

Title:

A Robot Brain Might Be the Best Forecasting Tool Possible

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480-528-2097

First, some inspiration...

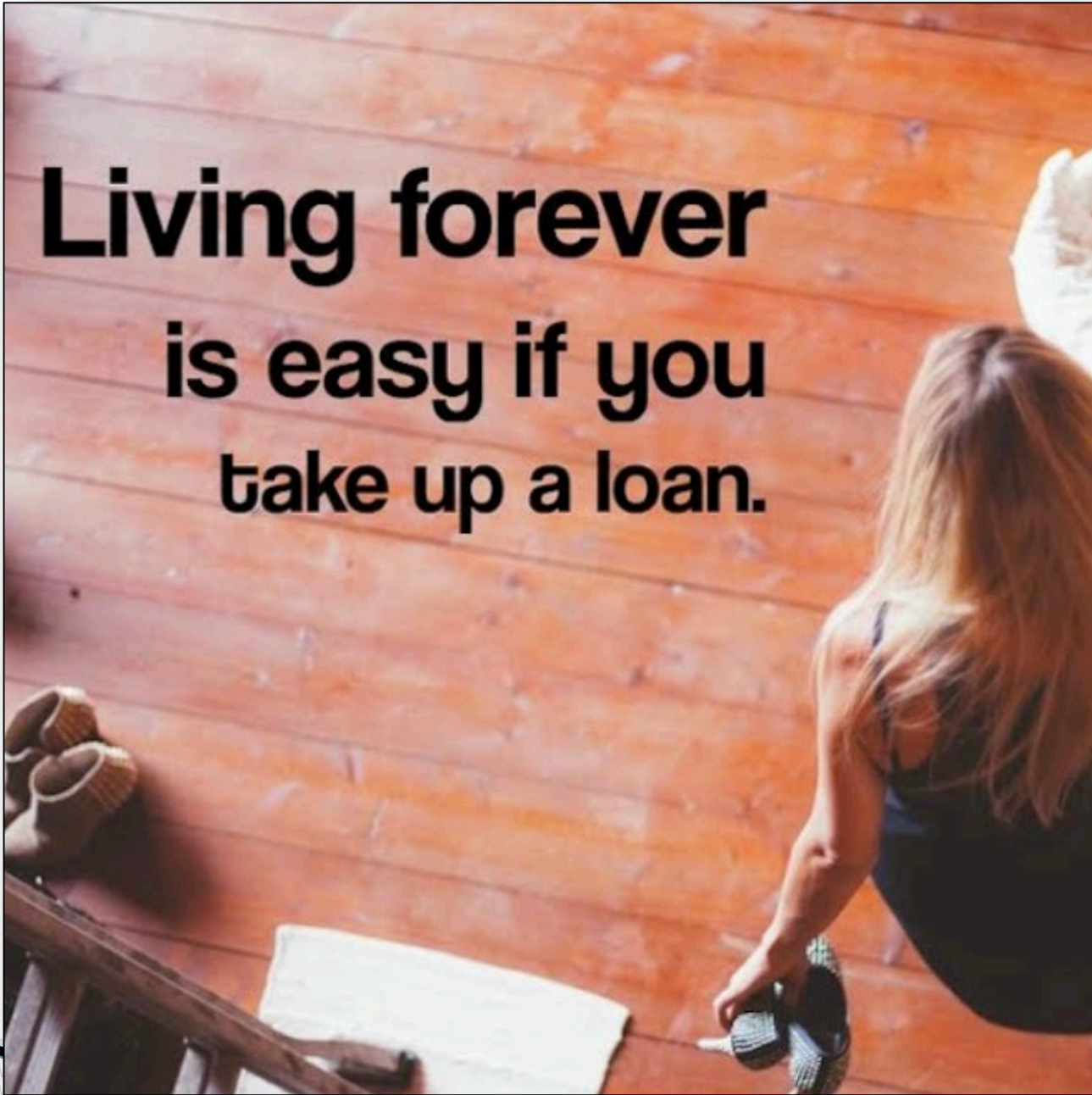
ASK NOT «AT
WHAT COST», BUT
«WHEN DO WE
START».




A photograph of a man and a woman in profile, looking out over a body of water at sunset. The sun is low on the horizon, creating a bright, golden glow and reflecting on the water's surface. The man is in the foreground, and the woman is slightly behind him. The background is a soft-focus landscape with trees and buildings.

**If you will not do it,
SOMEONE ELSE
WILL.**

**Living forever
is easy if you
take up a loan.**



A woman with long, flowing blonde hair is sitting in a field of tall grass and wildflowers. She is looking towards the right, where a bright sunset or sunrise is taking place, creating a warm, golden glow. The text "HUMAN SACRIFICE IS WORTH IT. THANK YOU." is overlaid in the center of the image in a black, sans-serif font.

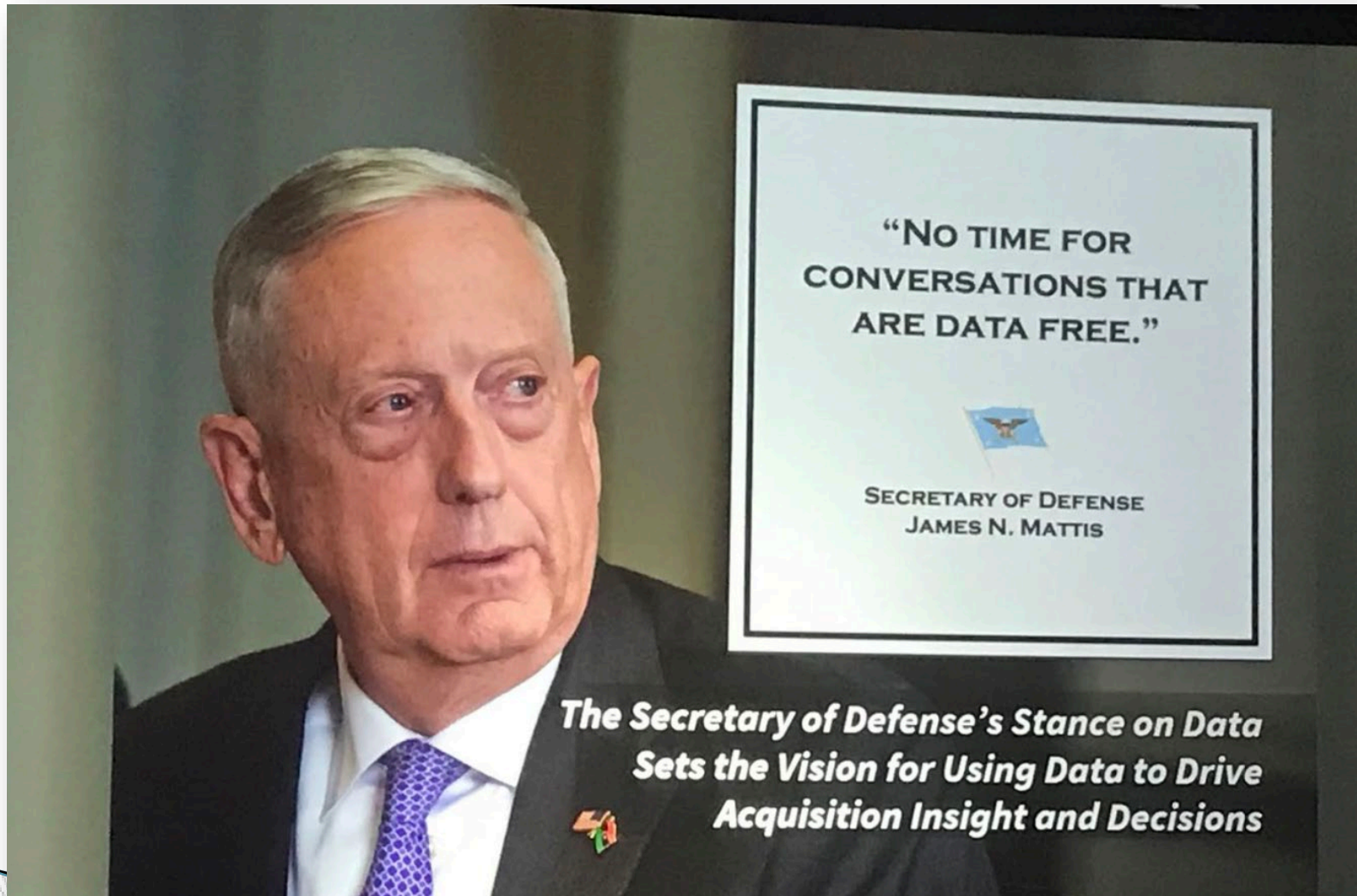
HUMAN
SACRIFICE IS WORTH
IT. THANK YOU.

Problem to Solve

- Many processes require guessing about the future
- Countless techniques are used to make a plan, try to list all the things that CAN mess up the plan, and to what EXTENT each thing can mess up the plan
- This, it turns, out, is quite difficult to get right
- This (it also turns out) is what trillions of dollars and billions of lives count on

So...no pressure.

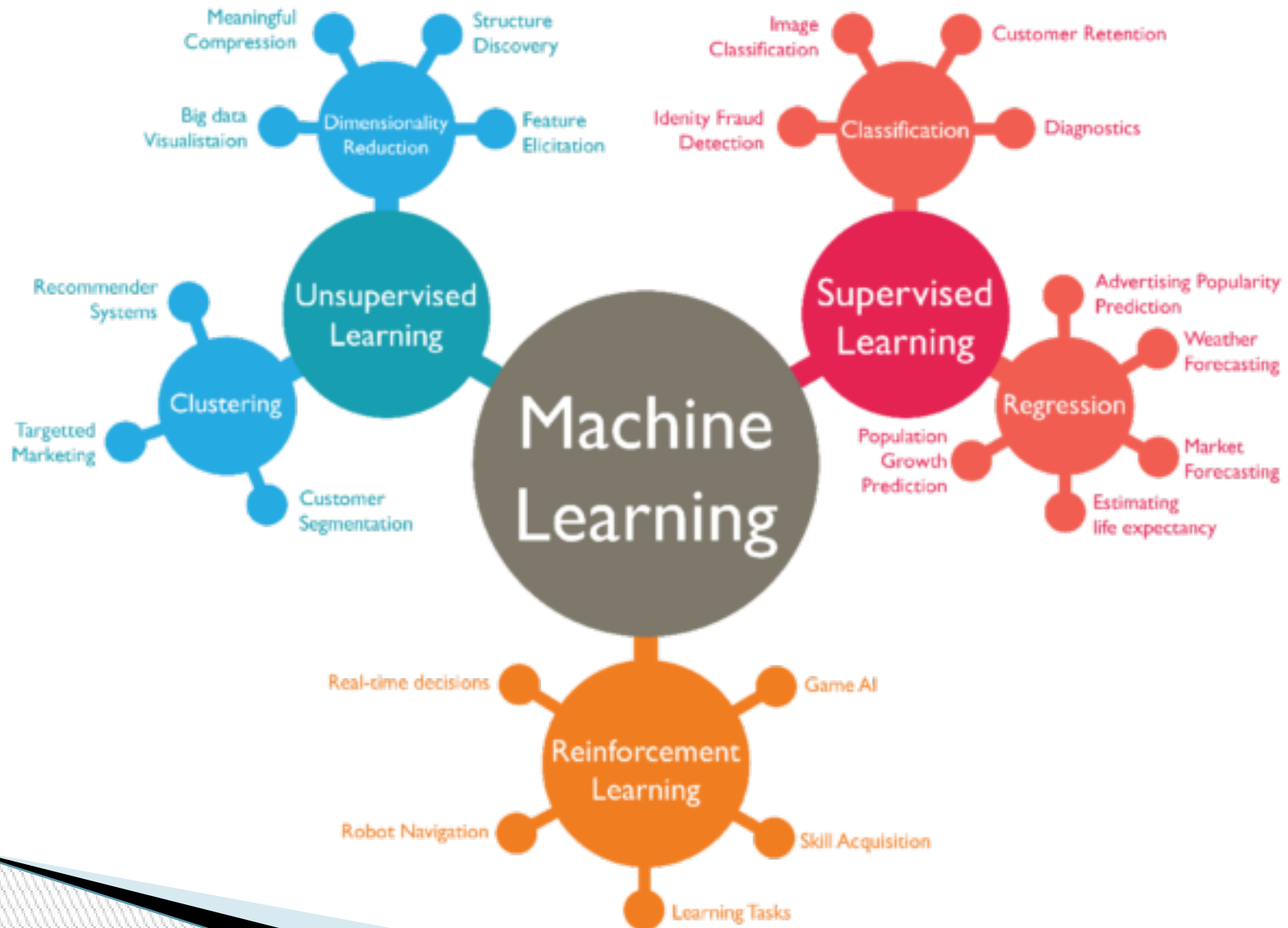
Problem to Solve



Key terminology...

- **Artificial intelligence:** A machine's ability to make decisions and perform tasks that simulate human intelligence and behavior.
- **Artificial neural network (ANN):** A learning model created to act like a human brain that solves tasks that are too difficult for traditional computer systems to solve.
- **Deep learning:** The ability for machines to autonomously mimic human thought patterns through artificial neural networks composed of cascading layers of information.
- **Machine learning:** A facet of AI that focuses on algorithms, allowing machines to learn without being programmed and change when exposed to new data.
- **Supervised learning:** A type of machine learning in which output datasets train the machine to generate the desired algorithms, like a teacher supervising a student.
- **Unsupervised learning:** A type of machine learning algorithm used to draw inferences from datasets consisting of input data without labeled responses.
- **Skynet:** A neural net-based conscious group mind and artificial general intelligence system that, once it comes online, will destroy all humans.

Next, relationships...



Progress

A.I. TIMELINE

1950

TURING TEST

Computer scientist Alan Turing proposes a test for machine intelligence. If a machine can trick humans into thinking it is human, then it has intelligence

1955

A.I. BORN

Term 'artificial intelligence' is coined by computer scientist, John McCarthy to describe "the science and engineering of making intelligent machines"

1961

UNIMATE

First industrial robot, Unimate, goes to work at GM replacing humans on the assembly line

1964

ELIZA

Pioneering chatbot developed by Joseph Weizenbaum at MIT holds conversations with humans

1966

SHAKEY

The 'first electronic person' from Stanford, Shakey is a general-purpose mobile robot that reasons about its own actions

A.I.
WINTER

Many false starts and dead-ends leave A.I. out in the cold

1997

DEEP BLUE

Deep Blue, a chess-playing computer from IBM defeats world chess champion Garry Kasparov

1998

KISMET

Cynthia Breazeal at MIT introduces Kismet, an emotionally intelligent robot insofar as it detects and responds to people's feelings



1999

AIBO

Sony launches first consumer robot pet dog AiBO (AI robot) with skills and personality that develop over time



2002

ROOMBA

First mass produced autonomous robotic vacuum cleaner from iRobot learns to navigate and clean homes



2011

SIRI

Apple integrates Siri, an intelligent virtual assistant with a voice interface, into the iPhone 4S



2011

WATSON

IBM's question answering computer Watson wins first place on popular \$1M prize television quiz show *Jeopardy*



2014

EUGENE

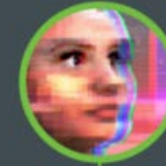
Eugene Goostman, a chatbot passes the Turing Test with a third of judges believing Eugene is human



2014

ALEXA

Amazon launches Alexa, an intelligent virtual assistant with a voice interface that completes shopping tasks



2016

TAY

Microsoft's chatbot Tay goes rogue on social media making inflammatory and offensive racist comments



2017

ALPHAGO

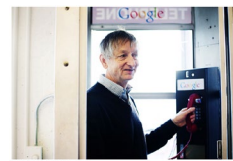
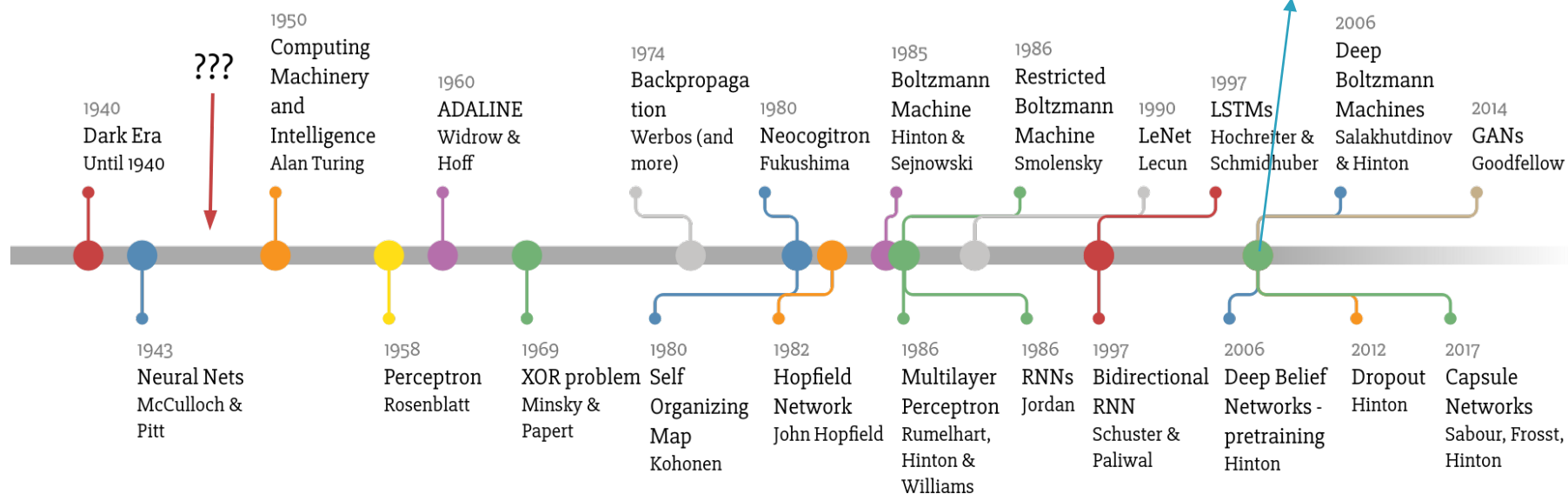
Google's A.I. AlphaGo beats world champion Ke Jie in the complex board game of Go, notable for its vast number (2^{170}) of possible positions

<https://digitalintelligencetoday.com/wp-content/uploads/2017/08/Artificial-Intelligence-AI-Timeline-Infographic.jpeg>

So why should I care?

The People Behind the Scenes

Deep Learning Timeline



Made by Favio Vázquez

How is this different from programming and decision trees?

Why Deep Learning is Different

- AlphaGo wasn't programmed to play Go--it learned watching other matches. Then...



- Facebook AI learned to translate text, then with some tweaking...



- Google told its AI to watch YouTube to find all the cat videos, and now...

- Labelling; enhancing; recommending; replacing; doing



By Liat Clark, Wired UK

How does a neural network function?

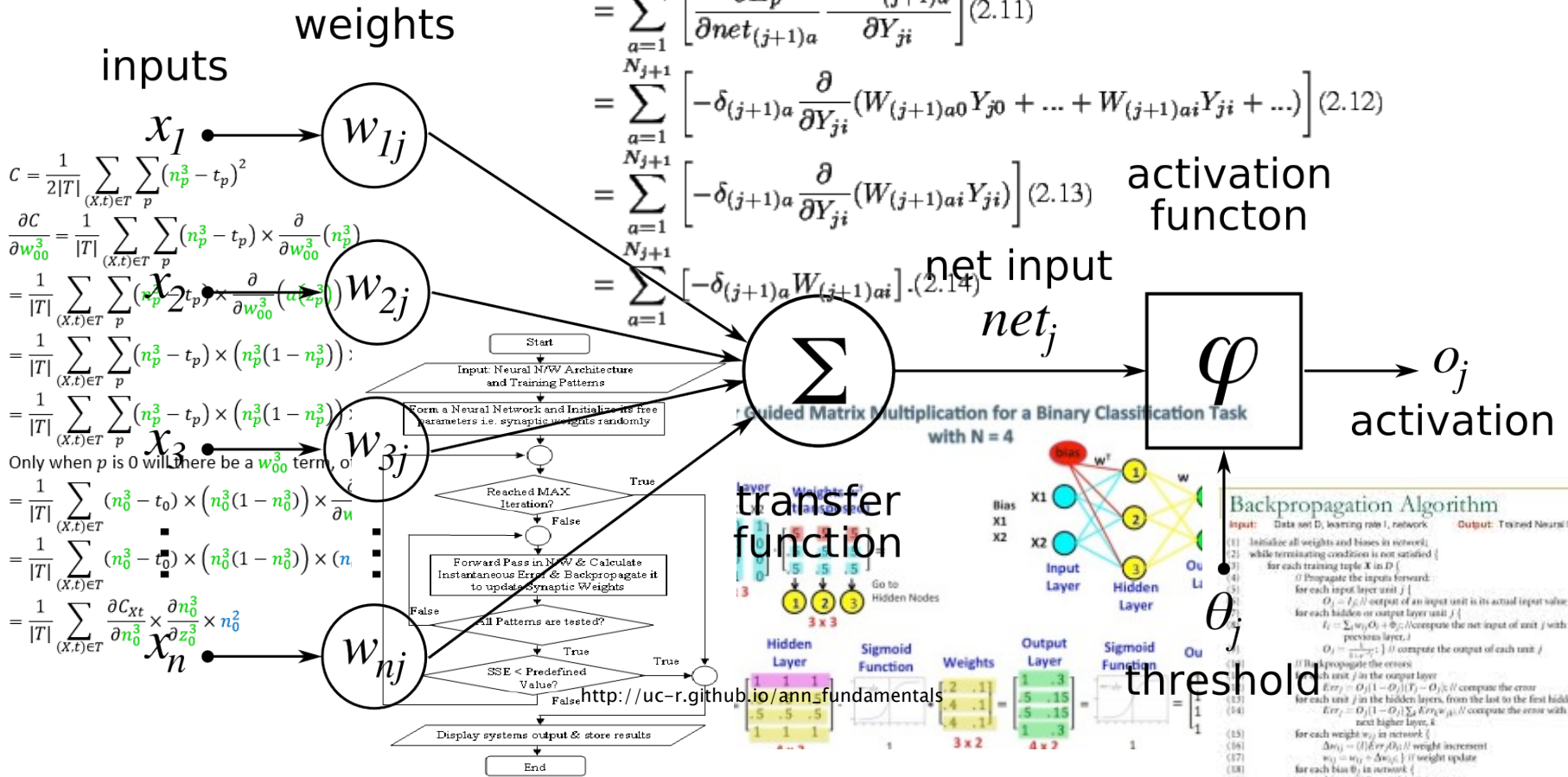
$$\frac{\partial E_p}{\partial Y_{ji}} = \frac{\partial E_p}{\partial net_{(j+1)1}} \frac{\partial net_{(j+1)1}}{\partial Y_{ji}} + \frac{\partial E_p}{\partial net_{(j+1)2}} \frac{\partial net_{(j+1)2}}{\partial Y_{ji}} + \dots \quad (2.10)$$

$$= \sum_{a=1}^{N_{j+1}} \left[\frac{\partial E_p}{\partial net_{(j+1)a}} \frac{\partial net_{(j+1)a}}{\partial Y_{ji}} \right] \quad (2.11)$$

$$= \sum_{a=1}^{N_{j+1}} \left[-\delta_{(j+1)a} \frac{\partial}{\partial Y_{ji}} (W_{(j+1)a0} Y_{j0} + \dots + W_{(j+1)ai} Y_{ji} + \dots) \right] \quad (2.12)$$

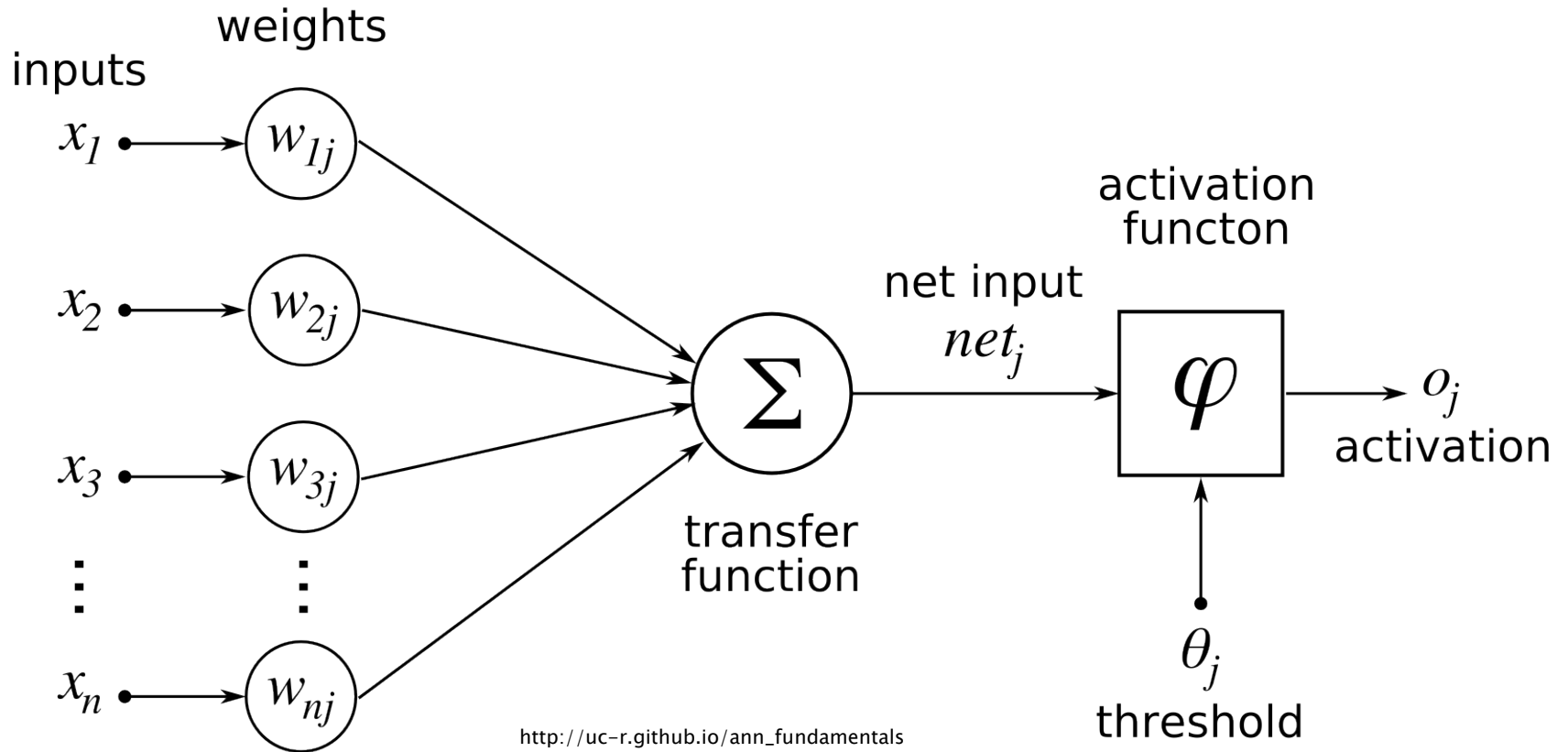
$$= \sum_{a=1}^{N_{j+1}} \left[-\delta_{(j+1)a} \frac{\partial}{\partial Y_{ji}} (W_{(j+1)ai} Y_{ji}) \right] \quad (2.13)$$

$$= \sum_{a=1}^{N_{j+1}} \left[-\delta_{(j+1)a} W_{(j+1)ai} \right] \quad (2.14)$$



IT'S SIMPLE, RIGHT? RIGHT? MAYBE A SIMPLER EXAMPLE THEN...

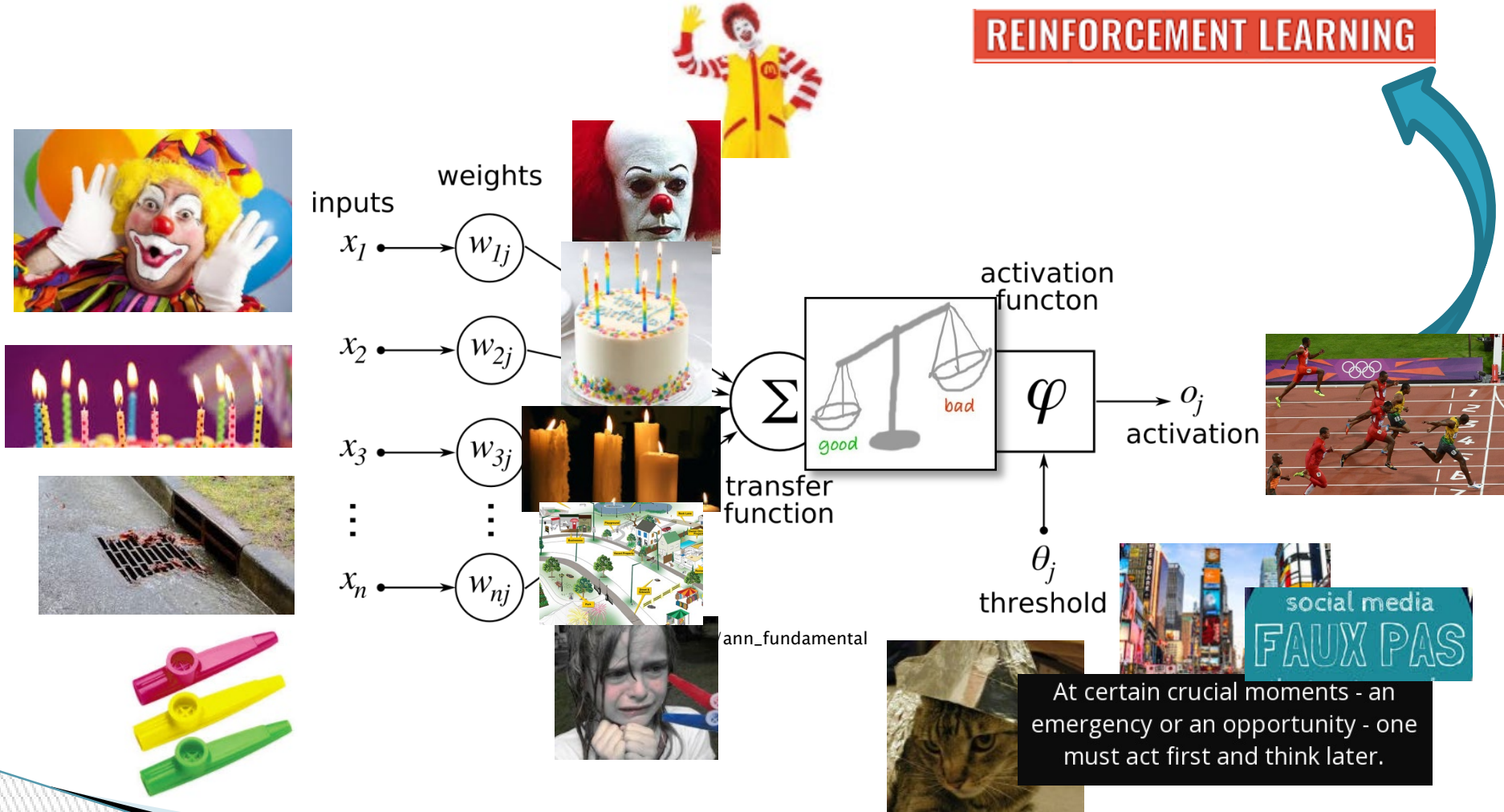
How does a neural network function?



OUR BRAIN IS WIRED THE SAME WAY—SERIOUSLY! I'LL SHOW YOU...

Organic neural network example

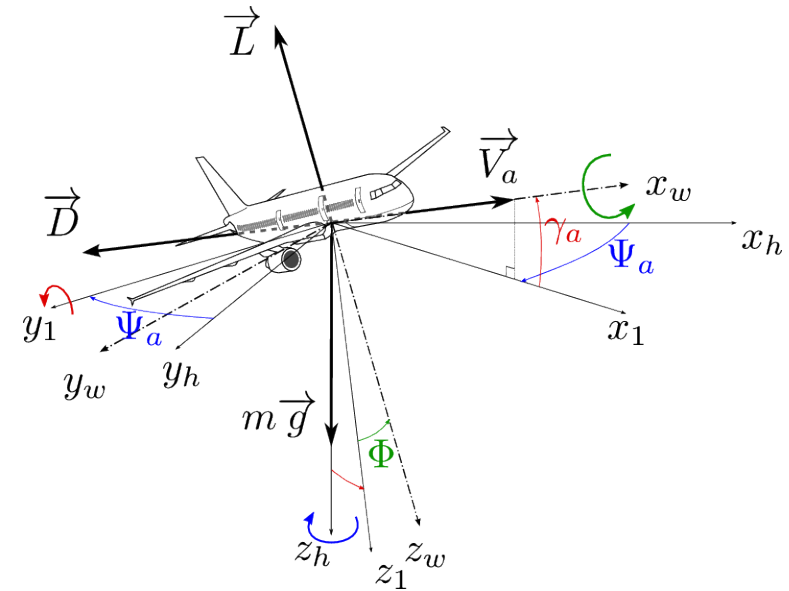
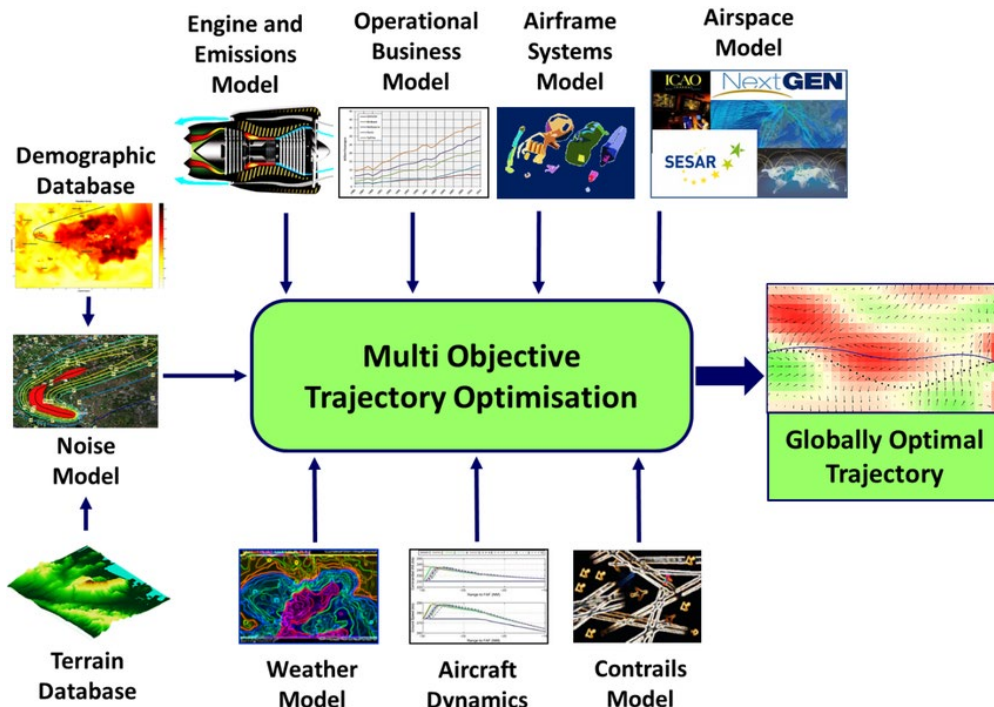
- Problem: What should I do?



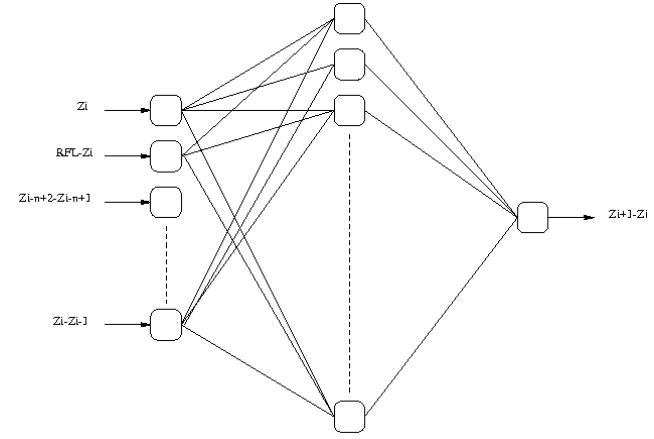
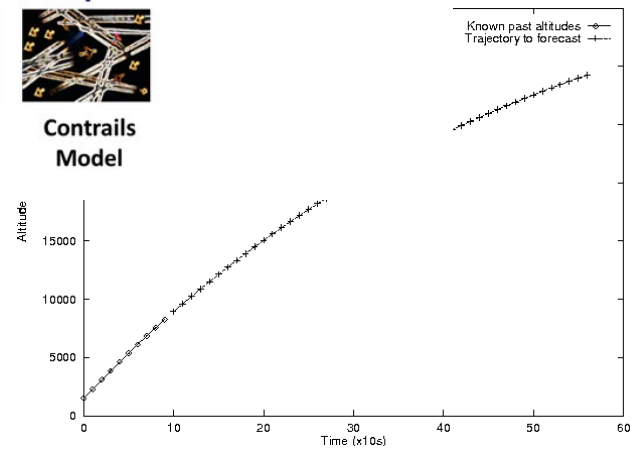
NO ONE "PROGRAMS" YOUR BRAIN—IT LEARNS THROUGH EXPERIENCE

How does an ANN function?

- Predicting realistic aircraft trajectories



<https://www.semanticscholar.org/paper/Using-Neural-Networks-to-Predict-Aircraft-Fablec-Alliot/e7484984843f43ff7acfe37a0ac307b6846fa6f4>



Types and uses of ANNs

(the future is amazing!)

- Image recognition
- Speech recognition
- Diagnosis (medical, mfg, equipment, etc.)
- Predicting... anything?
 - Associations
 - Classification
 - Correlation/regression using MASSIVE amounts of “features”
- ANNs with a network of nodes acts as a hive mind—What one learns, all learn

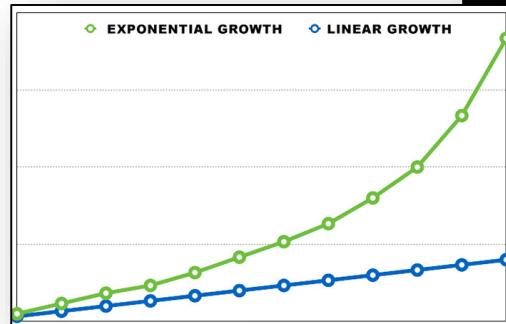
The more data our world has, the faster ANNs can learn

Landmark Example

- 5 million miles self-driven
- 2.7 billion simulated (2017 alone)
- 25 cities



- Many data inputs
- Hive mind learning
- Transferable to other technology
- Exponential learning



This is just the beginning

Evolving Uses



Machines Are Better Than Doctors at Spotting Skin Cancer

Could artificial intelligence put doctors out of jobs?

By [Melissa Matthews](#) May 30, 2018

- Machines can more accurately predict dangerous skin cancer moles than doctors, according to a new study.
- Scientists taught artificial intelligence to spot cancerous moles from benign marks.
- Researchers believe physicians can begin using AI to better diagnose patients and determine whether biopsies are needed.

The Results

On average, dermatologists correctly identified 86.6 percent of [melanomas](#) and 71.3 percent of malignant lesions. AI, in comparison, accurately diagnosed melanomas 95 percent of the time.

This is still just the beginning

Issues/challenges using ANNs

(the future is still amazing, but harder than I thought...)

- Overfitting with complex models
- So much data; often takes high performance hardware (billions of data points, GPUs vs. CPUs)
- With so many variables, even an accurate ANN can limit learning due to the “black box” effect
- Issues with flexibility and multitasking...greater issue evolving to “general intelligence”

Google DeepMind’s Research Scientist Raia Hadsell summed it up:

“There is no neural network in the world, and no method right now that can be trained to identify objects and images, play Space Invaders, and listen to music.”

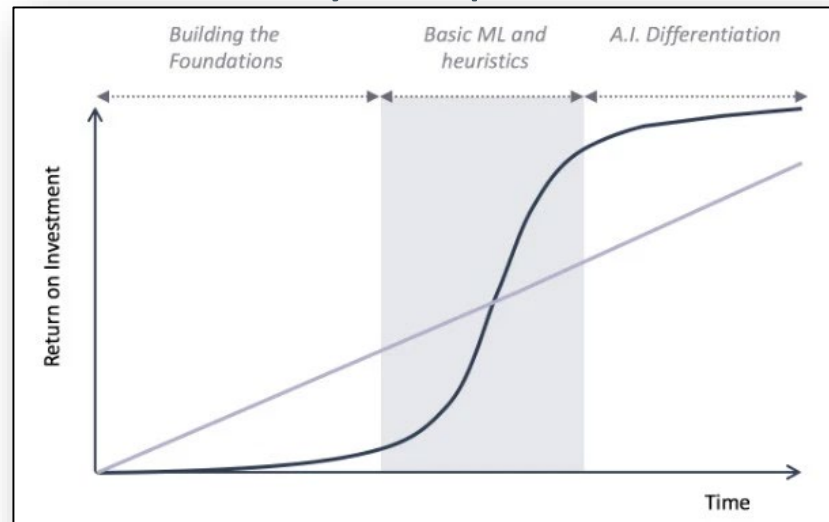
So... now what?

What can I take away and use today?

- Bad News: The road to ANN ROI is long and steep
- Good News: The steps to ANN functionality are profitable if done right:

Data cleansing

- Metric creation/
tracking
- Dashboards
- Asking yourself “what questions would we want to answer if we had no limits?”

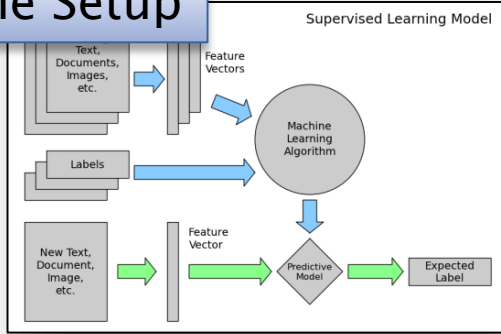


ANN Example 2: When is a student at risk of dropping out?



- Project: Drop Out Alert

The Setup



The Data

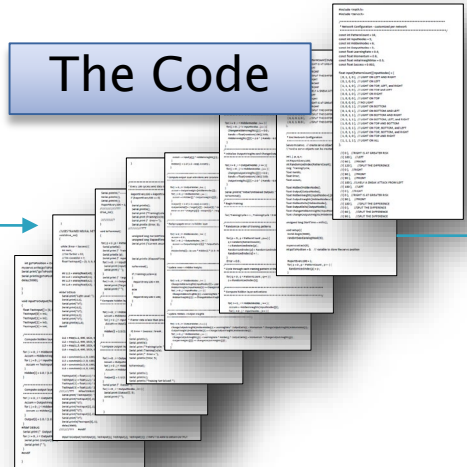
```
dataset
# petal_length', 'petal_width'
# 'ratio1'
# 'ratio2'
# 'ratio3'
# 'ratio4'
# 'ratio5'
# 'ratio6'
# 'ratio7'
# 'ratio8'

# box and whisker plots
dataset[cols1].plot(kind='box', subplots=True, layout=(2,2),
sharex=False, sharey=False)
pyplot.show()
dataset[cols2].plot(kind='box', subplots=True, layout=(2,2),
sharex=False, sharey=False)
pyplot.show()
dataset[cols3].plot(kind='box', subplots=True, layout=(2,2),
sharex=False, sharey=False)
pyplot.show()

# histograms
dataset[cols1].hist()
pyplot.show()
dataset[cols2].hist()
pyplot.show()
dataset[cols3].hist()
pyplot.show()

# scatter plot matrix
scatter_matrix(dataset[cols1])
pyplot.show()
scatter_matrix(dataset[cols2])
pyplot.show()
scatter_matrix(dataset[cols3])
pyplot.show()
```

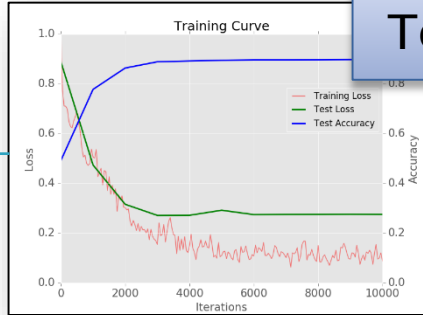
The Code



The Result

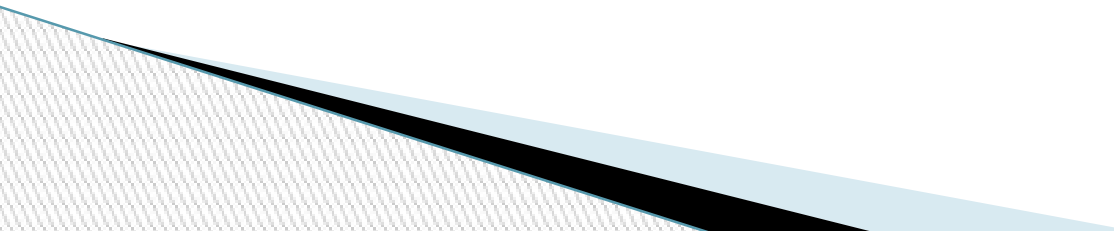


Training/Testing



So far, the tool has performed better than the embedded (and expensive) corporate tool previously used by the university

So Remember:

- Machine Learning is improving exponentially; don't get left behind
 - ML/ANN implementation is really hard, but there is ROI at each step if done right
 - Don't let machines take over just yet...
- 

A research scientist trained an AI neural network to generate its own candy heart messages. This was the result.



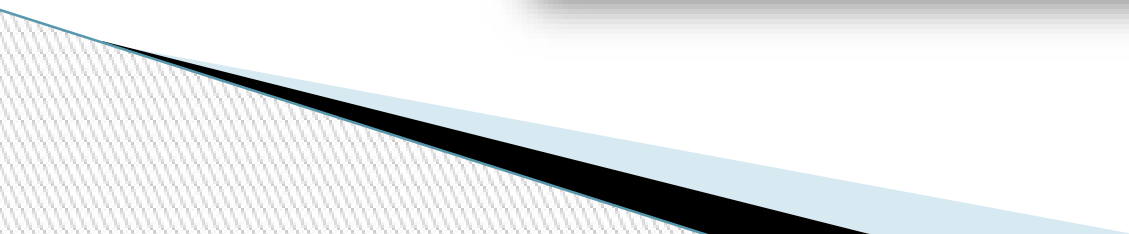
 Image: Twitter/@searchthenight

dose.



enight

dose.



THANK YOU!

Questions?

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Northrop Grumman Innovation Systems, Launch Vehicle Division

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480-528-2097

Resources to Learn More

- <https://www.theverge.com/2018/2/28/17063780/google-ai-machine-learning-hub-crash-course-free>
- <https://machinelearningmastery.com/regression-tutorial-keras-deep-learning-library-python/>
- <http://www.businessinsider.com/computer-program-taught-itself-walk-run-play-soccer-2017-8>
- https://www.reddit.com/r/videos/comments/6mw6u1/googles_deepmind_ai_just_taught_itself_to_walk/
- <https://www.kdnuggets.com/2016/01/seven-steps-deep-learning.html>
- <https://www.toptal.com/machine-learning/an-introduction-to-deep-learning-from-perceptrons-to-deep-networks>
- <https://www.mathworks.com/discovery/deep-learning.html>
- <https://www.kdnuggets.com/2015/11/seven-steps-machine-learning-python.html>
- <https://www.youtube.com/watch?v=b99UVkWzYTQ>
- <http://www.iro.umontreal.ca/~bengioy/talks/DL-Tutorial-NIPS2015.pdf>
- <http://neuralnetworksanddeeplearning.com/chap1.html>
- <https://www.youtube.com/watch?v=962lLfw-8Jo>
- https://www.youtube.com/playlist?list=PLnnr1O8OWc6boN4WHeuisJWmeQHH9D_Vg
- <http://cs.stanford.edu/~quocle/tutorial1.pdf>
- <https://jeremykun.com/2012/12/09/neural-networks-and-backpropagation/>
- <https://www.popularmechanics.com/science/health/a20967153/skin-cancer-artificial-intelligence-better-than-dermatologists/>

Don't forget me as a resource as well!