Intelligent Machines

AI & THE FUTURE OF MINING

CORY KISER


Melvin Stone
Company
A JURGENSEN COMPANY

Let’s get this out of the way.

This is not a speech about ethics.

Intended Takeaways

- What is artificial intelligence? What is machine learning? What can it do TODAY?

- More broadly, what is intelligence in the first place?

- How over hyped and over marketed is AI?

- How will artificial intelligence impact Mining? What technologies can be expected to emerge?

- What changes will we have to get used to as an industry?

- How crucial will AI be to future profitability and competition?

- Is there a chance my company will miss out?

Human Intelligence

HOW THE HECK DO YOU DEFINE INTELLIGENCE IN THE FIRST PLACE?

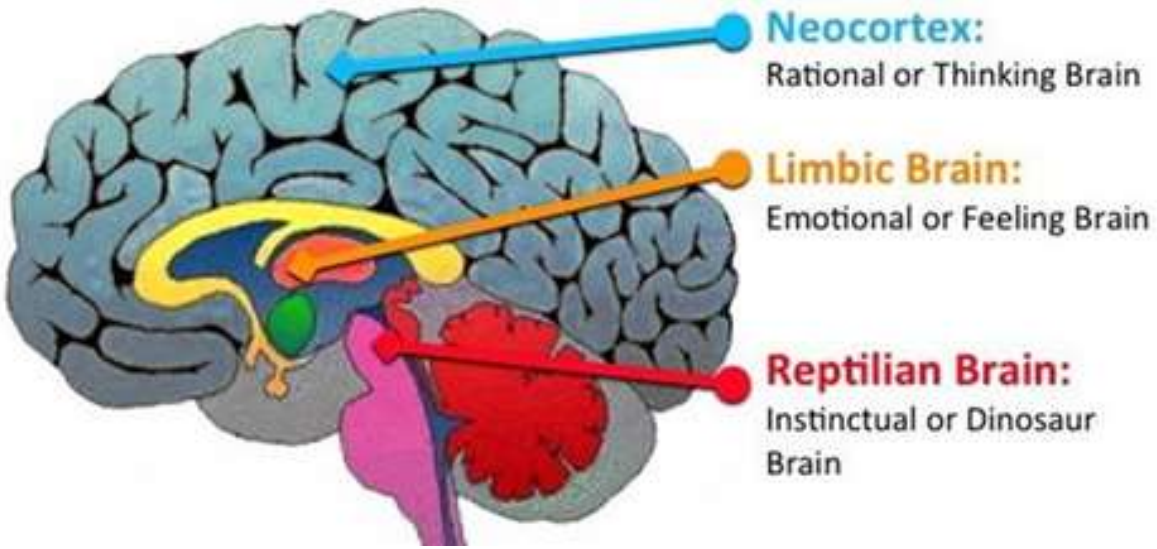

The Human Brain

What makes the brain special?

- The brain is the most complex known thing in the universe. You have one of them inside of you right now perceiving the world and acting as an agent in the world.

- Neurons are wired together into networks that communicate with each other via electrical impulses.

- The neocortex is the organ that gives rise to human intelligence.



“I like when things are boring.”

- The Free Energy Principle - Karl Friston

- Our brain’s driving goal is to minimize surprise.

- We spend our waking hours constantly running “simulations” of future events, interactions, and conversations to this end.

- The neocortex contains a powerful model of the world and how our actions will affect the world.

- The more wrong our predictions are, the more it catches our attention and resultantly causes the brain to rewire to update its model of the world.

- There are models for what sensory data that the brain expects to receive. The more the surprise, the more the rewiring.

- Making updates to better our prediction abilities in order to minimize surprise IS learning.


AAUGH

Artificial Intelligence

HOW CAN WE USE SOFTWARE TO EMULATE OR RECREATE INTELLIGENCE?

Examples that ARE NOT AI

- Perception vs Reality is way off today and used as misleading marketing.

- Most software is not AI b/c it is unable to learn from its mistakes

Mimicking the Brain

ATTEMPTS TO RECREATE HOW THE BRAIN WORKS IN LIMITED WAYS

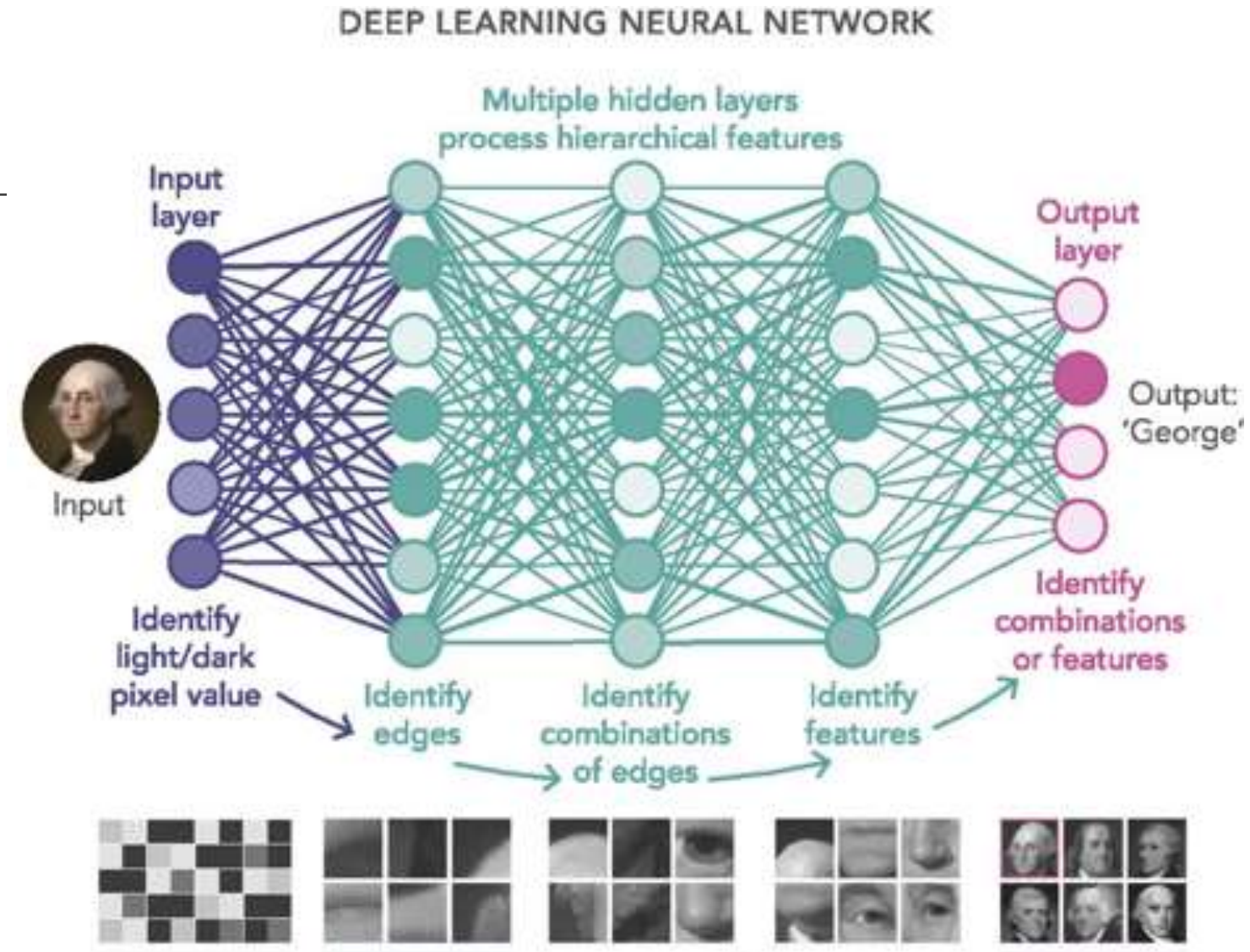
Deep Learning

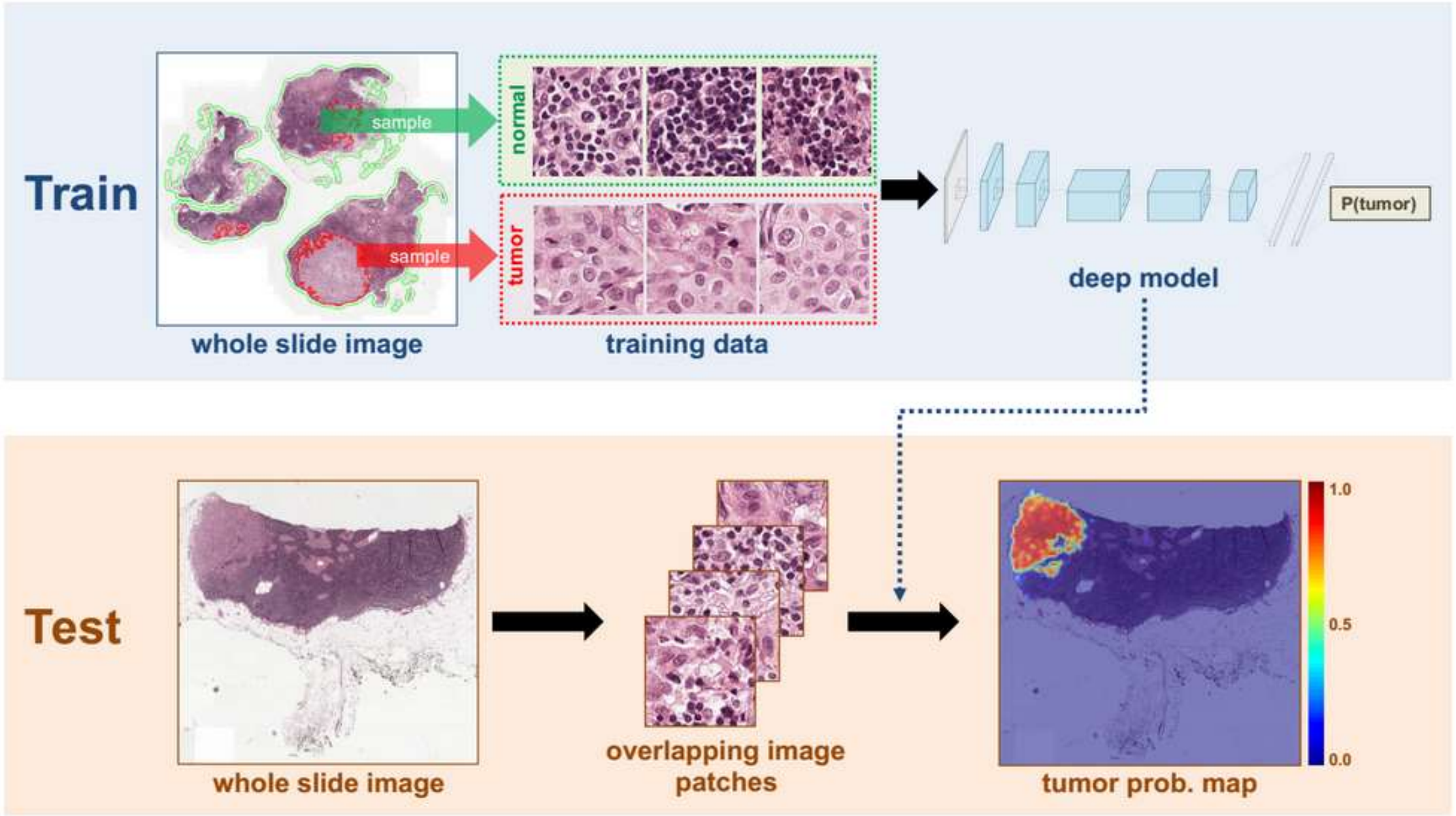
- Deep Learning is a technique based on emulating neural networks with software.

- It is the most advanced image recognition technology that exists today.

- Its applications include object detection, image classification, turning handwritten text into digital text, unlocking your phone, .

- Requires enormous example data to train the models on.




Train
sample
sample
whole slide image
normal
tumor
training data
deep model
P(tumor)
Test
whole slide image
overlapping image patches
tumor prob. map
1.0
0.5
0.0

Name an object in this photo.


YOLOv8 test by Prof. Dr. Jürgen Brauer, www.juergenbrauer.org
car
person
car
person
person
KAPWING


Ego Speed: 45.56 MPH
time: 1545.441322000
CAL P 0.60 Y 1.20 R 0.00 deg
Vision fps: 18.05 Draw fps: 17.67 Display fps: 21.34
NL(0.00), E(0.93), F(0.07), TF(0.00), S(0.00)
NRW: FLP(0.00), FRP(0.00)
CutInExcited (Prb 0.56)
+0.0001 AUTO_HIGH_BEAM
+0.0000 BLINDED
+0.0002 RAINING
+0.0000 TIRE_SPRAY
+0.0013 WET_ROAD
0.7902 RESTRICTED
0.0934 CONTROLLED_ACCESS
AP
L:0 R:0 F:2 ON:0
W:8.2 AP:1.0 I:0
VS: 46.7 MPH St: 1
merge: 1.0 1 160.2 R
40m
MAIN -
KAPWING


KAPWING

YOLO Object Detection
https://www.youtube.com/watch?v=-d6-thAu9dc

Tesla AutoPilot
https://www.youtube.com/watch?v=fKXztwtXaGo

Deep Dream
https://www.youtube.com/watch?v=dbQh1I_uvjo

This Person Does Not Exist
https://thispersondoesnotexist.com/

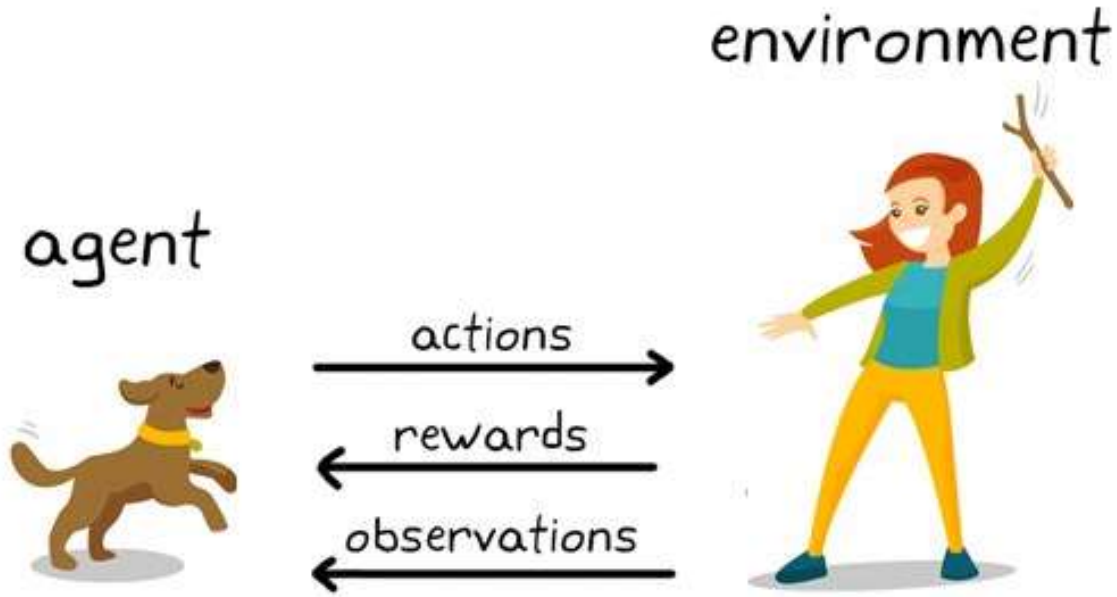
Deep Fake
https://www.youtube.com/watch?v=gLoI9hAX9dw


KAPWING

Reinforcement Learning

- Reinforcement learning is a type of machine learning where software on a computer learns to perform a task through repeated trial and error interactions with the dynamic environment that it is in.

- Environments are often modeled with video game like environments for research.

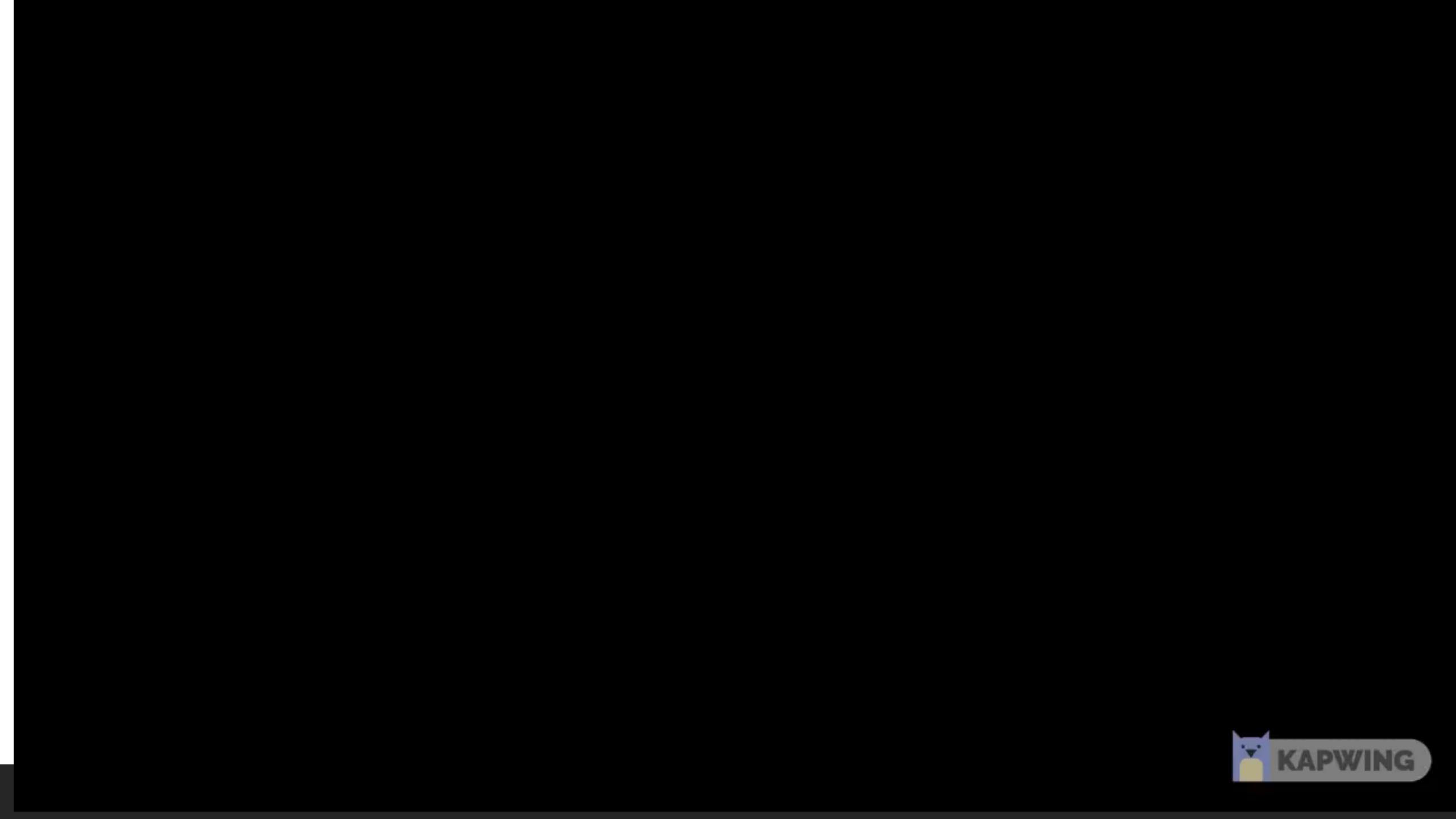


Parking
https://www.youtube.com/watch?v=VMp6pq6_QjI&t=1s

Training Novel Body Plans to Walk
https://www.youtube.com/watch?v=pgaEE27nsQw

Boston Dynamics
https://www.youtube.com/watch?v=fn3KWM1kuAw

Monkey Brain
https://youtu.be/3Ya-bAYri84?t=31


KAPWING


Boston Dynamics
KAPWING


KAPWING


NEURALINK VIDEO
KAPWING

Deep Reinforcement Learning

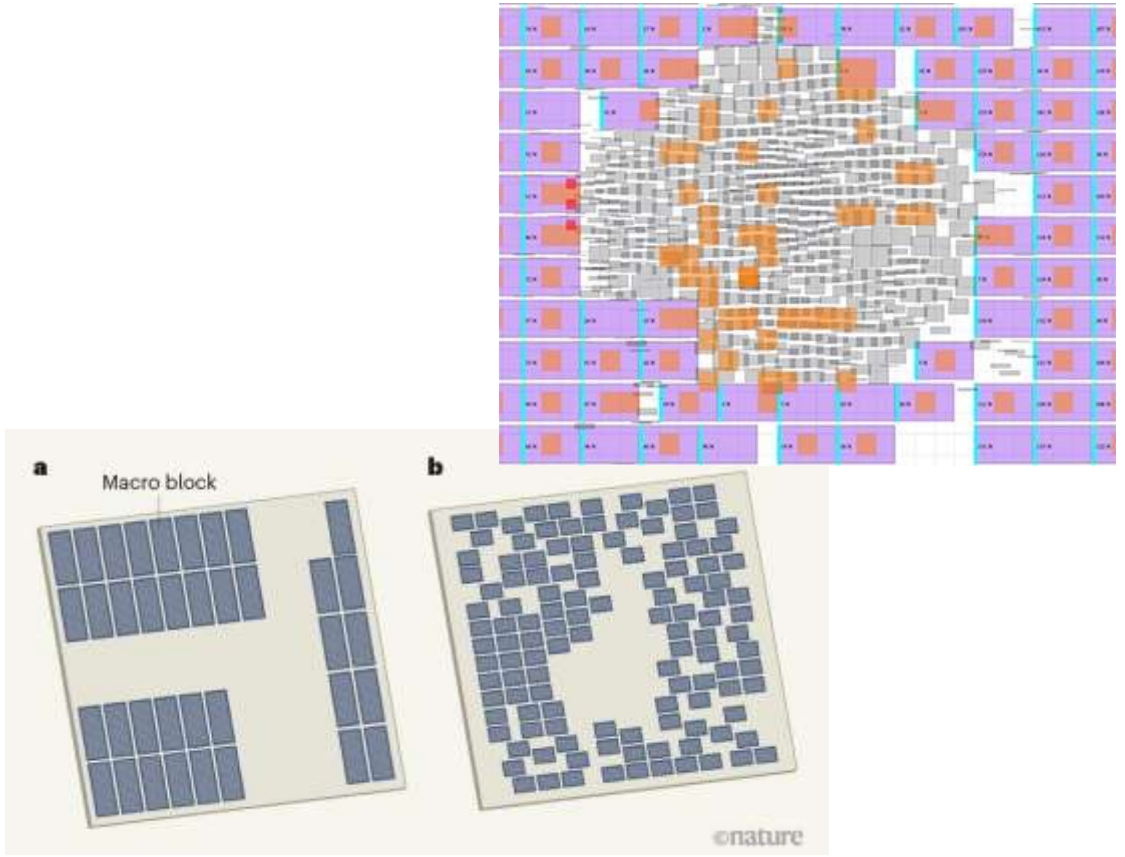
- Both techniques combined represent the latest and greatest technology.

- The industry leaders are DeepMind owned by Google and OpenAI owned by Musk.

- chip design

- https://youtu.be/dJ4rWhpAGFI?t=194

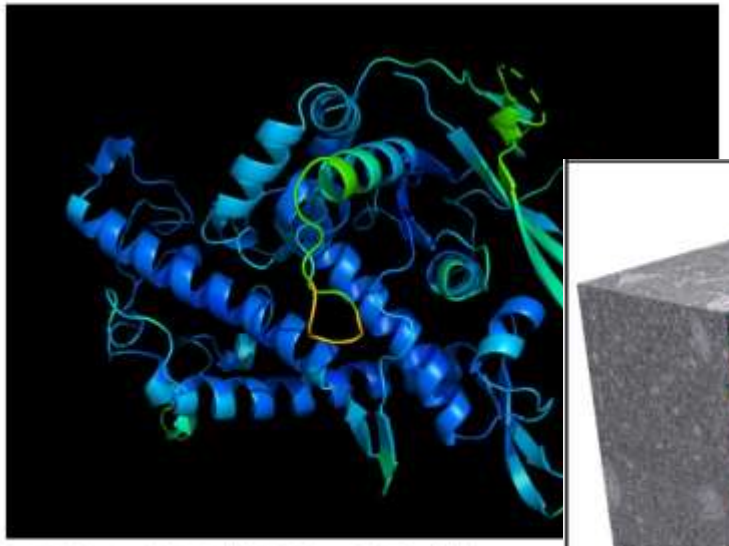
- https://openai.com/blog/dall-e/



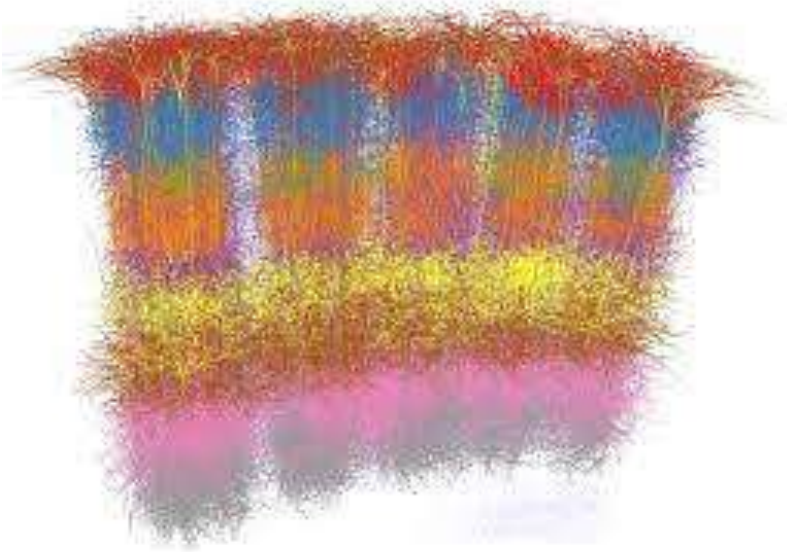
‘It will change everything’: DeepMind’s AI makes gigantic leap in solving protein structures

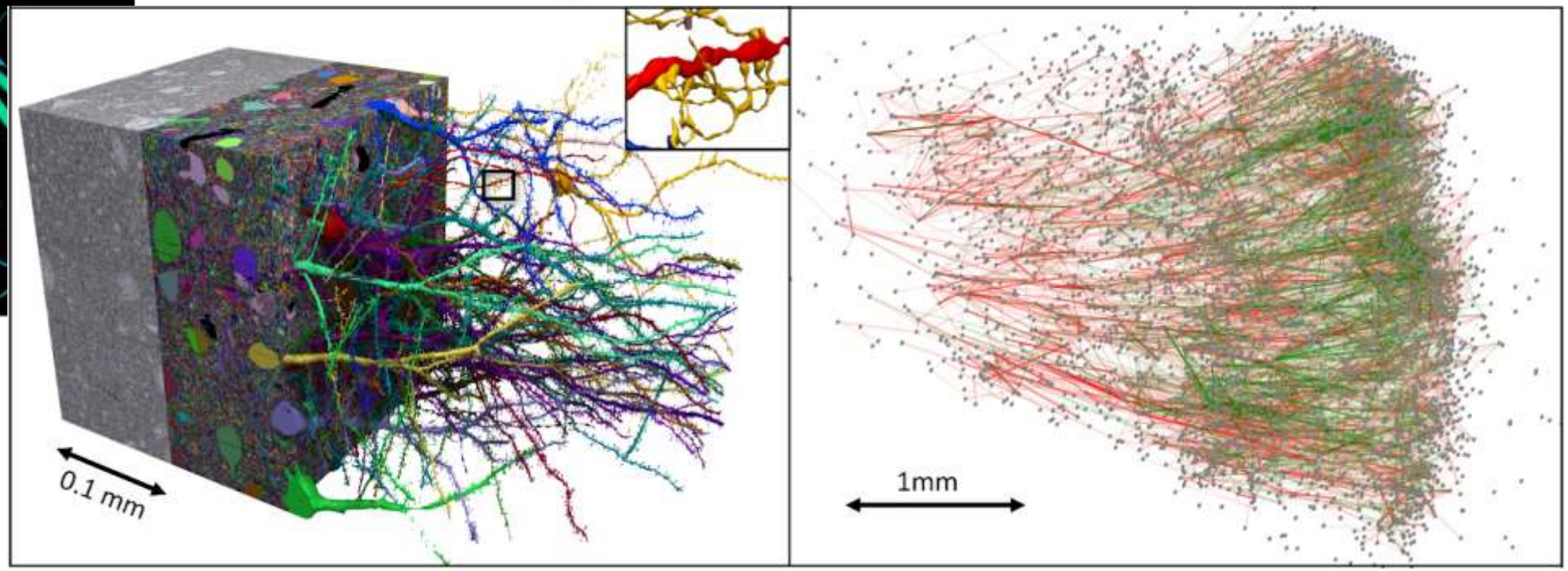
Google’s deep-learning program for determining the 3D shapes of proteins stands to transform biology, say scientists.

Ewen Callaway



A protein’s function is determined by its 3D shape. Credit: DeepMind





AI in Mining

WHAT’S TO COME AND WHAT'S TO EXPECT?

Mining

- It was a long journey to get here!

- Running a plant is a lot like playing a game. You have multiple metrics you are trying to optimize: Profitability, Electrical Usage, When to do Maintenance and how much, Maximizing sales without exceeding production ability, Maintaining stockpiles for unexpected jobs, etc.

What is holding us back?

- DATA, DATA, DATA

- AI models need data to learn on and be trained with.

- Huge deficit on how much plant data we record. It's our industry's limiting factor. The areas where they're reaping the benefits of AI are ones where data is very easily recorded.

- MORE SENSORS

- Cameras, Vibration data, position data of equipment and stackers, automatic gradations, Crusher sensors, Belt Scales, Stockpile volume data, etc.

- Changing CSS or speed of a crusher, swing a stacker out when the gradation goes out, ability to request when to QC, Request screen changes, Alerts when something unusual is happening, self driving loaders

Areas of Progress/Things to Expect

- Autonomous Haulage

- More data available at plants

- Example of an R+D project at Piqua Materials

- Machinery as good with its bucket as we are dexterous with our hands.

- There will be winners and losers based on how rapidly and effectively we can prepare for new technology.


Piqua
Materials
A JURGENSEN COMPANY

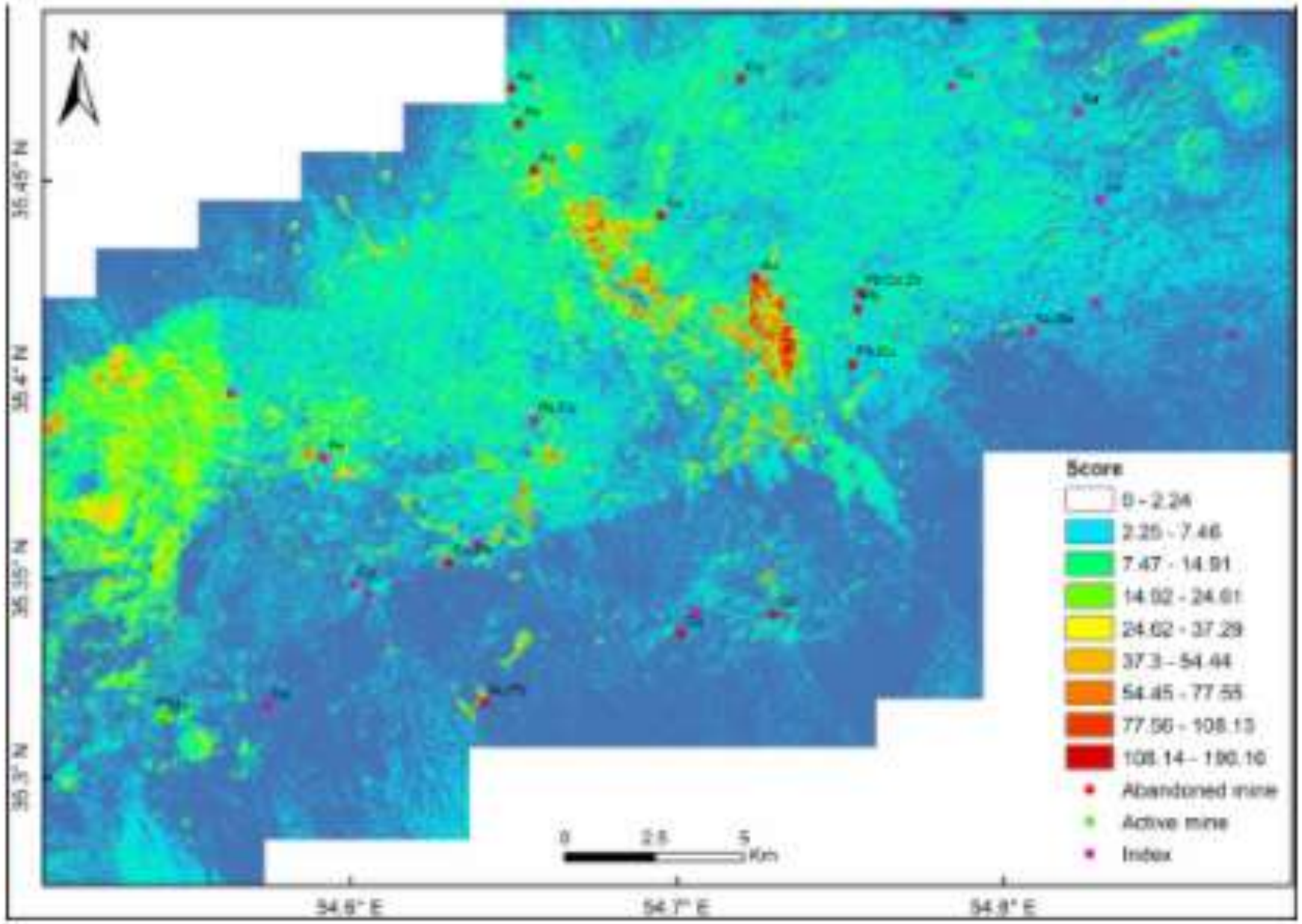
Output

Truck 21%

Person

Dump

Norm 78%


N
35.45° N
35.4° N
35.35° N
35.3° N
54.6° E
54.7° E
54.8° E
0
2.5
5
Km
Score
0 - 2.24
2.25 - 7.46
7.47 - 14.91
14.92 - 24.61
24.62 - 37.29
37.3 - 54.44
54.45 - 77.55
77.56 - 108.13
108.14 - 190.16
Abandoned mine
Active mine
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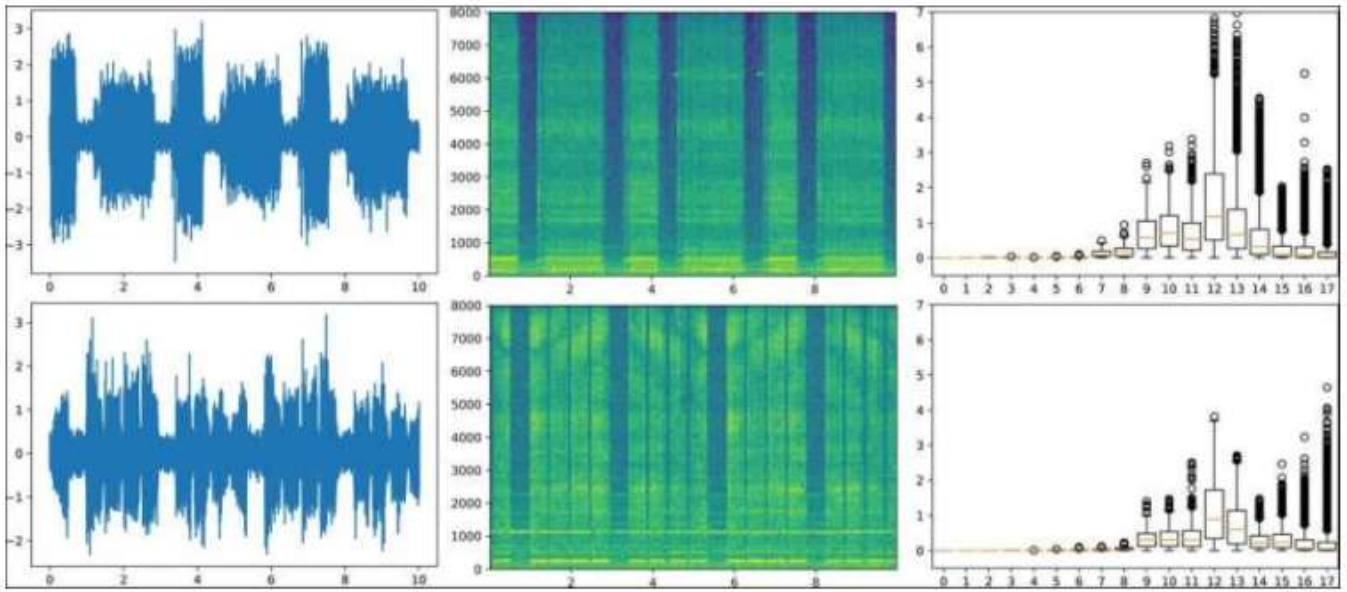
FEBRUARY 25, 2022

Artificial intelligence listens to the sound of healthy machines

by Florian Meyer, ETH Zurich



Examples of abnormal signals. Shown are raw data, log-spectrogram, and obtained coeffici…

Fully learnable deep wavelet transform for unsupervised monitoring of high-frequency time series

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Questions?

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