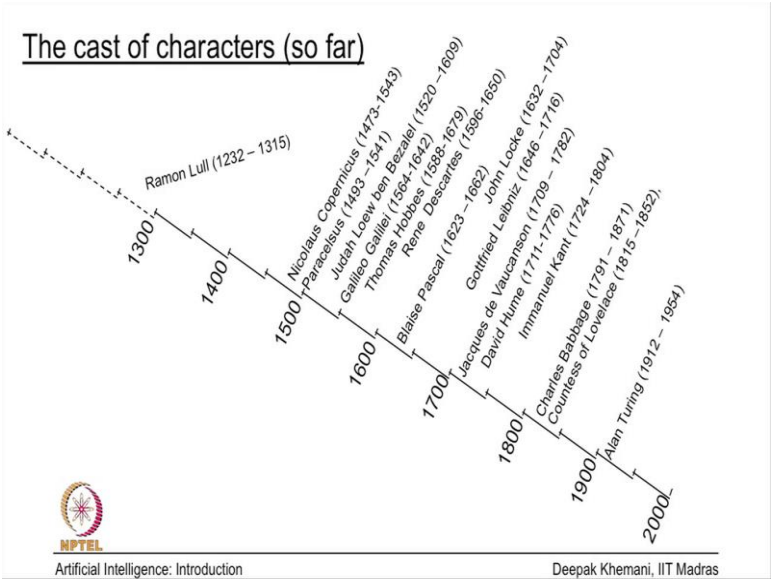
Artificial Intelligence
Prof. Deepak Khemani
Department of Computer Science and Engineering
Indian Institute of Technology, Madras

Lecture - 4
AI Introduction

(Refer Slide Time: 00:25)



We will begin, so we are entering a last lecture of our introduction part. And I do not know whether, you can read the names on the slides. These are the people we have met so far. Starting with Nicolaus Copernicus are even before that Ramon Lull. And host are people including Galileo and Hobbes and Descartes, Pascal. Pascal who said that perception is in our minds. And if is smell, the smell of a rose, then that is a reaction to though partials that are in ((Refer Time: 00:54)) upon our nose. And we are set of pursuing based on that essentially.

So, we saw that there was a stand of listening. Now, this is you can say the pre-history of AI. And you can see, from this diagram that it is about more than 500 years of history. And their two stands to this. And one is said the physical side of trying to make, talking heads, walking statues. And statues, which can you know not their heads and that kind of stuff. The engineering all the physical all the contraction site of it. Because, they was the

believes an it can move autonomously. It must be able to think also essentially.

So, there leap of faith, that one is to make. The others stand was the emergence of the motion of the mind. At some point you know, teachers like us for simply live in a world and see the world. And believe that what we see is what the world is like. But, then along cames somebody like Copernicus. And he said that, you thing at the sun is going around the earth during the day, but that is not what is happening. What is happening is at the earth is rotating. And it creates and elution of the sun going around the earth.

So, the fact it what you see is not necessarily what is out there had already started coming out. And gradually then that the distinction between what we see and what we think started happening. And that some point they cart said there two world out there. One is the world of a mind. And other is the world of the body. And he had this idea of mind what is dualism. Then as we moved along we saw cant for example.

Immanuel Kant one of the most influential philosophers a from Europe, who said that we perceive the world. In terms of a priory knowledge that we have in our heads. And we mold the world at we see into those a priory knowledge structures that we have. Of course, he did not use the term knowledge structure, which we used now a days concepts at we have essentially. And at the same time the mechanical contraptions of becoming more and more sophisticated. They was just duct in trance or a vacancies.

So, some of you saw, BBC every Sunday if you see BBC you get something for this course. So, this last Sunday, BBC showed a news item, in which in the south of France. They have open the museum of all these talking, walking mechanical creatures essentially, which apparently very popular. And you should keep them in shop window to attracts shoppers, then thinks like that. And I could see there, this vacancies duct also amongst the displease. So, they were getting sophisticated.

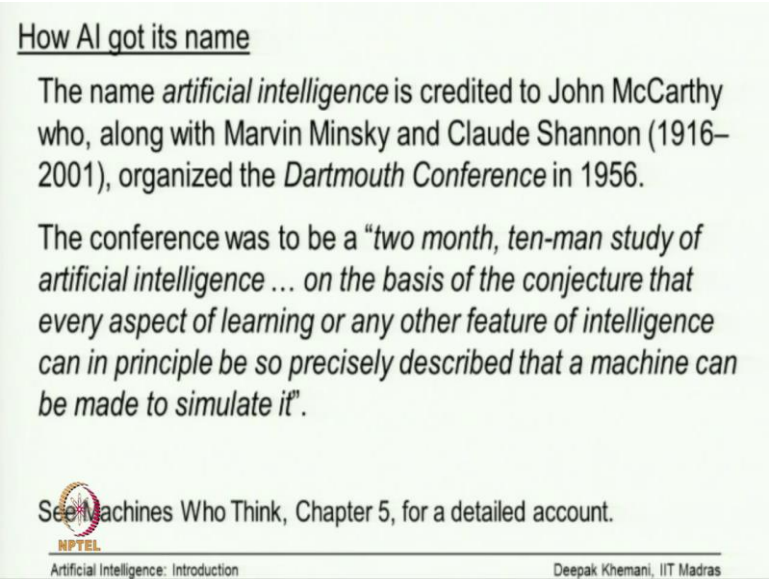
And we see that from, so these two stands the merging together. You know this moving creatures and thinking futures in some sense. So, Pascal for example, we will so those can recognize him here for the fact that he was the first person to invent a calculating machine. Of course, it could only do addition. But, nevertheless it was a calculating

machine, which was set of improve later by lightness into something, which could do more than addition, it could do multiplication and so on.

And it became more and more sophisticated, tell we came to Chales Babbage, who invented a machine which could store of a program. And run the instructions in that program, which is the notion of computers, that we are still working with essentially. We also met Alan Turing, who sort of try to put down this debate on, what is intelligence scan machine things. And that can he propose a Turing test that we saw earlier. He did many other things and we will just have a brief mention on of him later essentially.

So, let me remind you of this definition by hogiland. AI is the quest for building, machines with minds of your own. And we are ask this question, towards the end of the last lectures. So, what are minds, we will come to that question later today, but a little bit later. Before that with less complete the histories. So, we have seen the pre-digital computer hire so far, the mechanical contraptions are people use the bill. How they AI progress after the digital computer came into b, which is just along the time an Alan during was around.

(Refer Slide Time: 05:37)



So, let us first begin with this piece of information is tells us, how did he get this name

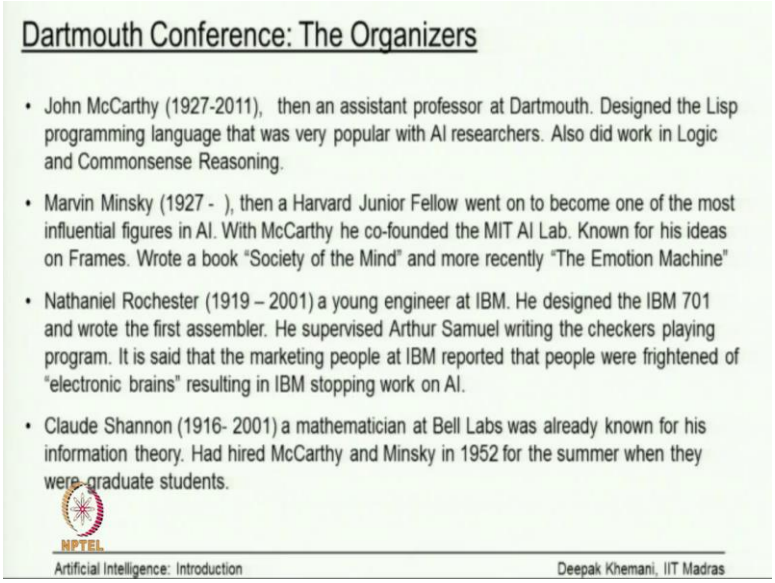
artificial intelligence essentially. And the name was devise by John McCarthy. I think you all know John McCarthy for some form of another. Among other things invent language lisp, which became very popular in AI for many years. So, the name is credited John McCarthy and Marvin Minsky, along with Claude Shannon. Who organized this conference called the Dartmouth confidence in Dartmouth college in 1956; where McCarthy is credited with the having devices name artificially intelligence.

Now, many people have said that, it is name is not a nice name. You should used something like heuristic programming or machine intelligence or something else. But, some of the name as stuck since that time. And we all know this area artificial intelligence. So, hogiland for example, suggest that you could call it synthetic intelligence. So, artificially and he makes with comparison with pearls for example. Now, you have real pearls we have artificial pearls, which have kind of fake essentially.

But, you also have synthetic pearls, which have not fake, but which are pearls in sort of made by humans. So, the conference was organized and it is charter was that if you two months, ten mans study of artificial intelligence. So, name was point there. On the basis of the conjecture that every aspect of learning was or any other future of intelligence can in principle be so precisely described. That a machine can we made to simulated. So, the focus all the emphasis is that when we are talking about intelligent behavior.

It is something, which we can describe up to the Manutius detail. And if you can do that, we can make a machine do with essentially. That was the idea behind that. So, who are the people, who organized this feels see them in the moment. So, for those of you hand residing history. So, we should look at this two books, which I have mention earlier. And this one book all machines for think, that is shown here by ((Refer Time: 07:57)) which describes the full chapter on the Dartmouth conference. And the other book is John hogiland, which is AI the very idea which is the most philosophical side of things. Essentially will come back to that bit later.

(Refer Slide Time: 08:16)



So, who are the organizes of this conference, we have already said that they were John McCarthy, he was then and assistant professor at Dartmouth. And he has done many, many, so these people who have contributed so much to AI in one way or the other that is not easy to list there. What all they are very active people. McCarthy inventor lisp he invented something called situational calculus, which we will may or may not see in this course.

He is also credited with having invented the alpha beta algorithm, which we will see a bit later in this course. And he did lot of work on logic commonsense listening essentially, which will see if you can come to that later. Marvin Minsky the only person of these

whose still alive was a junior fellow at Howard he and McCarthy towards set of the MIT lab AI lab in MIT. And as you will see in the history parts today most of these work in A I was concentrated in a few places in the US and few places in Europe.

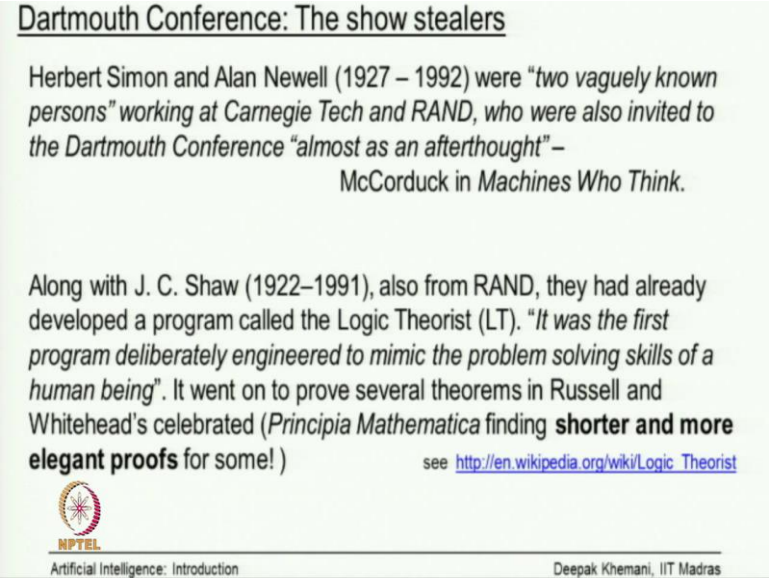
And it is not as a everybody everywhere was working on AI. So, MIT lab was on CMU was another place, stand for another place. And you know a couple of places in Europe essentially. So, Minskye is very well known for his idea on frames, which is a way of structuring knowledge into interconnected components. And it is basically, the for 1 hour for three college object one day programming nowadays essentially. He also wrote a very Influential book also society of mind.

And more recently book all the emotion machine essentially. The somebody have once pointed out dealing over machine, lectures that machines cannot display emotions. So, maybe it should look at that book. Another person there was what is turn, who was the inventor of release at the designer of this IBM 701, which was the best machine around the that time, in work the first assembly of for that machine.

He supervised arsis into writing of program for playing the game of checkers, which you will talk about little bit, which was one of the early successive of AI essentially. Now, I turns out that this Samuels program was a learning program. And Samuels goals for actually learning, he wanted to see how computers could learn. And his program was the program, which became better and better as it late more and more essentially.

And this kind of a generated, a kind of a fear amongst a people that is machines will become smarter than us. More powerful than us and thinks like that, will come back to that point little bit later. When we talk over is checkers program. And finally, Claude Shannon everybody knows Claude Shannon, because of is in information to the end there. He was the person who had hired Minsky and the McCarthy as in terns when they were graduate students. And it is they are that they got this idea of floating together this conference, which would talk about this new feel which was coming of call artificial intelligence.

(Refer Slide Time: 11:33)



But, they was couple of guys, who were in some senses are shows dealers that confidence essentially. So, let us first see, who there were the names we have might have mention before, Herbert Simon and Allen Newell and ((Refer Time: 11:52)) corded says are they that about them the two vaguely known persons working at Carnegie Tech. At that time ((Refer Time: 11:59)) university it later on became CMU.

At that point it was Carnegie Tech and grand, who are also in mighty to the Dartmouth conference ((Refer Time: 12:11)) as an afterthought. And it is these to people, who really creative then big impact at the conference. Because, they had along with J. C. Shaw, who also was that rand, build this return this program call the logic list. It was a logical listening machine, a theorem proving machine. It put prove theorems in mathematics. LT as short it was.

So, this say about this, it was a first program deliberately engineer to mimic the problem solving the skills of a human being essentially. So, Simon and Newell for greatly inference by the way human being solve problem. Because, after all we are sort of existential examples of smart creatures. You know, we set of are thinking creatures if you do not want to call us machines, who operate very effectively in the world. You know, solving problems and getting along and so on.

And he wrote a book, they wrote a book call human problem solving, which became very influential later essentially. Now, this program logic theories, went on to proves several theorems on from ((Refer Time: 13:16)). See, ((Refer Time: 13:17)) had embargoed upon this land exercise of formalizing all knowledge. And this had you know everything that you can do mathematics will put it down piece of paper. There great dream or shattered and 1931 by Kurt Godel, when he came and proved that you cannot become powerful.

You cannot construct powerful enough systems listening system, which are consistence at the same time. So, either you can be very powerful in the sense very expressive, that you can talk about all kinds of things. All you can be consistence, but not both at the same time any should that this is something, which will always followed if you try to will power systems. And as some of might know, his arguments are basically scented around, self-reference and self-negating sentences.

So, sentences like I am lying or the story about this barber, which resilient resolve so worried about that if there is the village, in which the rule is that everywhere, who does not shave himself shaved other barber. Then the question is who shaves the barber essentially. Because, the barber if you shaves himself then he shaving himself and therefore, he cannot shave himself. Also this kind of conundrums comes to self-referentially a sentences and curd ((Refer Time: 14:49)).

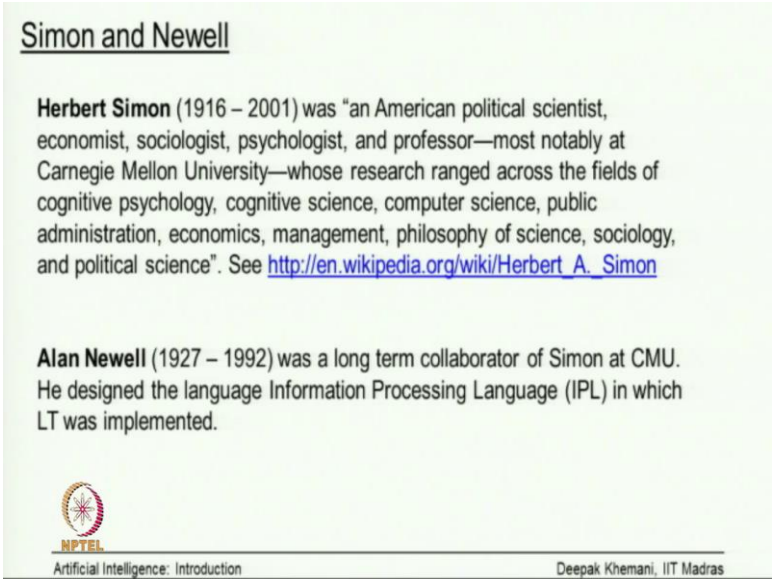
That any formals system, which is expressive enough, will and a become in consistent, which means in our the kind of things of day. And that however, do logics are never going to be consistent. And complete at the same time will come to this versions as some letter point of time. But, the simpler logic or first order logic are predicate logic is good enough for us. And first order logic can be seen into capture everything appear doing in programming essentially.

So, our programs can whatever, we can express in programs we can do consistently in some sense. Now, this program LT produce some shorter and more elegant proves that were present in this principia mathematical. This is a book barbers Russell and Whitehead's. And apparently, so this story goes I do not know well it is true or not. But,

apparently the journal of symbolic logic or journal of logic or something, refuse except people.

Because, it is the authored by computer program, co authored by computer program. I do not know whether, stories true a not, but you can find it in some places essentially.

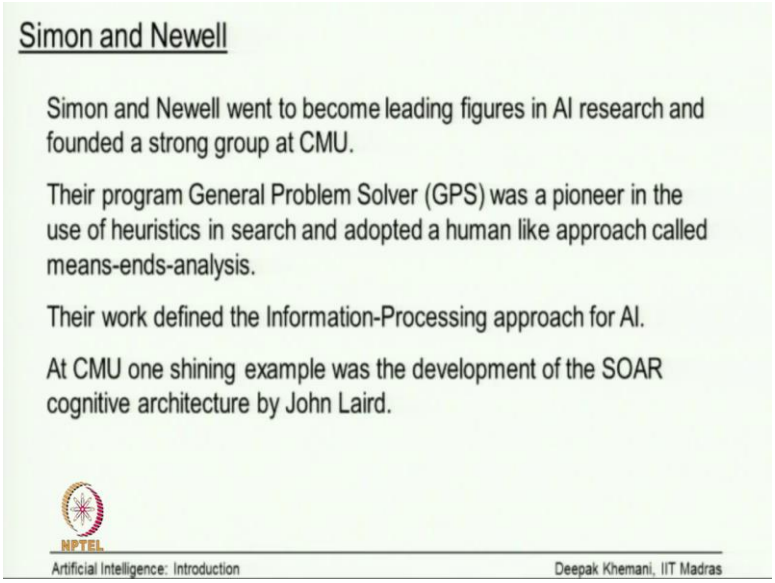
(Refer Slide Time: 16:03)



So, let us first talk a little bit about Simon and Newell. A Simon was a multi faceted person as you can see, from this court from Wikipedia. He was a political scientist economist, sociologist, psychologist and a professor mostly at CMU who's research range across all these fields cognitive psychology, cognitive science, computer science public administration economics and so on and so forth. He went on get a Nobel Prize in economics.

And his long time associate was Allen Newell about 10 years is junior. And they did a lot of collaborative work together essential. So, Allen Newell created this language for IPL, in which LT was implemented.

(Refer Slide Time: 16:40)

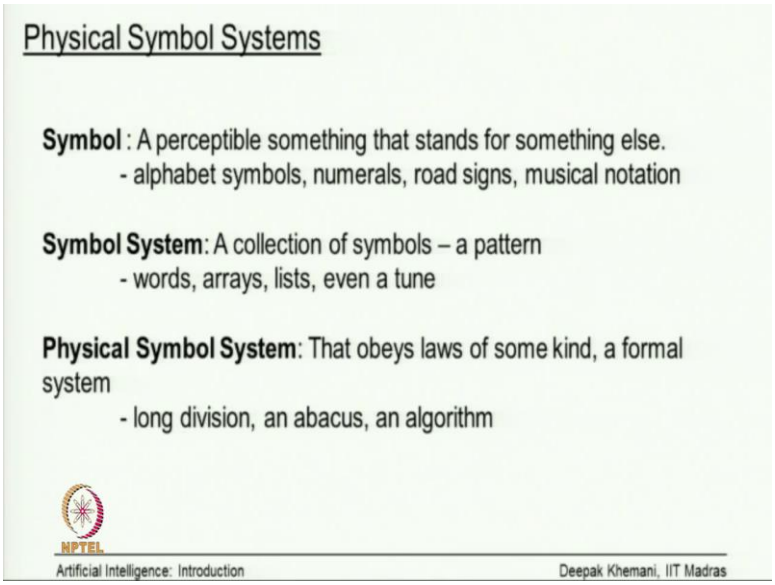


Some little bit more on them, because they give us something which we base our work on. So, they became reading figures at CMU. And they wrote this program for general problems, which is based on even problem solving. And how human beings use heuristics solve problem. And we will visit this general problem solve a idea, this idea of means on analysis, which is the heuristic that views. We will see that sometime needs in the courts essentially.

Their work also brought to focus a information processing approach to A I, which means at you are talking about, that if you all the create intelligence system. It is enough to do information processing. As approach to this others stand of effort, which was to say that will bill system form bottom of will put together components, which make intelligence systems and so on and eventually they will come intelligence. He said not we do not have to do that.

You can work are they information level was A I some people call as a knowledge level; and bell in the legend systems essentially. And one of things which came out of CMU, one of the many things which came out CMU was this cognitive architecture call so or which you can even or download and use to bill a good application. So, one all the things a talked about was this architecture for AI what you neat for AI.

(Refer Slide Time: 18:11)

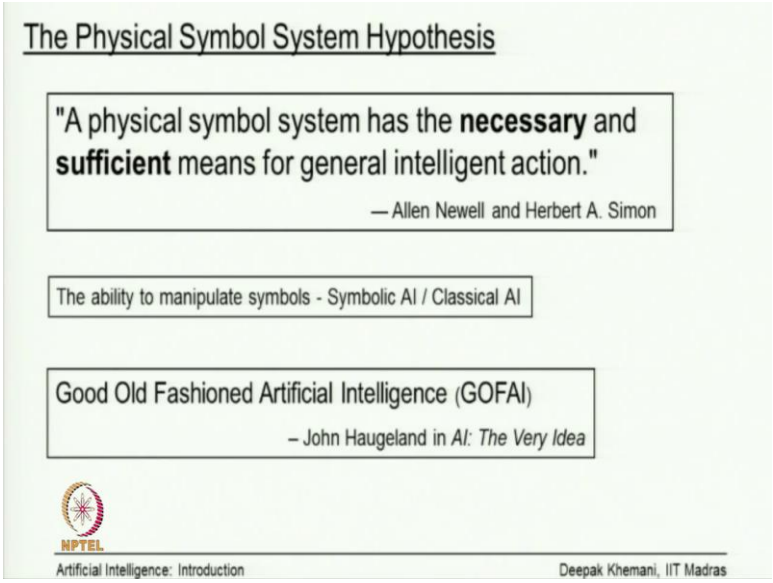


So, you have this idea of the physical symbol systems. And a symbol is something for as we I concern, a perceptible something which stand for something else. So, a symbol stand for something else. If you write the numeral seven, it stand for the number seven. Of course, it is not the number 7, it just stands for the number 7. We could have in different script, we could have written it differently. A symbol system is a collection of symbols.

So, for example, a data structure or English language would or he one musical tune essentially. So, you put them together you have a symbol system. So, you have alphabet, which is made of symbols and then you put together things of alphabet and he have a symbol system. And physical symbol is something which obeys laws which have like the laws of physics. So, in some sense, if you can men ably if then using well define laws, how rules then they are physical in that sense they are physical.

In the sense they can be manipulating apparently this law. So, anything you can use algorithms or so the procedure for long division for example and so on and so forth.

(Refer Slide Time: 19:15)



The important statement that they maid is known as the physical symbol system hypothesis. It says there the physical symbol system as a necessary and sufficient means to generate intelligent action. So, what they are saying, that earlier need in our terminology, earlier need to bill intelligent systems is the ability to create did the structures. And right algorithm which will operator from the data structures. You deal nothing else essentially. That is the basic infrastructure you need.

So, unlike for example, roger pen was who feels set the human mind, a human brain has some kind of physics, which is going on which we cannot replicate reset nothing of the slot. If you can do information processing which means, if you can operate on symbol systems using well define algorithms you can create intelligent behavior. So, this is known as the ability symbolic AI of classical AI. Classical AI follows this principle that, it is a top down design approach to build in intelligence system.

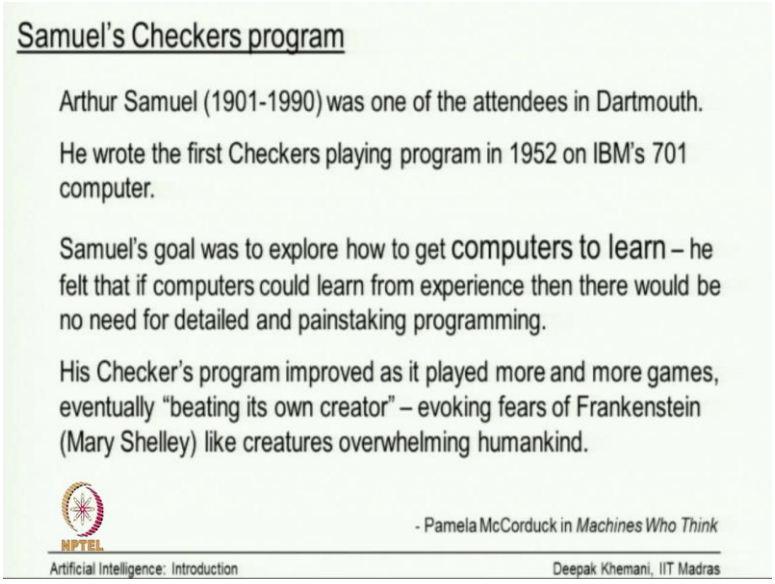
So, that you will create your data structure and you would like algorithm and you will producer intelligence systems. Ours Haugeland calls it good faction AI essentially. So, as a first symbolic classical AI, we have a sometimes he call a sub symbolic systems or signal level systems. Systems like human brain, which operate settle level where information is not and coded into symbol. So, if you look at a neural network for

example. It is made of many nods and many edges collecting nodes.

And edges have values, which are numbers essentially all weights as we call them. And everything, that the Newell is encoded in terms of those weight essentially. For the weight itself does not stands for anything. It was a mean anything to us. In that sense, it is not a symbol. A symbol should stand for a something, where as if a writer a let us say, program in which variable call x, which stands for let us say the distance from plays a to plays b.

Then it is some it is a symbol. Because, it is stamp for something. So, symbolic AI or classical AI concern with explicit representation. And I will go with them for working on representations.

(Refer Slide Time: 21:35)



And that is what we a perusing here. So, we have mention this Samuel's Checkers program he was also one of the participant in this Dartmouth conference. And he is contribution was this program to play checkers. And he wrote it in this IBM 701 perusing. And as a bit earlier his goal was so explode learning for computers. His idea was at if computers could learn. Then they would be known need to do all this pain trekking programming.

And when he says programming in the pain trekking passion, he really means that. Because, in those days be did not have this whole set of high level language is that you are so comfortable, which nowadays a you had somely language. And maybe you, I am not sure whether even four time was devise at the time. List was devise a little bit later then the dark mouth conference. So, programming was very pain sticking in those days.

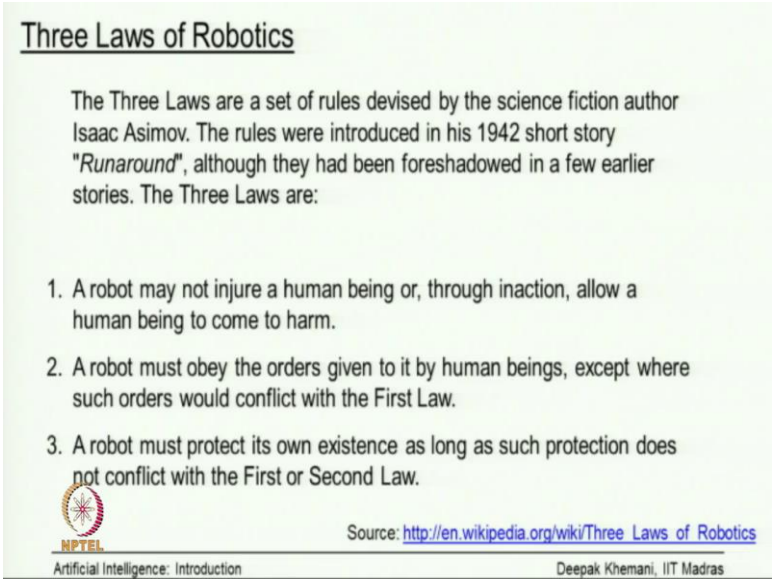
And Samuel said that, if you can make the machines learn then below have you program them essentially. And you know that so fascinating. So, the active idea, that you will some system and little learn and become efficient. And of course, we have a thriving machine learning community ((Refer Time: 22:49)). So, his checkers program Samuel was not great checkers clear. He was a computer scientist. But, story goes that he wrote this program the program became better and better and better.

And eventually beep it is own creators as be sick. You know this around the time. when Babbage was constructing is machine. And we have mention the his collaborator either contuse of loveless, who was the daughter of Lord Byron. And Lord Byron have this ((Refer Time: 23:30)) peter shell end. And peter shell is a may be wife was may be shell he, who wrote this novel call Frankenstein.

And this novel I do not know ((Refer Time: 23:42)) it is about a artificial creature, you know people were fractionated the artificial creatures. So, this novel about this artificial future creature call vector Frankenstein who was made by doctor. And eventually, became like a monster, who would you known destroy is the doctors essentially. So, that whole idea, that this machine would becomes smart and you know whole power us and kill us have always been around for a long time. So, you have seen the movie matrix.

So, that is one of the films and will come to matrix again later for different reason, so quite an interesting film. But, one of the I thinks in matrix is that this machines have Clint to control human spices essentially. So, you do not always realize it when you was things it film.

(Refer Slide Time: 24:36)



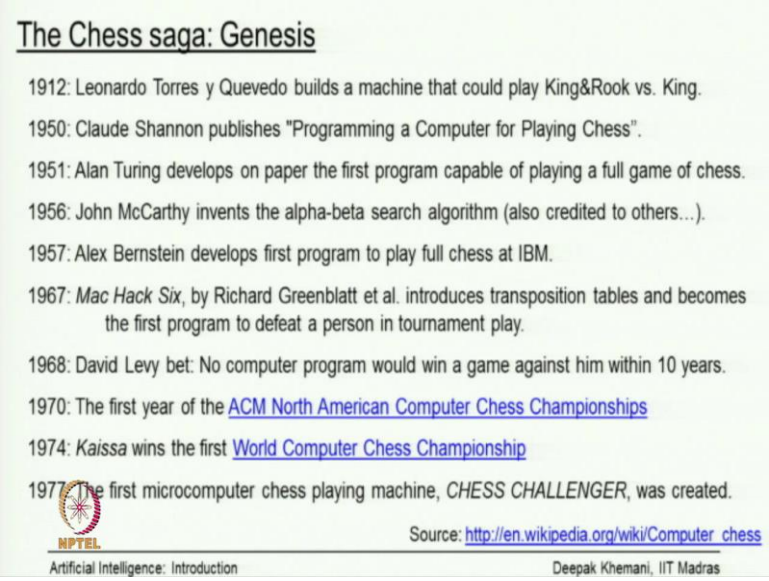
So, in 1940 sometime, I Isaac as Asimov who was the science fiction writers. He introduce the so called laws of robotics, which we can many popular. It took the fancy of all the people around. He wrote it as part of a slot story called run around, which he wrote in 1942. So, they are the three laws that Isaac of Asimov said. So, lose in the sense that, not like Newton's laws, which we discover that the physical world is the obeying.

But, mould like a laws at human beings make you know, well legislation by the parliament and so on essentially. So, for example, our parliament is necking a law that. They cannot come under RTI essentially, so this kind of laws essentially. So, his law was basically this three laws that the lowert will not injure a human being. That is the first law. You know protecting the human spices. Do a robot must always we built in such a fashion that never harm human being essentially.

Secondly, if will obey human beings at all times. Unless it voyages rule 1, so if I build the robot an I tell it to harm another person then the robot should not obey too. And thirdly, it must protect this old existence, as long it does not by late the first two laws. So, it is you know all this is they in the popular imagination, because people are worried about machines over taking human beings. Already for 4 500 years we looking at talking moving heads, which they think are thinking.

So, chess as we know, for many reasons has been fractionation for computer scientist for ever since a computers go invented.

(Refer Slide Time: 26:29)



So, let us look at the quick history of chess first. And then we look at a History of the rest of the computing world. Before, we come back to the question of what a minds and so on. So, you see all these name safe. And all this materials been taking by taking from Wikipedia. So, you just at ago to Wikipedia at computer chess in you will see this time line or part of this time line. So, clot channel first wrote a paper called programming a computer for playing chess.

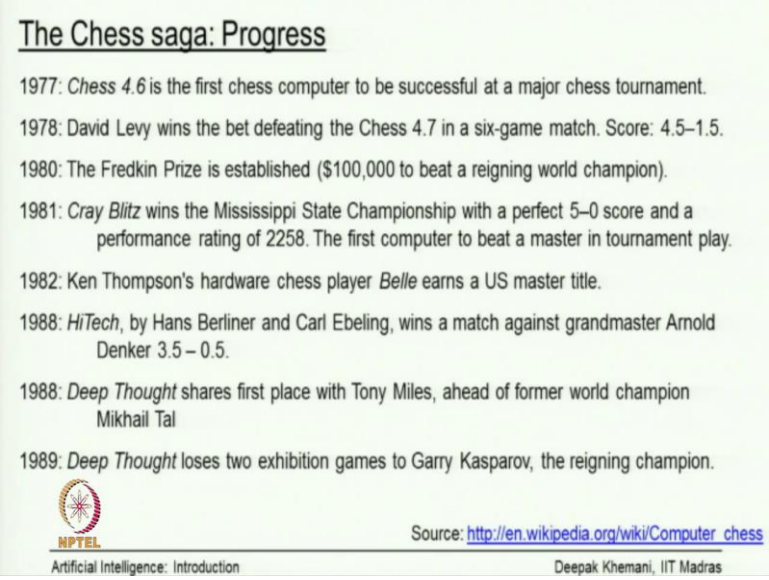
To will in developed up on paper and algorithm for doing it. McCarthy invented the alpha beta I will go with them that we will study. But, other people also set a have invented a including a Samuel essentially. Bernstein Alex once and who work then IBM was the person to who wrote the first actual program, which could play chess. Complete program a, who could which could play a complete game of chess.

Then program for Mack hack 6 by beam let was first program should defeat a person in tournament plays essentially. And we are already mention David levy, who made this bet in 1968 that no machine can him in 10 years. And it 2008 the wrote this book call love

and sex with robot essentiality. I when he is swan from one end of capability of machine intelligent to the other end. That they could be like human companions to us.

In 1970 the American computer chess championship started. In 1974 a program call case of from somewhere in the USS of won the first ((Refer Time: 28:11)) chess championships and the small micro computers subject playing chess in 1977.

(Refer Slide Time: 28:19)



So, that was a initial years then in the latest 70 is the started making progress. So, program call chess 4.6 well in the major chest tournament. 1978 David levy one his that defending a program call 4.7. In 1980 of Fred kin price was institute it 100, 000 dollar in 1980 was quiet the bit of women if a beating of reigning world champion, program call create it is. Now, creave was the you know super computer, which of deal by same ((Refer Time: 28:59)).

And they was the fastest for seems for a very long period of time the best and the fastest machine for create a machines. And create blitz all the program running on those machine. So, it when is the championship with the score of 5-0, which means it one all the games. If the performance rating for those of your family with chess rating 2258, which is the quite good. And it was a first program to be the human master. Along that

time people certain it investing in special purpose hardware to play chess essentially.

So, for example, a high tech mutual also developed on this time in 1988 ((Refer Time: 29:38)) had 64 processors. One processer dedicated for each where of the chess board. And that, kind of think. So, Ken Thomson had a hardware chess. So, people where investing more and more hardware. And the same time, so then a program call deep thought. Share the first place with Tony Miles a head of the former was champion, not the reigning world champion Mikhail Tal. So, deep thought is a name, which does it ring the bell for anyone.

Student: ((Refer Time: 30:15))

He ((Refer Time: 30:17)) to the galaxy. So, when as been taken from there, it lost two games to galicasple of 1989.

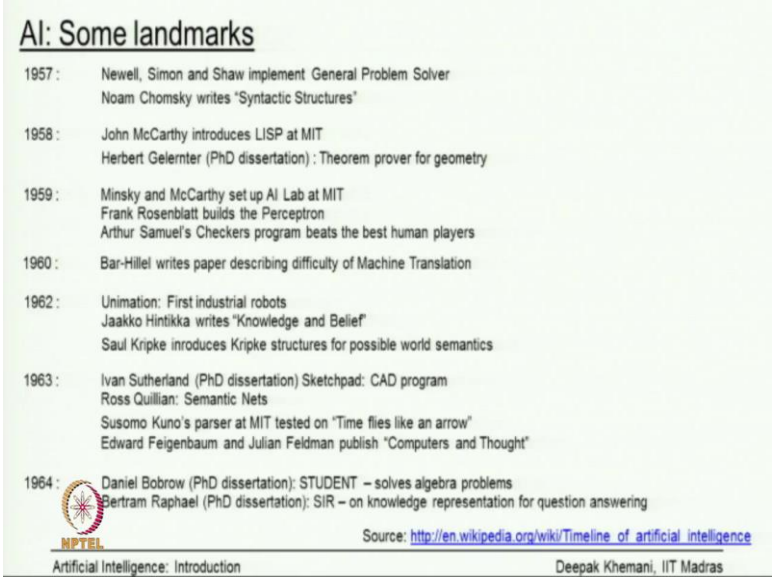
(Refer Slide Time: 30:28)

And after that, the years of tram for the machine. In 1992 a micro computers program one a computer chess championship playing against mean free in some super computers. A program call chess Genius actually, defeated cast ((Refer Time: 30:46)) game. In 1996 are program call deep loop, which was also developed at IBM lost to cast Kasparov of at

a 1997 it beet Kasparov when a 16 match. And it is creators a inventors or actually awarded the Fred kin Price at ((Refer Time: 31:05)) mention sometime ago.

Then after was it was a series of losses for the human players Kramnik do an 8 games of program call deep flits. Then program call hydra beet Adams 5.5 is to 0.5 which means Adams could only do one game. Then Kramnik lost two deep fritz later. And nowadays, it is routine for the human players including Vishwanathan Anandh from India to contently take help from machines, while preparing their own chest playing strategies. So, here we have a mention in 2010 Topalov prepares by sparring against super computer Blue Gene essentially.

(Refer Slide Time: 32:10)



So, let us move on to general AI and look at what is happened since the dark mouth conference. Before we come back to the main question again essentially. So, just quickly done through some of these things. We already mention the general problems solved by a Simon and Newell. Then known book on syntactic structure, which was very influential in natural languages ((Refer Time: 32:40)). McCarthy introduces list ((Refer Time: 32:47)) wrote a program for ((Refer Time: 32:51)) theorems in geometry.

This was a part of PhD ((Refer Time: 32:54)). So, you will see a list of people whose

PhD works appears in land marks in A I. So, which is a kind of a motivation for some of the PhD students setting here essentially. So, Minsky and McCarthy set of A I lab in 59 ((Refer Time: 33:10)) build us percept on. The percept was the single layout Newell network, which had this learning capacity. So, that Newell networks was program, which have basically pursuing this idea of learning. You are training as he call it.

You show system of sequence of pattern a little learn to recognize that pattern. Samuels programs beat the best players. People also started talking about machine translation along that time. But, one of the early ((Refer Time: 33:38)) set that machine translation is not something that we can do so easily, which is actually quite rule. In this early 60's the first industrial lower started coming indica wrote his influential book on knowledge and belief, which talks about how can you formal the reason about what people you know.

So, I know that, you know that something you know this kind of kripke. ((Refer Time: 34:08)) introduced a formal model for this kind of reasoning call kripke structures. There was progress in a cad so other land million wrote the program semantic nets. You knows parcel on MIT was tested with this very well known sentence time flies like an arrow essentially. So, I would earlier to look at this sentence and try to parse it. Now, the thing about our summons is that we always ((Refer Time: 34:42)) to one parts of this sentence.

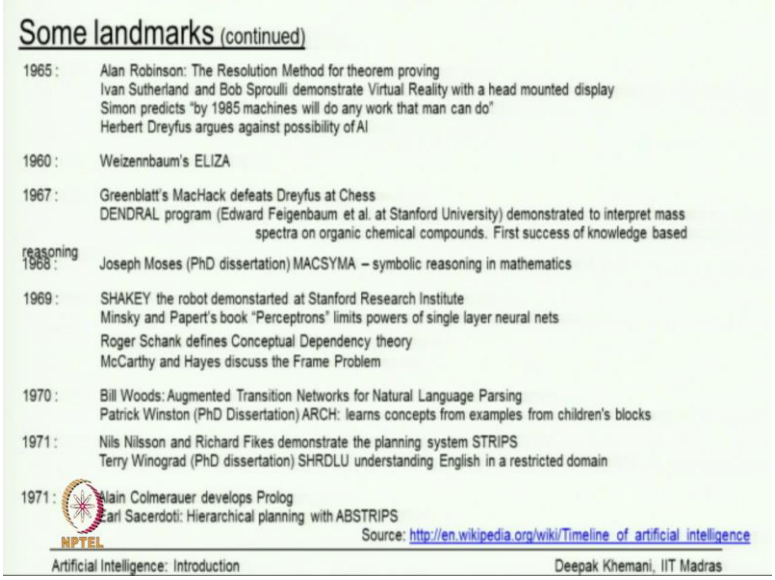
Because, we are like and said pre dispose to certain ideas award this world essentially. So, well we here a sentence like time files like an arrow. We do not even thing that it could have any other meaning then that time is going fast very quickly essentially. But, for a machines, which is not biased by h p dispose ideas there could be other meaning as well. So, this is the an ambiguous sentence. If you look at it from the fundamental point of view, it could have other meanings and worlds could have a other meanings.

So, one of the problems in natural language processing is that our language is so rich. That we can say, the same thing in many different ways. But, also conversely something we say can have many different meaning essentially you know. With you of course, were useful for politicians, because a say something and then they say that this, what a meant out of corteges store something like that essentially. So, this sentence time flies like an arrow. I would early to look at other meanings.

So, a look up the web and a try to see, what other past structures. So, when he say passed we mean you know subject, object and you know known face work frees and this kind of essentially. So, it is time adjective is it a verb. You can look at some of those option essentially. A very influential book all computers and thought by ((Refer Time: 36:23)) around that time. They were programs to do in a we saw program for geometry.

Then we saw program for algebra by ((Refer Time: 36:32)) a program to answer questions for people. You can put all this things together and build the system, which can you know.

((Refer Slide Time: 36:40))



Teeth somebody let us algebra or geometry or something like that. In 65 Allen Robinson introduce is varies this facets call the resolution method for theorem proving which revolutionize is whole idea of theorem proving. By theorem proving we mean the kind of seen that LT was doing logic theories was doing. That given a set of axioms. So, given a set of flimsies what are the things that you can proved from their essentially.

And there was other developments Herbert Simon predicted in 1965 that by 1985 machines will do any work that man can do essentially. You optimistic people, we have seen then Allen Turing also said that by 2000 the during test would be past essentially.

None of that has really happen. So, at the same time Herbert refers argues against, ((Refer Time: 37:39)) we have seen Eliza earlier in 1967 refers to a beaten by a chess program at chess.

Also there was this program call Dendron which was one of the early successive of A I we could do chemical analysis for us. So, we will not going to the details now, but later on in the course we will see what Dendron died. But, it was it officiate as the level often expert came is. Then mosses it is work on symbolic reasoning in A I, which is also common essentially. That everybody uses some symbolic integration passages you know mat lab, maxima and all these kind of packages.

Shaky the first robot appear then SRI's stand for research instituted. Minsky and paper wrote this book on perceptions. We mention perceptions they have single they have neutron. What minsky and paper should in 1969 was that perception was limited to recognizing only certain kinds of patterns essentially. And a kind of patterns at a person from problem could recognized was pattern at for linearly separable, which means that if you what the plot them in some space.

Let us a two dimensional of three dimensional space, a let us a two dimensional space. Then you goes draw straight line, which would say a one side of the line is class a and the other side of the line is class b. So, such patterns have call linearly separable patterns. And what minsky and papered show would was a that is all perception could do. And it is said, that this skilled the research in Newell quite a wild. It was not a till the mid 80's. The people started getting interested in Newell network again.

That is when they realize at multi laid Newell networks. Have do not have this limitation. That they are not limit it to finding only linier separates. So, about that is what happen in 69 essentially. So, shrank talked about is contextual dependency theory. McCarthy talked about the frame problem essentially. The frame problem says, the refiar representing about of wall. And if you a reasoning about change in the world. How do you figure out what is not change essentially.

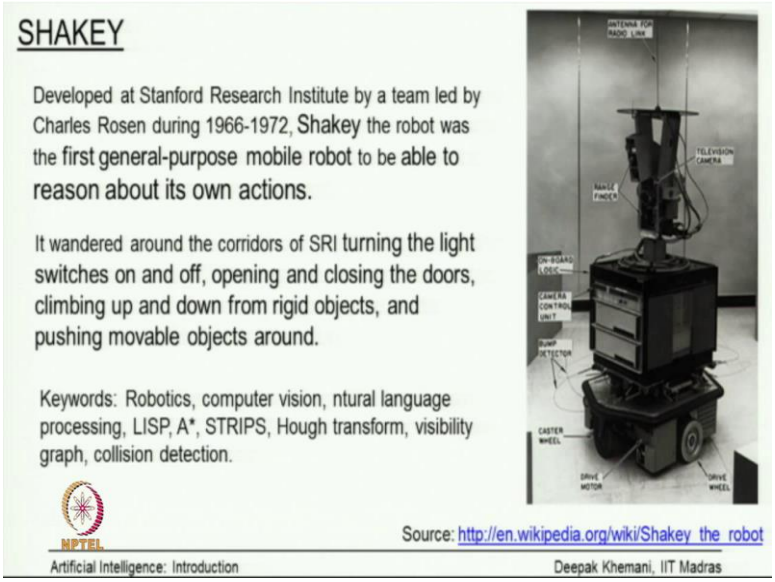
So, if something was true, if may I watch laying on the table here. And I look that side

for a few minutes. And then a look at this again is a watch still there of course, I can see it is still there. But, in the reason system after sometime after 2 hours will the watch still be there. Of course, they have a different example log out a loaded gun, if you will not get into right now. So, let me say, what was other staff so Nilsson and fikes demonstrated this planning system call strips. We will see, a strips later in this course.

And wino grad wrote the program call ((Refer Time: 40:46)), which could do lateral language conversation in a well limited domain, the domain of blocks world. So, it could converse with a person taking instructions and do things. So, he should look of on the net. And you probably get a sample conversation. So, you can say things like pickup the green block and put it down talk of the red one. And it could do that. Understand what you saying and do that.

In the sense, it would generate a plan for doing that essentially quite interesting. Along that time this language for log was device by is French pan ((Refer Time: 41:20)). And some more work on planning for example, apps strips essentially.

(Refer Slide Time: 41:23)

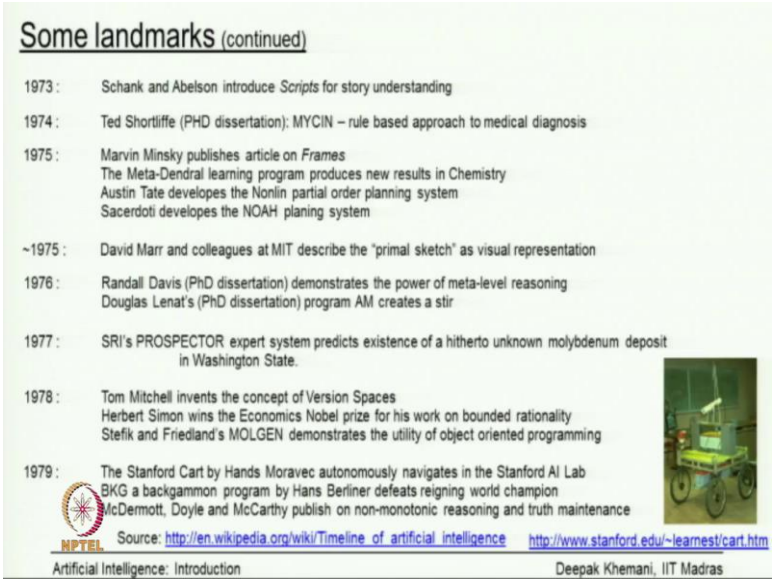


So, here the picture of shakey. This was the first autonomous robot that was built, which could take it is own decisions. So, it could one the a one coli does of SRI, which as stand

for research institute. And do some limited things like a open dose and plug itself or getting charge then things like that essentially. And so standard was another hotspot of a activity people like Nilsson and many others there. And some of the name set we associate with a shakeys lisp came by McCarthy.

But, as go with them like is a star and strips and visibility graph and collision detection they were all discussed at time put.

(Refer Slide Time: 42:12)



So, let us move on, so and early 70's. Schank and Abelson introduce idea of a script. This is if you on to understand remember this cant says that we perceive the world in terms of predefined a priory that is he call them. What are those a priories. Schank and Abelson say, that these are like script. So, it is like a movie script. That, you always follow a script when you have acting. So, if you so that the standard example that the used was rest a gone essentially.

If you go to a rest around you a essentially following a script. That this is how typically things are so if you here so the about somebody going to rest around. Then you can understand the story, if you have the script in your head essentially. So, that is the idea of scripts. We already ((Refer Time: 43:08)) Dendron another success was mission. It was

the rule based what people called as expert systems. And the 80's was the time and people wanted to bill lots of expert systems.

By expert systems they meant a system, which will capture the knowledge of an expert typically, in a roof form we will see this later in the course. And performer to expert level essentially. So, minimal the program, which this medical diagnose. Minsky wrote about this names a advance version of Dendron called ((Refer Time: 43:42)) had some learning capabilities. There were some more planning systems. There is more work on visual representation.

The power of metal level reasoning for example, Randall Davis we see a another PhD ((Refer Time: 43:59)) program call A M, A M stood for applied mathematician. Created quite it staff, when it was first published essentially. So, if you look at some those papers, which talk about A M. It was the program, which len it claimed was doing mathematical discovery. That you give it basic concepts and little learn you thinks. So, concepts like prime numbers, the concept of prime number.

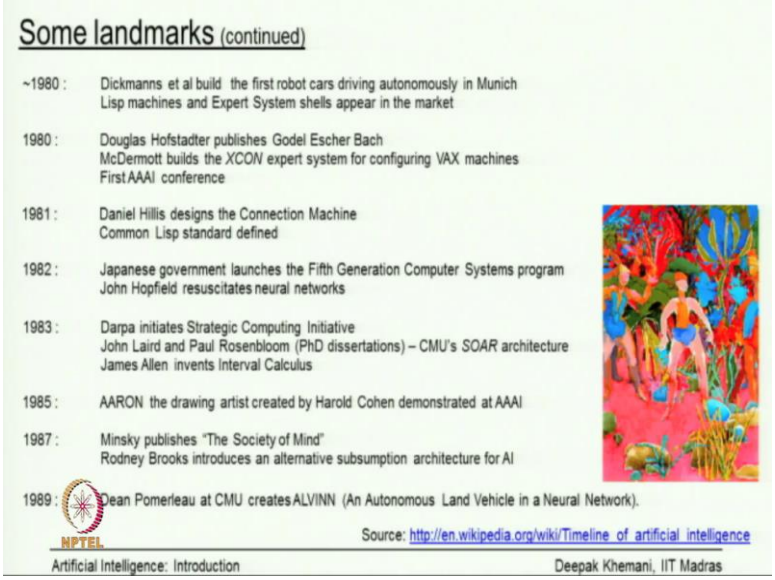
Not in algorithm to find prime or something. What is the notion that some there something call prime numbers len at claimed his program could learn. And essentiality, his thing was at it forward the heuristic that go towards the extremes of certain kind. And one extreme is that number of devices pattern number can have. So, one extreme is two essentially. You cannot have less than two devices except you know one and itself counting one and itself. So, the smallest number is 2, so those numbers are interesting.

So, len it claimed that his program was doing that, but has it often happens, if will discover that the lot of things for set of encoded into his learning program itself essentially. So, that something that we have to be very about essentially. Now, we write a program and we put in our knowledge some of which in embedded into the program. And then we say this system is discovered that knowledge.

So, it talking about experts systems the system called prospector, which was built at the SRI for prospecting the natural world. Found some unknown deposits of ((Refer Time: 45:39)) in Washington state. So, Mitchell events the concept of version spaces and so on

and so forth, which scripts some of these things.

(Refer Slide Time: 45:55)



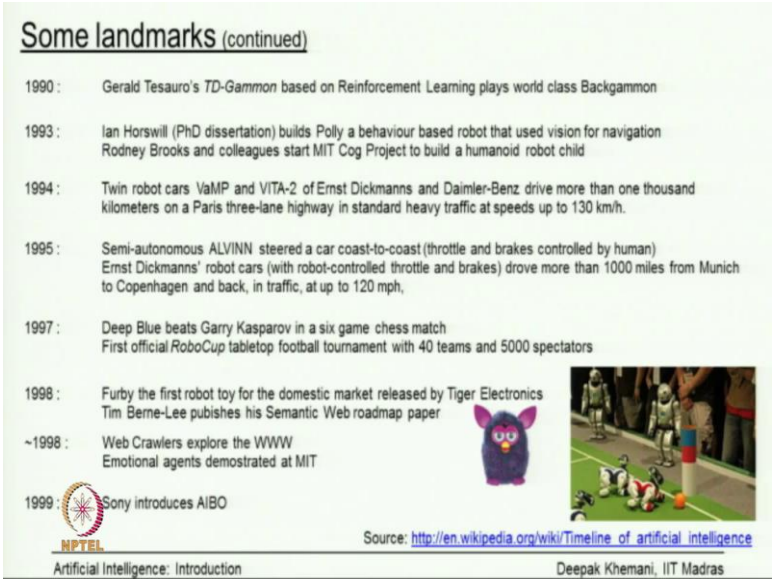
And so you can them from the slides often the Wikipedia page essentially. I want to point out the some of this, newer things, which were happening. So, one new thing we was happening around this time was autonomous vocals essentially. Can you have a car which will drive it selves. So, arise earlier 1980's people were building car it should navigate themselves on the road so in unique. The first car was done, then experts system self started appearing in a market.

Another expert system call expand for configuring vat system so was developed. The triple A I conference that A I conference started series started. In this design the connection machine, which was maid suppose to be machine of thousands of processes connected together little bit like our own brains are simple processing units connected together. So, one interesting thing was this program call Aaron develop by professor Harold Cohen whose still around, which could make drawing.

So, this drawing it is see there, painting that we see there is been created by a program. And when you say created, you mean visualized and drawn. It is not somebody has told the program draw man or something. The system has drawn this whole thing itself. And

if you look up Aaron on the web you will see a whole gallery of his spin, it is paintings so essentially. As she had try to get Allen to draw the cover for my book. But, professor co inside that know it not active any longer.

(Refer Slide Time: 47:39)



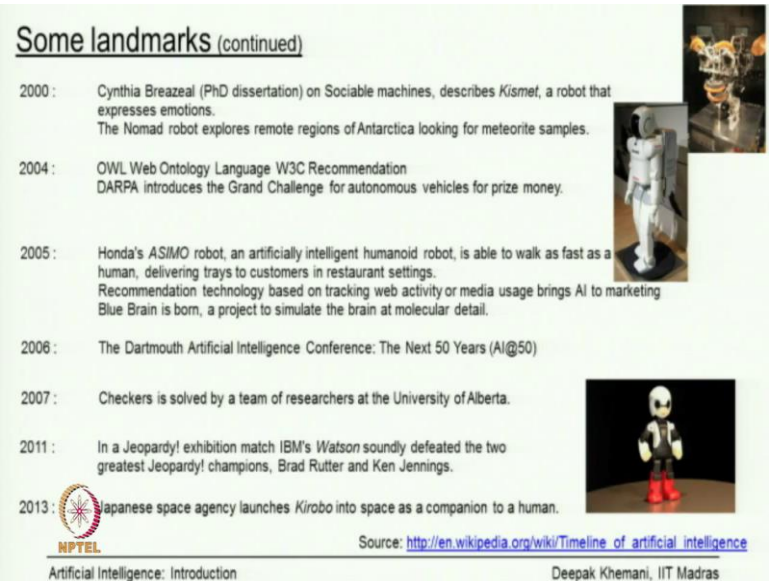
So, some of work and 1990 this program called TD gammon, which played the game of bargeman using this technique call wean forcemeat learning, in the course learning right now in the department. Beat the became the world champion in wage man essentially. So, what tells is, so way these to robot cars in 94, 95, if you look at 94, 95 we have descriptions of robot, robotic cars which can navigate themselves. So, here this car, which one men from munic to coo pen Hagen and came back all by itself essentially.

You driving, breaking, accelerating, avoiding vehicles and so on and so forth. And this already seen that 97 deep blue beat kasparov. The Robocop to an aments started is a football tournament for robots. Robotic toys like this furby that you see there. The tiger electronics came into picture. So, these a toys, which could furby apparently could learn your language, you could teach it how to speak this thing. Sony introduced this AIBO, AIBO is that small dog like robot that you can see in the picture on the bottom right.

So, there these to small dog like futures. They are these Sony AIBO robots, which

became very powerful of. In this picture they are participating the Robocop football tournament. So, you can see an orange colored boll. They and you can see some different proof humanity robots hanging around in the side line.

(Refer Slide Time: 49:26)



So, you see this picture, it is robot call kismet. Another PhD dissertation from MIT. A robot that expresses emotion. So, again if you go the web and look for kismachivels see videos of Sethia talking to this robot and robots smiling and you know, making all kind of human express human like expressions in the system. The language ((Refer Time: 49:55)) web ontology language was standardized. A darpa introduce the grand challenge in prize money.

Honda produce this robot call asimo is you can see, the small nee length robot which could work around at human piece. So, it is not the easy problem to make up two legged creature walk keep it is balance and walk and thinks like that. And that became very popular. Recommendation systems started coming into play like amazons recommendations if you go to Amazon or flip kart. And you look at the book, little all immediately make some recommendation see you the people bought this as well thinks like that.

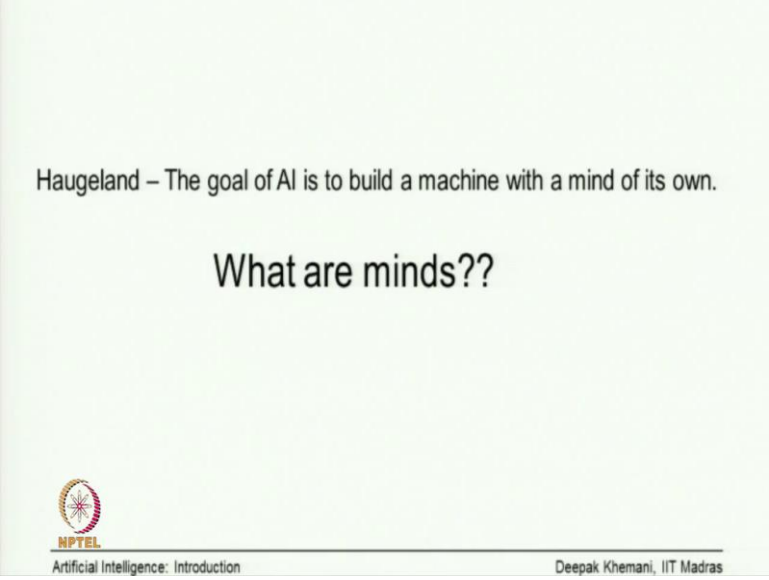
Collaborative filtering for those of you attendant none stoke yesterday. He talked about collaborate of filtering recommendation systems. When they was another dark mouth conference in 2006 with said what is A I going to be the next 50 years essentially. Checkers the game of checkers was slot. What do you mean by slot? Just as by solved mean that if both the place are playing perfectly we can tell you what the outcome will be essentially.

So, we can do that for things like, smaller games like cross and notes. A ticktack to as it is called. But, for checkers it was done quite recently using expensive computing essentially. So, we know that checkers is the drawn game. Or maybe it is a wind provided do not know. Then much more recently ideas program call Watson, which participated in this game call jeopardy, which look upon the wave deeds the world champions at this game essentially.

So, jeopardy is the program, which in which we need lot of general knowledge, geographic knowledge and thinks like that. So, this program add axis to all this knowledge and it could ((Refer Time: 52:01)) game better than human beings essentially. And we mentioned last week this could this robot call kerobo, which is a David levy was talking about human companions to human being essentially. So, this robot was saying him to space last week by the Japanese space agency.

And it is man it has a human companion to a human astronaut, which will follow in November essentially. So, this a very brief history of what has been happening in the last 50 years, will stop here.

(Refer Slide Time: 52:46)



And the next that we will followed is come back to this question about, what are minds. So, that will be the last segment of our introduction today's essentially.