A Survey on Artificial Intelligence

(Window to Mankind)

Apoorva R
Department of EIE
DSCE
Bengaluru, Karnataka, India

Deekshitha Arasa
Department of EIE
DSCE
Bengaluru, Karnataka, India

Shriyanka Jamadade
Department of EIE
DSCE
Bengaluru, Karnataka, India

***Abstract*— Artificial intelligence (AI) is a field of computer science that explores computational models of problem solving, where the problems to be solved are of the complexity of problems solved by human beings. Artificial Intelligence is the study of how to make computers do things which, at the moment, people do better. It is the intelligence of machines and the branch of computer science that aims to create it. The study and design of intelligent agents is also called as Artificial Intelligence. The central problems of AI include such traits as reasoning, knowledge, planning, learning, communication, perception and the ability to move and manipulate objects. This paper intends to study the techniques developed in artificial intelligence (AI) from the standpoint of their applications in all fields related to engineering. In particular, it focuses on techniques developed (or that are being developed) in artificial intelligence that can be deployed in solving problems associated with distinct processes. This paper highlights a comparative study between approaches and its applications.**

***Keywords*— Computerscience ;perception; reasoning; manipukated objects;**

I. INTRODUCTION

What is intelligence?

Fig. 1. Example of Intelligence

The ability of problem solving demonstrates intelligence. Consider a mouse trying to search/reach the piece of cheese placed at right top corner of the image the mouse can find more than one solutions to this problem. We can say that the mouse is intelligent enough to find a solution to the problem. Hence the ability of problem solving demonstrates intelligence. Intelligence is the computational part of the ability to achieve goals in the world, varying kinds and degrees of intelligence occur in people, many animals and some machines.

Artificial Intelligence, or AI for short, is a combination of computer science, physiology, and philosophy. AI is a broad topic, consisting of different fields, from machine vision to expert systems. The element that the fields of AI have in common is the creation of machines that can "think". One of the most challenging approaches facing experts is building systems that mimic the behaviour of the human brain, made up of billions of neurons, and arguably the most complex matter in the universe.

II. PROBLEMS OF ARTIFICIAL INTELLIGENCE

A. Deduction, reasoning, problem solving

Early AI researchers developed algorithms that imitated the step-by-step reasoning that human beings use when they solve puzzles, play board games or make logical deductions. By the late 80s and 90s, AI research had also developed highly successful methods for dealing with uncertain or incomplete information, employing concepts from probability and economics. For difficult problems, most of these algorithms can require enormous computational resources — most experience a "combinatorial explosion": the amount of memory or computer time required becomes astronomical when the problem goes beyond a certain size. The search for more efficient problem solving algorithms is a high priority for AI research.

Human beings solve most of their problems using fast, intuitive judgments rather than the conscious, step-by-step deduction that early AI research was able to model. AI has made some progress at imitating this kind of "sub-symbolic" problem solving: embodied approaches emphasize the importance of sensor motor skills to higher reasoning; neural net research attempts to simulate the structures inside human and animal brains that gives rise to this skill.

B. Knowledge representation

Knowledge representation and knowledge engineering are central to AI research. Many of the problems machines are expected to solve will require extensive knowledge about the world. Among the things that AI needs to represent are: objects, properties, categories and relations between objects; situations, events, states and time; causes and effects; knowledge about knowledge (what we know about what other people know); and many other, less well researched domains. A complete representation of "what exists" is an ontology (borrowing a word from traditional philosophy), of which the most general are called upper ontology.

C. Planning

Intelligent agents must be able to set goals and achieve them. They need a way to visualize the future (they must have a representation of the state of the world and be able to make predictions about how their actions will change it) and be able to make choices that maximize the utility (or "value") of the available choices. In some planning problems, the agent can assume that it is the only thing acting on the world and it can be certain what the consequences of its actions may be. However, if this is not true, it must periodically check if the world matches its predictions and it must change its plan as this becomes necessary, requiring the agent to reason under uncertainty.

D. Learning

Machine learning has been central to AI research from the beginning. Unsupervised learning is the ability to find patterns in a stream of input. Supervised learning includes both classification (be able to determine what category something belongs in, after seeing a number of examples of things from several categories) and regression (given a set of numerical input/output examples, discover a continuous function that would generate the outputs from the inputs). In reinforcement learning the agent is rewarded for good responses and punished for bad ones. These can be analyzed in terms of decision theory, using concepts like utility. The mathematical analysis of machine learning algorithms and their performance is a branch of theoretical computer science known as computational learning theory.

E. Natural language processing

Natural language processing gives machines the ability to read and understand the languages that the human beings speak. Many researchers hope that a sufficiently powerful natural language processing system would be able to acquire knowledge on its own, by reading the existing text available over the internet. Some straightforward applications of natural language processing include information retrieval (or text mining) and machine translation.

F. Motion and Manipulation

ASIMO uses sensors and intelligent algorithms to avoid obstacles and navigate stairs. The field of robotics is closely related to AI. Intelligence is required for robots to be able to handle such tasks as object manipulation and navigation, with sub-problems of localization (knowing where you are), mapping (learning what is around you) and motion planning (figuring out how to get there).

G. Perception

Machine perception is the ability to use input from sensors (such as cameras, microphones, sonar and others more exotic) to deduce aspects of the world. Computer vision is the ability to analyze visual input. A few selected sub problems are speech recognition, facial recognition and object recognition.

H. Creativity

A sub-field of AI addresses creativity both theoretically (from a philosophical and psychological perspective) and practically (via specific implementations of systems that generate outputs that can be considered creative).

III. APPROACHES TO ARTIFICIAL INTELLEGENCE

There is no established unifying theory or paradigm that guides AI research. Researchers disagree about many issues. A few of the most long standing questions that have remained unanswered are these: Can intelligence be reproduced using high-level symbols, similar to words and ideas? Or does it require "sub-symbolic" processing? Should artificial intelligence simulate natural intelligence, by studying human psychology or animal neurobiology? Or is human biology as irrelevant to AI research as bird biology is to aeronautical engineering? Can intelligent behavior be described using simple, elegant principles (such as logic or optimization)? Or does artificial intelligence necessarily require solving many unrelated problems?

A. Cybernetics and brain simulation

The human brain provides inspiration for artificial intelligence researchers, however there is no consensus on how closely it should be simulated. In the 40s and 50s, a number of researchers explored the connection between neurology, information theory, and cybernetics. Some of them built machines that used electronic networks to exhibit rudimentary intelligence, such as W. Grey Walter's turtles and the Johns Hopkins Beast. Many of these researchers gathered for meetings of the Teleological Society at Princeton University and the Ratio Club in England.

Fig. 2. Cybernetics example

B. Traditional symbolic AI

When access to digital computers became possible in the middle 1950s, AI research began to explore the possibility that human intelligence could be reduced to symbol manipulation. The research was centered in three institutions: CMU, Stanford and MIT, and each one developed its own style of research. John Haugeland named these approaches to AI "good old fashioned AI" or "GOFAI".

C. Cognitive simulation

Economist Herbert Simon and Alan Newell studied human problem solving skills and attempted to formalize them, and their work laid the foundations of the field of artificial intelligence, as well as cognitive science, operations research and management science. Their research team performed psychological experiments to demonstrate the similarities between human problem solving and the programs (such as their "General Problem Solver") they were developing. This tradition, centred at Carnegie Mellon University would

eventually culminate in the development of the Soar architecture in the middle 80s.

D. Logical AI

Unlike Newell and Simon, John McCarthy felt that machines did not need to simulate human thought, but should instead try to find the essence of abstract reasoning and problem solving, regardless of whether people used the same algorithms. His laboratory at Stanford (SAIL) focused on using formal logic to solve a wide variety of problems, including knowledge representation, planning and learning. Logic was also focus of the work at the University of Edinburgh and elsewhere in Europe which led to the development of the programming language Prolong and the science of logic programming.

E. Top down approaches

Because of the large storage capacity of computers, expert systems had the potential to interpret statistics, in order to formulate rules. An expert system works much like a detective solves a mystery. Using the information, and logic or rules, an expert system can solve the problem. For example it the expert system was designed to distinguish birds it may have the following as shown in Fig 3.

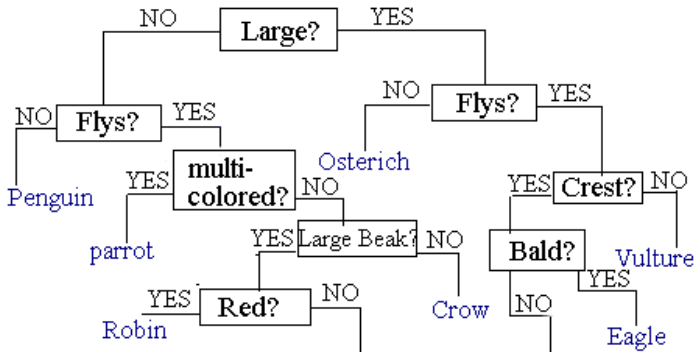

Fig. 3. Charts like these represent the logic of expert systems. Using a similar set of rules, experts can have a variety of applications. With improved interfacing,

IV. ARTIFICIAL INTELLIGENCE TECHNIQUES IN SOFTWARE ENGINEERING (AITSE):

Software Engineering is a knowledge-intensive activity, requiring extensive knowledge of the application domain and of the target software itself. Many Software products costs can be attributed to the ineffectiveness of current techniques for managing this knowledge, and Artificial Intelligence techniques can help alleviate this situation.

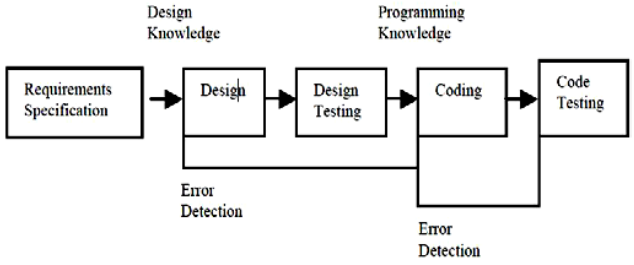

Fig. 4. Traditional software development process

The traditional view of software development process begins at the requirements specification and ends at testing the software. At each of these stages, different kinds of knowledge (design knowledge at design stage and programming and domain knowledge at the coding stage) are required. At each of the two stages: design and coding, exist a cycle: error recognition and error correction. Experience shows that errors can occur at any stage of software development. Errors due to coding may occur because of faulty design. Such errors are usually expensive to correct.

A basic problem of software engineering is the long delay between the requirements specification and the delivery of a product. This long development cycle causes requirements to change before product arrival. In addition, there is the problem of phase independence of requirements, design and codes. Phase independence means that any decision made at one level becomes fixed for the next level. Thus, the coding team is forced to recode whenever there is change in design. Expert system use knowledge rather than data to control the solution process. Knowledge engineers build systems by eliciting knowledge from experts, coding, that knowledge in an appropriate form, validating the knowledge, and ultimately constructing a system using a variety of building tools.

The main phases the expert system development processes are:-

- Planning
- Knowledge acquisition and analysis
- Knowledge design
- Code
- Knowledge verification
- System evaluation

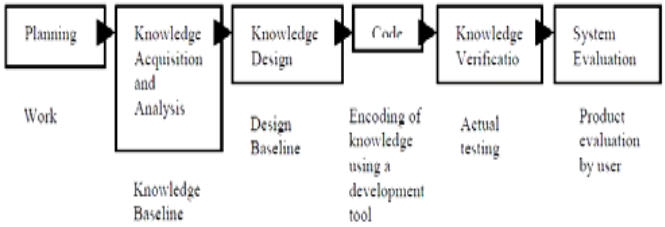

Fig. 5. Expert System development.

A. Specific characteristics of intelligent behavior:

- Learn from experience and apply the knowledge acquired from experience.
- Handle complex situations.
- Solve problems when important information is missing.
- Determine what is important.
- React quickly and correctly to a new situation.
- Understand visual images.
- Process and manipulate symbols.
- Be creative and imaginative.
- Use heuristics.

V. DIFFERENCE BETWEEN NATURAL AND ARTIFICIAL INTELLIGENCE

TABLE 1 DIFFERENCE BETWEEN NATURAL AND ARTIFICIAL INTELLIGENCE

Attributes	*Natural Intelligence (Human)*	*Artificial Intelligence (Machine)*
The ability to use sensors (eyes, ears, touch, smell)	high	low
The ability to be creative and imaginative	high	low
The ability to learn from experience	high	low
The ability to be adaptive	high	low
The ability to afford the cost of acquiring intelligence	high	low
The ability to use a variety of information source	high	high
The ability to acquire large amount of external information	high	high
The ability to make complex calculations	low	high
The ability to transfer information	low	high
The ability to make a series of calculations rapidly and accurately	low	high

VI. APPLICATIONS OF AI

The applications of Artificial Intelligence are abundant and widespread, especially in developed countries. In fact, Artificial Intelligence has become such a mainstay in today's world that it is taken for granted by the majority of people who benefit from its efficiency. Air conditioners, cameras, video games, medical equipment, traffic lights, and refrigerators: all function by way of developments in "smart" technology or fuzzy logic. Large financial and insurance institutions rely heavily on Artificial Intelligence to process the huge quantities of information that are fundamental to their business practices.

The application of computer speech recognition, though more limited in utilization and practical convenience, has made it possible to interact with computers by using speech instead of writing. Robotics, the study and development of robots, is another common application whose end goal can be anything from entertainment (such as robot pets), to research (such as Mars rovers), to safety (such as fire detection and extinguishment). Natural language processing, a subfield of Artificial Intelligence, provides computers with the understanding they require to handle information being encoded by humans. Computer vision instructs computers on how to comprehend images and scenes. It has as some of its goals: image recognition, image tracking and image mapping. This application is valued in the fields of medicine, security, surveillance, military operations, even movie-making.

A. Current Usage:

- There are many applications of artificial intelligence at present. Some of them have been listed here.
- Banks and other financial institutions rely on intelligent software, which provide accurate analysis of the data and helps make predictions based upon that data.
- Stocks and commodities are being traded without any human interference - all thanks to the intelligent systems.
- Artificial intelligence is used for weather forecasting.
- It is used by airlines to keep a check on its system.
- Robotics is the greatest success story, in the field of artificial intelligence. Spacecrafts are sending by NASA and other space organizations into space, which are completely manned by robots. Even some manufacturing processes are now being completely undertaken by robots. Robots are being used in industrial processes that are dangerous to human beings, such as in nuclear power plants.
- Usage of artificial intelligence is quite evident in various speech recognition systems, such as IBM ViaVoice software and Windows Vista.

(a) (b)

Fig. 6. (a) **ASIMO** uses sensors and intelligent algorithms to avoid obstacles and navigate stairs. (b)**KISMET**, a robot with rudimentary social skills.

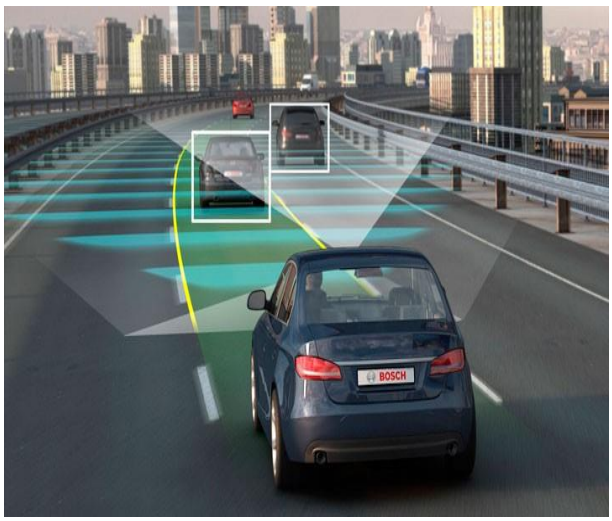

Fig. 7. Driverless cars

Fig. 8. Sofia- an artificial intelligence robot

VII. ADVANTAGES AND DISADVANTAGES

A. *Advantages*

- **Jobs** – depending on the level and type of intelligence these machines receive in the future, it will obviously have an effect on the type of work they can do, and how well they can do it (they can become more efficient). As the level of AI increases so will their competency to deal with difficult, complex even dangerous tasks that are currently done by humans, a form of applied artificial intelligence.
- **They don't stop** – as they are machines there is no need for sleep, they don't get ill , there is no need for breaks or Facebook, they are able to go, go, go! There obviously may be the need for them to be charged or refuelled, however the point is, they are definitely going to get a lot more work done than we can. Take the Finance industry for example, there are constant stories arising of artificial intelligence in finance and that stock traders are soon to be a thing of the past.
- **No risk of harm** – when we are exploring new undiscovered land or even planets, when a machine gets broken or dies, there is no harm done as they don't feel, they don't have emotions. Whereas going on the same type of expeditions a machine does, may simply not be possible or they are exposing themselves to high risk situations.
- **Act as aids –** they can act as 24/7 aids to children with disabilities or the elderly, they could even act as a source for learning and teaching. They could even be part of security alerting you to possible fires that you are in threat of, or fending off crime.
- **Their function is almost limitless** – as the machines will be able to do everything (but just better) essentially their use, pretty much doesn't have any boundaries. They will make fewer mistakes, they are emotionless, they are more efficient, and they are basically giving us more free time to do as we please.

B. *Disadvantages for Artificial Intelligence (AI)*

- **Over reliance on AI** – as you may have seen in many films such as The Matrix, iRobot or even kids films such as WALL.E, if we rely on machines to do almost everything for us we become very dependent, so much so they have the potential to ruin our lives if something were to go wrong. Although the films are essentially just fiction, it wouldn't be too smart not to have some sort of backup plan to potential issues on our part.
- **Human Feel** – as they are machines they obviously can't provide you with that 'human touch and quality', the feeling of a togetherness and emotional understanding, that machines will lack the ability to sympathise and empathise with your situations, and may act irrationally as a consequence.
- **Inferior** – as machines will be able to perform almost every task better than us in practically all respects, they will take up many of our jobs, which will then result in masses of people who are then jobless and as a result feel essentially useless. This could then lead us to issues of mental illness and obesity problems etc.
- **Misuse** – there is no doubt that this level of technology in the wrong hands can cause mass destruction, where robot armies could be formed, or they could perhaps malfunction or be corrupted which then we could be facing a similar scene to that of terminator (hey, you never know).
- **Ethically Wrong? –** People say that the gift of intuition and intelligence was God's gift to mankind, and so to replicate that would be then to kind of 'play God'. Therefore not right to even attempt to clone our intelligence.

VIII. CONCLUSION

First, we should be prepared for a change. Our conservative ways stand in the way of progress. AI is a new step that is very helpful to the society. Machines can do jobs that require detailed instructions followed and mental alertness. AI with its learning capabilities can accomplish those tasks but only if the worlds conservatives are ready to change and allow this to be a possibility. It makes us think about how early man finally accepted the wheel as a good invention, not something taking away from its heritage or tradition.

Secondly, we must be prepared to learn about the capabilities of AI. The more use we get out of the machines the less work is required by us. In turn less injuries and stress to human beings. Human beings are a species that learn by trying, and we must be prepared to give AI a chance seeing AI as a blessing, not an inhibition.

Finally, we need to be prepared for the worst of AI. Something as revolutionary as AI is sure to have many kinks to work out. There are so many things that can go wrong with a new system so we must be as prepared as we can be for this new technology.

However, even though the fear of the machines are there, their capabilities are infinite Whatever we teach AI, they will suggest in the future if a positive outcome arrives from it. AI are like children that need to be taught to be kind, well mannered, and intelligent. If they are to make important decisions, they should be wise. We as citizens need to make sure AI programmers are keeping things on the level. We should be sure they are doing the job correctly, so that no future accidents occur.

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