Machine Learning Overview

Learning Goal

- The implications of Machine Learning: How and when it should be used.

Machine Learning Overview

- Machine Learning is a general purpose technology, what does this mean?

Machine Learning Overview

- A **general purpose technology** or **GPT** is a term coined to describe a new method of producing and inventing that is important enough to have a protracted aggregate impact.

- Similar to electricity or the internet, in that it can be applied across domains and work to improve market outcomes.

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- Will Machine Learning/AI replace certain workforces, take away jobs?

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- Depends on the type of actively being completed and the value proposition between trading manual labor for automation.
- Manufacturing automation is ripe for machine learning.
- TrendForce – Estimates smart manufacturing is a $200 billion a year industry and will increase to over $320 billion by 2020.
  - That is a projected compound annual growth rate of 12.5 percent.
- Similarly, the International Federation of Robotics estimates by 2019 the number of operational industrial robots installed in factories will grow to 2.6 million from just 1.6 million in 2015.

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- However, before we all turn into robots consider two important facts:
  1. We remain remarkably far away from what would be consider a similar general intelligence that can be compared to humans
  2. Machines cannot do the full range of tasks that humans can do
- We can then refer to jobs or activities that might be good cases for Machine Learning as SML or Suitable for Machine Learning
- These replacements will most likely continue to contribute to income inequality and could have broad impacts over the next 10 years.
- What are other examples of jobs that might be seen as SML?

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- What is driving the continued progress of machine learning techniques?

- Increased Access to Computing Power
- Larger Training Datasets
- Improved Algorithms - DNN

- Facebook moved from phrase-based translations to DNNs for roughly 4.5 billion language translations each day
- Error rates on ImageNet (10,000 labelled images) have been driven down from 30% in 2010 to less than 3% today.
  - 5% is important because that's typically the human error rate

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- Successful implementation of ML requires very detailed specifications on what is to be learned and data to support that learning activity, engineering features through a series of trial and error and then most importantly embedding these products into **normal business operations** in such a way that efficiencies can be realized.
  - This includes a process for capturing additional training examples
- What then are the implications for ML teams?
- Learning apprentice?

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- What tasks are most suitable for ML to take over:
  - Most recent successes are predicated on supervised learning
  - Competency is actually really narrow as compared to the complexity of human decision making

1. Learning a function that maps well-defined inputs to well-defined outputs
   - If can predict Y given any value of X – still might not produce the actual causal effect
2. Large Data is present or can be created containing input-output pairs
   - The more training data available the more arcuate the model
3. Task provides clear feedback with well definable goals and metrics
   - If we know what to achieve – (optimize flight patterns not a single flight)
4. Where reasoning and diverse background knowledge is not necessary
   - Good at empirical associations but terrible at decision making that requires common sense of historical knowledge
5. No need for why the decision was made to be clear
   - NN could use millions numerical weights

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6. A tolerance for error or sub-optimal solutions
   - ML use probabilistic outputs…what does this mean?
7. Function of item being learned should not change rapidly over time
   - Work best when the distribution of future test examples is the same roughly as the training set over time
8. Emotional intelligence or creativity may always be outside the reach of Machine Learning….or will it?

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1. Substitution – Jobs will be replaced and labor demand reduced
2. Price elasticity – total spending goes up
3. Complementarities – as ML becomes more universal so will the need for Data Scientists (Computers versus Software Programmers)
4. Income elasticity – drive wages up and down, contributing to income inequality
5. Elasticity of labor – Because of the barriers to entry of being a data scientist or a ML professional wages will likely reflect demand increases not available labor
6. Business Process Redesign – production process will continue to be re-defined and economize on high price inputs – which will likely be skilled labor