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| BAHIR DAR UNIVERSITY INSTITUTE OF TECHNOLOGY SCHOOL OF COMPUTING AND ELECTRICAL ENGINEERING DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING |
| ARTIFICIAL INTELLEGENCE |
| ASSIGNMENT 1 AND 2 |
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Answers for Assignment 1

1. *Read and list out the contribution of various disciplines to the foundation of Artificial Intelligence (AI) to exist as a science?*

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### The Disciplines of Artificial Intelligence

The subject of artificial intelligence spans a wide horizon. It deals with the various kinds of knowledge representation schemes, different techniques of intelligent search, various methods for resolving uncertainty of data and knowledge, different schemes for automated machine learning and many others.

Among the application areas of AI, we have Expert systems, Game-playing, and Theorem-proving, Natural language processing, Image recognition, Robotics and many others. The subject of artificial intelligence has been enriched with a wide discipline of knowledge from Philosophy, Psychology, Cognitive Science, Computer Science, Mathematics and Engineering. Thus in fig. , they have been referred to as the parent disciplines of AI. An at-a-glance look at fig. also reveals the subject area of AI and its application areas.

**Philosophy**:-logic, methods of reasoning mind as physical system foundation of learning

**Psychology**:-adaption phenomena of perception and experimental techniques (psychophysics).

**Mathematics**:-formal representation and proof algorithms computation, decidability, tractability, probability

**Linguistics**:-knowledge representation grammars

**Control theory**:-homeostatic systems, stability simple optimal agent designs

**Computer engineering**:-provided the artifact that makes AI applications possible. AI programs tend to be large, and they could not work without the great advances in speed and memory that the computer industry has provided.


Fig.: AI, its parent disciplines and application areas.

1. What are the potted histories of AI? Read more about the technological evolution related to AI (state of the art)

**History**

The origin of AI can be traced to the end of World War II, when people started using computers to solve non numerical problems. The first attempt to create intelligent machines was made by Warren McCulloh and Walter Pitts in 1943 when they proposed a model of artificial networked neurons and claimed that properly defined networks could learn, thus laying the foundation for neural networks.

In 1950, Alan Turing published “Computer Machinery and Intelligence,” where he explored the question of whether machines can think. He also proposed the Turing Test as an operational measure of intelligence for computers. The test requires that a human observer interrogates (i.e., interacts with) a computer and a human through a Teletype. Both the computer and the human try to persuade the observer that she or he is interacting with a human at the other end of the line. The computer is considered intelligent if the observer cannot tell the difference between the computer responses and the human responses.

In 1956, John McCarthy coined the term “artificial intelligence” at a conference where the participants were researchers interested in machine intelligence. The goal of the conference was to explore whether intelligence can be precisely defined and specified in order for a computer system to simulate it. In 1958, McCarthy also invented LISP, a high-level AI programming language that continues to be used in AI programs. Other languages used for writing AI programs include Prolog, C, and Java.

1. Read about the following topics and write a note about.
	* Computer Vision
	* Robotics
	* Expert Systems (knowledge based systems)
	* Natural Language Processing
	* Knowledge representation (knowledge management)
	* Machine Learning
	* Neural Networks

**Applications**

There are two types of AI applications: **stand-alone AI programs** and **programs that are embedded in larger systems** where they add capabilities for knowledge representation, reasoning, and learning.

 Some examples of AI applications include robotics, computer vision, natural-language processing; and expert systems.

**Computer vision**- The goal of a computer vision system is to interpret visual data so that meaningful action can be based on that interpretation. The problem, as John McCarthy points out, is that the real world has three dimensions while the input to cameras on which computer action is based represents only two dimensions. The three-dimensional characteristics of the image must be determined from various two-dimensional manifestations.

 To detect motion, a chronological sequence of images is studied, and the image is interpreted in terms of high-level semantic and pragmatic units. More work is needed in order to be able to represent three-dimensional data (easily perceived by the human eye) to the computer. Advancements in computer vision technology will have a great effect on creating mobile robots. While most robots are stationary, some mobile robots with primitive vision capability can detect objects on their path but cannot recognize them.

**Robotics** - Robotics is the intelligent connection of perception by the computer to its actions. Programs written for robots perform functions such as :-

* + - trajectory calculation
		- interpretation of sensor data,
		- executions of adaptive control,
		- and access to databases of geometric models

 Robotics is a challenging AI application because the software has to deal with real objects in real time. An example of a robot guided by humans is the Sojourner surface rover that explored the area of the Red Planet where the Mars Pathfinder landed in 1997. It was guided in real time by NASA controllers. Larry Long and Nancy Long (2000) suggest that other robots can act autonomously, reacting to changes in their environment without human intervention. Military cruise missiles are an example of autonomous robots that have intelligent navigational capabilities.

**Expert system**- is a program that answers questions or solves problems about a specific domain of knowledge, using logical rules that are derived from the knowledge of experts. Expert systems consist of a knowledge base and mechanisms/programs to infer meaning about how to act using that knowledge. Knowledge engineers and domain experts often create the knowledge base.

One of the first expert systems, MYCIN, was developed in the mid-1970s. MYCIN employed a few hundred if-then rules about meningitis and bacteremia in order to deduce the proper treatment for a patient who showed signs of either of those diseases. Although MYCIN did better than students or practicing doctors, it did not contain as much knowledge as physicians routinely need to diagnose the disease.

Although Alan Turing’s prediction that computers would be able to pass the Turing Test by the year 2000 was not realized, much progress has been made and novel AI applications have been developed, such as industrial robots, medical diagnostic systems, speech recognition in telephone systems, and chess playing (where IBM’s Deep Blue supercomputer defeated world champion Gary Kasparov).

**Natural-Language Processing*-***Language understanding is a complex problem because it requires programming to extract meaning from sequences of words and sentences. At the lexical level, the program uses words, prefixes, suffixes, and other morphological forms and inflections. At the syntactic level, it uses a grammar to parse a sentence.

 Semantic interpretation (i.e., deriving meaning from a group of words) depends on domain knowledge to assess what an utterance means. For example, “Let’s meet by the bank to get a few bucks” means one thing to bank robbers and another to weekend hunters. Finally, to interpret the pragmatic significance of a conversation, the computer needs a detailed understanding of the goals of the participants in the conversation and the context of the conversation.

**Neural Network -**A Neural network is an interconnected assembly of simple processing elements, units or node, whose functionality is loosely based on the human neuron. The processing ability of the network is stored in the inter-unit connection strengths, or weigths,obtained by a process of adaptation to ,or learning from, a set of training patterns.

e.gbrain modeling, time series prediction, classification

## Fundamental System Issues

An AI system must be able to store knowledge, apply that knowledge to the solution of problems, and acquire new knowledge through experience. Among the challenges that face researchers in building AI systems, there are three that are fundamental: **knowledge representation** and **machine learning.**

***Knowledge Representation-***What AI researchers call “knowledge” appears as data at the level of programming. Data becomes knowledge when a computer program represents and uses the meaning of some data. Many knowledge-based programs are written in the LISP programming language, which is designed to manipulate data as symbols.

Knowledge may be declarative or procedural. Declarative knowledge is represented as a static collection of facts with a set of procedures for manipulating the facts. Procedural knowledge is described by executable code that performs some action. Procedural knowledge refers to “how-to” do something. Usually, there is a need for both kinds of knowledge representation to capture and represent knowledge in a particular domain.

**Machine learning-**The advent of highly parallel computers in the late 1980s enabled machine learning through neural networks and connectionist systems, which simulate the structure operation of the brain. Parallel computers can operate together on the task with each computer doing only part of the task. Such systems use a network of interconnected processing elements called “units.” Each unit corresponds to a neuron in the human brain and can be in an “on” or “off” state. In such a network, the input to one unit is the output of another unit. Such networks of units can be programmed to represent short-term and long-term working memory and also to represent and perform logical operations (e.g., comparisons between numbers and between words).

A simple model of a learning system consists of four components:

* the physical environment where the learning system operates
* the learning element
* the knowledge base and
* the performance element.

 The environment supplies some information to the learning element, the learning element uses this information to make improvements in an explicit knowledge base, and the performance element uses the knowledge base to perform its task (e.g., play chess, prove a theorem). The learning element is a mechanism that attempts to discover correct generalizations from raw data or to determine specific facts using general rules. It processes information using induction and deduction. In inductive information processing, the system determines general rules and patterns from repeated exposure to raw data or experiences. In deductive information processing, the system determines specific facts from general rules (e.g., theorem proving using axioms and other proven theorems). The knowledge base is a set of facts about the world, and these facts are expressed and stored in a computer system using a special knowledge representation language

e.g. decision tree learning, version space learning

4. What an AI system can and cannot do?

**AI system can do**

As i already explained above at question, two artificial intelligence have so many application areas and some of them are listed below:-

* Computer vision
* Robotics
* Natural language processing
* Expert systems
* Spoken language systems- 1000 word continuous speech
* Planning and scheduling- Hubble Telescope experiments
* Learning
* User modeling
* Games-Grand Master level in chess (world champion), checkers, etc

**AI system cannot do**

* Understand natural language robustly
* Surf the web
* Interpret an arbitrary visual scene
* Learn a natural language
* Play Go well
* Construct plans in dynamic real-time domains
* Refocus attention in complex environments
* Perform life-long learning

Answer for assignment 2

**Q.**As show in the figure above, AI mostly studies designing agents which simulates the characteristics of humans that exhibit the areas marked with red dots. Write your justification why it is so? What are the critical factors that AI studies titled towards to it as compared to the perspectives of “thinking like humans” and “acting like humans”.



Answer

* Since system said to be rational if it thinks/does the right thing through correct reasoning.
* Rational action requires the ability to represent knowledge and reason with it so as to reach good decision.
* As we know AI is the study of mental faculties through the use of computational models.
* Provided the correct arguments/ thought structures intelligence machine must provide the correct answer unless the inputs are invalid or wrong. Rational action requires the ability to represent knowledge and reason with it so as to reach good decision. Learning for better understanding of how the world works
* The study of AI as rational agent design therefore has two advantages.
* First, it is more general than the ``laws of thought'' approach, because correct inference is only a useful mechanism for achieving rationality, and not a necessary one.
* Second, it is more amenable to scientific development than approaches based on human behavior or human thought, because the standard of rationality is clearly defined and completely general. Human behavior, on the other hand, is well-adapted for one specific environment and is the product, in part, of a complicated and largely unknown evolutionary process that still may be far from achieving perfection.
* So AI must focus or tends to work on making the machines rational agents for achieving the desired goal.