

**Artificial Intelligence**  
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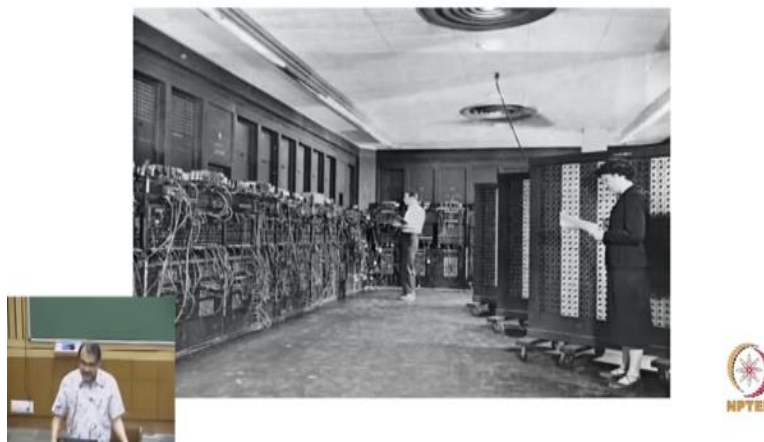
**Lecture - 2**  
**Introduction: History of AI from 40's - 90's, Part 2**

So what I am going to do today is I am going to talk about just start talking about the history of AI. So, in terms of the introduction, we will first talk about the history of AI the president of AI why is there so much interest in here? Then we will start asking the question, what is AI, AI as a phenomenon is actually a very complicated question lot of people disagrees on what is AI, so we will try to have our best definition possible and some recurrent themes in the field of AI.

This would be our introduction, then we will start talking about the technical content so, the initial first few lectures are going to be just introducing this subject for you and let us start from one of the salient events way back in 1940's.

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**1946: ENIAC heralds the dawn of Computing**



Where an ENIAC computers was constructed, designed, developed now, ENIAC stands for electronic numerical integrator and computers. It is a first electronic general purpose computer and it was Turing complete Turing complete if for people who are advanced enough there is a Turing machine which the mathematical model and technically with a fixed amount of tape the whatever to the machine can do ENIAC can do too.

And it was capable of being reprogrammed to solve a large class of numerical problems at the time. Now, let us go back to the 40's by the way, this is one computer just so you know and it is not it is much worse than the computers you and I have on our phones so offcourse, we know this. What would I use the computer for if I am in the 40's and I suddenly have something that can do computations was applied logistics that is a good suggestion you require probably more algorithms to be developed before you can do logistics, but that is a reasonable suggestion.

Yes, code breaking yeah code that I think I was trying some code working at the time I do not know I do not think ENIAC itself was used for code breaking, anybody else. So it was designed to compute artillery firing tables for the United States Army, but you both had the right intuition in mind. It was being used for defense purpose by the way this is not just the 40's. I will claim that a lot of progress in AI has happened because of defense and was and enemies.

This is I mean, we can smile about it but which in every country have you see the country which puts in more money for science and less money for defense, at least some of the countries which have more money, like significant amount of money. We all know US government policies, I mean, they offcourse put a lot of money for science, but they usually put money for science for defense, or engineering for defense is right from the very beginning AI has been heavily funded by defense agencies.

And, of course, we are talking 40's World War has just happened and obviously defenses, you know, in on minds of everybody. So they would create use the, this computer for artillery firing tables and it was said at the time that it could do things it could compute a trajectory of a projectile in 30 seconds. We are a human computer and by the way, we do not hear about the word human computer now, have you heard this word human computer? You have there was a time when they were there was a job called human computer.

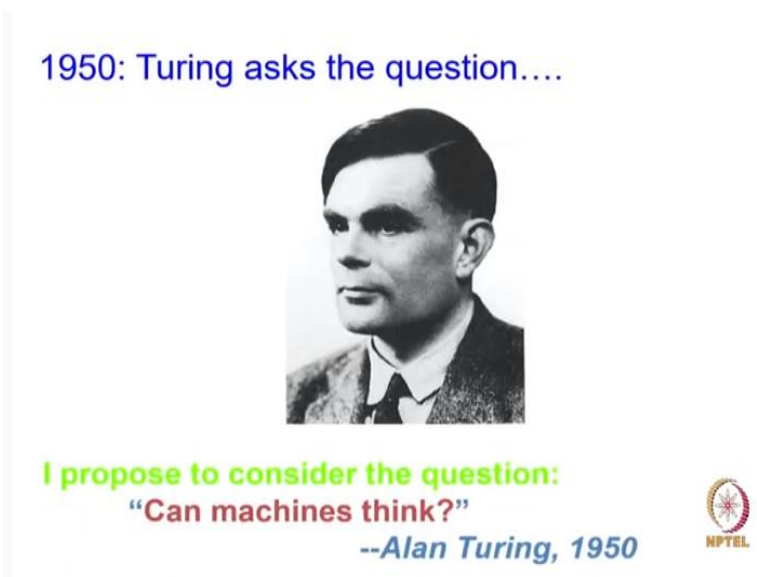
There is a beautiful movie about NASA and 3 women, does somebody remember the name of the movie? Nobody remembers, I am sure somebody has seen it. It is about 3 African American women who are employed in NASA as human computers or at least as some form of computers. So basically, their job was and we will find a name if somebody remembers or can google it, let me know. So we there, their job was to do computation.

They would compute the these projectiles and they may take about 10 hours to compute one projectile and this thing can do the ENIAC could do the same thing in 30 seconds, right? So notice that right from

there, and of course, now human computers are is not a job and not surprising. There is also a beautiful story about a woman who really got a bunch of these women together and train them as human computers in a time where these women did not have much to eat and so on that is a different, beautiful book.

But anyway, so that was then and now that this was the time when computers were coming into the fold, it was a reality, not just a figment of somebody's imagination. They did not ask the question, can I use computers for word processing or can I use computers for excel like spreadsheet management, or maintaining my database?

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In 1950, Alan Turing, who is considered the father of computer science, you all about Alan Turing some of you may have seen The Imitation Game. You must see that movie beautiful movie, he said in his seminal paper that I propose to consider the question can machines think? That is why we call him the Father, because that particular question that he asked in 1950 when there is one big computers or you know, some of these computers have just started coming out and the only thing they are doing is computing the trajectory of projectiles and so on so forth.

He is starting to think as far into the future as possible and being somewhat of a luminary and writing these seminal papers thinking about these philosophical questions, and he asked the question at, let us say a machine can think, how would I know that it thinks, I think about this question for a minute. Suppose I claim that this podium which is made of wood thinks has the ability to think. Without casting any judgment on what wood is made often is I mean, what is wood and whether we have any prior on whether this is living or not living, let is not worry about this.

Let us say I make this claim that this podium thing, how would you and I even assess whether this podium thing or not? The let us take another example, whenever they asked such philosophical questions in AI, we relate them back to our life, suppose I have to ask the question, does my friend think, what would I do? I would ask them a question. I would ask them a question which I think my friend should give a correct answer for.

If I want to believe that this person really thinks this is a good question, it is an intelligent question. If I ask an intelligent question, and my friend is able to give me an answer, then I would make the claim this, my friend thinks suppose my friend could not speak what would you do? Written answers, suppose my friend did not have any hands, another person could write for them how they cannot speak, they do not have hands? Create a situation that they have to make a decision and decision would be seen by some movement of hand, blinking of eye in a movement of arm moving of legs, whatever, right?

Suppose they did not even have an ear and an eye. Now I know why we do not want to visualize such a person and I it is, it is becoming really very gloomy at this point. But think of it as a thought experiment. This is probably what Alan Turing also thought about at the time I do not know, hopefully. Suppose I have a person who cannot see who cannot we observe the environment? Who cannot make a difference to the environment so, does not have hands does not have voice does not have eyes to blink does not have any motors has a brain inside is it possible that this friend, this person's not friend this person still things.

But we will have no idea about it, is it possible? Come on at least not one way or the other. Yes, it is quite possible that and you may have seen and you sometimes I met a person, you know who had Parkinson's disease, but the Parkinson's disease had, you know, gone to a certain extent that there was full paralysis and so, the person was not able to communicate very much and we did not know very well, whether the person is able to observe the discussion or not, whether the person is able to understand what is going on around their surroundings or not this is even possible in a human in today's world.

It is possible that their brain was working perfectly they just had no way to communicate it is possible that their brain was not working at all and we just have no idea. So, the point is not working at all means not working in terms of the understanding perception of the man. So, the point that Alan Turing came back with is that it is possible that this podium thing we have no way to know because the podium has no way to communicate with us.


So, you will overtime see that communication with the world by listening producing an output not listening by ear necessarily by observing or by looking at the environment perceiving the moment and then coming out producing an output is critically important for us to judge whether there is an AI system sitting in there or not, because the brain is meaningless in absence of the communicators in the body, and there for he said that the only way we can figure out data machine things is by asking it questions or creating a scenario where we can judge its decisions.

And he devised the very famous during test, right? I am happy many of you know about it, it has become part of, you know, folklore of AI and folklore of computer science and we will talk more about it at the time a little later, but he said that the Turing test would be a good test to figure out whether machine things are not. Notice by that time the field of AI is still not born, this is still his thought experiment and he is written this paper, now offcourse, this idea starts to pick up.

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### 1956: A new field is born

- We propose that a 2 month, 10 man study of artificial intelligence be carried out during the summer of 1956 at Dartmouth College in Hanover, New Hampshire.  
– [Dartmouth AI Project Proposal](#); J. McCarthy et al.; Aug. 31, 1955.



And in 1956, 4 of these people come together to do a 2 month workshop at the Dartmouth College in 1956. These 4 people are called the founding fathers of artificial intelligence. They say in the project proposal, we propose a 2 month 10 man study of artificial intelligence. So this is the first time the word artificial intelligence starts to get used and it was given by the very first person on the right John McCarthy, the John was at Stanford.

He worked a lot on chess and he also created or co created the language called Lisp, which is a declarative programming language, which became very popular in the 70's and 60's. They say that in 2 months, we will solve artificial intelligence and they meet together at Dartmouth College over the

summer, and that is where the field was officially born. Offcourse, they had to spend more than 2 months for AI to be solved and we have still not solved it.

So therefore, there is one thing that I feel when I do think about most AI researchers is that they are highly optimists, heavy optimists. They feel that we can do something much before anybody in the world is ready to achieve it and they of course, fail, but that is okay. They move the field forward and these were the full optimists who thought that they can solve most of AI in 2 months, this job, but that is somewhat true also let us talk about the other 3 people.

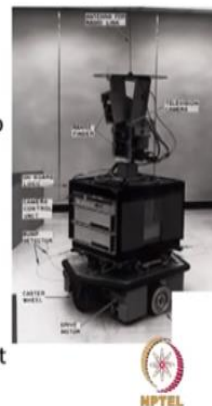
Alan Newell and Herbert Simon, are in the middle they are they were from CMU, they were working on logic theorists, they are trying to figure out, can we somehow create theory of how to prove theorems? Can we create an AI system which will be able to prove theorems automatically and lastly, at the bottom there is Marvin Minsky from MIT who has many contributions including he built one of the first neural network learning machine and he is my great great grandfather, at least Academy grandfather.

So my advisor is Marvin Minsky, and he was the person who started the MIT AI laboratory, so at the time, these 4 people from Stanford, CMU and MIT came together and officially started the field. So now what happened? Initially, of course, there was enthusiasm people were coming together, you know, trying to solve these problems.

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## 1956-1966

- 1950: Turing Test for Machine Intelligence
- 1956: AI born at Dartmouth College Wrkshop
- 1964: Eliza – the chatbot psychotherapist
- 1966: Shakey – general purpose mobile robot



So if you look at the history, I mean, there are many, many things going on but at the highest level, you know, Turing tests came in 50's AI itself was born in 56 in 64 so by the way, language and language

communication, all that also was part of AI and Eliza was the first chatbot way back in 1964. By the way, we have now we live in a world where chat bots have become extremely important. We all have chat bots to play with and you know, spend time with kill time with and so on.

The first chatbot was in 1964 and believe it or not, and it is a funny story, where somebody on the private messaging system instead of having your own response put Eliza in and one person started communicating with Eliza and started getting the Eliza started asking personal questions and this person started answering personal questions and this person felt like there was a real psychotherapist setting on the other side. When we when you come to my NLP class, we will talk more about Eliza and how to make chatbot not in this course, but this happened way back in the 60's.

The first general purpose mobile robot and you can see a picture on the right is shakey you should google shakey you should learn about it and So on. Shakey was an amazing project this was this robot which had many sensors and so on, it had a camera control unit it had a television camera, it had a rangefinder it had wheels and so on and at that time, people in Stanford, were using shakey as a platform to do interesting AI and AI remember in 2016 there was a 50 year celebration of shakey at a AAAI conference.

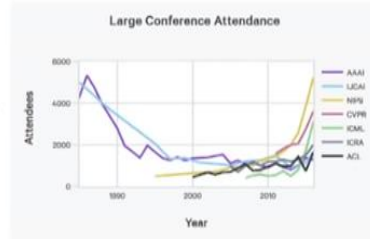
A lot of the people who worked on shakey at the time who was still alive, they came together and started narrating very funny stories about shakey and so on. It was really amazing to hear, you know, 50 years down the line shakey was still relevant, because in the process, they developed one of the most important algorithms of AI called the a star algorithm and we will talk about a star algorithm and hopefully week 3, you will see that you know what happened 50 years ago, 52 years 53 years ago, was still extremely important and being used in many, many places including possibly assignment one.

Then things started to go bad, they started to go down south and since we are in the US summer is a great word spring is a great word, but winter is a bad word. So you should think of a winter not from an Indian point of view where you are like wow, we have winters now, you should think of it from the US point of view where Oh damn, we have winters now it is going to snow, it is going to be negative minus 20 degrees Celsius or whatnot I cannot go out my eyeballs are going to freeze and so on so forth.

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# AI Winters

- 1974 – 1980: Winter #1
  - Failure of machine translation
  - Negative results in Neural nets
  - Poor speech understanding
- 1987 – 1993: Winter #2
  - Decline of LISP
  - Decline of specialized hardware for expert systems



- Lasting effects
  - [Economist07] "Artificial Intelligence is associated with systems that have all too often failed to live up to their promises."
  - [Pittsburgh BT06] "Some believe the word 'robotics' actually carries a stigma that hurts a company's chances at funding."



You have seen those videos where you know you put water in the air and the water freezes midway we are talking about winters and they were winters and they were not one but they were 2 AI winters that came over time. In 1974 to 80 there was one winter where people were working in language started to feel that Oh, man, this is not working out. There was one seminal report which said machine translation is very hard it is not going to succeed.

A lot of funding in machine translation at the time came from defense agencies, can you guess which language did they care for at the time? English Russian, we are in the cold war time so of course all the effort will go into making sure that we can understand any things that we can intercept in Russian language and they said that oh man, machine translation is very hard neural network had come in, but Marvin Minsky wrote a paper saying that neural network is very hard it cannot even do XOR function, you know, XOR function from a logic, I hope.

And similarly, there was a report where there was some frustration on speech understanding, they were able to show that if you speak words in a certain order, you are able to pass it, I understand it, but otherwise the system cannot do anything and by the way, all these problems remain unsolved are mostly unsolved until very recently, and they are still not completely solved, but we have made substantial progress in the last year.

So because of all this, suddenly we were in a place where there was so much excitement about a earlier and it died down. Then it started coming back up and the LISP was working there was something called the experts systems era and even now, some people who are still stuck in the 90's, who teach the old style



AI course, they will teach expert systems we do not talk about expert systems in this course anymore because those this is what thing from the past.

But the idea of expert system was somebody uses a logical language to encode all knowledge about their field. Like if you want to make an automated doctor, you will say that this disease causes these symptoms this symptom, this disease can be you can be treated by this medicine, etc, etc. So, put everything in a logical framework and then given the symptoms, you do some inference to figure out what disease you may have, what treatment should be given, that was an expert system.

At the time, they started making specialized hardware for expert system and it became a half billion dollar industry. But within a year, all that half billion dollar industry was wiped out, because new machines came out which were much better and they were general purpose and so on, so forth, and all this industry died out. But more importantly, what died out the reason why I went through these winters is the because AI researchers were diehard optimists, not cautious optimists or realists.

They started saying from the very beginning we are going to solve intelligence, we will make a machine that will be more intelligence than you, we will defeat you in chess, we will solve theorems, we will communicate in language, we will understand your speech, we will do machine translation, they kept making all these claims again and again and again and again and again and offcourse, defense agencies will do nothing they said, we will give you a million dollars, we will give you \$2 million.

What happened? What came out? Nothing I would not sell the money down the drain. But from the perspective of a person who wants to use the technology, they will feel that the money is down the drain because nothing substantial, which is workable, has come out. So AI started getting bad name to the extent that people thought that Oh, AI folks, the other thing you have to realize is that they were also computer scientists, to the theoreticians mostly who really cared about proving things.

They were like, give me a problem, I will figure out its complexity class, give me a problem, I will create an algorithm and prove things about it. On the other hand this AI folks why interested in working demonstrations? They will proof, but they were interested in working demonstrations more than the proofs. Because of which the computer scientists theoretical computer scientists will say, you guys are not formal enough you guys are not mathematically rigorous enough.

On the other hand, the applications people will say, your guys solutions do not work. So they were sandwiched in the middle neither the applications people are happy that you know you can achieve anything that works nor that the theorists are happy where you can achieve something you can prove anything about. So even in the computer science world AI started getting bad name, it started being looked at as set of people who have these heuristic techniques, which sometimes work.

But have no theoretical basis so therefore, I remember and by the way, some people remain stuck in time, for example, after being in it for 4 years, if you go home, your mom will still think you are a 17 year old. They would not she would not know that you are 21 now and you have moved on and you have become a different person. You know, I remember a beautiful dog, my shamba Nagel, who said that my mom still thinks I am 14 year old, I am not getting you he said that explicitly.

We remain stuck in time you go to look at your friends who are in the US now they are notion of India is the notion that was when they left India. If you go talk to uncles and Aunties who left India 30 years ago, their notion of India no longer matches with any notion of India today. But they are stuck in time so we are always stuck in time. So they were people, even in this department and in India in general, who was stuck in time they thought that AI has not moved because they will get their PhD in the 90's.

That is where AI was not a very good word, AI became a bad word actually. In fact, they were people who cut their cords from AI they were topics which were part of AI and they created their own sub communities and started saying we are not AI we are computer vision, we are not AI we are natural language processing, we are not AI via machine learning and I lived through the time therefore I can relate to it I remember that in 2000s when I was doing my PhD, AAAI, there were 5 communities which will still say we are part of AAA 5 is just a number 3, 4 7 something Like that.

There were many such communities which will only go to their local conferences when will never come back to AI conference because they thought is AI bad word let us stay away from it. Let us say we are whatever we are right so, when I would come back to in IIT Delhi, I was a student here undergrad when I came back as I was still doing PhD at the time, I told some of my ex professor, I mean professors not ex professors now, my colleagues today that I am doing AI they will say, oh, you are doing AI.

They will give me the sheepish smile I do not know why they are giving me a smile. But it was clear that it is not a smile of appreciation and then I have a one person who I would not name who always speaks his mind thankfully, so he said, you are doing AI what are you doing in AI? So I told him, I am working

on this Markov decision process model oh, so say you are doing operations research. Why did you say you are doing AI now for people who do not know, a model came from operations research in the 50's.

But you know, over time it got adopted by AI and it is the something we will study later in the course. So it is very confused what is going on and then it dawned on me, that to them AI still the AI of the 80's and 90's. When we were having a winter and AI had become a bad word. So this had lasting effects, because and this is an economist 2007 note, which says AI is associated with systems that have all too often fail to live up to their promises and in this world, over time AI has now come out.

We will talk about the present in the next class, but this graphic shows you the number of attendees for several AI conferences and at the 80's it was only AAAI, if you see and they were almost 5,000 attendees if you see here, they were almost 5000 attendees at HI conference in 1985 and it went down so rapidly that over time the it was less than 2000, maybe 50,100 people started coming I remember a time in AAAI had less than 1000 attendees and we were very worried that we will maybe even have to close the conference we cannot fund it anymore.

From there, we have now reached a point where all conferences are starting to see a jump in the attendees and ofcourse, the conference that has one the most in this is new NIPS or NIPS. NIPS is the old name now its new NIPS, Neural Information Processing systems and notice that this is not even the current figure. So I remember that for NIPS one year there were 2000 attendees next year, there were 4000 attendees and next year, there were 8000 attendees.

To the point that the year after that the general registration closed down in less than 12 minutes. But think about World Cup cricket tickets even for India, Pakistan match you will probably get more than 12 minutes to buy the tickets. This is new NIPS technical conference we are talking about believe it or not, if you really want to go to new NIPS you have to buy it in the first minute of registration opening or you should have a paper in there so, those are the 2 possibilities.

So AI It is said that yanlakoon is a celebrated in China, Yann Le Cunn wrote on his facebook page that he was walking in the streets of China and random people started coming to him and started saying oh, you are professor Yann Le Cunn so nice to meet you or things like that, this only happens to people like Shahrukh Khan and Vidya Balan in India I have never felt that I feel so sad about it someday and this is before Yann Le Cunn during the award I want to say.