Working In Contemporary Teams

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Lecture - 11

Introduction to Human-AI teams

Welcome to lecture 2 of module number 3, Working in Contemporary Teams. In this lecture, we will be discussing about Human-AI teams. What is the agenda for this lecture? In this lecture, first I will give an introduction to what is Artificial Intelligence. Then we will see what is Human-AI teams. Finally, we will look at some of the applications of Human-AI teams. Then we will look at a distinct category of Artificial Intelligence : robots.

We will look at what are Human-Robot teams and what are the different types of Human-Robot teams and its applications. Let us dive into the second lecture. But before that, let me set the expectations. This lecture is not going to be about Artificial Intelligence or robots.

There are a lot of courses on different platforms which will give you in-depth knowledge about Artificial Intelligence and robots. This lecture is going to be about Human beings working with Artificial Intelligence systems and what implications it brings for team works. That said, I will give a short introduction on what is Artificial Intelligence and what are robots. So, like I said, let us dive in. The phrase Artificial Intelligence was coined in the year 1950.

It denotes the study of agents which receive information from the environment, process that information and then perform certain actions. These actions are usually performed only with the capability of Human Intelligence. So, what does Artificial Intelligence do? It leverages combination of computers and machines to mimic the problem-solving and decision-making capabilities of the Human mind. Think about looking at a big database of songs and then choosing one to play out of them. Suppose a machine could do that for you.

That is, based on the songs that you heard before, look at what songs are available in the data set and make a recommendation. That is Artificial Intelligence working at scale to help you. To summarize, Artificial Intelligence is a set of technologies that enables computers to perform a variety of advanced functions that would normally be capable only by the Human mind. Now, to make this happen, Artificial Intelligence brings together information from a variety of disciplines. This includes Computer Science, Data Analytics, Statistics, Engineering and also Linguistics.

Now, what are the different kinds of Artificial Intelligence? Artificial Intelligence can be classified in many ways. I have presented here three popular ways of classifying Artificial Intelligence. First, it can be classified on the basis of the stage of development the Artificial Intelligence is in. The first category are Reactive Machines. This is very limited Artificial Intelligence which works on a set of pre-programmed tools.

It does not have a memory and it is also not capable of taking in new data and then using that new data to refine its models. A good example for a Reactive Machine is IBM's Deep Blue which beat the chess champion Gary Castro in a game of chess. Another more recent example of a Reactive Machine is the spam filter which is in your inbox. It decides based on certain pre-programmed rules whether a mail that's coming into your mailbox should go into the inbox or into the spam. The second category of Artificial Intelligence are the Limited Memory Machines.

Limited Memory Machines have the advantage over Reactive Machines that they have a memory, they are capable of taking in new data and refining the models that underlie their functioning and give us better outputs in terms of prediction. A good example for a Limited Memory Machine is an Autonomous Car. A host of sensors on this car taking information, process the information and then guide and steer the car in such a way that it brings no harm to the people who are within the car as well as the environment around it. Reactive Machines and Limited Memory Machines are practical and very much in use today. The next two categories of Artificial Intelligence, Theory of Mind and Self-Aware AI are only theoretical.

We have our researchers working on developing them right now. So what is Theory of Mind? The Theory of Mind mimics the human mind but is limited by its incapacity to understand or process human emotions. Yes, there are a few artificial intelligence agents which are capable of recognizing and mimicking human emotions but they are very limited. Next comes Self-Aware AI. Self-Aware AI is very much like the human mind in the sense that it not only has its emotions and feelings but it's also aware of itself as a being and can set its own agenda.

So these are the different categories of Artificial Intelligence based on the stage of development the artificial agent is currently in. A more useful way of categorizing Artificial Intelligence is based on what the artificial intelligence can do. The first category is Narrow AI. Most of the artificial intelligence which we interface with is Narrow AI. It is the first generation artificial intelligence.

What does it do? It does exactly what it has been programmed to do. That is, for example, if you have developed an artificial intelligence system which can recognize images you cannot ask it to recognize speech. Therefore, Narrow AI does only what it has been programmed to do. Reactive machines and limited memory machines are Narrow AI. The next category of Artificial Intelligence based on what the artificial intelligence system can do is the Artificial General Intelligence.

You would be more familiar with this in terms of what we have seen in our literature and in our movies. The enthiran from the Tamil movie Enthiran is an example for Artificial General Intelligence. That is, it is very similar to a human mind. Like a human mind it can take learning from one situation and apply that learning in a completely different context. Theory of mind and self-aware AI belong to the category of Artificial General Intelligence.

The next category which I have actually not given here, the third category is the Artificial Super Intelligence, a being that is more intelligent than the average human being. Finally, we can classify Artificial Intelligence on the basis of how it will be utilized. If the Artificial Intelligence system is downloaded as an application on your mobile or on your computer and used as such, then it is software. However, if it has a physical body in which it comes, then it is called as Embodied Artificial Intelligence. Robots are Embodied Artificial Intelligence.

So now, having seen what are the different kinds of Artificial Intelligence, let's look at what are its common applications. Based on what the AI does, we can easily understand some of its applications. For example, Artificial Intelligence is capable of speech recognition. That is, it captures the voice and converts it into a text. Image recognition is where the Artificial Intelligence can identify who or what is there in an image.

Translation is where the AI captures a voice, converts it into text and then converts the text in the current language to a different language without changing the intent or meaning. There are also predictive modeling and data analytics AIs. Now, how does it find application? The voice assistant in your phone is an example of Artificial Intelligence. Say you ask your phone to call up a friend. What the AI in the system is doing is to capture your voice, convert it into text, identify your friend's name in the list

of contacts and then initiate a call.

Navigation and travel also works on speech recognition, but also predictive modeling and data analytics. That is, it not only recognizes the intent of your speech, but it also looks at the map and then identifies the shortest or fastest way to get from where you're going to where you want to go. So now that we have seen some applications of AI in general, let us see what it has to do with Teams. In the first lecture, I talked about Teams and the growing application of Teams in business. Considering the scale and the complexity of the activities which have to be carried out in organizations, many organizations have started adopting Teams.

Team researchers have been looking at different ways to improve the productivity of Teams. Teams, though heavily utilized by organizations, are plagued with different problems. There are problems in communication. There are problems which are associated with conflict. And we are looking at ways in which, in the first lecture, I talked about increasing application of Teams in organizations.

Given the scale and the complexity of work, it is not possible for a single human being to carry out many tasks. We rely on group of people to collaborate, communicate and coordinate with each other to carry out these complex tasks. But given the fact that we have been using them for a long time, and also the fact that team research has been actively going on for more than 50 years, we still have not found a team that operates at 100% effectiveness or efficiency. Teams are still plagued with problems. And researchers and practitioners are continuously looking at ways in which we can increase the productivity of Teams.

That is how we find ourselves applying artificial intelligence in Teams. The need to apply artificial intelligence in Teams has been because of the increasing complexity of the work. And we are able to apply artificial intelligence in Teams because of the increasing capability of technology. Even 20 years back, we could not have considered using several of the artificial intelligence systems in our teams. But that said, I should still make a point that as early as the 1990s, organizations such as the National Aeronautical Space Agency of the United States was thinking about how it can apply artificial intelligence systems in Teams.

So what is AI in Teams or what is human autonomy teaming? Application of AI in Teams is really on a continuum. At one end of the continuum, you have AI as a tool. That is, the human members of the team use AI to collaborate, coordinate or communicate with each other. On the other end of the spectrum, we have AI, which is a full-fledged team member. That is, a team member who has decision-making capabilities

and a team member on whom the other members of the team rely.

This has been made possible because of the changing way in which we interface with technology. Therefore, we can define a human AI team or a HAT as one where there is one or more intelligent and autonomous agent operating as a full-fledged member of a team which has human membership. So what are the important key factors which we need to keep in mind here? First of all, the human AI team already has human membership and into this team, we introduce AI as a full-fledged team member. What are some of the common applications of AI in Teams? Well, we are all very familiar with AI in urban search and rescue teams. We have seen robots which go ahead of the team members to scour buildings which are damaged and look for survivors.

We have also AI being used in engineering design. AI also finds application in team sports in terms of analyzing extensive team data and also in the classroom where it is used to increase the engagement of the students. AI is also being used to improve processes such as identifying and promoting team flow, identifying and preventing conflict within the teams. So these are some of the common applications of AI in Teams. The next part that we are going to is looking at one very specific kind of AI, robots.

We are very familiar with robots in our literature and in our movies. You would have seen Enthiran, the twin almost to the hero in the movie Enthiran. You would have seen the terrifying Terminator and also the lovable Wall-E. Several of these movies talk about robots and we identify a lot with them because not only do they look like human beings to a certain extent but they also express their feelings and thoughts like human beings. We come to care and think about these robots as the movie progresses.

So what are robots? Robots are a kind of artificial intelligence. In the beginning of this lecture, I had said that we can classify artificial intelligence into two types based on how it is utilized. Robots are a form of embodied AI. That is, they are machines which have capabilities for computation.

Usually they are programmed by a computer. How do we control them? We can control them through the presence of a computer placed within the body of the robot or by connecting a computer to the machine through a cable or through wireless. So to recap, robots are machines which have physical presence and computational capability. Usually they have a computer embedded in their body or controlled by an external device. Why are we looking at robots specially? The fact that they have a body means that there is a possibility of physical interaction between the human team member and the robot. We have to be careful to program the robot in such a manner that it does not first of all cause any harm to the people who are working with it.

And it is because of this, the fact that it is embodied and therefore interacts on a physical plane with the human members of the team that we are looking at robots in special. Let us see what are the different kinds of robots. The first set of robots which I am presenting here do not look like human beings. Autonomous mobile robots are capable of movement. They have a host of sensors and cameras which gather a lot of information about the environment and convey it to the robot.

The robot analyzes this and uses this information to decide its next action. For example, the autonomous mobile robot can sense the presence of a human being and can stop its movement to avoid collision with that human team mate. Some of the common applications of autonomous mobile robots are in warehouses where a human team mate can ask the autonomous mobile robot to identify a parcel, pick the parcel and bring it for dispatch. These robots require very little human inputs to do their job. The next category of robots is the automated guided vehicles.

Automated guided vehicles are very much like AMRs but their mobility is highly restricted. Usually they can move only on a track or a pre-defined path and they cannot take action unless there is operator oversight. Usually their use is limited to delivering materials and moving things in a controlled environment. The final robot which I am introducing to you in this slide is the articulated robots.

We are actually quite familiar with this. We have been seeing robots on the industry floors for a quite long time. Articulated robots are usually robotic arms with one or more joints. The presence of these joints help the robotic arm to move in multiple directions or it gives the robotic arm a greater degree of motion. And these robots are widely used on the industry floors for welding, material handling, machine tending and packaging. Having seen these robots, let's see what are the other kinds of robots.

The robots which I am presenting to you here are different from the ones in the slide before. Why? Because they look and feel a little bit more like human beings. For example, humanoids. Humanoids are very much like autonomous mobile robots. That is, they are capable of motion, they are capable of sensing their environment, processing the information and then taking decisions.

However, they have the added advantage of looking like a human body. That is, they have a face, they may have other human body parts like arms, which give the person who is looking at the robot the feeling that he is looking at a human. Where are we using humanoids? Humanoids are used in situations where they have to interact with other people. You may see their use in hospitals, you may also see their use in amusement

parks, usually providing directions or offering concierge services in hotels.

The next category of robots are the cobots. Cobots are collaborative robots for short. They have an added advantage over humanoids. That is, a cobot is capable of manipulating an object along with the human team member. Humanoids, even though they look or have certain features of humans like faces, are not designed to manipulate an object along with another human being. Cobots, on the other hand, can work along with a human being to do things like repairing machines.

It has moving parts which can manipulate objects along with the human team member. Consider a situation where a human team member and a cobot are working together to repair a machine. Cobots are autonomous to a certain extent and can carry out its functions more or less without the help of a human. For example, a cobot which is sent into a damaged building to survey what is the extent of damage and probably look out for survivors is a cobot.

The final kind of robots that we are looking at are hybrids. A hybrid is two different kinds of robots in one. You can have an autonomous mobile robot fitted with a robotic arm. An example of this would be used in farming where you can have a robot which goes around a farm looking at different plants and taking an assessment of the crop. A robotic arm which is fitted on this autonomous robot can help either pick the fruits or vegetables or spray pesticides and fertilizers on the farm.

So these are the different kinds of robots. So what are the general applications of robots? Well, we are all familiar with robots in manufacturing. Robotic arms have found their presence on the shop floor for a long time now. These robotic arms are capable of welding, assembly, material transportation and so on. Robots also find application in farming and agriculture. We are also familiar with the application of robots in search and rescue in damaged buildings and war zones.

Often these robots are designed to go ahead of the human team members and then search for potential threats and then relay that information back to the human members and also look for survivors. Only if there is a presence of survivor in the area do the human members need to go into this building. Robots also find application in scientific exploration in dangerous or inaccessible areas. Some of you will be familiar with the movie Titanic where our first glimpse of the ship which has sunk into the bottom of the sea is actually captured by a robot which is being maneuvered and manipulated by the human operators on board another ship. Considering the dangers which are associated with deep sea diving, it is safer for us to send a robot first to scout to understand the situation in the area.

Robots also find a lot of application in entertainment. At a personal level we can now purchase robots which take the place of pets and even human companions. Another application of robots in entertainment is in the film industry where robots can be used to wield the camera and also bring in special effects into the films. Application of robots in healthcare is also very prevalent. The robots can be of great aid to the nurses especially when it comes to rehabilitation which requires a lot of repetition of the same instructions with people who are recovering and learning.

So these are some of the general applications of robots. But the basic unit of a human-robot team is the interaction between the human and the robot. Like I said since robots are embodied they have a physical presence and can make a physical impact on the human team members. Therefore human-robot interaction is a field of study which is dedicated to understanding, designing and evaluating robotic systems for use by or with humans. So what is a human-robot team? Very much like human-AI teams, human-robot teams are those where humans and robots jointly perform tasks, share common goals and interact socially and exhibit task interdependencies. One person's job is dependent on the outputs given by the partner be it the human or the robot.

HRTs find a lot of application in agriculture, rescue, construction and mining as I said before. There are different ways in which human-robot teams are seen. Many people fear that robots are going to displace human beings and take their place on teams. There is another way to look at human-robot teams. We can see humans and robots working together so that we bring in our diverse capabilities and complement each other.

So far we have been accustomed to the role of robots as mere tools. However, now we are moving to a situation where the robot is a full-fledged member of the team and therefore brings in several advantages to the teams. The presence of AI or robots on a team is on a continuum. Let us look at what are the different kinds of human-robot teams based on the extent to which the robot team member is an autonomous agent. The first kind of human-robot teams is the human-directed robot team. This is a team where there is a single human operator usually handling multiple robots.

Where do we usually see this? We usually see this in hazardous situations like construction and application in the war zone where the single human operator sends out one or multiple robots to scour the damaged buildings for any kind of threats. The second kind of human-robot teams is the human-robot-directed mixed team. Here we find that human workers perform tasks in coordination with their robotic partners. So the common application of this is in a warehouse where a human team member tells the robot to seek objects or parcels and then bring it for dispatch.

The next kind of human-robot team is a robot-directed human team. Here the robot takes the leadership role or it gives instructions to its human team members. A very common application of this is in situations where there have been accidents. So if there has been a chemical, biological or nuclear accident we may send in a robot with a lot of sensors. These sensors are used to check the danger involved in the situation and this information is sent back to the human team member who takes a decision on how to respond.

The final kind of human-robot teams are the autonomous mixed teams. Autonomous mixed teams are where the humans and the robots collaborate on tasks. That is they share the same workspace and objects and they work in a collaborative manner. For example, consider an astronaut and a robot who are working together to fix or repair a machine in deep space. This is an example of an autonomous mixed team because the human and the robot are constantly assessing the situation and giving each other feedback on what to do next. So to summarize, we have human-robot teams where the human is in control or in a leadership position and gives instructions to the robot and the robot takes these instructions and carries it out.

The next we have the robot sensing the environment and giving inputs or instructions to the human team members and the last we have the humans and the robots having equal responsibility for carrying out a particular task. What are the benefits of using AI in teams? Well, it is very obvious that robots can replace humans in dangerous environments. So like I said before, whether it is a place where an accident has happened or whether it is a war zone or a damaged building or even the earlier example of deep sea diving, robots can go ahead and tell the team members whether it is safe to approach. Another benefit of using AI in the team is that mundane and repetitive tasks can be carried out by the AI. Since the AI is a machine, it does not get tired and therefore does not make mistakes.

It also is much more faster and more accurate for gathering information. For example, AI in healthcare can be used to quickly go through the medical history of the patient and compare it with the medical history of patients who are displaying similar symptoms. Using an AI in teams can also reduce the cognitive load of the team members. Like we said, tasks which are mundane and repetitive and are very difficult to scale can easily be given to the AI teammate and the AI teammate will do it without making any mistakes. This leaves more cognitive bandwidth with the human members.

Also, AI is more efficient in certain tasks like planning. So how is the industry in terms of application of AI and robots? Well, we are all very familiar with industry 4.0. Industry

4.0 is the integration of digital technologies in work. You have machines which are fitted with sensors, you have machines which are fitted with digital technologies and you have machines relaying information to each other.

A very simple example of this will be a sensor which is fitted in a car. If the car is involved in an accident, the sensor can be used to relay information to an ambulance, to designated family members and once the car comes back to the company, the company can use the information stored in the sensor to improve the safety features of the car. We can also think about digital technologies which are used within the company. For example, on the assembly line in case we are running short of a particular part, the AI can sense that and either alert the human team members who are controlling the assembly line or by itself dispatch an order for getting more inventory.

Industry 5.0 is the next level which is the integration of robots and smart machines. So what is the implication for us? Whether we see AI as a tool or a teammate, it is here to be part of our work. So now that we have seen the use of AI in the industry, let us see what the future holds for us. Pause the video for a moment and think about a time when you may have an AI as a teammate. Think about sitting across to it and having a conversation with it. What do you think the conversation would be about? How do you think the AI will help you in carrying out your work? If you are thinking of the AI as a super human teammate, well, then you are a little ahead of what is currently available today.

The reality is that the cost of designing humanoid robots with functional human behaviors is very expensive today. Not only that, the reaction time and the reliability of some of the AI is a little low. Not only that, there are a host of challenges which are present when a human works with an AI.

Let us see some of them. The first challenge is designing interface. Now, please go back where I asked you to imagine having a conversation with your AI teammate. Your AI teammate is very likely to be incapable of catching your expressions or any changes in your emotions. It is very likely only to be capable of taking certain specific instructions and based on certain pre-program rules carrying those out. Also, we rely on a lot of non-verbal communication to give information to our current human team members.

We cannot expect the same from AI. Therefore, our researchers are currently looking at designing interfaces which make the interaction between the humans and the AI as effortless and as error-free as possible. The second main challenge of using AI in teams is dealing with the fear of team members. Primarily surrounding the fear of job loss, there are also additional fears about the team members, about the human team members learning new competencies or skills or acquiring new skills so that they can work with

their AI teammates. The third problem is the fact that human behaviors change when we introduce AI into the team. Human team members are likely to consider what is the implication for them when an AI is introduced into the team.

Does their autonomy reduce? Does their decision-making authority reduce? And because of these issues, there can be issues and because of these doubts, there can be issues related to trust. And we know that without trusting your teammates, you cannot have an effective team running. There is also a final issue of the black box behavior of AI. That is, most of the team members do not know how AI makes its decisions.

And because of this lack of transparency, there can be trust issues. Having considered the benefits and challenges associated with human AI teaming, let us look at what is the real state of integrating AI into teams as of now. Gartner's hype cycle for emerging technologies tells us that we are somewhere over the peak of inflated expectations, slowly descending into the trough of disillusionment. Some had expected that AI would be the solution to all teaming problems. However, as we calibrate our expectations, improve AI human interface, and improve the capability and capacity of AI, we will slowly move on to the slope of enlightenment. To summarize, what have we covered in this lecture? In this lecture, we have taken an introduction to artificial intelligence.

We have seen AI in teams. Then we have looked at a distinct category of AI, which is the robot. We looked at what are human robot teams. And we finally looked at the benefits and challenges of using AI in teams. We finish off this lecture by looking at some interesting topics that you may want to look up, but which I have not covered extensively in this lecture.

They include human computer interactions, human robot interactions, and industry 4.0. I have mentioned this at certain points in the lecture, but I could not cover it in depth. Thank you for joining me for this lecture. Till I see you again, bye.