

# Intelligent Agents

Mini-project of  
Artificial Intelligence (CS-5109)



Submitted by -

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# 1 Abstract

One agent in computer science is software or other computational type entity with some intelligence characteristics. Therefore, an intelligent agent is a composition of hardware, software with some intelligent features. Each intelligent agent perceives its environment with collecting some information about that environment through its sensors attempt to achieve its goals by acting through its actuators. Intelligent agents are having some internal characteristics (such as: autonomy, Learning/ reasoning, reactivity and goal oriented) and some external characteristics (such as: communication, cooperation, mobility). In this work, we attempt to provide a comprehensive survey about history of intelligent agents' evolution, various types of intelligent agents which are proposed, different applications of intelligent agents and some discussion about creating favorite intelligent agent.

## 2 Introduction

Artificial Intelligence provides facilities for creating intelligent agents which are having some intelligent behaviors and they are able to act instead of human or robots. Each intelligent agent is capable to perceive its environment by sensors and act upon that environment through actuators. Commonly three major types of intelligent agents including Human agents (different organs of human body such as eyes, ears are used as sensors and other parts of the body such as hands or legs are used as actuators) and Robot agents (using some devices such as Camera as a sensor and other devices such as motors as actuators) and Software agents (using file contents or other received packages through network as a sensor and some files are using as actuators) are available and various applications of these agents in education, business, industry, different government or private organizations are using these agents for specific goals such as Transportation systems management, Traffic and Incident management, Geographic Information Systems management and etc. There are six types of environments and each intelligent agent based on its goal or structure should perceive minimum one of these environments. These environments are: Fully observable vs. partially observable, Deterministic vs. stochastic, Episodic vs. sequential, Static vs. Dynamic, Discrete vs. Continuous, and Single agent vs. Multi-agent. Therefore, each agent has specific goal and attempts to achieve that goal with the help of perceiving its environment by sensors and then try to select right action which helps the agent to be successful on obtaining its main goal with highest performance. The architecture of intelligent agent is shown in the fig.1.

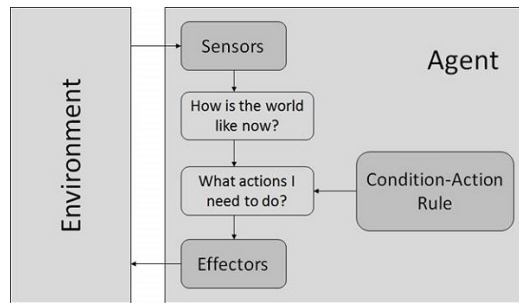


Figure 1: Architecture of Intelligent Agents

## 2.1 Defining an Agent

Based on Russell and Norvig [1] definition, an agent is anything that can get information about its environment or perceive its environment by sensors and then try to select appropriate action within various actions which are available and attempt to achieve the expected goals by acting through actuators.

Based on Maes [2] definition, an autonomous agent is a computational system that has some complex dynamic environment and some sensors and can act autonomously in this dynamic environment and do some act for achieving goals for which they are designed.

Hermans [3] defined intelligent agent as a pieces of software that act based on information which is gathered from dynamic environment and achieve the goals successfully. Further, the type of action for achieving goals might be change due to changes in dynamic environment.

Gilbert [4] defined an intelligent agent as software that can act instead of human user and do some repetitive task automatically or remember the things which are forgotten by people or making recommendation for people and doing some complex tasks instead of people intelligently.

## 3 Characterstics of Agents

### 3.1 Internal Characterstics

An intelligent agent has some internal characteristic including autonomy, Learning/reasoning, reactivity and goal oriented. We discuss about each characteristic in below.

**Autonomy:** Intelligent agents especially software agents can be sense their environment and act based on their perceive and knowledge obtained from their environment and the rules given by the designer. In the other words, each agent has control over the tasks which are done by its own.

**Learning/Reasoning:** An intelligent agent has capability to learn experiences and then use these experiences for adopting its behavior in environment.

**Reactivity:** Each intelligent agent should be able to react based on information which is getting from its environment.

**Goal-Based:** Each intelligent agent has a goal and based on information

which is having from its environment, it attempts to achieve that goals.

### 3.2 External Characteristics

Moreover, each intelligent agent has some external characteristics such as: communication, cooperation, mobility which is more discussed in below.

**Communication:** Each agent need to interact with its environment (such as a human, other agents and etc.) to achieve its goals.

**Cooperative:** For doing some complex tasks one agent needs to cooperate with other agents and increase its own capabilities for achieving its goals or doing tasks easily.

## 4 Types of Intelligent Agents Based on Their Actions

There are four types of intelligent agents which are using generally for various purposes are shown in the fig. 2 . These types are:

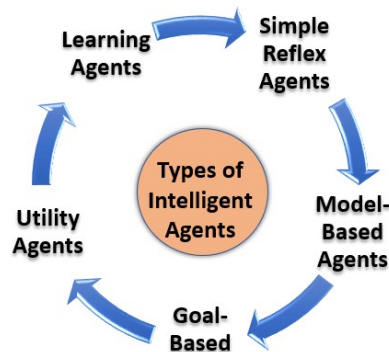


Figure 2: Types of Intelligent Agents

### 4.1 Simple Reflex Agent

These agents are working basically based on the current states or current percept or information which is gathering by their sensors. Therefore,



the before information or percepts are not considering for selecting the appropriate actions for achieving the goals. Structure of this agent is shown in Figure:

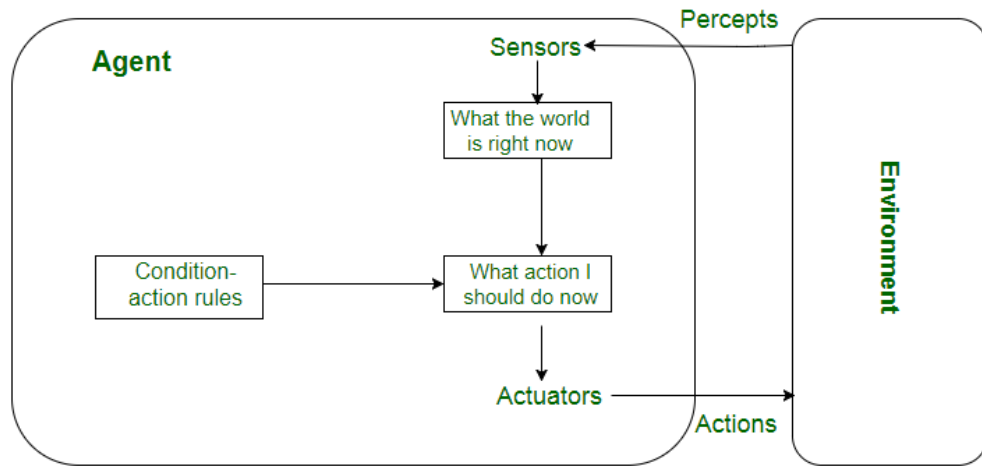


Figure 3: Simple Reflex Agent

## 4.2 Model-Based Reflex Agent

These agents have history of before states or percepts and actions which are made for achieving goals by agent that are stored. Therefore, in case of partially observable environment or whenever, some percepts are incomplete, agent can search for finding the matching state or percept, actions and their goals in the history and use that case for current state and try to act such as before successful action to achieve the requested similar results. Structure of this agent is shown in Figure:

## 4.3 Goal-Based Agents

In some cases, knowing the current state or percept of environment, is not sufficient for selecting appropriate actions within available actions. Therefore, selection of exact and correct action is depending on desirable goal which is expected to obtain by the agent. . The Structure of this agent is shown in Figure:

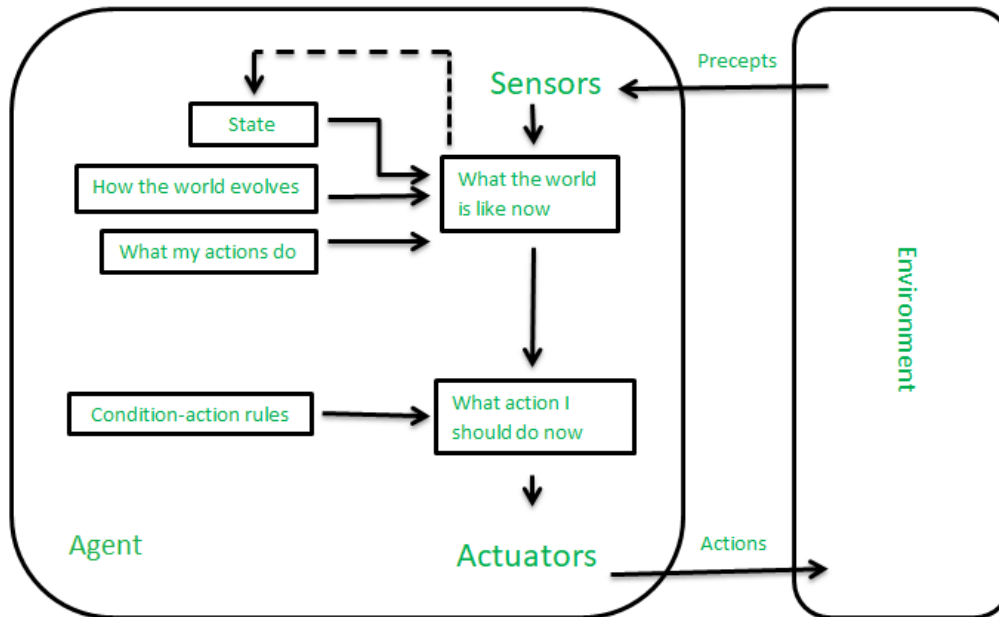


Figure 4: Model-Based Reflex Agent

#### 4.4 Utility-Based Agents

In this agent, each utility is a function that maps a state onto a real number. In the other words, it makes an internal map of functions. This map is useful for handling unexpected situations for achieving their goals. The Structure of this agent is shown in Figure:

## 5 VARIOUS APPLICATIONS OF INTELLIGENT AGENTS

There are several applications of intelligent agents are available in various area including medical and healthcare, transportation and travel agents, e-Learning, Internet searching, Web Applications, Computer Network Management and Evolution of Web, grid computing and software distribution,telecommunication, and etc. Some of research works which have been published related to these applications are mentioned in the remaining of this section.

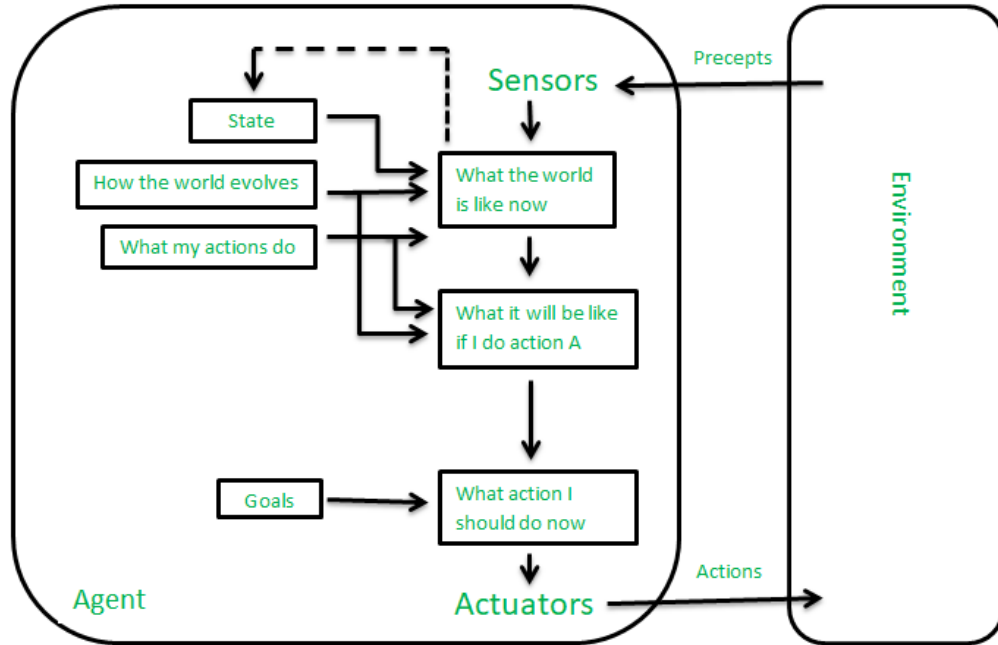


Figure 5: Goal Based Agent

## 5.1 Medical and Healthcare Applications

Several applications of intelligent agents are available. Several research efforts have proposed an intelligent agents for collecting information about problem or disease of patients data from different sources , analyzing these data, selecting important information and presenting the extracted knowledge for doctors. The main goal is generating realistic models with the help of knowledge that is available in each case and uses these models for diagnostic training.

## 5.2 Transportation and Travel Agents

Intelligent agents are useful for solving problems in the area of traveling and developing agent-based control and management systems. Some of these issues were: extendibility, flexibility and interoperability.

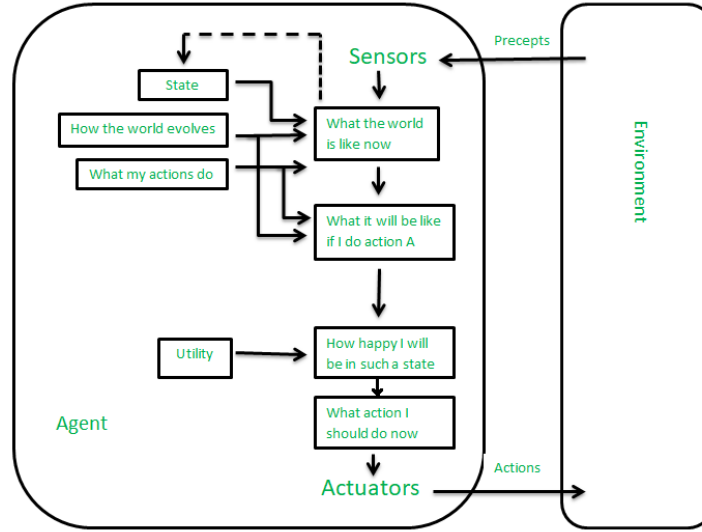


Figure 6: Utility Based Agent

### 5.3 Military

Lockheed Martin Advanced Technology Laboratories has been designing and implementing intelligent mobile agent proto-types for various military applications since 1995. An agent have several capabilities of agents in the military domain such as: information push and pull, monitoring of sentinel information.

### 5.4 Market Analysis E-Business E-Commerce

Intelligent agents providing facilities for managing buying and selling activities and cope with overloading and expedite the process of buying activity.

### 5.5 E-Library

In this article, different intelligent agents technologies are divided in two main application area: digital library (DL) [including architecture of multi-agent for DLs, agent-based DL projects, agents that are supporting search process in DLs, intelligent agents for distributed heterogeneous information retrieval

and etc.] of and services in traditional libraries [including automatic reference service, user interface for library systems, multi-agent architecture for library services and etc.]. This survey covers information about different architecture, framework and technology models of intelligent agents in library systems.

## 6 Problem Definition

In the current scenario, the distinction between driver and passenger mutations are being manually done. Manually going through the clinical literature for every test mutation is highly labour intensive, tiring and time consuming. Moreover, there is the possibility of error as well as life risks in case of wrong analysis. To optimize this labour intensive task, we have blended together technology with medical experience. We used different machine learning algorithms to train a classification model that automatically classifies genetic variations of interest into nine classes. These classes help a pathologist to distinguish among the mutations that contribute to tumour growth (driver mutations) and those that do not (passenger mutations). It also reduces computational time by automatically classifying genetic variations and making output interpretable.

## 7 Literature Survey

### 7.1 Historical Perspective

During 20th century a brief history of AI can be given as: 1923 – Karel Kapek’s play named “Rossum’s University Robots (RUR)” opens in London, first use of the word “robot” in English. 1945 – Isaac Asimov, alumni at Columbia University, invented the term Robotics. 1950 – Turing Test for evaluation of intelligence was introduced by Alan Turing. Claude Shannon published detailed Analysis of chess playing as a search. 1956 – John McCarthy coined the term Artificial Intelligence. 1958 – John McCarthy invents LISP programming language for AI. 1964 – Danny Bobrow’s thesis at MIT showed that computers can understand natural language well enough to solve algebra word problems correctly. 1979 – The First Computer controlled autonomous vehicle, Stanford Cart was built. 1984 – Dennett discusses the

frame problem and how it relates to the difficulties arising from attempting to give robots common sense.

## **7.2 Complications**

There are abundant complications when trying to create an intelligent system. Many complications involve ‘Human- Machine interaction’ because of the complexity of human interaction. A lot of the communication that happens that happens between humans cannot be coded facts a machine could simply recite. There are hundreds of subtle ways that humans interact with each other that affect communication.

## **7.3 Risk**

Most of the scientists believe that an intelligent system is not capable of representing human emotions like love or hate, and on the second thought there is also no need for a system to willfully become generous or vengeful.

## **7.4 Safety**

The ultimate goal is to keep the concussion of Artificial Intelligence Agent in favor to the society which in turn results in triggering the research in many areas like control and security, validation and verification and even also law and economics.

## **7.5 Future**

Artificial Intelligence Agent has come a long way in the last decade. But there’s still a large amount of work required to develop strong AI. Giving a machine Common Sense or intuition is a critical component of allowing a machine to truly learn. Knowing how to convert the input to output appears important, but a machine that truly understands why output relates to the input is necessary for strong AI.

## **8 Proposed methodology / approach**

### **8.1 Dataset**

The proposed Intelligent Agent Workflow system has both mobile and stationary agents.

#### **8.1.1 Mobile Agents**

Student Agent (SA), Advisor Agent (AdA)

#### **8.1.2 Stationary Agents**

Accounts Agent (AA), Academics Agent (AcA)

#### **8.1.3 Student Agent**

SA is a personalized mobile agent and it is created when a student initiates a registration request. It takes the request to the advisor, and come back after getting acceptance or rejection.

#### **8.1.4 Advisor Agent**

Each student is assigned a personalized Advisor Agent. AdA is an intelligent mobile agent and performs two duties: one is to collect the academic and financial information and secondly is to provide advisory after having intelligent analysis on the collected data and the request based on the specified registration rules.

#### **8.1.5 Accounts Agent**

The purpose of Accounts Agent is to provide information regarding the fees payment/dues to AdA as well as to provide fee payment acknowledgment to the academics department via e-mail.

#### **8.1.6 Academic Agents**

The purpose of Academics Agent is to provide past history of academic information of student to AdA as well as to inform student about the registration confirmation through e-mail.

## **9 Proposed Work Flow**

Many researchers used software agent for workflow systems but no one considered the distinctive environment of academic system. The paper presented benefits of using agent for workflow. It specified that agent can play crucial role in identifying and reacting on different kind of exception conditions as well as in implementing a form of relaxed transaction processing. In an ad-hoc workflow system based on mobile agent architecture is presented. They argue that using ad-hoc workflow and mobile agent can enables ebusiness processes over loosely coupled web based services. They exploited agent's mobility property to have better monitoring of workflow transitions and dynamic rule changing.

### **9.1 Intelligent Work Flow**

The scenario that we have chosen is a major component of any academic system i.e. semester registration process. This process has all components on which the requirement of workflow system and the use of intelligent agent are justified. System is proposed on the scenario of Semester Registration process of our university (FAST-NU).

#### **9.1.1 Existing Scinario**

The semester registration process of university is partial automated. An online registration request form is used that helps the advisor in accepting or declining student registration request. The current workflow is as follows: First of all an offered course list for the current semester is issued by the academic department from which the student selects the courses. Student fills the registration form by mentioning his/her selected courses manually. In addition to that an online registration request form is also filled by the student. An advisor assigned to the student may accept or decline online registration request based on the student past performance, GPA and the prerequisites.



## 10 Conclusion and Future work

Agent-based systems technology is a vibrant and rapidly expanding field of academic research and business world applications. By providing a new paradigm for designing and implementing systems for a complex, dynamic and distributed environment where the common currency is negotiation, unplanned for events can be managed in a way that is beneficial to the overall system performance. Agent technology is greatly hyped as a panacea for the current ills of system design and development, but the developer is cautioned to be aware of the pitfalls inherent in any new and untested technology.

This article is a comprehensive study about intelligent agents, different types of intelligent agents based on their functionalities, their various applications. Various definitions which are existing for intelligent agents along with several applications of intelligent agents are covered. Further, autonomous agents are discussed and various applications of these agents are presented separately.

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