10-15-2020

Applications of AI in Business, Industry, Government, Healthcare, and Environment

University of Maine Artificial Intelligence Initiative

UMaine Artificial Intelligence: Applications of AI in Business, Industry, Government, Healthcare, and Environment

Date: October 15, 2020
Run Time: 00:59:41
https://youtu.be/5889aoX9zDM

This webinar marks the first in the Fall 2021 series.

UMaine AI draws top talent and leverages a distinctive set of capabilities from the University of Maine and other collaborating institutions from across Maine and beyond, while it also recruits world-class talent from across the nation and the world. It is centered at the University of Maine, leveraging the university's strengths across disciplines, including computing and information sciences, engineering, health and life sciences, business, education, social sciences, and more.

Transcript is machine generated, unedited, in English.

00:01
Okay good morning good afternoon and good night everyone. You're joining us from all over the
00:08
world today. We have the second series of our UMaine Artificial Intelligence webinar series
00:16
with the topic of applications of AI in business industry, government health care
00:20
and the environment. This webinar series has been sponsored by IEEE Maine Communication
00:28
Society and Computer Society Joint Chapter, as well as IEEE Region one in the northeast U.S and
00:35
promoted by IEEE USA. So we have three speakers today. Each speaker will make the presentation and
00:42
then after all three are over, we'll have around 10-15 minutes for answering your questions. So
00:51
during the presentations, you can use the Q and A feature to post your questions and you can do that
00:57

through the entire presentation and toward the end we'll go through that Q & A to answer your
01:02
questions. So without further ado, I'm going to introduce our first speaker, Dr. Mohamad Musavi,
01:09
Associate Dean of the College of Engineering and Professor of Electrical and Computer Engineering
01:14
at the University of Maine. Prior to his current position, he was the Chair of the ECE department.
01:21
Dr. Musavi received his MS and PhD degrees in electrical engineering from the University of
01:26
Michigan. He has over 35 years of experience in engineering education and research in the areas of
01:33
smart grid power systems and intelligent systems. including neural networks, robotics and computer
01:40
vision. Dr. Musavi is the recipient of IEEE USA engineer and educator partnership award
01:46
and I would like to invite him to the podium to start us off with his talk.
01:53
Good afternoon everybody and thank you Ali for the introduction. I'm going to start sharing my
02:02
screen. Okay, I hope everybody can see my screen and again I want to thank everybody and also Ali
02:12
for the introduction and the opportunity to share my experiences in artificial neural network,
02:19
an area that I have been involved in for the past 30 years. I have enjoyed working in this area
02:30
because of its connection to human intelligence and its applicability to any area
02:37
where you need to learn from data. Over the past 30 years this area has grown tremendously and we
02:45
can see its applications in many aspects of our lives and there are many more to come.
02:55
What are neural networks and why are they important? The idea is to create a computer system
03:04
to mimic human intelligence. Human brain is a massive network of 80 to 100 billion neurons that

03:14
are highly interconnected and act at the level of sophistication yet unknown to human. On the other
03:22
hand, the latest computer processors are made of 8 billion processing nodes, but can work at a much
03:32
faster speed in the order of several trillion operations per second. The question is how can
03:40
we learn from our biological neuron systems to create artificial intelligence in machines.
03:50
So let's consider a biological neuron as shown on the left. The main parts of this cell
03:59
as relate as relates to our work are the dendrites on the bottom left inputting signals to the cell's
04:09
nucleus that processes the signals or information. The axon that transmits the information from
04:18
one cell to the others and the synaptic connections that identify how much information
04:25
is passed from one cell to another. One very simple artificial presentation of such a neuron
04:34
is given on the right identifying the four important functions of a biological neuron.
04:43
The input information via dendrites are shown by X, vector X. The synaptic
04:50
strength or weights are shown by W. The nucleus processing action is shown by the function
05:03
phi of sigma and the axon that carries the information from one cell to the others.
05:12
Here is an artificial neural network made
05:15
from the interconnection of many nodes the simple nodes I described in the
05:20
previous slide. This is the popular feedfort network which has been around since the 40s
05:29
more than a decade before the invention of digital computers and rule-based artificial intelligence.
05:37
However, the work was almost forgotten due to lack of a learning process. It was in the mid
05:46
80s that the supervised back propagation learning algorithm was developed to train such a network
05:55
from the functionality point of view, a neural network can be viewed as a black box to use data

06:04
as its input and provide knowledge as output as its output. If you are the manager of an operation
06:15
you may be interested in knowing what you can learn from your available data,
06:21
but if you are the one who are going to do the task, it is important that you
06:26
learn the topic before implementing any network. I'm pleased to inform you that
06:33
we do offer an artificial artificial neural network course here at the University of Maine.
06:41
So, we talked about being able to create knowledge from a neural network. Human intelligence
06:48
comes in the form of recognizing things that we have seen in the past, for example, recognizing
06:57
a person or being able to group things like being able to distinguish a car from a truck,
07:06
or an airplane from a submarine. We are also able to interpolate data and predict the future. For
07:15
example, if we see sufficient but incomplete data from an object, we may be able to state
07:22
what that object is. Or if we observe the path of a hurricane or know of the other and
07:32
know of the other factors affecting it, we can predict where it's going to go next. So I have
07:40
categorized the knowledge provided by a neural network into four categories - classification,
07:48
clustering, function approximation and prediction. For every one of these categories I have prepared
07:57
one example that I will present next.
08:05
Before giving the examples let's go over different steps in developing reliable
08:12
neural networks. First, we need to design the network architecture or the network architecture,
08:20
which involves defining the number of inputs, outputs, nodes and their interconnections.
08:30
Next is to train the network with a section of the data available to us, followed by verifying
08:37
that the network is capable of doing its job using the other section of the data,
08:45
and finally testing the network with unseen data that has not been used

08:55
in the training or verification processes.
09:00
I should say training and verification processes, not all.
09:06
The first example I present here is a supervised classification
09:13
to identify chromosomes in a cell. This work was done in collaboration with the Jackson Lab,
09:21
and to the left you will see mouse chromosomes in a cell under the microscope.
09:28
The task is to identify all chromosomes and arrange them in an organized karyotype on the left
09:39
for scientists to review. The input data to the network
09:44
can be an image or features of a chromosome. We completed this job with 88 percent accuracy
09:55
at a time where there was not any software to do the job, and if you google my last name Musavi
10:05
m-u-s-a-v-i and mouse chromosomes, you will find the scientific paper describing this work.
10:15
This example is also in the medical field and the task is prediction and identification of DNA
10:26
bases which are A, C, G and T. Given the DNA electrophoresis gel image as shown on the left
10:40
through the use of neural network, we not only predicted where the next base should occur,
10:48
but also predicted what it should be with over 98% accuracy. To the right you will see the
10:57
output of the software that we developed for this automated process we call the trace tool.
11:05
The green bars show the level of confidence in the identification of the bases. It is very
11:12
important, the confidence level is very important.
11:17
So again if you google up my name and DNA base calling,
11:26
you will see this work described in a paper. Further description of the job. So
11:33
this application presents an unsupervised learning. We were given

11:41
digital terrain elevation data or insured DTED from a region and asked to identify the watershed
11:54
with the watershed areas of the data. We designed the neural network and what you see
12:06
on the right is the output of the network showing the watershed areas in the image. In addition to
12:18
the obvious lakes and brooks the network also identified the possible flood areas after high
12:28
rain or melting the snow especially during the spring, earlier spring time. The aerial image of
12:36
this same area is also shown and given here for verification. The network did a pretty good job.
12:50
The pictures under the black box are different stages of neural network learning process.
13:00
Here is the background for a continuous process industry where raw materials are entered from one
13:08
end, the left, and the final product comes out from the other end, on the bottom right.
13:18
We have historically had many pulp and paper plants in Maine, but you can find similar
13:26
continuous processes in oil industries, flooring, ceiling tiles and many others, where the quality
13:37
of raw material is constantly changing due to the type and location of the raw materials used.
13:47
In a pulp and paper industry, waw materials could come from a variety of trees and a number
13:53
of localities, but the final paper product should always have consistent properties.
14:03
While we worked on digester refining and bleaching as I showed to you in the previous slide.
14:13
Here I'm only using two very important quality measures
14:18
at the end of this continuous process when the final product which is paper here comes out.
14:27
These measures are brightness and opacity. The top picture shows real brightness data
14:37
in red. The red again is real data that is coming out of the plant and the blue information

14:48
overimposed on the red is the prediction of the neural network
14:55
as what the brightness should be one hour in advance.
15:03
Similar results have been presented for opacity below. Why is it important to predict?
15:10
Because the operators can make corrective actions to ensure that the paper quality
15:17
is satisfactory at all times and there is no waste in the process,
15:22
exactly in the same way that is important to predict the path of a tornado or hurricane.
15:33
So, in conclusion and in the last 30 years we have worked on many other applications,
15:41
in the energy sector, smart grid utilities and NASA satellite imaging imagery. In fact,
15:51
as I mentioned before if you Google my last name and neural networks in general
15:58
you would see, I would say, about 60 to 70 scientific papers related to our works and
16:05
whichever is of interest to you, you can study. Below are some other examples and that is why
16:13
these days you will notice a significant surge in AI applications. I would end my presentation by
16:21
stating that wherever there is data neural networks can provide insight into the process
16:31
or event. Here at the University of Maine we do have expertise to help our state organizations,
16:39
industries, nonprofits and others to gain knowledge from their data. So with that
16:49
I am ending my presentation. Thank you for the time to listening to me and my contact information
16:57
is given as Musavi@maine.edu. Thank you again Ali. Thank you very much Dr. Musavi for the great
17:06
presentation. So as I mentioned the beginning of this talk if you're joining us a little bit late,
17:14
if you missed the first talk, we're gonna post the recording later on the UMaine AI website
17:20
and this series is sponsored by IEEE, as well as University of Maine. So let's go on to the next
17:27
talk as our next speaker is sharing his talks. It's my great pleasure to introduce Owen McCarthy,

17:34
President and Co-Founder of Med Rhythms, a digital therapeutic company that uses sensors,
17:40
music and software to build evidence-based neurologic intervention to measure
17:47
and improve walking. Owen has become a leader in the field of digital therapeutics, a member
17:53
of digital therapeutic alliance is developing evidence-based FDA regulated devices to treat,
18:00
manage and diagnose neurological injuries and diseases. Since founding Med Rhythm in 2016 Owen
18:07
has been invited to speak at digital therapeutics conferences and events across the country
18:13
including DTX west, DTX east, neurotech investing and partnering conference, partners
18:19
connected health conference, HLTH evercore ISI panel,
18:23
so without further ado I would like to invite Owen to the podium to start his time. All right,
18:31
really thrilled to be here and glad all of you could join us from all over the world. You know,
18:37
As Ali said I'm a proud UMaine alum and really glad that there's a lot of activity going
18:43
on in cutting edge innovation, and always thrilled to hear from, you know, people like Dr. Musavi on
18:50
their work and and things that are going on in our our university. So today my plan is to talk
18:56
a little bit about how AI is being used in sort of regulated healthcare. You know there's a lot
19:02
of applications that I'm not going to talk about where you know, AI is being used in
19:08
sort of drug development or defining care pathways or you know even at you know better
19:14
understanding DNA and in our genetic makeup, and so those will not be part of my talk today,
19:19
but what I'm really going to be talking about is what I'm seeing you know both through the digital
19:24
therapeutics alliance at med rhythms and you know with my colleagues in the field for things that
19:31

directly treat, manage and diagnose disease, that require some sort of FDA approval in oversight.
19:39
You know because those are you know this is some super fascinating trends going on there and so
19:44
as you know I mean you see headlines all the time that some of them might scare you about
19:48
how the machines might be taking jobs or these things are coming. And will
19:53
physicians be obsolete and rest assured I don't believe that physicians
19:58
will be obsolete and these things, the things that are coming will take all the jobs
20:04
but what's really happening and what we're really seeing
20:08
is a couple of different things in the field, and we're seeing physicians and doctors
20:14
and clinicians and other people in healthcare becoming more effective because of assistive AI
20:20
tools which I'll talk about some of them and then there's some autonomous AI that is coming out
20:26
that makes things more efficient. Though those right now have larger challenges both in terms of
20:32
approval pathways from the FDA and in terms of how it changes how products are are paid for and
20:40
reimbursed. And so here you'll find a chart that Nature just published actually, and I think it was
20:46
maybe last month for all of the FDA approvals for you know intelligence-based devices in medicine.
20:54
You'll notice actually that the majority of them actually fall in that radiology bucket
21:01
because as we know you know the systems that Dr. Musavi was talking about have been proven actually
21:09
pretty well at understanding imaging and doing image recognition and in radiology there's a
21:14
lot of images to understand. And so that's where you're seeing the majority of the the work these
21:20
days. But to break it down even further there has been 29 products approved

21:26
by the FDA that includes AI and machine learning. Eight of these do use a deep learning approach. 21
21:32
of them are in radiology and these products are sort of across the board where
21:43
the AI is actually being adapted in real time um you know to change the outputs of the algorithms
21:51
or there's a stepwise approach where the live version of the algorithm that might detect
21:57
what's happening on the image and the radiology is locked, but in the background, there's an
22:03
ML AI system that's making it better. They'll do a set of quality checks and then they'll re-release
22:10
another locked version of an algorithm and sort of a process and to date each of those sort of um
22:17
setups have been negotiated sort of on a one-off basis with the FDA. I'm going to spend maybe a
22:23
little bit of time trying to make it more concrete and talk about sort of use cases in dermatology
22:31
and this information and a lot of this comes from you know one of my colleagues who's at digital
22:37
diagnostics who's educated me a lot about in dermatology how AI can be used, and it's not just
22:45
take a picture of your skin and diagnose if you have cancer or not. So if you think
22:49
about teledermatology and if you have some sort of something that's happening on your skin and
22:56
you know, I actually do have something I have to get checked out, which hopefully it's nothing bad
23:00
but if you have something on your skin, the flow in health care is often you go to your
23:05
primary care doc who will check it out, give it a first pass then you get put into a maybe a remote
23:12
dermatologist to take a look and covet times or you go immediately to an in-person dermatologist.
23:18
Some of the challenges might be that to schedule a visit in some parts of the country

23:25
with a dermatologist, it might take six to twelve months but some conditions that you detect may be
23:30
more lethal in that time frame and so a first sort of pass for AI based systems is they're starting
23:39
to be rolled out and three durham this company I was talking about does this in primary care
23:44
where they'll take an image when you come into the office and then quality check if the image is good
23:50
of quality in the beginning before it gets sent to a remote durham to triage to see
23:56
what makes the most sense. The next level of that is if you add the the AI in
24:04
after that quality checkpoint at the primary care office it can sort of be like an urgent expediter
24:10
where it says this is melanoma or this is a basal cell please see a dermatologist immediately, or
24:18
it might you know, it's as Dr. Musavi said, it's probably it's 80% likely this or 70%
24:24
likely this there's some sort of threshold though there that it has to hit to
24:30
get over that point to jump the line and then a real dermatologist can make the call. And you'll
24:35
see this a lot and it continues to be more of a trend for how these sort of things roll out,
24:41
but the next case is and this is what they're working on at digital diagnostics is
24:47
you know, the auto triage where the FDA would approve an algorithm that says you know this can
24:56
diagnose this condition, this condition and this condition, and if that image is taken whether it
25:03
be at primary care or in home, though there's some challenges more challenges there, that it can jump
25:10
the line with the system that takes you know a learning approach to drive someone directly to
25:17
an in-person dermatologist. So those are those are some of the types of things that that you
25:23

know we're seeing you know there's there's also applications where there's this company called IDX
25:29
that has a you know eye image software that can automatically detect diabetes retinopathy
25:37
that really you know kind of it follows this same path where it can take an image, and then triage
25:45
it instead and diagnose you with that and then get you the right care at the right time. In
25:51
all of these cases you know there's still a human in the loop, you know at some point down the line
25:57
they might be remote instead of in person, but but there's still a human and a lot of loops because
26:03
there's it's more complicated than that like one niche area that's being diagnosed and you
26:10
know that will likely sort of flex over time, but it's it's you know it's important because
26:16
if you think about I mean I don't know, you know all you're familiar with the healthcare but if
26:21
you pick a profession in healthcare - nurses or probably radiologists or physical therapists you
26:27
know there's always a shortage you know every area particularly enrollment particularly where it is
26:32
there's a shortage of them. They're always booked out a long time and so tools that can
26:39
either make them better make sort of individual diagnosis that get that can better treat patients
26:44
or better diagnose patients will not only help you know, they're not going to replace jobs. They're
26:51
going to really alleviate sort of the tension of we need you know 40 percent or 25 percent more
26:58
physical therapists or other things like that. So it's a really exciting time you know as as
27:03
these come and help you know these tools become you know the tools that have been invented
27:09
since the 40s as Dr. Musavi said and then you know took hold in the 80s and now computing
27:15

power allows us to do them better in real world now are coming to fruition, you know they're
27:20
really changing the landscape, you know some of the considerations though you know if you were
27:25
to look at from you know taking it to market or if you're building technology in the market that
27:30
that still need to be sorted out are there are
27:36
five of them that I think need to be sorted out you know across the spectrum. And there's
27:42
some instances where where real world clinical data is messy because the
27:51
inputs, the differences between the image that's taken makes all the difference whether or
27:58
not something is detected in something like a hair or something else in the the image on the skin
28:04
could really change how some of the algorithms really detect. So you know what 3 arm found was
28:10
you know their their goal would be to get the webcam the camera here that for the
28:16
for the picture to be used for the for the input. However for now they're they're doing
28:24
a more controlled approach in a primary care office because they found that the quality
28:28
wasn't as good, maybe that maybe a generation or two before you know some of the phones that came
28:35
out and because of the data coming in and so you know that's a real constraint on any system is the
28:40
the the quality of the inputs particularly as you put it in the real world. And then next
28:47
is there's actually a whole class of products that are coming out and trying to go around
28:54
the FDA regulation, which some of it might be good and some of it might be bad, but
28:58
what they're doing is they're taking data, providing information, giving it to
29:05
a non-specialist and allowing them to try to make a determination based on that. Some of them could
29:10
and some of it may be okay, but the more you do that the more likely you
29:18
maybe lose control over some of the regulated nature that may be necessary

29:23
if you're really dealing with life or death or someone's health and so that's something
29:27
to keep an eye out particularly as you might find. Bad actors or people that that that don't
29:35
you know understand the quality controls on health care. The other one is, back to inputs is,
29:41
you know there is there's a real challenge across even clinical trials, but if you think about you
29:48
know AI-driven dermatology that there's a lack of diversity in terms of the pictures and things
29:54
that have been training these algorithms and so you really would you wouldn't want to leave by you
30:03
know behind ethnic groups or other groups in terms of you know how they're being treated and so it's
30:08
something to really put some thought behind both on the you know if you're a policy person on the
30:13
policy angle as is and how to how to be inclusive in the development of these technologies,
30:18
or if you're a technologist and you're developing software that uses these things,
30:25
that you really think about how inputs could be different and how treatment could be different
30:30
based on someone's, you know background so that's something that needs more sort of more
30:37
focus. And then finally I did mention you know nine there's you know there's been 29
30:43
approvals through the FDA. Each of those have sort of been negotiated separately in terms of
30:48
how you set up the frameworks for regulating the algorithms. The FDA right now is coming out with a
30:57
with what they call a document, the framework document that they publish as a draft last year
31:03
and it should finalize soon that talks about sort of how as a manufacturer of software a builder of
31:09

software that uses AI in treating, diagnosing or managing diseases, you can set up frameworks to be
31:17
able to allow it to adapt and change and not have to meet with them you know over and over again to
31:23
individually come up with a plan for that, sort of come up with a blueprint. So that's something
31:27
to watch and that will could drive innovation. I will mention you know the FDA has actually
31:33
been pretty forward-thinking as it relates to software as a medical device and AI-based systems
31:39
and just created a center for digital health excellence, I think last week. And they're
31:44
really I mean they're really thoughtful in this regard, but also you know take keep in mind the
31:52
you know that there's an efficacy and safety risk and benefit for patients that needs to be
31:57
evaluated you know through these processes but they're definitely forward thinking there. And
32:03
then finally I think the last frontier one of the last frontiers to say will these type of
32:09
systems scale in a way in healthcare and really transform is how things get paid for. You know
32:15
the if you think about I mean we're now maybe outside of like tech and AI, but if you
32:21
think about a system you know the back to those scare tactics and in the articles it says are the
32:27
systems coming for your job. Well no, is my answer because there's plenty of flex there however
32:34
you know the way health care gets paid for is really set up by in the US by insurance companies
32:39
public and private and they have a really rigid rules around what can get reimbursed and by who,
32:45
and if a software system is doing the full diagnosis of melanoma,
32:50
but the treatment might go to a dermatologist, you need to create new ways for incentives for
32:55
like you getting paid for that versus getting paid for a clinician's time for that, and if you do

33:00
that improperly you could put the the technology up against the clinician and make them, make turn
33:09
it into a policy lobbying war instead of a what's better for the patient. And so you know medicare,
33:15
Medicaid is thinking about this and so are private insurers but it's going to be - I think you
33:20
get that figured outright, you're going to see a lot more innovation in this space. So that's
33:26
you know, that's my you know my quick sort of view of what I'm seeing
33:30
in the real world. Look for the Q and A period and thankful for the opportunity to talk Ali.
33:37
Thank you very much Owen for the interesting talk. Again those who are joining us late all of
33:43
these talks will be recorded and posted on the UMaine AI website. Please don't forget to post
33:48
your questions on the Q & A feature and we'll answer those questions right after the next talk.
33:55
So our third and last talk for today is delivered by Dr. Somayeh Khosroazad.
34:02
She received her BS and MS degrees in Eelectrical Engineering from Ferdowsi University of Mashhad
34:08
in 2006 and 2009, and her PhD degree from University of Birjand in 2017. From 2018 to
34:16
2020 she was a signal processing specialist at Activos diagnostics and a post-doctoral
34:23
research fellow at the department of electrical and computer engineering at the University
34:27
of Maine. She's currently liberal visiting diversity professor at the University of Maine.
34:33
Her research interests include theory and development of wireless communication system,
34:37
wireless sensor networks, artificial intelligence techniques, modeling, analyzing and optimizing
34:43
new wireless systems. So without further ado I would like to invite Dr. Khosroazad to the podium.
34:50
Thanks very much, thank you for the introduction and let me share my screen. Good afternoon
34:58
or good morning everyone that is depending on which times you're in.

35:02
The subject that I want to talk about that is the applications of AI in healthcare and environment.
35:12
As you know artificial intelligence or AI refers to a computer imitating intellectual
35:18
processes characteristic of humans to learn from past experiences and reach goals without
35:24
being explicitly programmed for a specific result. Today, AI is one of the most attractive subjects
35:31
that all over the science world talk about and try to solve problems with this new tool.
35:36
There is no doubt that ai is a strong tool to escape some of the disabilities or weaknesses
35:43
of human beings to solving and solving complex or very time consuming problems.
35:48
In many areas, however, much work needs to be done to bring out AI from papers or simulations
35:56
to the real world. The most basic or perhaps the simplest perception that the general public
36:03
has of artificial intelligence is face recognition or a little more general case, image processing
36:10
or speed or voice recognition, meaning that there are some algorithms in which the computer
36:16
is trained to classify data after receiving some information and prototypes, and then for
36:22
any new data it tracks the pattern which has been trained with it to detect the classification of
36:28
the new data. However this is this is definitely not the most impressive attraction of AI.
36:38
What makes it the most attention getter is that it is a pervasive in all science in all
36:45
sciences and a a wide range of applications. Here, given the limited time that I have, I just want
36:53
to focus briefly on the application of artificial intelligence in wireless communications, wireless
36:58
sensor networks and healthcare applications. We all know that the world is moving towards
37:05

internet of things or IOT awards in which wireless sensor networks continuously exchange information
37:12
among a large number of devices, and all these devices work simultaneously.
37:18
And the goal is monitoring and controlling some specific parameters in the systems. Obviously,
37:24
for such applications AI conceptually could be a tremendously useful tool
37:30
for increasing the speed of processing data, as well as decreasing costs and energy.
37:35
However, one important question is how much today and in the near future AI is powerful
37:42
and trustable to be applied for more serious application applications in the real world.
37:51
Let me categorize AI problems from a specific view to two groups. Some
37:56
specific problems in which a huge amount of data is collected and AI supervised or unsupervised
38:04
tries to classify the data to multiple groups by finding one or more thresholds or some limits
38:10
based on all statistical and probabilistic logics that are predefined for it. In such matters,
38:20
in such matters, AI directly force fit the data. In this case, the distinctive feature
38:25
of artificial intelligence is its accuracy and speed to search for all possibilities
38:31
and choose the best solution considering again, some predefined general statistical criterias.
38:41
There is another type of AI applications however in which some kind of pre-processing needs
38:47
to be done before using AI, means that the classification is not done on data directly,
38:54
but it is done on some other features that should be extracted from the data first,
39:00
and for extracting these features a sort of knowledge and expertise beyond AI is required.
39:09
I would like to clarify this ladder case with an example from our sleep monitoring project which
39:14
is being done at activist diagnostics company in collaboration with two engineering and psychology
39:20

groups. In this project a sleep move device is used which is a wireless device commercialized
39:27
by activist diagnostics. This device is capable of collecting data from various types of
39:34
piezo-resistive sensors deployed in a network to improve the dynamic range of sensor arrays and
39:41
satisfy the requirements of feature detection and extraction from the collected neuromotor
39:48
signals. Hardware and software integrate movement and respiration variability using a fast normal
39:55
motor about detection algorithm. Obviously, there are some pre-processing and screening
40:02
design stages that should be done first, like denoising and choosing the most informative data
40:08
among the data achieved from all sensors at each moment. But after that the question is
40:15
what we have and what we are looking for. What we have is body movement signals during the sleep,
40:21
and what we are looking for is early detection of alzheimer's disease.
40:30
In such a situation, the body movement signals depend on so many different factors, that even
40:38
physicians cannot make any prospects about the result factors like age, weight, position of the
40:46
body during a sleep which is based on the habits of different people and a lot more. In hospital
40:54
sleep studies utilizing many non-energy signals to characterize a sleep disorder
40:59
like eye and body movements, respiratory frequency or volume cardiac variability and so on,
41:06
show there is a strong relation uh relationship between sleep disorders and neurological status,
41:13
and fragmented sleep results in the impairment of cognitive function
41:18
or disrupt autonomic nervous system regulatory processes
41:22
during their sleep periods. However, there is no definitive algorithm to assist in diagnostics.
41:31

In such situations,
41:38
in such a situation where pure data have a very high dispersion compared to the amount of
41:44
available data and there is no statistically direct relationship between the data
41:50
and the desired output. This is necessary to first extract some more informative and
41:57
relevant features from the pure data and then use AI tools to classify these features.
42:06
What we did for this project is the whole two nice data are separated into 10 minutes
42:14
epochs with epochs with one minute overlaps. This window size is chosen based on the number of
42:22
sleep-related spontaneous movements with a periodicity of three to five minutes yielding
42:29
two to three events in each 10 minutes epoch, then considering the properties of spontaneous movement
42:36
signals and respiratory signals which was taken from expertise of psychologists and physicians.
42:43
Some filters were designed to separately
42:47
extract respiratory and movement signals from the raw data. The next step was extracting important
42:56
features from these two signals. Movements induce physiological of regulation of cardiorespiratory
43:04
rate to maintain homeostasis a process that may be indexed by the respiratory rate change.
43:11
The first analysis tracks the similarity of the changes in these two signals in other words,
43:17
to see how movement and respiratory signals affect each other the correlation.
43:25
The correlation between them
43:29
is calculated. In general correlation describes the mutual relationship
43:33
which exists between two or more signals. The cross-correlation of the two signals is maximum
43:40
at the time that equals to time lag. This time lag is considered as an important feature.
43:50
Some other features then are like sleep duration and fragmentation estimates or maximum amplitude

43:57
which were perceived to be related to brain activities, were extracted and then these features
44:05
plus some other information like age and weight were used as the inputs of the AI tools and now
44:14
these extracted information could be used as the input of AI tools to be processed and classified,
44:22
and as you can see now by using this processing algorithm AI could give us,
44:29
88 percent accuracy in early detection of Alzheimer's disease.
44:40
In general what I want to highlight is AI is a strong tool for deep learning, but as they say
44:49
it is not half it does not have necessarily a deep sight for solving the problems. What do we need
44:56
for make it more applicable and trustable for the real world is to learn how make right connections
45:03
among experienced expertise and AI tools. Thank you for hearing me and I'm looking forward
45:12
to any question you have and let me thank you Ali. Thank you very much Dr. Khosroazad for
45:20
the great presentation. I'm glad to see we had a very sort of wide range of applications kind
45:27
of covered today so hopefully that inspires you to ask some relevant questions. We started from
45:34
Dr. Musavi's talk which was basically the history of UMaine working neural network and the basic and
45:40
fundamentals of AI kind of gives you an idea of what people need to learn to be able to retool for
45:46
future jobs. And then we had a new application that Owen covered for us and then the final
45:53
applications that Khosroazad was talking about is basically moving on to the direction
45:58
of personalized health care and using AI for different kind of diagnostics. So let's get into
46:07
the Q & A session again if you have questions, don't post them in the chat window just post them
46:12

in the Q & A session. And I will start with the first question here and all the panelists you can
46:20
maybe turn on your video so you can answer live. I'm directing the first question to Owen McCarthy.
46:27
The question is from Jared. You talked about AI as a job modifier without much effect on the number
46:33
of jobs in the healthcare field. Could you talk about what kind of maintenance these AI systems
46:38
require and would they require specialized roles within an organization to train and maintain?
46:45
Yeah okay thanks Ali and Jared. Thank you for your question. You know I think,
46:51
I will say I don't have a crystal ball to say how it's all going to play out so I love
46:54
everyone else's thoughts on this as well, but you know I think
46:58
where the specialized roles will fall will be likely with the manufacturers and I put that in
47:03
quotes because they're building software so you know they're software development manufacturers.
47:09
You know there's going to be a heavier need on you know their you know if you think about the
47:16
traditional quality engineering group that you'd have at, in a software shop. There's going to be
47:21
someone that's on the teams that are really crossing over from quality engineering for
47:27
the software but also on the regulatory side and has the combined knowledge and so I can see that
47:32
as a specialized role in an organization. And then what's it mean on the health care people
47:39
and their jobs, you know. That's it's going to be an interesting one to see how it plays out because
47:44
you know, will it mean they'll get to spend more time with their patients sort of
47:48
on you know and and start having to you know right now it's a very like structured you have
47:54
10 minutes, you come in, you have 10 more minutes you come in. Would they have more time to work on
48:00

lifestyle changes or other things at the clinical level because some of these other things will be
48:04
taken away? Maybe. Will it allow for services like Lavongo etc to offer full digital connected care
48:12
no matter where you are? That's also a trend so in which then the jobs might turn into some more
48:18
remote jobs or more you know, clinicians that that understand different data streams that can make
48:25
better decisions on them coming through. So Jared, I don't know the exact answer to your question,
48:30
but there's some there's definitely some threads that you know that will change. But I think
48:37
related to AI i think the the specialized roles will rely within them will be exist within the
48:43
manufacturers likely of the the products. Thank you Owen and while we have you here on video let
48:50
me ask you another question before we go to the other panelists. So there is also another
48:55
question from Marie. What is your company's experience with FDA and CMS? Yeah no thank you. So
49:03
we have had I think eight interactions and maybe nine now with the FDA related to our our initial
49:11
product which is helping people improve their walking following stroke. It's in our pivotal
49:16
trial stage and those interactions have been in like what they call a pre-submission meeting,
49:21
so you meet with them to get their buy-in about the approach that you're taking, and so we in and
49:26
to do that you have a host of consultants and other folks that you work with and it's been
49:34
very collaborative, very positive. We're fortunate enough, earlier this year to get breakthrough
49:39
designation for our stroke product which means that the FDA believes it could better treat an
49:48
irreversibly debilitating disease more effectively with a full unmet need there. So that was thought
49:55

that was helpful and then on the CMS side you know we've you know the more you know about healthcare,
50:01
you realize the less you know, but we've been diving in to you know the is there a code,
50:08
like how do you get paid, like how does it fit into the legal requirements, and
50:13
we've got sort of we've done some analysis sees with people that used to work with at CMS and
50:19
then also with internal teams for how the product could roll out. We just, we've also been able to
50:25
comment on a rule that just got released that will automatically reimburse for breakthrough status
50:31
designation products for approval for four years from CMS which we believe that could be really
50:36
positive for our stroke product. And we've so on the policy side we've been working with that so
50:41
it's a policy slash you know strategy angle with CMS but we've had some interaction there
50:49
but as I might have mentioned you know from Marie feel free to reach out, I'm happy to talk about
50:53
all these things offline as well. Thank you very much, Owen. So next question is for Somayeh.
51:01
So what is the impact of AI with next generation communications networks.
51:09
Sure I was just typing the answer for this question because I saw the question
51:14
and I can say it has definitely a great impact on the next generation because most important
51:23
most important topic of the next generation is as I told, internet of things. When sensor networks,
51:31
wireless sensor networks has a really important role in this subject and when different
51:39
devices are working with each other simultaneously and they want to extend their information
51:47
and we need to control and monitor different parameters in such a big and large network.
51:56
AI can help a lot because it is an intelligence,
52:03

artificial intelligence and it can it should be actually designed in somehow that
52:09
can be estimate some specific changes in this network and give us some good estimations about
52:17
future and how these devices work with each other without controlling by human beings directly
52:30
at the AI tools need to be are designed for such a great and large network to
52:37
do the best for controlling ammo entering such a system.
52:42
Very good thank you very much. So the next question is for Dr. Musavi. It's a long question. So
52:50
basically it refers that you're teaching to the neural network to their students. Recently we
52:56
have pretty solid solutions for deep neural network and machine learning in general over
53:01
cloud, whereas machine learning looks like a plug-and-play of some blocks. If the goal is
53:07
to prepare our students for job market, do we still need to teach them theories and concept
53:14
or do we need to teach them how to work with these clouds cloud-based applications? I mean do we need
53:20
to teach them how to use python libraries and so on or we need to focus on how to use cloud-based
53:27
systems? Thank you Ali and thank you for the question. Yeah that's a very important question.
53:34
It depends on what you are looking at. Of course cloud computing
53:42
and available software is important to use but we have gone through this many times in the past,
53:48
that people use available software online and provide their data to the system and they don't
53:55
get the result that they want, and of course I try to avoid using this terminology, but some
54:02
people call it garbage in garbage. If you do not have the knowledge of how the system is working,
54:10
then you the result that you may get you just looking at it from a
54:17
dark point of view, not having inside information. Therefore, I suggest that again,

54:24
if you have an application and if you want to give it to cloud computing or available software go for
54:30
it. If it gives you the result that you want you're all set you don't need that knowledge.
54:35
However, if you are encountering difficulty honestly, you need to go ahead and
54:42
have at least a knowledge of neural network. So that is what my experience has been.
54:50
I think I don't want people to lose their trust in neural network because not knowing how to handle
54:57
it and at the same time, I think you want to tune to our next presentation. I believe is next week
55:06
or next month. Next month when we have one of our faculty members talk about deep learning and big
55:14
data and that's so we offer both courses. We offer courses in application audience that
55:22
and we also offer courses in what's under the engine, what's under the hood. So
55:29
hopefully I was able to answer your question and again as I said over my 30 years I have
55:34
gone through this process many times. I had people who said I don't need this knowledge
55:39
and I can go ahead and use this but then after a couple of, a month came back to me and said
55:45
this doesn't make sense I'm getting garbage out. So it depends on what you are looking at
55:51
and what your application is. Thank you very much Dr. Musavi for answering that. There is
55:56
also another question I'm going to direct this one to Owen McCarthy. So how do we keep the algorithms
56:03
produced via public funding free for advancing future AI developments in a world where increased
56:09
governmental regulation intellectual property rights etc are locking the code. Additionally
56:16
how do we keep health care processes down as if these algorithms are adding more costs? Yeah
56:23
thank you, so the second part of that question you know I think comes down to this really
56:28
that's more of almost a policy angle because the the problem you often see in healthcare is people just

56:35
add things and that you know because no one wants to lose anything. It's additive. However you know
56:43
now in COVID has highlighted this. Now that we can treat anyone wherever they are and like treat them
56:50
per in a personalized way and maybe even prevent, you should keep long-term health care costs down.
56:57
And to do that like the technologies will enable that to happen and then it comes down to you know
57:04
a policy angle for how then the health care systems adopt that and you know that's you know
57:11
that's a bit outside my pay grade for that one you know that's and gets political real fast on
57:18
how that can happen. But but the the technologies under themselves will make efficiencies and stop
57:25
things from happening you know like you know or you can treat people earlier before they get
57:32
things to happen and so it should keep health care prices down but it's gonna require some some swift
57:38
policy work and on the intellectual property side you know I think that's a place where
57:43
you know there's two things you know the the there's actually if you're a software developer
57:50
you've unto yourself over time said we believe in the open source movement and that's how we build
57:58
a lot of things and we care about employers in places that can that continue to do that
58:05
so I think that attitude will force companies from to at least keep some things from being
58:11
locked down. And then places like University of Maine play a huge role in that because you are
58:17
you you're an institution and we're an institution that does research for the public good and
58:23
you disseminate that information through papers and other ways and so there's a huge role for
58:29
higher education to lead the charge in advancing the future in AI development. Thank you very

58:36
much Owen. That's all the time we have for today the rest of the questions will be posted online
58:41
again. I would like to thank all our panelists for presenting the talks today. I also want to thank
58:48
the staff at The Office of Vice President for Research who have been running this
58:52
in the background Mindy, Tilan and Liz, as well as search from UMaine I.T to help us
58:59
make sure there is no technical issues. Again thanks to sponsors and promoters of this event
59:04
IEEE from all over the world our colleagues in California in Silicon Valley, in Boston section as
59:11
well as Bangalore in India and Shenzhen in China. I would like to invite everybody to attend our
59:17
future AI webinars first Thursday of the month at noon time eastern time. Our next event is
59:23
happening on November 5th and the last one for the fall will be December 3rd with more
59:28
interesting talks to come. My name is Ali Abedi I'm Assistant of Vice President for
59:32
Research at the University of Maine. I would like to thank everybody for joining us today
59:37
and hope to see you in future events. Thank you and have a great day everyone.

The University of Maine in Orono is the flagship campus of the University of Maine System, where efforts toward racial equity are ongoing, as is the commitment to facing a complicated and not always just institutional history. The University recognizes that it is located on Marsh Island in the homeland of the Penobscot nation, where issues of water and its territorial rights, and encroachment upon sacred sites, are ongoing. Penobscot homeland is connected to the other Wabanaki Tribal Nations — the Passamaquoddy, Maliseet, and Micmac — through kinship, alliances, and diplomacy. The university also recognizes that the Penobscot Nation and the other Wabanaki Tribal Nations are distinct, sovereign, legal and political entities with their own powers of self-governance and self-determination.