GUDLAVALLERU ENGINEERING COLLEGE

(An Autonomous Institute with Permanent Affiliation to JNTUK, Kakinada)

Seshadri Rao Knowledge Village, Gudlavalleru – 521 356.

Department of Computer Science and Engineering

HANDOUT

on

ARTIFICIAL INTELLIGENCE

(ELECTIVE I)

Vision

To be a Centre of Excellence in computer science and engineering education and training to meet the challenging needs of the industry and society

Mission

- To impart quality education through well-designed curriculum in tune with the growing software needs of the industry.
- To be a Centre of Excellence in computer science and engineering education and training to meet the challenging needs of the industry and society.
- To serve our students by inculcating in them problem solving, leadership, teamwork skills and the value of commitment to quality, ethical behavior & respect for others.
- To foster industry-academia relationship for mutual benefit and growth.

Program Educational Objectives

- Identify, analyze, formulate and solve Computer Science and Engineering problems both independently and in a team environment by using the appropriate modern tools.
- Manage software projects with significant technical, legal, ethical, social, environmental and economic considerations
- Demonstrate commitment and progress in lifelong learning, professional development, leadership and Communicate effectively with professional clients and the public.

HANDOUT ON ARTIFICIAL INTELLIGENCE

Class & Sem. :III B.Tech – II Semester Year : 2019- 20

Branch : CSE Credits : 3

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1. Brief History and Scope of the Subject

The seeds of modern AI were planted by classical philosophers who attempted to describe the process of human thinking as the mechanical manipulation of symbols. This work culminated in the invention of the programmable digital computer in the 1940s, a machine based on the abstract essence of mathematical reasoning. This device and the ideas behind it inspired a handful of scientists to begin seriously discussing the possibility of building an electronic brain.

The field of AI research was founded at a workshop held on the campus of Dartmouth College during the summer of 1956. Those who attended would become the leaders of AI research for decades. Many of them predicted that a machine as intelligent as a human being would exist in no more than a generation and they were given millions of dollars to make this vision come true.

In the 1940s and 50s, a handful of scientists from a variety of fields (mathematics, psychology, engineering, economics and political science) began to discuss the possibility of creating an artificial brain. The field of artificial intelligence research was founded as an academic discipline in 1956.

2. Pre-Requisites

- Mathematical Logic
- Formal Reasoning

3. Course Objectives:

- To familiarize the concepts of AI for representation of knowledge and problem solving

4. Course Outcomes:

At the end of the course, the students will be able to

- **CO1:** Analyze different problem solving and game playing techniques.
- **CO2:** Compare different approaches to represent knowledge.
- **CO3:** Analyze expert systems and their applications.
- **CO4:** Apply probability theory for real world problems.

5. Program Outcomes:

Graduates of the Computer Science and Engineering Program will have an ability to

a. apply knowledge of computing, mathematics, science and engineering fundamentals to solve complex engineering problems.
b. formulate and analyze a problem, and define the computing requirements appropriate to its solution using basic principles of mathematics, science and computer engineering.
c. design, implement, and evaluate a computer based system, process, component, or software to meet the desired needs.
d. design and conduct experiments, perform analysis and interpretation of data and provide valid conclusions.
e. use current techniques, skills, and tools necessary for computing practice.
f. understand legal, health, security and social issues in Professional Engineering practice.
g. understand the impact of professional engineering solutions on environmental context and the need for sustainable development.
h. understand the professional and ethical responsibilities of an engineer.
i. function effectively as an individual, and as a team member/ leader in accomplishing a common goal.
j. communicate effectively, make effective presentations and write and comprehend technical reports and publications.
k. learn and adopt new technologies, and use them effectively towards continued professional development throughout the life.
l. understand engineering and management principles and their application to manage projects in the software industry.

6. Mapping of Course Outcomes with Program Outcomes:

	a	b	c	d	e	f	g	h	i	j	k	l
CO1	H	H		M								
CO2				H								M
CO3		H		H	M							M
CO4	H				M							M

7. Prescribed Text Books

1. Elaine Rich & Kevin Knight, 'Artificial Intelligence', Tata McGraw Hill Edition, 2 nd Edition.
2. Stuart J. Russell,Artificial Intelligence: A Modern Approach,2nd Edition.

8. Reference Text Books

1. Patrick Henry Winston, 'Artificial Intelligence', Pearson Education.
2. Russel and Norvig, 'Artificial Intelligence', Pearson Education/ PHI.

9. URLs and Other E-Learning Resources

URLs:

- **https://nptel.ac.in/courses/106105077/**
- **https://nptel.ac.in/courses/106105079/**
- **https://ocw.mit.edu/courses/electrical...and...artificial-intelligence.../lecture-videos/**

Journals:

- International Journal on Artificial Intelligence Tools
- Journal of Artificial Intelligence Research
- Applied Artificial Intelligence

10. Lecture Schedule / Lesson Plan

Topic	No. of Periods	
	Theory	Tutorial
UNIT - I : Introduction to artificial intelligence		
Introduction	1	1
History	1	
Intelligent systems	1	
Foundations of AI	1	1
Applications	2	

tic-tac-toe game playing	2	
Current trends in AI	2	
UNIT - II: Problem solving and game playing		
Problem solving: state-space search and control strategies	2	1
Introduction, general problem solving	1	
Characteristics of problem	1	1
Exhaustive searches	2	
Heuristic search techniques	2	
Iterative-deepening a*	2	
Problem reduction	2	
Constraint satisfaction	2	
Game playing: Introduction	1	1
Game playing	2	
Alpha-beta pruning	2	
Two-player perfect information games	1	
UNIT - III: Logic Concepts		
Introduction	1	1
Propositional calculus	1	
Proportional logic	1	
Natural deduction system	1	
Axiomatic system	1	1
Semantic tableau system in proportional logic	1	
Resolution in proportional logic	1	
Predicate logic	1	
UNIT - IV: Knowledge representation		
Introduction	1	1
Approaches to knowledge representation	1	
Knowledge representation using semantic network	1	
Extended semantic networks for KR	1	
Knowledge representation using frames	1	
Advanced knowledge representation techniques: Introduction	1	
Conceptual dependency theory	1	1
Script structure	1	
Semantic web	1	
UNIT - V: Expert system and applications		
Introduction phases in building expert systems	1	1
Expert system versus traditional systems	1	
Rule-based expert systems	1	
Blackboard systems truth maintenance systems	1	1
Application of expert systems	1	
List of shells and tools	1	
UNIT - VI: Uncertainty measure		
Introduction	2	1
Probability theory	2	

Bayesian belief networks	2	1
Certainty factor theory	1	
Total No.of Periods:	**60**	**13**

UNIT – I

Introduction to artificial intelligence

Syllabus:

Introduction, history, intelligent systems, foundations of AI, applications, tic-tac-toe game playing, current trends in AI.

Outcomes:

Student will be able to:

- define the concept of Artificial Intelligence
- explain brief history that contributed ideas and techniques to Artificial Intelligence
- outline current trends in AI
- interpret the steps in solving of tic-tac-toe problem

Introduction:

- The field of **artificial intelligence,** or AI, attempts to understand intelligent entities.
- Computers with human-level intelligence (or better) would have a huge impact on our everyday lives and on the future course of civilization.
- Computers have unlimited potential for intelligence.
- AI currently encompasses a huge variety of subfields, from general-purpose areas such as
  perception and logical reasoning, to specific tasks such as playing chess, proving mathematical theorems, writing poetry, and diagnosing diseases.

Definitions of artificial intelligence:

- Definitions of AI vary along following dimensions.
  - thought processes and reasoning
  - address behaviour
  - measure success in terms of human performance,
  - measure against an ideal concept of intelligence, which we will call **rationality**
- A system is "**rational"** if it does the right thing.
- Definitions are organized into four categories:

Systems that think like humans.	Systems that think rationally.
Systems that act like humans.	Systems that act rationally.

- **Systems that think like humans:** The exciting new effort to make computers think machines with minds.
- **Systems that think rationally:** The study of the computations that make it possible to perceive, reason, and act.
- **Systems that act like humans:** The study of how to make computers do things at which, at the moment, people are better.
- **Systems that act rationally**: The branch of computer science that is concerned with the automation of intelligent behaviour.

Acting humanly: The Turing Test approach:

- **The Turing Test,** proposed by Alan Turing (1950), was designed to provide a satisfactory operational definition of intelligence.
- Turing defined intelligent behaviour as the ability to achieve human-level performance in all cognitive tasks, sufficient to fool an interrogator.
- The test he proposed is that the computer should be interrogated by a human via a teletype, and passes the test if the interrogator cannot tell if there is a computer or a human at the other end.
- The computer would need to possess the following capabilities:
  - **natural language processing** to enable it to communicate successfully in English (or some other human language);
  - **knowledge representation** to store information provided before or during the interrogation;
  - **automated reasoning** to use the stored information to answer questions and to draw new conclusions
  - **machine learning** to adapt to new circumstances and to detect and extrapolate patterns.
- Turing's test deliberately avoided direct physical interaction between the interrogator and the computer, because physical simulation of a person is unnecessary for intelligence.

Thinking humanly: The cognitive modelling approach:

- To say that a given program thinks like a human, we must have some way of determining how humans think. We need to get inside the actual workings of human minds.
- There are two ways for this:
  - through introspection—trying to catch our own thoughts as they go by.
  - through psychological experiments

- Once we have a sufficiently precise theory of the mind, it becomes possible to express the theory as a computer program. If the program's input/output and timing behaviour matches human behaviour, that is evidence that some of the program's mechanisms may also be operating in humans.

Thinking rationally: The laws of thought approach:

- The Greek philosopher Aristotle was one of the first to attempt to codify "right thinking," that is, irrefutable reasoning processes.
- His famous syllogisms provided patterns for argument structures that always gave correct conclusions given correct premises. For example, "Socrates is a man; all men are mortal; therefore Socrates is mortal."
- These laws of thought were supposed to govern the operation of the mind, and initiated the field of logic.
- There are two main obstacles to this approach.
    - First, it is not easy to take informal knowledge and state it in the formal terms required by logical notation, particularly when the knowledge is less than 100% certain.
    - Second, there is a big difference between being able to solve a problem "in principle" and doing so in practice.

Acting rationally: The rational agent approach:

- Acting rationally means acting so as to achieve one's goals, given one's beliefs.
- An agent is just something that perceives and acts.
- In this approach, AI is viewed as the study and construction of rational agents. In the 'laws of thought" approach to AI, the whole emphasis was on correct inferences.
- Making correct inferences is sometimes part of being a rational agent, because one way to act rationally is to reason logically to the conclusion that a given action will achieve one's goals, and then to act on that conclusion.
- Correct inference is only a useful mechanism for achieving rationality, and not a necessary one.

Foundations of Artificial Intelligence:

- AI itself is a young field; it has inherited many ideas, viewpoints, and techniques from other disciplines.

- Over 2000 years of tradition in philosophy, theories of reasoning and learning have emerged, along with the viewpoint that the mind is constituted by the operation of a physical system.
- From over 400 years of mathematics, we have formal theories of logic, probability, decision making, and computation.
- From psychology, we have the tools with which to investigate the human mind, and a scientific language within which to express the resulting theories.
- From linguistics, we have theories of the structure and meaning of language.
- From computer science, we have the tools with which to make AI a reality.

Philosophy (428 B.C.-present)

- We have the idea of a set of rules that can describe the working of (at least part of) the mind, the next step is to consider the mind as a physical system.
- Mental processes and consciousness are therefore part of the physical world, but inherently unknowable; they are beyond rational understanding.
- Some philosophers critical of AI have adopted exactly this position.
- Barring these possible objections to the aims of AI, philosophy had thus established a tradition in which the mind was conceived of as a physical device operating principally by reasoning with the knowledge that it contained.
- All knowledge can be characterized by logical theories connected, ultimately, to observation sentences that correspond to sensory inputs.
- Confirmation theory of Rudolf Carnap and Carl Hempel attempted to establish the nature of the connection between the observation sentences and the more general theories—understand how knowledge can be acquired from experience.

Mathematics (c. 800-present)

- AI used mathematical formalization in three main areas: computation, logic, and probability.
- First-order logic is used today as the most basic knowledge representation system.
- Theory of reference that shows how to relate the objects in a logic to objects in the real world.
- There are some functions on the integers that cannot be represented by an algorithm—that is, they cannot be computed.

- This motivated Alan Turing (1912-1954) to try to characterize exactly which functions are capable of being computed.
- Church-Turing thesis, which states that the Turing machine (Turing, 1936) is capable of computing any computable function, is generally accepted as providing a sufficient definition.

Psychology (1879-present)

- The view that the brain possesses and processes information, is the principal characteristic of cognitive psychology,
- The three key steps of a knowledge-based agent:
  - The stimulus must be translated into an internal representation,
  - The representation is manipulated by cognitive processes to derive new internal representations,
  - These are in turn retranslated back into action.

Computer engineering (1940-present)

- For artificial intelligence to succeed, we need two things: intelligence and an artifact.
- The computer has been unanimously acclaimed as the artifact with the best chance of demonstrating intelligence.
- AI also owes a debt to the software side of computer science, which has supplied the operating systems, programming languages, and tools needed to write modern programs.
- AI has pioneered many ideas that have made their way back to "mainstream" computer science, including time sharing, interactive interpreters, the linked list data type, automatic storage management, and some of the key concepts of object-oriented programming and integrated program development environments with graphical user interfaces.

Linguistics (1957-present)

- Understanding language requires an understanding of the subject matter and context, not just an understanding of the structure of sentences.
- Much of the early work in knowledge representation (the study of how to put knowledge into a form that a computer can reason with) was tied to language and informed by research in linguistics, which was connected in turn to decades of work on the philosophical analysis of language.
- Modern linguistics and AI were "born" at about the same time, so linguistics does not play a large foundational role in the growth of AI.

Instead, the two grew up together, intersecting in a hybrid field called computational linguistics or natural language processing, which concentrates on the problem of language use.

The History of Artificial Intelligence

The gestation of artificial intelligence (1943-1956)

- The first work that is now generally recognized as AI was done by Warren McCulloch and Walter Pitts (1943). They drew on three sources:
  - knowledge of the basic physiology
  - function of neurons in the brain
  - the formal analysis of propositional logic
- Turing's theory of computation: They proposed a model of artificial neurons in which each neuron is characterized as being "on" or "off," with a switch to "on" occurring in response to stimulation by a sufficient number of neighbouring neurons.
- Claude Shannon (1950) and Alan Turing (1953) were writing chess programs for von Neumann-style conventional computers.
- At the same time, two graduate students in the Princeton mathematics department, Marvin Minsky and Dean Edmonds, built the first neural network computer in 1951.

Early enthusiasm, great expectations (1952-1969)

- Newell and Simon's early success was followed up with the General Problem Solver, or GPS. Unlike Logic Theorist, this program was designed from the start to imitate human problem-solving protocols.
- Within the limited class of puzzles it could handle, it turned out that the order in which the program considered subgoals and possible actions was similar to the way humans approached the same problems. Thus, GPS was probably the first program to embody the "thinking humanly" approach.
- Herbert Gelernter (1959) constructed the Geometry Theorem Prover. Like the Logic Theorist, it proved theorems using explicitly represented axioms.
- Gelernter soon found that there were too many possible reasoning paths to follow, most of which turned out to be dead ends.
- Arthur Samuel wrote a series of programs for checkers (draughts) that eventually learned to play tournament-level checkers. Along the way, he disproved the idea that computers can only do what they are told

to, as his program quickly learned to play a better game than its creator.

- McCarthy defined the high-level language Lisp, which was to become the dominant AI programming language.
- Rosenblatt proved the famous perceptron convergence theorem, showing that his learning algorithm could adjust the connection strengths of a perceptron to match any input data.

A dose of reality (1966-1974)

- Most of the early AI programs worked by representing the basic facts about a problem and trying out a series of steps to solve it, combining different combinations of steps until the right one was found.
- The early programs were feasible only because micro worlds contained very few objects.
- Before the theory of NP-completeness was developed, it was widely thought that "scaling up" to larger problems was simply a matter of faster hardware and larger memories.
- Resolution theorem proving, was soon dampened when researchers failed to prove theorems involving more than a few dozen facts.
- A two-input perceptron could not be trained to recognize when its two inputs were different.
- Although their results did not apply to more complex, multilayer networks, solved the problem.
- The new back-propagation learning algorithms for multilayer networks that were to cause an enormous resurgence in neural net research.

Knowledge-based systems: The key to power? (1969-1979)

- General-purpose search mechanism performs elementary reasoning steps to find complete solutions. Such approaches are called **weak methods**, because they use weak information about the domain.
- The only way around this is to use knowledge more suited to making larger reasoning steps and to solving typically occurring cases in narrow areas of expertise.
- The DENDRAL program solves the problem of inferring molecular structure from the information provided by a mass spectrometer.
- The input to the program consists of the elementary formula of the molecule, and the mass spectrum giving the masses of the various fragments of the molecule generated when it is bombarded by an electron beam.

- The naive version of the program generated all possible structures consistent with the
- formula, and then predicted what mass spectrum would be observed for each.
- The significance of DENDRAL was that it is the first successful knowledge-intensive
- System.
- MYCIN diagnoses blood infections. With about 450 rules, MYCIN was able to perform as well as some experts, and considerably better than junior doctors.
- It also contained two major differences from DENDRAL.:
    - First, unlike the DENDRAL rules, no general theoretical model existed from which the MYCIN rules could be deduced. They had to be acquired from extensive interviewing of experts, who in turn acquired them from direct experience of cases.
    - Second, the rules had to reflect the uncertainty associated with medical knowledge. MYCIN incorporated a calculus of uncertainty called certainty factors.

AI becomes an industry (1980-1988)

- In 1981, the Japanese announced the "Fifth Generation" project, a 10-year plan to build intelligent computers running Prolog in much the same way that ordinary computers run machine code.
- It has the ability to make millions of inferences per second.
- The project proposed to achieve full-scale natural language understanding, among other ambitious goals.
- The booming AI industry also included companies such as Carnegie Group, Inference, Intellicorp, and Teknowledge that offered the software tools to build expert systems, and hardware companies such as Lisp Machines Inc., Texas Instruments, Symbolics, and Xerox that were building workstations optimized for the development of Lisp programs.

The return of neural networks (1986-present)

- Back-propagation learning was applied to many learning problems in computer science and psychology, and the widespread dissemination of the results in **Parallel Distributed Processing.**
- In recent years, approaches were based on **hidden Markov models (HMMs)** which are based on a rigorous mathematical theory. These are generated by a process of training on a large corpus of real speech data.

Intelligent Systems

- **Intelligence:**The ability of a system to calculate, reason, perceive relationships and analogies, learn from experience, store and retrieve information from memory, solve problems, comprehend complex ideas, use natural language fluently, classify, generalize, and adapt new situations.
- **Intelligent systems** are technologically advanced machines that perceive and respond to the world around them.
- An **intelligent system** is a computer-based system that can represent reason about, and interpret data.
- An **intelligent system** is a system with artificial intelligence.

- **Reasoning** – It is the set of processes that enables us to provide basis for judgement, making decisions, and prediction.
- **Learning** – It is the activity of gaining knowledge or skill by studying, practising, being taught, or experiencing something.
- **Problem solving**- It is the process of selecting the best suitable alternative out of multiple alternatives to reach the desired goal are available.
- **Perception** – It is the process of acquiring, interpreting, selecting, and organizing sensory information. Perception presumes sensing. In humans, perception is aided by sensory organs. In the domain of AI, perception mechanism puts the data acquired by the sensors together in a meaningful manner.
- **Linguistic Intelligence** – It is one's ability to use, comprehend, speak, and write the verbal and written language. It is important in interpersonal communication.

Applications of AI

- **Air Operations Division (AOD) -** uses AI for the rule based expert systems.
    - The AOD has use for artificial intelligence for surrogate operators for combat and training simulators, mission management aids, support systems for tactical decision making,

and post processing of the simulator data into symbolic summaries.

- Airplane simulators are using artificial intelligence in order to process the data taken from simulated flights.
- Simulated aircraft warfare computers are able to come up with the best success scenarios in these situations

- **Computer Science:** AI researchers have created many tools to solve the most difficult problems in computer science.
  - time sharing ,
  - interactive interpreters,
  - graphical user interfaces and the computer mouse,
  - rapid development environments,
  - the linked list data structure,
  - automatic storage management,
  - symbolic programming,
  - functional programming,
  - dynamic programming
  - object-oriented programming
- **Education:** Number of companies that create robots to teach subjects to children ranging from biology to computer science.
  - **Intelligent tutoring systems**: An ITS called **SHERLOCK** teaches Air Force technicians to diagnose electrical systems problems in aircraft. Another example is **DARPA**, Defense Advanced Research Projects Agency, which used AI to develop a digital tutor to train its Navy recruits in technical skills in a shorter amount of time.
- **Finance: Algorithmic Trading** involves the use of complex AI systems to make trading decisions at speeds several orders of magnitudes greater than any human is capable of, often making millions of trades in a day without any human intervention. Such trading is called **High-frequency Trading**. Many banks, funds, and proprietary trading firms now have entire portfolios which are managed purely by AI systems.
- **Hospitals and medicine:** used as clinical decision support systems for medical diagnosis.
  - Computer-aided interpretation of medical images help scan digital images, e.g. from computed tomography, for typical appearances and to highlight conspicuous sections, such as possible diseases. A typical application is the detection of a tumor.
  - Heart sound analysis

- Companion robots for the care of the elderly
- Mining medical records to provide more useful information.
- Design treatment plans.
- Assist in repetitive jobs including medication management.
- Provide consultations.
- Drug creation[27]
- Using avatars in place of patients for clinical training[28]
- Predict the likelihood of death from surgical procedures
- Predict HIV progression

➢ **Media and E-commerce:** Typical use case scenarios include:
- analysis of images using object recognition or face recognition techniques,
- analysis of video for recognizing relevant scenes, objects or faces.
- facilitation of media search,
- creation of a set of descriptive keywords for a media item,
- media content policy monitoring (such as verifying the suitability of content for a particular TV viewing time),
- speech to text for archival or other purposes, and the detection of logos,
- products or celebrity faces for the placement of relevant advertisements
- AI is also widely used in E-commerce Industry for applications like Visual search, Visually similar recommendation, Chatbots, Automated product tagging etc

➢ **Music:** At Sony CSL Research Laboratory, their Flow Machines software has created pop songs by learning music styles from a huge database of songs. By analyzing unique combinations of styles and optimizing techniques, it can compose in any style.

➢ **News, publishing and writing:** Artificial intelligence is used to turn structured data into intelligent comments and recommendations in natural language. We can be able to write financial reports, executive summaries, personalized sales or marketing documents and more at a speed of thousands of pages per second and in multiple languages including English, Spanish, French & German.

➢ **Online and telephone customer service:** Artificial intelligence is implemented in automated online assistants which uses natural language processing.

➢ **Sensors:** Artificial Intelligence has been combined with many sensor technologies, such as Digital Spectrometry TM which enables many applications such as at home water quality monitoring.

- **Telecommunications maintenance:** Many telecommunications companies make use of heuristic search in the management of their workforces, for example BT Group has deployed heuristic search in a scheduling application that provides the work schedules of 20,000 engineers.
- **Toys and games:** AI has been applied to video games, for example video game bots, which are designed to stand in as opponents where humans aren't available or desired.
- **Transportation:** Fuzzy Logic controllers have been developed for automatic gearboxes in automobiles. For example, the 2006 Audi TT, feature the DSP transmission which utilizes Fuzzy Logic.

AI trends in various sectors

- **Healthcare:**
  - AI and ML technology has been particularly useful in the healthcare industry because it generates massive amounts of data to train with and enables algorithms to spot patterns faster than human analysts.
  - Medecision developed an algorithm that detects 8 variables in diabetes patients to determine if hospitalization is required.
  - An app called BiliScreen utilizes a smartphone camera, ML tools, and computer vision algorithms to detect increased levels of bilirubin in the sclera (white portion) of a person's eye, which is used to screen people for pancreatic cancer. This cancer has no telltale symptoms, hence it has one of the worst prognoses of all cancers.
  - NuMedii, a biopharma company, has developed a platform called Artificial Intelligence for Drug Discovery (AIDD), which uses big data and AI to detect the link between diseases and drugs at the systems level.
  - GNS Healthcare uses ML algorithms to match patients with the most effective treatments for them.
- **Entertainment:**
  - A familiar application of AI in everyday life is seen with services like Netflix or Amazon, wherein ML algorithms analyze the user's activity and compare it with that of other users to determine which shows or products to recommend. The algorithms are becoming intelligent with time—to the extent of understanding that a user may want to buy a product as a gift and not for him/her, or that different family members have different watching preferences.

- **Finance:**
  - Financial services companies use AI-based natural language processing tools to analyze brand sentiment from social media platforms and provide actionable advice.
  - Investment companies like Aidya and Nomura Securities use AI algorithms to conduct trading autonomously and robo-traders to conduct high-frequency trading for greater profits, respectively.
  - Fintech firms like Kensho and ForwardLane use AI-powered B2C robo-advisors to augment rebalancing decisions and portfolio management performed by human analysts. Wealthfront uses AI algorithms to track account activity and help financial advisors customize their advice.
  - Chatbots, powered by natural language processing, can serve banking customers quickly and efficiently by answering common queries and providing information promptly.
  - Fraud detection is an important application of AI in financial services. For example, Mastercard uses Decision Intelligence technology to analyze various data points to detect fraudulent transactions, improve real-time approval accuracy, and reduce false declines.
- **Data security:**
  - Cyber attacks are becoming a growing reality with the move to a digital world. There are also concerns about AI programs themselves turning against systems.
  - Automatic exploit generation (AEG) is a bot that can determine whether a software bug, which may cause security issues, is exploitable. If a vulnerability is found, the bot automatically secures it. AEG systems help develop automated signature generation algorithms that can predict the likelihood of cyberattacks.
  - PatternEx and MIT's Computer Science and Artificial Intelligence Laboratory (CSAIL) have developed an AI platform called AI2 which claims to predict cyber attacks better than existing systems. The platform uses Active Contextual Modeling, a continuous feedback loop between a human analyst and the AI system, to provide an attack detection rate that is better than ML-only solutions by a factor of 10.
  - Deep Instinct, an institutional intelligence company, says that malware code varies between 2%-10% in every iteration and

that its AI model is able to handle the variations and accurately predict which files are malware.

- **Manufacturing:**
  - Landing AI claims to have created machine-vision tools to find microscopic defects in objects like circuit boards using an ML algorithm trained using tiny volumes of sample images. In the future, self-driving robots may be created which can move finished goods around without endangering anyone or anything around.
  - Robots in factories are often stationary but are still in danger of crashing into objects around it. A new concept called collaborative robots or "cobots, enabled by AI, can take instructions from humans, including instructions that the robot has not been previously exposed to, and work productively with them.
  - AI algorithms can influence the manufacturing supply chain by detecting the patterns of demand for products across geographies, socioeconomic segments, and time, and predicting market demand. This, in turn, will affect inventory, raw material sourcing, financing decisions, human staffing, energy consumption, and maintenance of equipment.
  - AI tools help in predicting malfunctions and breakdown of equipment and taking or recommending preemptive actions as well as tracking operating conditions and performance of factory tooling.
- **Automotive industry**
  - Tesla introduced TeslaBot, an intelligent virtual assistant integrated with Tesla models S and X, allows users to interact with their car from their phone or desktop.
  - Uber AI Labs is working on developing self-driven cars with the help of the best engineers and scientists. Uber has already tested a batch of self-driving cars in 2016.
  - Nvidia has partnered with Volkswagen to develop "intelligent co-pilot systems" in cars that will enable safety warnings, gesture control, and voice and facial recognition.
  - Ericsson predicts that 5G technology will improve vehicle-to-vehicle communication wherein sensors will be implanted in airport runways, railways, and roads.

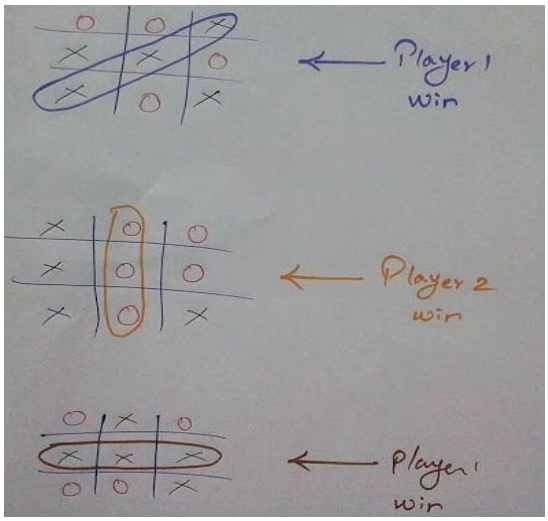
Tic Tac Toe Game playing

- The game Tic Tac Toe is also known as Noughts and Crosses or Xs and Os ,the player needs to take turns marking the spaces in a 3x3 grid with their own marks, if 3 consecutive marks (Horizontal, Vertical, Diagonal) are formed then the player who owns these moves get won.

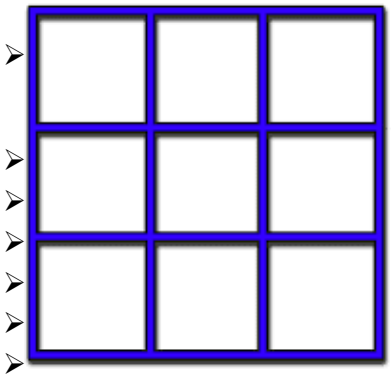
  Assume ,

  Player 1 - X

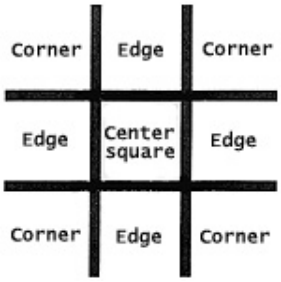
  Player 2 – O



- **Board's Data Structure:**



- The cells could be represent as Center square, Corner,Edge as like below:



Unit- I
Assignment-Cum-Tutorial Questions

Objective Questions

1. Define Artificial Intelligence.
2. A system is said to be_____ if it does the right thing, given known facts.
3. The study of how to make computers do things at which, at the moment, people are better-is a characteristic of_____. [ ]

   (a) Systems that think like humans (b) Systems that think rationally
   (c) Systems that act like humans (d) Systems that act rationally
4. The "Turing Test approach" is used to test whether a system __ .[ ]

   (a) think like humans (b) think rationally
   (c) act like humans (d) act rationally
5. The "Cognitive Modelling" approach is used to test whether a system ____.

   (a) think like humans (b) think rationally [ ]
   (c) act like humans (d) act rationally
6. The "Laws of Thought" approach is used to test whether a system _ _.

   (a) think like humans (b) think rationally [ ]
   (c) act like humans (d) act rationally
7. For artificial intelligence to succeed, we need_____. [ ]

   (a) intelligence (b) artifact (c) both a & b (d) none
8. Understanding language requires an understanding of_____. [ ]

   (a) subject matter (b) context (c) structure of sentences (d) only a & b
9. GPS was probably the first program to embody_____ approach.

   (a) thinking humanly (b) acting humanly [ ]
   (c) thinking rationally (d) acting rationally
10. The_____program solves the problem of inferring molecular structure from the information provided by a mass spectrometer. [ ]

    (a) MYCIN (b) DENDRAL (c) both a & b (d) none

11. _____ diagnoses blood infections. [ ]

(a) MYCIN (b) DENDRAL (c) both a & b (d) none

12. _____teaches Air Force technicians to diagnose electrical systems problems in aircraft. [ ]

(a) SHERLOCK (b) DARPA (c) DENDRAL (d) none

13. DARPA stands for_____.

SECTION-B

SUBJECTIVE QUESTIONS

1. Summarize AI definition categories?
2. Illustrate the capabilities that a computer must possess to pass Turing Test?
3. Explain the areas from which Artificial Intelligence laid its foundation?
4. Explain the history of Artificial Intelligence?
5. List the applications of Artificial Intelligence?
6. Outline the current trends in Artificial Intelligence?
7. What is an Intelligent System? Explain its characteristics?
8. Interpret the steps to solve tic-tac-toe problem.