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

University of Maine Artificial Intelligence Initiative

Institute of Electrical and Electronics Engineers Maine COM/CS Chapter

Foundational AI Research – Applications of AI in Business, Industry, Government, Healthcare and Environment
Session: 2
Applications of AI in Business, Industry, Government, Healthcare and Environment

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Panelists: Kay Aikin, Co-founder of Introspective Systems
Sepideh Ghanavati, Assistant Professor of Computer Science, UMaine
Yonggang "Tim" Lu, Harold Alfond Associate Professor of Business Analytics, Maine Business School
Auroop Ganguly, Professor of Civil and Environmental Engineering, Director of the Sustainability and Data Science Laboratory, Northeastern

The University of Maine Artificial Intelligence Initiative (UMaine AI) is a unique Maine-based venture that brings together university, industry, government, and community collaborators from Maine and beyond to advance the field of artificial intelligence, and through development of innovative technologies and applications find transformative solutions to enhance human life and societal well-being in Maine and beyond.

Transcript is machine generated, unedited, in English.

00:00
so the application of AI in business
00:02
industry government healthcare
00:04
environment is the next panel I will
00:06
start off with a few examples of some of
00:09
the research that we have been doing at
00:11
humain starting from a space
00:13
applications in the past six to seven
00:16

years through multiple different
00:18
projects funded by NASA we flew the
00:21
first artificial intelligence software
00:24
to international space station all
00:26
hardware was built by University of
00:29
Maine students they were all tested by
00:31
NASA and flight certified by Boeing we
00:34
launched this to space to find tiny leak
00:38
locations inside international space
00:40
station by listening to the ultrasonic
00:43
sounds what a postdoc to PhD a student
00:46
to master student several publication
00:49
invention disclosure came out of this so
00:51
the point I want to make here is that
00:53
solving problems is one fourth of they
00:57
all work that you're doing here but the
00:58
most important mission at the University
01:01
of Maine is to actually educate the
01:02
workforce and educate their students for
01:04
the next phase so look at the next slide
01:09
we look at the host care applications
01:11
University of Maine in collaboration
01:13
with a startup company it's been knocked
01:16
out of humane actually was diagnostics
01:18

and Northland Lloyd tells one of the
01:21
largest healthcare systems it may have
01:24
been working on using artificial
01:25
intelligence for detecting Alzheimer's
01:29
disease and related dementias so
01:31
recently after almost a decade of
01:33
prototype development the past two years
01:36
we have had the National Institute of
01:38
Health contract because that hundred
01:42
patients with mild cognitive impairment
01:45
prions Eimer and maybe a little bit
01:48
deeper into a service disease with
01:50
wireless sensors embedded into their
01:52
mattress pad so it was the homecare sort
01:55
of technology that was being tested on
01:58
hundred patient trained the system by
02:01
physicians at Northland Lloyd Hospital
02:04
and we were very excited to see over 95%
02:08
accuracy when they or can detect things
02:11
in your sleep pattern that
02:13
mr. C's Nexus slide is an application of
02:17
a in environmental scenarios this is a
02:21
new project funded last year in the next
02:24
three to four years we are going to
02:26

build and instrument the forest
02:30
ecosystem with different kind of sensors
02:33
for measuring soil moisture measuring a
02:36
snow depth measuring carbon cycle and
02:39
all that and they are my key ear will
02:42
help us
02:48
in two different bed throughout the year
02:51
to be able to actually create wireless
02:53
sensor networks that can operate
02:55
throughout the entire year not just for
02:59
a few months because of their in
03:02
efficiency in the wireless Channel we
03:04
also provide this data to the foresters
03:06
for monitoring the forest ecosystem this
03:09
is a National Science Foundation project
03:11
in collaboration with the school of
03:12
forest resources University New
03:14
Hampshire and the next Miss Lloyd
03:18
basically talks about business and
03:21
industry application we are working with
03:23
the Maine based industry company called
03:26
lde electronics that has one of the
03:29
largest contract with quick service
03:30
restaurants and we're trying to help
03:32

them with building multi type sensor
03:35
networks that they can detect with much
03:38
higher accuracy than current systems the
03:41
cores and different kind of trailers and
03:45
cars coming in the drive through of
03:48
different restaurants and we are going
03:50
to apply the same methodology for
03:53
automobile detection for self-driving
03:56
cars etc so don't want to take too much
03:59
time you just want to kind of give you
04:01
some overview of things that are going
04:03
on at UMaine in the past decade or so
04:06
apply they are in electrical
04:08
accomplished in GT Baartman and without
04:10
further ado I would like to pass the mic
04:13
to our first panelist dr. kay Aiken
04:16
co-founder and CEO of introspective
04:20
systems to talk about her exciting
04:22
research ok take it away I don't think
04:28
my video is on yet by the way Olli thank
04:30
you for the promotion but I am one of
04:32
the few non PhDs here I have a Bachelors
04:36
of Engineering in energy systems so I'm
04:39
gonna do a really quick summarization of
04:42

research that was mostly funded by the
04:45
Department of Energy but also a
04:47
foundation in Israel called the Burn
04:49
Foundation which is a joint
04:51
collaboration between US companies and
04:54
Israeli companies next slide
04:59
so a lot of talk has been about most of
05:05
this world wanting to get to renewable
05:07
energy Maine is now has initiative by
05:10
Governor Mills too by 2045 to be 100%
05:14
renewable and that's just not what her
05:16
percent renewable in the my video is
05:20
apparently not working thank you is what
05:25
our one our percent renewable in across
05:28
the entire energy use so that is
05:30
including the electrical system
05:32
transportation process heat and space
05:35
heating for our homes and businesses
05:37
this is actually making the electrical
05:44
infrastructure very very complex and one
05:47
of the ways we can solve this problem is
05:49
using artificial intelligence the work
05:52
we're doing with the Department of
05:53
Energy is to design a new architecture
05:57

that can be rolled out in the entire
05:58
United States the advantages to it is if
06:03
you try to do a centralized system you
06:06
would end up with so many separate
06:09
agents so many individual nodes that you
06:12
would have to control that the computing
06:14
power required would be astronomical and
06:17
be unable to be able to solve a problem
06:19
so we've actually building an
06:21
architecture using artificial
06:23
intelligence to split the grid up into
06:26
many many small cases so you can think
06:28
of one small area would be your house
06:31
and then the next area would be your
06:33
neighborhood and the next area would be
06:35
from your substation down and then it
06:37
would be a part of the state and then
06:39
the entire state and this is actually
06:42
how ecosystems work ecosystems are all
06:45
autonomous individual agents that work
06:48
together to solve a global optimization
06:50
problem and that is living so the idea
06:55
is biomimetic it requires distributed
06:58
intelligence and in this case
06:59

distributed AI has aspects of being
07:03
adaptive just like an ecosystem and is
07:06
also fractal numbers in multiple layers
07:07
next slide
07:15
so the biggest problem in this area is
07:18
how do you coordinate the control how do
07:21
you not have runaway conditions working
07:24
across the entire system
07:28
some people might remember the 2003
07:30
blackout in New York City over the most
07:33
of the Northeast where a single one
07:35
error caused a blackout over 10 or 12
07:39
states so what we've done is actually
07:43
use brought two areas together control
07:46
theory and economics into one type of
07:50
algorithm that is able to use
07:52
market-based constructs market-based
07:54
economics to actually manage the flow of
07:57
energy this idea uses the sub
08:01
optimization of breaking the electrical
08:03
grid up into multiple layers and then
08:06
pricing gateways that actually price
08:09
power at the local area based upon the
08:15
scarcity or amount of power that's
08:18

available next slide very quick review
08:23
some of the control theory people will
08:25
recognize this this is actually called
08:27
the bellman equation this is a subset of
08:30
that using the idea of adaptive dynamic
08:35
programming which was formed early in
08:37
the 1980s our particular special sauce
08:42
is we have both online and offline
08:44
learning that are continuing to learn
08:47
and evolve on the grid as they're
08:50
working this class of algorithms are
08:54
very very good at solving
08:56
multi-dimensional problems that are up
08:59
till now have been unable to be solved
09:01
one of them is a prime idea that a lot
09:06
of the AI researchers have talked about
09:08
is the Traveling Salesman problem of
09:10
having a hundred places to stop at and
09:14
finding out what the quickest route is
09:15
to do that as quickly it's possible this
09:18
is actually a very very hard problem to
09:20
solve and these classes of algorithms
09:22
have worked on solving those
09:26
this form of ATP allows that
09:29

consistently allows the system he
09:30
evolved as me as time progresses next
09:33
slide this is actually a real-world
09:37
example of the research some of you
09:41
might have heard about micro grid being
09:43
developed on the Isle of Iowa and in
09:49
that case where we're using a 300
09:52
kilowatt solar array a one megawatt hour
09:54
storage facility of battery as well as
09:59
20 over 20 heat pumps that actually help
10:02
balance the grid and what is driving the
10:05
decision-making for those devices is
10:08
actually a price signal and that price
10:11
signal prices power at in real time
10:16
using AI to try to balance the system so
10:21
there's enough power at all times so
10:23
when when power is scarce sumption will
10:26
go down heat pumps will start turning
10:28
off and production will go up now where
10:29
does a battery will provide more power
10:31
and when power is abundant consumption
10:33
will go up basically shifting power used
10:37
to a different time and and production
10:39
will go down so all have that and we'll
10:41

go with the questions
10:42
thank you very much K for this slide so
10:47
let's move on to the next today please I
11:00
so I we have privacy engineering
11:04
regulatory compliance lab thirsty lab at
11:08
UMaine that we deal with different
11:10
aspects of protecting privacy of
11:12
individuals at the age of AI and we deal
11:17
with basically making sure that the
11:20
applications they don't collect and use
11:23
or process personal information without
11:26
the users consent next slide so
11:33
one of the advancement of AI size like
11:37
mobile applications they collect lots of
11:39
a massive amount of information from the
11:41
users and they process those betas and
11:44
lots of times they might violate privacy
11:47
of their individuals and for example
11:51
they might collect record the audio
11:55
without permission or they might for
11:57
example collection location with I was
12:00
like you even know it and what we were
12:03
doing at person Eli we try to solve
12:05
these problems of protecting personal
12:07

information even though the applications
12:10
use and process those information for
12:13
their purposes makes light however
12:18
protecting personal information is not
12:20
easy one of the factor is that
12:22
governments impose those on developers
12:26
that they need to give notices to the
12:27
individuals that what are they
12:29
collecting what they're doing and how
12:32
their applications are using these data
12:35
to create these type of notices you need
12:39
a lot of efforts because first of all
12:41
you need to have some legal backgrounds
12:43
and getting legal experts are very
12:45
expensive and the applications stay
12:48
constantly updated the laws also getting
12:50
updated and it's not very easy for
12:54
developers to match their application
12:57
behavior with with what actually they
13:00
give notice to the user and in person
13:04
what we try to resolve these problems by
13:06
developing some frameworks that
13:08
basically tries to instead of just like
13:13
writing their privacy notices tries to
13:15

translate directly what happens in the
13:18
applications international language
13:21
statements related to privacy so instead
13:24
of that Eva developers use some privacy
13:26
generators that they just create
13:29
inconsistent and generic application we
13:31
try to resolve this problem next slide
13:34
please
13:36
and one of the project that we have is
13:39
basically developing a recommender
13:42
system that goes from the code segments
13:45
of the application
13:46
into some statements like what you see
13:49
on the slides just very simple
13:51
statements that the users and the
13:53
developers they will understand next
13:55
slide and as I said for this we are
13:59
using the AI techniques and we are also
14:02
protecting the data so the advancement
14:05
of AI we're still protecting the users
14:07
so that they have both of the balance
14:09
between getting benefit from their
14:12
techniques that's AI offers and also
14:15
protecting their individual privacy next
14:19

slide so we have like several projects
14:25
like one of them is related to Android
14:27
application you're also dealing with
14:29
Internet of Things and blockchain to
14:31
protect the individuals privacy in
14:33
healthcare in smartphone environment and
14:37
we are also looking at the regulations
14:40
to make sure that these privacy
14:42
statements are also compliant with the
14:45
regulations and we have four phases for
14:48
this project and several of our PhD
14:52
students and undergraduate students are
14:54
dealing with this project next slide
14:59
so the can main contributor at the
15:02
moment of the project the senior privacy
15:05
research scientist from Google we have
15:07
two PhD students involved in the project
15:09
and several undergraduates are also
15:11
working to develop such application to
15:15
protect individuals privacy thank you
15:19
thank you very much today
15:21
so next step panelist is dr. Tim Lu an
15:25
associate professor of business
15:27
analytics from main visit Thank You Ali
15:32

I would like to add some comments on
15:35
this important topic from the business
15:38
perspective in two different aspects one
15:42
is business application of AI and the
15:45
other one is the philosophy of reusing
15:47
AI in business so first at the
15:52
application side we can classify you
15:56
know general science oai business
15:59
applications into
16:00
three categories and each serves a
16:04
specific objective so first is a rule
16:08
based immersion learning to support
16:10
high-level businesses that are making
16:12
using transparent and accessible
16:17
algorithms like regression or tree based
16:20
algorithms that require significant
16:24
human intervention so here it is very
16:29
important to point out that the rule
16:32
refers to business rules not any
16:35
mathematical rule and secondly we have
16:40
purely data-driven machine learning to
16:43
efficient eyes low-level business of a
16:47
process using new networks or deep
16:50
neural networks based algorithm that
16:52

depends less only to human intervention
16:56
and the third is the automation to
17:01
optimize business operation and the
17:04
production by replacing human labor with
17:08
robotics I believe the most recent
17:11
example is automation in meat processing
17:15
and at the philosophy side I believe the
17:21
fundamental reason that AI technologies
17:25
are playing and will play much more
17:29
enhance the roles in business is because
17:33
we're in the so called third AI wave the
17:37
key feature of the third AI wave is that
17:41
it is powered by high-performance
17:44
computing infrastructure and big data so
17:49
because business is actually all about
17:53
human behavior which is probably the
17:56
most important lesson we learn from the
17:59
combination pandemic so in business
18:03
environment it is not really about
18:06
artificial intelligence at all it is
18:09
really about collective intelligence
18:13
of human and machine so the for example
18:19
human is better at the thinking and
18:22
perceiving and machine is better at
18:25

predicting and recognizing so there are
18:28
two key questions for anyone who wants
18:31
to introduce AI technology into their
18:33
business why is what work should machine
18:37
down to and what work should a human do
18:40
so the other question is how to
18:42
optimally integrate the human work with
18:48
the merging work together so it is a
18:51
widely upgrade in business researcher
18:54
community conceptually to serve the
18:58
three different types of applications of
19:00
AI in business a I can play the role of
19:03
tool assistant peer and manager so
19:08
essentially what we really want in
19:11
business is a bidirectional relationship
19:14
between human and machine so that
19:17
machine can better support or manager
19:20
manage human work and human so thank you
19:39
thank you very much I think my video
19:41
needs to be started from the outside
19:44
till them okay thank you alright so once
19:51
again thank you for this opportunity
19:54
I am Northeastern University and verily
19:59
the sustainability and data Sciences
20:01

laboratory I'll talk a little bit about
20:03
what research we do there in terms of
20:06
this particular panel one of my former
20:10
PhD students have started this time at
20:13
risk analytics company which focuses on
20:17
climate change adaptation through data
20:20
analytics and especially in the urban
20:23
sector they started as an NSF SBIR
20:27
project and then now it has been
20:31
embedded within one large exchange so
20:34
with that if you could move to the next
20:37
slide please thank you very much so yes
20:44
thank you very much
20:44
so the keys are trying I'm trying to
20:47
make here is that very thing about
20:49
climate when you think about the science
20:51
of climate and adaptation and the
20:52
implications we are talking about
20:55
inherently coupled complex systems so
20:59
here is just one example from the
21:02
country where I was born and grew up in
21:04
which is India where you know there's a
21:07
lot of dependence on the monsoon so in
21:11
2012 there was delayed monsoon and
21:16

extreme heat waves which together caused
21:20
a surge in agricultural water demand and
21:23
because of various policies that have
21:25
been put in place with with all good
21:27
intentions but then the way they
21:30
sometimes were they have unintended
21:32
consequences so there's an extreme surge
21:36
in agricultural water demand as well as
21:39
electric pumps that were put in place
21:40
and that led to increased stress on the
21:44
power grid and what that caused is the
21:48
2012 India blackouts which is the
21:51
largest blackout ever in terms of
21:53
population impacted and that in turn
21:55
because of the way the power system
21:57
impacts railways that in turn or signals
22:01
and systems that in turn impact at one
22:03
of the major lifelines of India which is
22:05
the railway network so right here we
22:08
have going from the national system of
22:12
climate and weather and masoom and
22:14
connecting with both policy and human
22:17
behavioral issues in terms of surge in
22:19
agricultural water demand use of
22:21

electricity and then go into engineered
22:22
systems basically power grid and railway
22:25
networks so just shows how
22:28
interconnected we are anything about
22:30
climate and adaptation if we go to the
22:32
next slide please
22:34
so the kind of work we have been doing
22:37
then is in the front is on the
22:40
climate side use of machine learning for
22:44
weather extremes and on the engineering
22:46
and infrastructure side impact side
22:48
looking at critical urban lifelines
22:51
interconnected critical urban lifelines
22:53
the one common theme is what some people
22:56
have called domain aware machine
22:58
intelligence
22:59
so in the climate side with complex
23:02
spatial temporal systems we have been
23:04
looking at physics guided machine
23:06
learning and with critical
23:08
infrastructure side we have been looking
23:09
at network science and engineering which
23:11
are informed by novel insights and
23:15
principles from engineering and policy
23:18

so broadly the theme here is machine
23:21
intelligence but which are domain aware
23:23
if we can go to the next slide things so
23:27
one work that we have also done is I
23:30
mean we have been working with the city
23:33
of Boston climate ready
23:36
Boston report the last version some of
23:38
the my PhD students right now are
23:42
working with the next version of the
23:44
report we have worked with the town of
23:46
Brookline Mass in dealing with public
23:49
health impacts of urban heat waves
23:51
looking at risk exposure vulnerability
23:54
as well as looking at adaptation and
23:55
mitigation aspects and next slide things
24:01
and we have also looked at climate risk
24:04
in in urban areas with you know for
24:08
example looking at sea level rise and
24:10
what that means in terms of urban floods
24:12
and then connecting that with assets at
24:14
risk and looking at recovery models with
24:18
network signs such as after sandy in New
24:22
York City how did the New York City MPA
24:24
the mass transit recover and what could
24:27

have been done in terms of systemic
24:30
recovery principles this was an article
24:32
that we published in climate 2020 it's
24:36
the United Nations Association report if
24:38
we go to the next slide please
24:40
these are all the students and postdocs
24:43
who have helped in many of these efforts
24:45
thank you very much early over to you
24:47
thank you very much sir so at this point
24:49
to open it up for questions
24:52
so good luck to all the panelists this
24:55
panel to turn on your videos and mute
24:58
yourself and I'm going to go over the
25:00
Q&A service to see what kinda questions
25:06
we have so the first question that is
25:11
coming from Karissa from University of
25:14
Maine she's asking that what sort of
25:17
resources will be available moving
25:18
forward for labs that you want to apply
25:20
neural networks I can answer this
25:24
question there is a plan to basically
25:28
have a series of seminars related to
25:31
different aspects of the AI and machine
25:34
learning application and theory side
25:37

that we talked about today in the fall
25:39
so we'll get much more deeper into these
25:43
in future so and I would also recommend
25:47
to reach out to any of our panelists
25:49
this webinar to start you know forming
25:53
collaborations so I'm going down the
25:57
list for for the question I have a
25:59
question for K how does decentralizing
26:03
the great affect susceptibility to cyber
26:07
attacks or natural disasters okay
26:12
that's a good question so one of the
26:15
innovations that we're doing with our
26:17
transact with the term we use is
26:20
transactive energy which is the idea of
26:22
using economic systems to manage the
26:24
grid in our case the system is naturally
26:29
cyber secure not only because it's
26:32
fractal where particular it's called
26:35
encapsulation in the computer industry
26:36
where you can actually isolate parts of
26:40
the grid from the other parts but also
26:42
in our particular algorithms we strictly
26:46
use a downward facing pricing signal so
26:49
a price is sent from an upper node to a
26:52

lower node and all it does is say right
26:55
now the price of power is 12 cents a
26:58
kilowatt there is no upward
27:00
communication so that makes the system
27:02
very very secure it does make it a
27:04
little more
27:05
fragile in other words if you do have
27:08
cascading it can propagate but we the
27:13
idea of fractal izing the grid mitigates
27:16
that problem so it's idea of min reward
27:20
of rewards versus penalties and you try
27:23
to balance that thank you okay so next
27:27
question is from Eileen from Maine
27:30
geospatial Institute so the question is
27:34
that what are some other methods being
27:36
used to build Maine's Resource Network
27:38
to help us all tap into available
27:41
expertise for shared projects and
27:43
programs so anybody want to take that so
27:52
I will try to kind of briefly answer
27:55
this at least from University of Maine
27:58
or no point we have created you Maine
28:02
any oil initiative so we have a website
28:04
that basically lists all the faculty who
28:07

are involved in this research all
28:09
different projects and we'll definitely
28:12
be happy to serve as a hawk for this and
28:15
of course there is I think a lot of
28:18
activity also happening at the Maine
28:21
businesses school that dr. you also
28:22
mentioned and I think Tim can can you
28:25
also comment on how your business sort
28:30
of connections with the Maine businesses
28:31
can help people get connected to the
28:34
network so actually currently in peace
28:37
in our main this is a school we have
28:40
recently added one new concentration in
28:44
business analyticals into our MBA
28:46
program and we are also in the process
28:50
of proposing a new master of science
28:52
program in business analytical's and the
28:56
way I was actually closely working with
28:59
couple of local businesses in Maine to
29:04
build the programs for example I have
29:07
been working working with IO being and
29:10
the Bhangra Singh is back to provide
29:13
opportunities for current and future
29:15
students like internship
29:18

or some real business projects provided
29:22
by these two companies so we will have a
29:24
lot more to do in future

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.