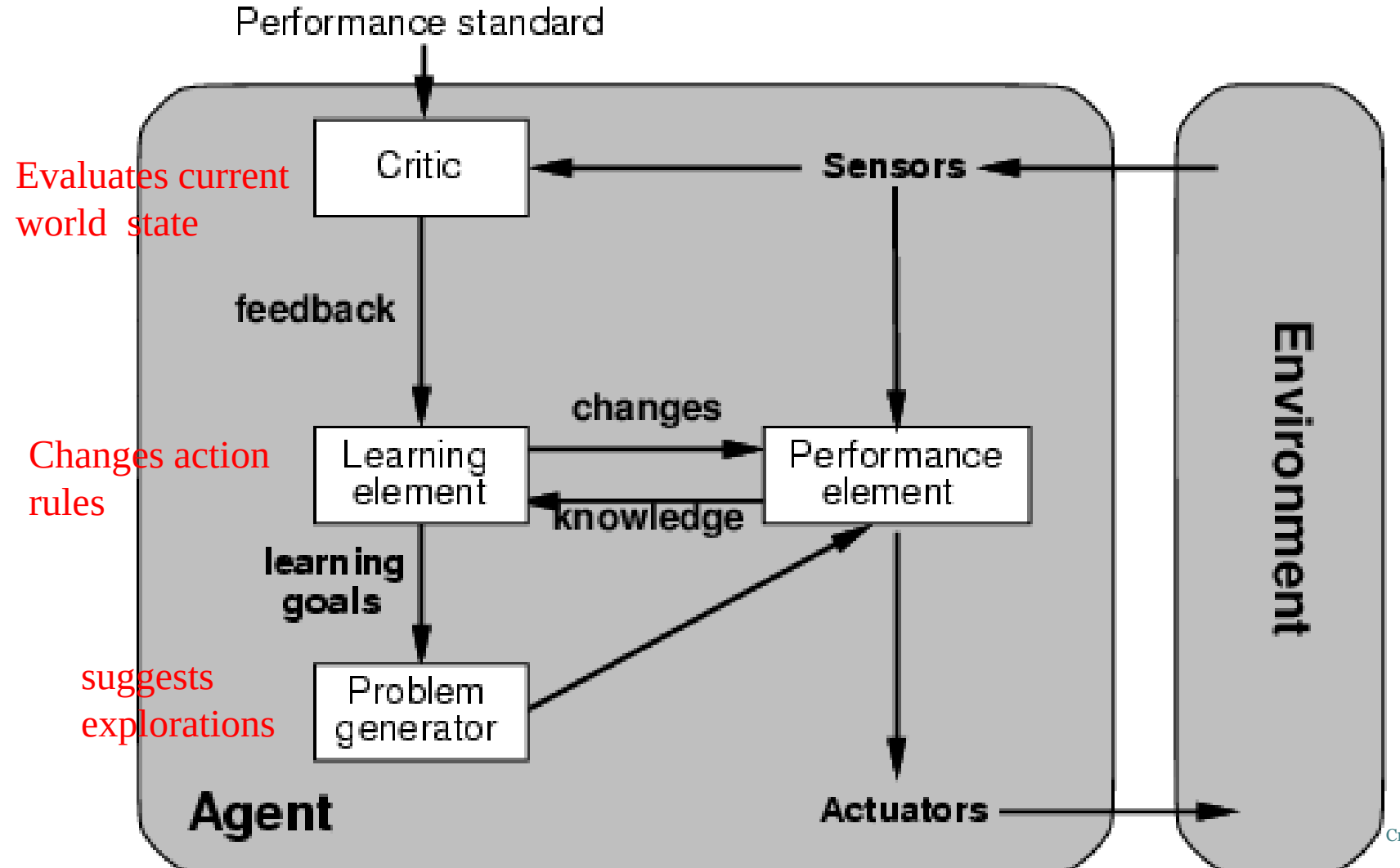
learning Based agent:

- A learning agent in AI is the type of agent that can learn from its past experiences or it has learning capabilities.
- It starts to act with basic knowledge and then is able to act and adapt automatically through learning.

Types/Structure of agents :

learning Based agent:

How does an agent improve over time? By monitoring it's performance and suggesting better modeling, and new action rules, etc.



Credit: Khola Naseem

AI-Agents Application:

- **AI assistants: like Alexa and Siri:**
  - are examples of intelligent agents as they use sensors to perceive a request made by the user and the automatically collect data from the internet without the user's help.
  - They can be used to gather information about its perceived environment such as weather and time.
- Self Driving Car
- Spam Email Detection
- Recommender system
- Emotion Detection
- Sentiment Analysis
- And many more

Credit: Khola Naseem

AI-Agents Application:

- **Parcel delivery:**

Credit: Khola Naseem

AI-Agents Application:

- **Example Of Autonomous Delivery Robots**
  - https://www.youtube.com/watch?v=13jqscTESNM&ab_channel=BernardMarr
- **10 Most Advanced AI Robots in the World**
  - https://www.youtube.com/watch?v=zhVDk8Y55pA&ab_channel=Motech
- **Mark Zuckerberg's AI - Personal Assistant - Jarvis - Home Automation**
  - https://www.youtube.com/watch?v=vvimBPJ3XGQ&ab_channel=SREERAJM

Reference material

- **For Reading and Practice, refer to these sources**

- Artificial Intelligence: A Modern Approach 3rd Edition Stuart Russell and Peter Norvig
- Hart, P.E., Stork, D.G. and Duda, R.O., 2001. Pattern classification. John Willey & Sons.
- Luger, G.F. and Stubblefield, W.A., 2009. AI algorithms, data structures, and idioms in Prolog, Lisp, and Java. Pearson Addison-Wesley
- Web