ARTIFICIAL INTELLIGENCE

Intelligence: It is the ability to reason, to trigger new thoughts, to perceive and to learn.

Artificial Intelligence:

- AI refers to the ability to learn, to trigger new thoughts add reason artificially. Hence artificial intelligence can be defined as developing computer programs to solve problems by application of processes that are analogous to human reasoning process.
- It is a branch of computer science which deals with the study and creation of computer systems that exhibits some form of intelligence.
- Artificial intelligence is the study of how to make computers do things, which, at the moment, people do better.
    - According to the father of artificial intelligence, John McCarthy, it is "the science and engineering of making intelligent machines, especially intelligent computer programs".
    - Artificial Intelligence is a way of making a computer, a computer-controlled robot, or a software think intelligently, in the similar manner the intelligent humans think. AI is accomplished by studying how human brain thinks and how humans learn, decide, and work while trying to solve a problem, and then using the outcomes of this study as a basis of developing intelligent software and systems.
- It is a branch of computer science that pursues creating computers or machines as intelligent human beings. It is the science and engineering of making intelligent machines, especially intelligent computer programs.
- Artificial intelligence is a way of making a computer, a computer-controlled robot, or a software think intelligently, in the similar manner the intelligent humans think.

Some Definitions of AI:

- The exciting new effort to make computers think ... machines with minds, in the full literal sense.

  Haugeland, 1985

- The study of mental faculties through the use of computational models.

  Charniak and McDermott, 1985

- A field of study that seeks to explain and emulate intelligent behavior in terms of computational processes.

  Schalkoff, 1990

- The study of how to make computers do things at which, at the moment, people are better.

  Rich & Knight, 1991

Application areas of AI:

- **Game Playing**

  AI plays crucial role in strategic games such as chess, poker, tic-tac-toe, etc., where machine can think of large number of possible positions based on heuristic knowledge.

- **Natural Language Processing**

  It is possible to interact with the computer that understands natural language spoken by humans.

- **Speech Recognition**

  Some intelligent systems are capable of hearing and comprehending the language in terms of sentences and their meanings while a human talks to it. It can handle different accents, slang words, noise in the background, change in human's noise due to cold, etc.

- **Expert Systems**

  There are some applications which integrate machine, software, and special information to impart reasoning and advising. They provide explanation and advice to the users.

- **Vision Systems**

  These systems understand, interpret, and comprehend visual input on the computer. For example,

  - A spying aeroplane takes photographs which are used to figure out spatial information or map of the areas.
  - Doctors use clinical expert system to diagnose the patient.
  - Police use computer software that can recognize the face of criminal with the stored portrait made by forensic artist.

- **Handwriting Recognition**

  The handwriting recognition software reads the text written on paper by a pen or on screen by a stylus. It can recognize the shapes of the letters and convert it into editable text.

- **Intelligent Robots**

  Robots are able to perform the tasks given by a human. They have sensors to detect physical data from the real world such as light, heat, temperature, movement, sound, bump, and pressure. They have efficient processors, multiple sensors and huge memory, to exhibit intelligence. In addition, they are capable of learning from their mistakes and they can adapt to the new environment.

- **Medical Diagnosis**

- **Simulation for Driving & Flight**, and so on...

History of AI

1943: early beginnings

McCulloch & Pitts: Boolean circuit model of brain

1950: Turing

Turing's "Computing Machinery and Intelligence"

1956: birth of AI

Dartmouth meeting: "Artificial Intelligence"name adopted

1950s: initial promise

Early AI programs, including
Samuel's checkers program
Newell & Simon's Logic Theorist

1955-65: "great enthusiasm"

Newell and Simon: GPS, general problem solver
Gelertner: Geometry Theorem Prover
McCarthy: invention of LISP History of AI

1966—73: Reality dawns

Realization that many AI problems are intractable
Limitations of existing neural network methods identified
Neural network research almost disappears

1969—85: Adding domain knowledge

Development of knowledge-based systems
Success of rule-based expert systems,
E.g., DENDRAL, MYCIN
But were brittle and did not scale well in practice

1986-- Rise of machine learning

Neural networks return to popularity
Major advances in machine learning algorithms and applications

1990-- Role of uncertainty

Bayesian networks as a knowledge representation framework

1995-- AI as Science

Integration of learning, reasoning, knowledge representation
AI methods used in vision, language, data mining, etc

History of AI (Cont.)

- **1943 McCulloch & Pitts: Boolean circuit model of brain**
- **1950 Turing's "Computing Machinery and Intelligence"**
- **1956 Dartmouth meeting: "Artificial Intelligence" adopted**
- **1950s Early AI programs, including Samuel's checkers program, Newell & Simon's Logic Theorist, Gelernter's Geometry Engine**
- **1965 Robinson's complete algorithm for logical reasoning**
- **1966—73 AI discovers computational complexity Neural network research almost disappears**
- **1969—79 Early development of knowledge-based systems**
- **1980-- AI becomes an industry**

- **1986-- Neural networks return to popularity**
- **1987-- AI becomes a science**
- **1995-- The emergence of intelligent agents**

AI Concepts :

Three basic AI concepts: **machine learning**, **deep learning**, and **neural networks**.

Machine learning and applications

It's likely that you've interacted with some form of AI in your day-to-day activities. If you use Gmail, for example, you may enjoy the automatic e-mail filtering feature. If you own a smartphone, you probably fill out a calendar with the help of **Siri**, **Cortana**, or **Bixby**. If you own a newer vehicle, perhaps you've benefited from a **driver-assist feature** while driving.

As helpful as these software products are, they lack the ability to learn independently. They cannot think outside their code. Machine learning is a branch of AI that aims to give machines the ability to learn a task without pre-existing code.

In the simplest terms, machines are given a large amount of trial examples for a certain task. As they go through these trials, machines learn and adapt their strategy to achieve those goals.

For example, an image-recognition machine may be given millions of pictures to analyze. After going through endless permutations, the machine acquires the ability to recognize patterns, shapes, faces, and more.
A well-known example of this AI concept is **Quick, Draw!**, a Google-hosted game that lets humans draw simple pictures in under 20 seconds, with the machine-learning algorithm trying to guess the drawing. More than 15 million people have contributed more than 50 million drawings to the app.

Deep learning gets ready to play

How do we get machines to learn more than just a specific task? What if we want it to be able to take what it has learned from analyzing photographs and use that knowledge to analyze different data sets? This requires computer scientists to formulate general-purpose learning algorithms that help machines learn more than just one task.

One famous example of deep learning in action is Google's **AlphaGo** project written in Lua, C++, and **Python** code. The AlphaGo AI was able to beat professional Go players, a feat that was thought impossible given the game's incredible complexity and reliance on focused practice and human intuition to master.
How was a program able to master a game that calls for human intuition? Practice, practice, practice — and a little help from an artificial neural network.

Neural networks follow natural model

Deep learning is often made possible by **artificial neural networks**, which imitate neurons, or brain cells. Artificial neural networks were inspired by things we find in our own biology. The neural net models use math and computer science principles to mimic the processes of the human brain, allowing for more general learning.

An artificial neural network tries to simulate the processes of densely interconnected brain cells, but instead of being built from biology, these neurons, or nodes, are built from code.

Neural networks contain three layers: an input layer, a hidden layer and an output layer. These layers contain thousands, sometimes millions, of nodes. Information is fed into the input layer. Inputs are given a certain weight, and interconnected nodes multiply the weight of the connection as they travel. Essentially, if the unit of information reaches a certain threshold, then it is able to pass to the next layer. In order to learn from experience, machines compare outputs from a neural network, then modify connections, weights, and thresholds based on the differences among them.

Knowledge

Knowledge is the information about a domain that can be used to solve problems in that domain. To solve many problems requires much knowledge, and this knowledge must be represented in the computer. As part of designing a program to solve problems, we must define how the knowledge will be represented. A **representation scheme** is the form of the knowledge that is used in an agent.

A **representation** of some piece of knowledge is the internal representation of the knowledge. A representation scheme specifies the form of the knowledge.

A **knowledge base** is the representation of all of the knowledge that is stored by an agent.
A good representation scheme is a compromise among many competing objectives. A representation should be

- Rich enough to express the knowledge needed to solve the problem.
- As close to the problem as possible; it should be compact, natural, and maintainable. It should be easy to see the relationship between the representation and the domain being represented, so that it is easy to determine whether the knowledge represented is correct. A small change in the problem should result in a small change in the representation of the problem.
- Agreeable to efficient computation, this usually means that it is able to express features of the problem that can be exploited for computational gain and able to trade off accuracy and computation time.
- Able to be acquired from people, data and past experiences.

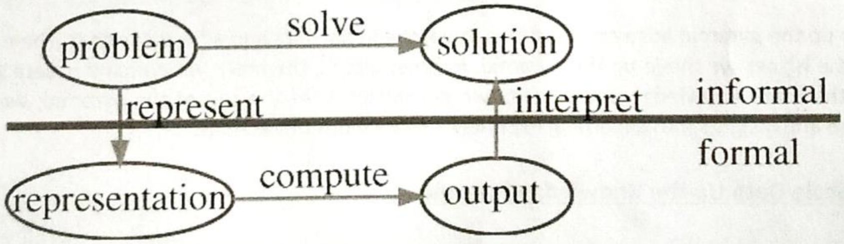


Figure 1.4: The role of representations in solving problems

Many different representation schemes have been designed. Many of these start with some of these objectives and are then expanded to include the other objectives. For example, some are designed for learning and then expanded to allow richer problem solving and inference abilities. Some representation schemes are designed with expressiveness in mind, and then inference and learning are added on. Some schemes start from tractable inference and then are made more natural, and more able to be acquired.

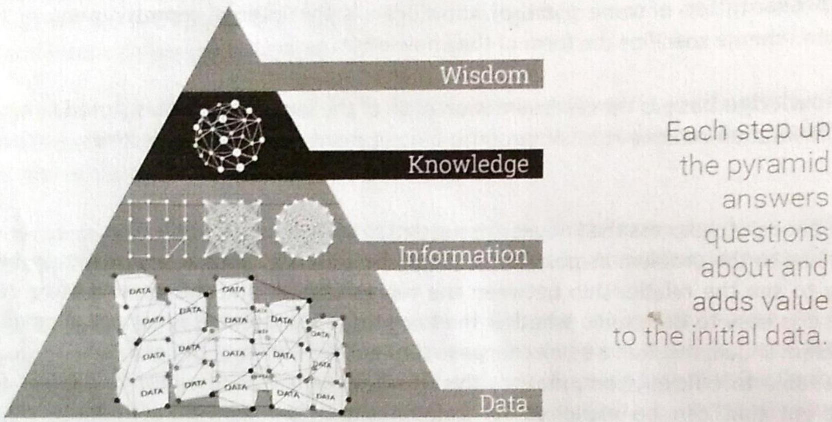
Some of the questions that must be considered when given a problem or a task are the following:

- What is a solution to the problem? How good must a solution be?

- How can the problem be represented? What distinctions in the world are needed to solve the problem? What specific knowledge about the world is required? How can an agent acquire the knowledge from experts or from experience? How can the knowledge be debugged, maintained, and improved?
- How can the agent compute an output that can be interpreted as a solution to the problem? Is worst-case performance or average-case performance the critical time to minimize? Is it important for a human to understand how the answer was derived?

Knowledge Pyramid

The DIKW Pyramid represents the relationships between data, information, knowledge and wisdom. Each building block is a step towards a higher level - first comes data, then is information, next is knowledge and finally comes wisdom. Each step answers different questions about the initial data and adds value to it. The more we enrich our data with meaning and context, the more knowledge and insights we get out of it so we can take better, informed and data-based decisions.



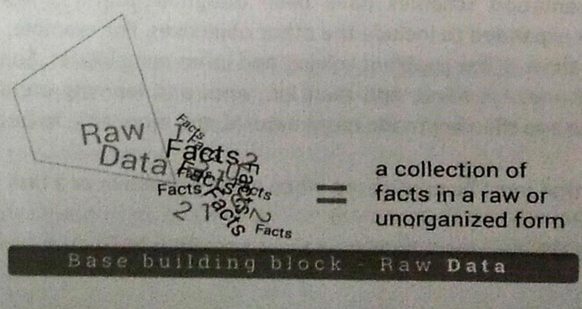
Like other hierarchy models, the Knowledge Pyramid has rigidly set building blocks – data comes first, information is next, then knowledge follows and finally wisdom is on the top.

Each step up the pyramid answers questions about the initial data and adds value to it. The more questions we answer, the higher we move up the pyramid. In other words, the more we enrich our data with meaning and context, the more knowledge and insights we get out of it. At the top of the pyramid, we have turned the knowledge and insights into a learning experience that guides our actions.

How to Scale Data Up the Knowledge Pyramid

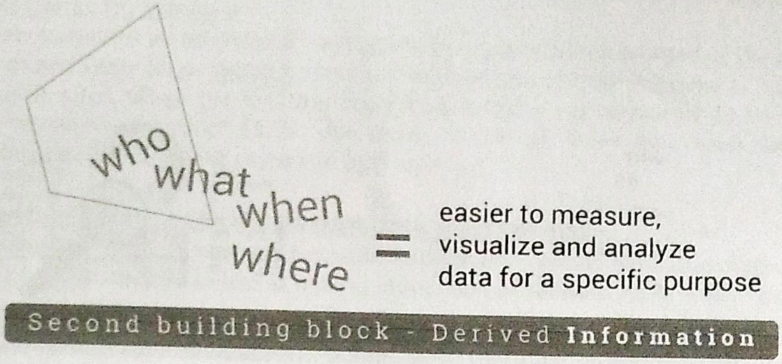
So, let's have a look at the individual components of the Knowledge Pyramid and how we move from one to the next.

Data



Data is a collection of facts in a raw or unorganized form such as numbers or characters. However, without context, data can mean little. For example, *12012012* is just a sequence of numbers without apparent importance. But if we view it in the context of 'this is a date', we can easily recognize *12th of January, 2012*. By adding context and value to the numbers, they now have more meaning. In this way, we have transformed the raw sequence of numbers into

Information



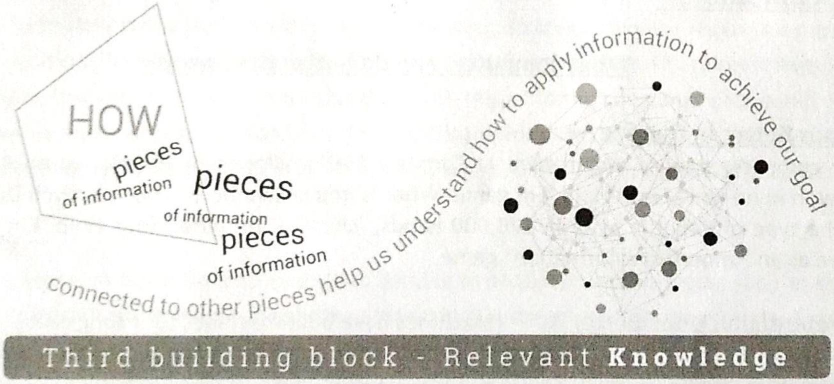
Information is the next building block of the DIKW Pyramid. This is data that has been "cleaned" of errors and further processed in a way that makes it easier to measure, visualize and analyse for a specific purpose.

Depending on this purpose, data processing can involve different operations such as combining different sets of data (aggregation), ensuring that the collected data is relevant and accurate (validation), etc. For example, we can organize our data in a way that exposes relationships between various seemingly disparate and disconnected data points. More specifically, we can analyze the Dow Jones index performance by creating a graph of data points for a particular period of time, based on the data at each day's closing.

By asking relevant questions about 'who', 'what', 'when', 'where', etc., we can derive valuable information from the data and make it more useful for us.

But when we get to the question of 'how', this is what makes the leap from information to

Knowledge

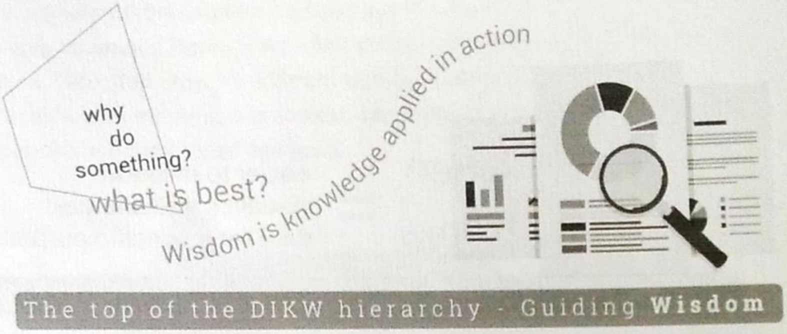


"How" is the information, derived from the collected data, relevant to our goals? "How" are the pieces of this information connected to other pieces to add more meaning and value? And, maybe most importantly, "how" can we apply the information to achieve our goal?

When we don't just view information as a description of collected facts, but also understand how to apply it to achieve our goals, we turn it into knowledge. This knowledge is often the edge that enterprises have over their competitors. As we uncover relationships that are not explicitly stated as information, we get deeper insights that take us higher up the DIKW pyramid.

But only when we use the knowledge and insights gained from the information to take proactive decisions, we can say that we have reached the final – 'wisdom' – step of the Knowledge Pyramid.

Wisdom



Wisdom is the top of the DIKW hierarchy and to get there, we must answer questions such as 'why do something' and 'what is best'. In other words, wisdom is knowledge applied in action.
We can also say that, if data and information are like a look back to the past, knowledge and wisdom are associated with what we do now and what we want to achieve in the future.

- **How Enterprises and Organizations Move Up the Knowledge Pyramid**

One easy and fast way for enterprises to take the steps from data to information to knowledge and wisdom is to use Semantic Technologies such as Linked Data and Semantic Graph Databases. These technologies can create links between disparate and heterogeneous data and infer new knowledge out of existing facts.

Armed with this new knowledge, enterprises can climb up the mountain of wisdom and gain a competitive advantage by supporting their business decisions with data-driven analytics.

People & Computers –

What computers can do better than people

- **AI Does Better In Gaming** —
  The computer science department at Carnegie Mellon University developed an AI named 'Libratus' that won in no-limit Texas Hold 'Em game. What is impressive here is not so much that it won at Poker, but the type of Poker it won. In 120,000 hands, 'Libratus' defeated four Hold 'Em experts in what is known as an "imperfect information" game.

- **AI (potentially) Does Better AI** — (Machines have built machines for a long time)

- **AI Does Better At Providing More Accurate Medical Diagnosis** —
  Ever since the achievements of AI has been the talk out of town, a major focus area for their use has been in medical diagnosis. For example in the field of oncology and diagnosis of cancer, it is challenging for humans to have an absolutely accurate diagnosis. According to research by University Hospitals Birmingham. The delivery of results by AI systems correctly detected a disease state 87% of the time –

compared with 86% for healthcare professionals – and correctly gave the all-clear 93% of the time, compared with 91% for human experts.

More recently, IBM has used Watson's ability to absorb huge volumes of information. That will help them with diagnosing rare illnesses. Some of which most doctors may only see within a few cases in their lifetime. It will help doctors at the Centre for Undiagnosed and Rare Diseases at the University Hospital Marburg, Germany, deal with the thousands of patients referred to them yearly. As well as with the thousands of pages of medical records that are supplied by the patients to be analyzed.

@ **AI Does Better at Transcribing** —

AI can now transcribe audio better than humans. During a test implemented by the National Institute of Standards and Technology, this AI system had an error rate of 5.9%, the same as human transcribers that Microsoft hired. When the test was replicated, it had an error rate of 11.1%. This was almost matching the human score of 11.3%. This shows us that AI leave little room for error in audio transcription and is certainly not any worse than we are.

@ **AI Does Better At Creating Entertainment (than most people)** —

Not long ago, MIDI seemed new and futuristic before it transformed music and pop culture for good. It is not a fantasy that AI does better at making music than us humans. An AI system capable of creating original pieces of art has been developed by a team of scientists. The idea is to make art that is "novel, but not too novel".

What people can do better than computers

@ **Critical Thinking** —

One of the soft skills that humans have that AI does not possess is critical thinking. While technology has advanced to an extent that it can perform tasks with great speed and precision, it is still by far incapable of employing critical thinking. AI is often taught to perform tasks in routine, but it cannot make decisions when faced by eventualities that go beyond what it has learned. For example, a human can improvise or follow gut instinct, but a machine cannot. Consider, for instance, a nurse or doctor who needs to make sense of separate bits of information to determine the best course of action for a patient in a medical emergency.

@ **Strategic Thinking** —

Another competency that gives humans an edge over AI is strategic thinking, which is basically the ability to formulate strategies. Similar to critical thinking, strategic thinking requires a person to be able to make decisions based on analysis of information including their complex relationships to each other. For example, one program can gather a lot data with regard to the consumer preference for a given product while another program can collect the demographic data of buyers, but it takes a human with strategic thinking to synthesize the data to develop a marketing plan for the said product.

@ **Creativity** —

In recent years, AI has advanced enough to be able to produce creative works such as art, music, and even pieces of writing. However, what these works lack is the uniquely human touch. AI can produce creative works only in imitation of input, and it does so without understanding and consciousness. But nothing equals a creative work that?s original, innovative, relatable, and able to capture and express human emotion and the human condition. This is why jobs that require creativity such as those in writing, music, the visual and performing arts, and even engineering and marketing are less likely to be replaced.

- **Empathy and Communication Skills** —

  Another advantage that humans have is their capacity for empathy and their effective communication skills. Humans are able to relate to and understand each other in ways that machines are unlikely to achieve anytime soon, if at all. This is why jobs that require excellent communication skills and empathy are unlikely to be automated. Take for example the way professionals in healthcare, education, social work, and psychology employ a full range of competencies to know how to converse, interact, and respond to their clients. Such jobs are currently irreplaceable.

- **Imagination** —

  Much like creativity, imagination is currently unique to human. As mentioned earlier, AI can only execute tasks that it has learned through input. More advanced AI, meanwhile, can get better in performing more complex tasks. But what AI cannot do right now is to go beyond the parameters of what it has learned.

  Humans, by contrast, can use their imagination to dream up new possibilities. Consider a designer who uses a computer program for renditions. The program quickens and streamlines the process of rendering, but it cannot make stylistic decisions the way the designer can. This is why inventors, thought leaders, entrepreneurs, writers, artists, and visionaries are unlikely to be replaced by robots or computers anytime soon.

- **Psychical Skills** —

  Another ability that gives humans the upper hand is the possession of unique physical skills. This may stem from the fact that humans have great appreciation for exceptional physical skills. After all, there is nothing quite like watching an accomplished ballerina dancing gracefully across the stage or a star athlete running at record speed. Whether these are fine skills such as that of a concert pianist or a brute strength such as that of a weightlifter, extraordinary physical skills will remain an important asset for getting a job in the years to come.

- **Technical Know-How** —

  Finally, technical knowledge is an advantage that humans have over AI. Regardless of their abilities, robots and machines still depend on humans for design and upkeep. Unless these technologies acquire the ability to maintain themselves, humans capable of working on them will remain employable.

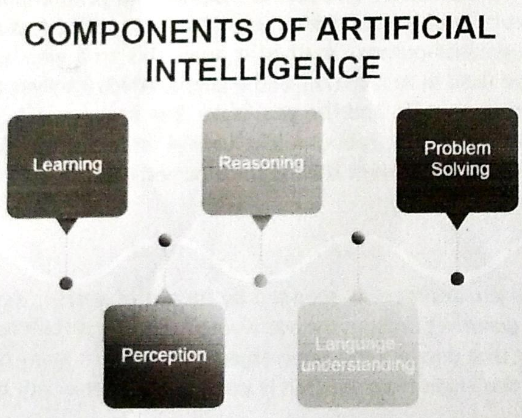
Characteristics of AI Problems

Problem Characteristics

1. Is the problem decomposable?
2. Can solution steps be ignored or undone?
3. Is the universe predictable?
4. Is a good solution absolute or relative?
5. Is the solution a state or a path?
6. What is the role of knowledge?
7. Does the task require interaction with a person?

Problem characteristic	Satisfied	Reason
Is the problem decomposable?	No	One Single solution
Can solution steps be ignored or undone?	Yes	
Is the problem universe predictable?	Yes	Problem Universe is predictable bcz to slove this problem it require only one person .we can predict what will happen in next step
Is a good solution absolute or relative?	absolute	**Absolute solution** , water jug problem may have number of solution , bt once we found one solution,no need to bother about other solution **Bcz it doesn't effect on its cost**
Is the solution a state or a path?	Path	Path to solution
What is the role of knowledge?		lot of knowledge helps to constrain the search for a solution.
Does the task require human-interaction?	Yes	additional assistance is required. Additional assistance, like to get jugs or pump

Components of AI



Learning

Learning is distinguished into a number of different forms. The simplest is learning by trial-and-error. For example, a simple program for solving mate-in-one chess problems might try out moves at random until one is found that achieves mate. The program remembers the successful move and next time the computer is given the same problem it is able to produce the answer immediately. The simple memorising of individual items--solutions to problems, words of vocabulary, etc.--is known as rote learning.

Rote learning is relatively easy to implement on a computer. More challenging is the problem of implementing what is called generalisation. Learning that involves generalisation leaves the learner able to perform better in situations not previously encountered. A program that learns past tenses of regular English verbs by rote will not be able to produce the past tense of e.g. "jump" until presented at least once with "jumped", whereas a program that is able to generalise from examples can learn the "add-ed" rule, and so form the past tense of "jump" in the absence of any previous encounter with this verb. Sophisticated modern techniques enable programs to generalise complex rules from data.

Reasoning

To reason is to draw inferences appropriate to the situation in hand. Inferences are classified as either deductive or inductive. An example of the former is "Fred is either in the museum or the cafe; he isn't in the cafe; so he's in the museum", and of the latter "Previous accidents just like this one have been caused by instrument failure; so probably this one was caused by instrument failure". The difference between the two is that in the deductive case, the truth of the pre-misses guarantees the truth of the conclusion, whereas in the inductive case, the truth of the pre-miss lends support to the conclusion that the accident was caused by instrument failure, but nevertheless further investigation might reveal that, despite the truth of the pre-miss, the conclusion is in fact false.

There has been considerable success in programming computers to draw inferences, especially deductive inferences. However, a program cannot be said to reason simply in virtue of being able to draw inferences. Reasoning involves drawing inferences that are relevant to the task or situation in hand. One of the hardest problems confronting AI is that of giving computers the ability to distinguish the relevant from the irrelevant.

Problem-solving

Problems have the general form: given such-and-such data, find x. A huge variety of types of problem is addressed in AI. Some examples are: finding winning moves in board games; identifying people from their photographs; and planning series of movements that enable a robot to carry out a given task.

Problem-solving methods divide into special-purpose and general-purpose. A special-purpose method is tailor-made for a particular problem, and often exploits very specific features of the situation in which the problem is embedded. A general-purpose method is applicable to a wide range of different problems. One general-purpose technique used in AI is means-end analysis, which involves the step-by-step reduction of the difference between the current state and the goal state. The program selects actions from a list of means--which in the case of, say, a simple robot, might consist of pickup, putdown, moveforward, moveback, moveleft, and moveright--until the current state is transformed into the goal state.

Perception

In perception the environment is scanned by means of various sense-organs, real or artificial, and processes internal to the perceiver analyse the scene into objects and their features and relationships. Analysis is complicated by the fact that one and the same object may present many different appearances on different occasions, depending on the angle from which it is viewed, whether or not parts of it are projecting shadows, and so forth.

At present, artificial perception is sufficiently well advanced to enable a self-controlled car-like device to drive at moderate speeds on the open road, and a mobile robot to roam through a suite of busy offices searching for and clearing away empty soda cans. One of the earliest systems to integrate perception and action was FREDDY, a stationary robot with a moving TV 'eye' and a pincer 'hand' (constructed at Edinburgh University during the period 1966-1973 under the direction of Donald Michie). FREDDY was able to recognise a variety of objects and could be instructed to assemble simple artefacts, such as a toy car, from a random heap of components.

Language-understanding

A language is a system of signs having meaning by convention. Traffic signs, for example, form a mini-language, it being a matter of convention that, for example, the hazard-ahead sign means hazard ahead. This meaning-by-convention that is distinctive of language is very different from what is called natural meaning, exemplified in statements like 'Those clouds mean rain' and 'The fall in pressure means the valve is malfunctioning'.

An important characteristic of full-fledged human languages, such as English, which distinguishes them from, e.g. bird calls and systems of traffic signs, is their *productivity*. A productive language is one that is rich enough to enable an unlimited number of different sentences to be formulated within it.