Introduction to AI/ML





GRAHAM TAYLOR

SCHOOL OF ENGINEERING UNIVERSITY OF GUELPH

VECTOR INSTITUTE FOR AI

CANADIAN INSTITUTE FOR ADVANCED RESEARCH





What is Artificial Intelligence?

12 Jul 2018 / 2 MLRG Tutorial in Reykjavik • AI 101 / G Taylor

What is Artificial Intelligence?

<u>An Ideal</u>



12 Jul 2018 / 2 MLRG Tutorial in Reykjavik • AI 101 / G Taylor

What is Artificial Intelligence?

<u>An Ideal</u>

<u>A Scientific Discipline/</u> <u>Class of Technology</u>





12 Jul 2018 / 2 MLRG Tutorial in Reykjavik • AI 101 / G Taylor

MEDIA TRENDS: AI VS BIG DATA



Al OR artificial intelligence

Firm Viv, Created By Siri Makers

Google's Alphago Al Beats Human In First Game Of Go Contest





2016

2017



via CB Insights



*Represents date earnings call took place

via CB Insights



250



via CB Insights



Artificial Intelligence



MLRG Tutorial in Reykjavik · AI 101 / G Taylor

Artificial Intelligence



Image credit: Google

12 Jul 2018 / 8 MLRG Tutorial in Reykjavik • AI 101 / G Taylor

- There are many tasks that computers can do much more efficiently than humans
 - e.g. computing π to high precision, sorting a huge list

12 Jul 2018 / 8 MLRG Tutorial in Reykjavik · AI 101 / G Taylor



- There are many tasks that computers can do much more efficiently than humans
 - e.g. computing π to high precision, sorting a huge list
- There are tasks which come very naturally to • humans but are very challenging to automate
 - e.g. recognizing a face or a song, understanding speech





Machine learning is about enabling computers to do these tasks, not by programming them with rules, but by learning from data.

12 Jul 2018 / 9 MLRG Tutorial in Reykjavik • AI 101 / G Taylor

12 Jul 2018 / 10 MLRG Tutorial in Reykjavik • AI 101 / G Taylor



Input (Data)



e.g. Image

12 Jul 2018 / 10 MLRG Tutorial in Reykjavik • AI 101 / G Taylor







e.g. Image



e.g. Feature Extraction + Object Detector

12 Jul 2018 / 10 MLRG Tutorial in Reykjavik • AI 101 / G Taylor







e.g. Image



e.g. Feature Extraction + Object Detector

12 Jul 2018 / 10 MLRG Tutorial in Reykjavik • AI 101 / G Taylor



Output (Something useful)



Detection (Specified by labeled bounding box)

- def square(x): return x * x
 - square(1) = 1square(2) = 4square(3) = 9









Generalization

The central challenge in machine learning is that the algorithm must perform on *previously unseen inputs*

The ability to perform well on previously unseen inputs is called generalization

12 Jul 2018 / 14 MLRG Tutorial in Reykjavik • AI 101 / G Taylor

via Gazette Review

Generalization

The central challenge in machine learning is that the algorithm must perform on *previously unseen inputs*

The ability to perform well on previously unseen inputs is called generalization



12 Jul 2018 / 14 MLRG Tutorial in Reykjavik • AI 101 / G Taylor

via Gazette Review

Supervised Learning



12 Jul 2018 / 15 MLRG Tutorial in Reykjavik · AI 101 / G Taylor



via <u>thetimes.co.uk</u>

Ground-Truth



12 Jul 2018 / 16 MLRG Tutorial in Reykjavik · AI 101 / G Taylor



Ground-Truth



12 Jul 2018 / 16 MLRG Tutorial in Reykjavik · AI 101 / G Taylor



Ground-Truth



12 Jul 2018 / 16 MLRG Tutorial in Reykjavik · AI 101 / G Taylor







Supervised Learning: Classification

Assignment of inputs to one or more known categories.

Examples:

- **Object recognition**
- Scene labeling •
- Medical diagnosis
- Ad click-through prediction •
- Tagging news articles •
- Spam filtering
- Gesture recognition



Thalmic Labs Myo

Unsupervised Learning



12 Jul 2018 / 18 MLRG Tutorial in Reykjavik • AI 101 / G Taylor

via <u>thetimes.co.uk</u>

Unsupervised Learning: Clustering

Assignment of inputs to unnamed groups ("clusters") such that objects in the same group are similar.

Examples:

- Exploratory data mining
- Plant and animal ecology
- Human genetic clustering
- Grouping of shopping items
- Market research
- Semi-automated grading

12 Jul 2018 / 19 MLRG Tutorial in Reykjavik · AI 101 / G Taylor



for Code Submissions to a MOOC"

Unsupervised Learning: Generative Modelling



12 Jul 2018 / 20 MLRG Tutorial in Reykjavik • AI 101 / G Taylor



Reinforcement Learning



12 Jul 2018 / 21 MLRG Tutorial in Reykjavik · AI 101 / G Taylor

via Jamie Campbell from Emsworth (nr Portsmouth), U.K - Falling down

Reinforcement Learning: Game Playing



MLRG Tutorial in Reykjavik · AI 101 / G Taylor



Google DeepMind's AlphaGo A Hybrid of Several Learning Paradigms + Some "Brute Force"

Representations in ML

 The choice of representation has an enormous effect on the performance of ML algorithms







via deeplearningbook.org



Artificial Intelligence



Artificial Intelligence

Learning a Feature Hierarchy

- It can be very difficult to extract high-level, abstract features from • raw data
- **Deep learning** solves this challenge by composing representations •
- Each layer extracts features from output of previous layer •



Deep learning allows us to build complex concepts out of simpler concepts

Credit: Rob Fergus



Artificial Intelligence



Artificial Intelligence



Artificial Intelligence

Why So Successful Now?



MLRG Tutorial in Reykjavik · AI 101 / G Taylor



Credit: Marc'Aurelio Ranzato







SW DEV PROCESS Write code, compile, test, debug, repeat...

via Clement Farabet



Source code	 Dat
Compiler	 Dee
Executable	 Pred

а

ep Learning

dictor

via Clement Farabet



DL-BASED SW PROCESS Collect initial data, train, run/debug, mine new data

via Clement Farabet

Medium



Andrej Karpathy Follow Director of Allat Tesla. Previously Research Scientist at OpenAl and PhD student at Stanford. I like to train deep neural nets on large datasets. Nov 11, 2017 · 8 min read

Software 2.0

I sometimes see people refer to neural networks as just "another tool in your machine learning toolbox". They have some pros and cons, they work here or there, and sometimes you can use them to win Kaggle competitions. Unfortunately, this interpretation completely misses the forest for the trees. Neural networks are not just another classifier, they represent the beginning of a fundamental shift in how we write software. They are Software 2.0.

The "classical stack" of **Software 1.0** is what we're all familiar with—it is written in languages such as Python, C++, etc. It consists of explicit instructions to the computer written by a programmer. By writing each line of code, the programmer is identifying a specific point in program space with some desirable behavior.

Deep Learning is Eating Software

NOVEMBER 13, 2017 By Pete Warden in UNCATEGORIZED 22 COMMENTS



Thanks to: the Machine Learning Research Group @ U of G



Thanks to: all of our generous sponsors!

UNIVERSITY OF ICELAND

