

**Department of Computer Science**  
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To define AI, let us first try to understand that what is **Intelligence**?

### **1.1 What is Intelligence?**

If you were asked a simple question; how can we define Intelligence? many of you would exactly know what it is but most of you won't exactly be able to define it. Is it something tangible? We all know that it does exist but what actually it is. Some of us will attribute intelligence to living beings and would be of the view that all living species are intelligent. But how about these plants and trees, they are living species but are they also intelligent? So can we say that Intelligence is a trait of some living species? Let us try to understand the phenomena of intelligence by using a few examples. Consider the following image where a mouse is trying to search a maze in order to find its way from the bottom left to the piece of cheese in the top right corner of the image.



This problem can be considered as a common real life problem which we deal with many times in our life, i.e. finding a path, may be to a university, to a friends house, to a market, or in this case to the piece of cheese. The mouse tries various paths as shown by arrows and can reach the cheese by more than one path. In other words the mouse can find more than one solutions to this problem. The mouse was intelligent enough to find a solution to the problem at hand. Hence the ability of problem solving demonstrates intelligence.

Let us consider another problem. Consider the sequence of numbers below: 1, 3, 7, 13, 21, \_\_\_\_

If you were asked to find the next number in the sequence what would be your answer? Just to help you out in the answer let us solve it for you "adding the next even number to the" i.e. if we add 2 to 1 we get 3, then we add 4 to 3 we get 7, then we get 6 to 7 we get 13, then we add 8 to 13 we get 21 and finally if we'll

add 10 to 21 we'll get 31 as the answer. Again answering the question requires a little bit intelligence. The characteristic of intelligence comes in when we try to solve something, we check various ways to solve it, we check different combinations, and many other things to solve different problems. All this thinking, this memory manipulation capability, this numerical processing ability and a lot of other things add to one's intelligence.

All of you have experienced your college life. It was very easy for us to look at the timetable and go to the respective classes to attend them. Not even caring that how that time table was actually developed. In simple cases developing such a timetable is simple. But in cases where we have 100s of students studying in different classes, where we have only a few rooms and limited time to schedule all those classes. This gets tougher and tougher. The person who makes the timetable has to look into all the time schedule, availability of the teachers, availability of the rooms, and many other things to fit all the items correctly within a fixed span of time. He has to look into many expressions and thoughts like "If room A is free AND teacher B is ready to take the class AND the students of the class are not studying any other course at that time" THEN "the class can be scheduled". This is a fairly simple one, things get complex as we add more and more parameters e.g. if we were to consider that teacher B might teach more than one course and he might just prefer to teach in room C and many other things like that. The problem gets more and more complex. We are pretty much sure that none of us had ever realized the complexity through which our teachers go through while developing these schedules for our classes. However, like we know such time tables can be developed. All this information has to reside in the developer's brain. His intelligence helps him to create such a schedule. Hence the ability to think, plan and schedule demonstrate intelligence.

Consider a doctor, he checks many patients daily, diagnoses their disease, gives them medicine and prescribes them behaviours that can help them to get cured. Let us think a little and try to understand that what actually he does. Though checking a patient and diagnosing the disease is much more complex but we'll try to keep our discussion very simple and will intentionally miss out stuff from this discussion. A person goes to doctor, tells him that he is not feeling well. The doctor asks him a few questions to clarify the patient's situation. The doctor takes a few measurements to check the physical status of the person. These measurements might just include the temperature (T), Blood Pressure (BP), Pulse Rate (PR) and things like that. For simplicity let us consider that some doctor only checks these measurements and tries to come up with a diagnosis for the disease. He takes these measurements and based on his previous knowledge he tries to diagnose the disease. His previous knowledge is based on rules like: "If the patient has a high BP and normal T and normal PR then he is not well". "If only the BP is normal then what ever the other measurements may be the person should be healthy", and many such other rules.

The key thing to notice is that by using such rules the doctor might classify a person to be healthy or ill and might as well prescribe different medicines to him using the information observed from the measurements according to his previous knowledge. Diagnosing a disease has many other complex information and observations involved, we have just mentioned a very simple case here. However, the doctor is actually faced with solving a problem of diagnosis having looked at some specific measurements. It is important to consider that a doctor who would

have a better memory to store all this precious knowledge, better ability of retrieving the correct portion of the knowledge for the correct patient will be better able to classify a patient. Hence, telling us that memory and correct and efficient memory and information manipulation also counts towards ones intelligence.

Things are not all that simple. People don't think about problems in the same manner. Let us give you an extremely simple problem. Just tell us about your height. Are you short, medium or tall? An extremely easy question! Well you might just think that you are tall but your friend who is taller than you might say that NO! You are not. The point being that some people might have such a distribution in their mind that people having height around 4ft are short, around 5ft are medium and around 6ft are tall. Others might have this distribution that people having height around 4.5ft are short, around 5.5ft are medium and around 6.5ft are tall. Even having the same measurements different people can get to completely different results as they approach the problem in different fashion. Things can be even more complex when the same person, having observed same measurements solves the same problem in two different ways and reaches different solutions. But we all know that we answer such fuzzy questions very efficiently in our daily lives. Our intelligence actually helps us do this. Hence the ability to tackle ambiguous and fuzzy problems demonstrates intelligence.

Can you recognize a person just by looking at his/her fingerprint? Though we all know that every human has a distinct pattern of his/her fingerprint but just by looking at a fingerprint image a human generally can't just tell that this print must be of person XYZ. On the other hand having distinct fingerprint is really important information as it serves as a unique ID for all the humans in this world. Let us just consider 5 different people and ask a sixth one to have a look at different images of their fingerprints. We ask him to somehow learn the patterns, which make the five prints distinct in some manner. After having seen the images a several times, that sixth person might get to find something that is making the prints distinct. Things like one of them has fewer lines in the print, the other one has sharply curved lines, some might have larger distance between the lines in the print and some might have smaller displacement between the lines and many such features. The point being that after some time, which may be in hours or days or may be even months, that sixth person will be able to look at a new fingerprint of one of those five persons and he might with some degree of accuracy recognize that which one amongst the five does it belong. Only with 5 people the problem was hard to solve. His intelligence helped him to learn the features that distinguish one finger print from the other. Hence the ability to learn and recognize demonstrates intelligence.

Let us give one last thought and then will get to why we have discussed all this. A lot of us regularly watch television. Consider that you switch off the volume of your TV set. If you are watching a VU lecture you will somehow perceive that the person standing in front of you is not singing a song, or anchoring a musical show or playing some sport. So just by observing the sequence of images of the person you are able to perceive meaningful information out of the video. Your intelligence helped you to perceive and understand what was happening on the TV. Hence the ability to understand and perceive demonstrates intelligence.

