Jake Mayeux
3/22/2017
ENGW 1111
Machine Learning Research Paper

Annotated Bibliography

https://www.wired.com/2017/02/ai-learn-like-humans-little-uncertainty/
Metz, Cade. "AI Is About to Learn More Like Humans-with a Little Uncertainty." Wired. Conde Nast, 03 Feb. 2017. Web. 22 Mar. 2017.

- Summary
  - Artificial Neural Networks (ANN) require large data sets to be useful for finding patterns. AI Researchers also do not always understand why ANNs make the decisions that they do.
  - A new type of machine learning based on the Bayesian Theorem. The Bayesian AI Researchers' approach AI in a way that resembles the scientific method.
  - Machine Learning Algorithms (MLA) based on Baye's rule excel at things that ANNs are not good at.
  - "What we're interested in is automating the scientific method" - Ben Vigoda
  - Gary Marcus, CEO of Geometric Intelligence, is developing an AI that learns from much smaller data sets than ANNs. It learns more like a human
  - "There are problems in the domain of language and in driverless cars where you're never going to have enough data to use brute force the way that deep learning does," he [Gary Marcus] said when Uber acquired Geometric Intelligence this past December.
  - Another MLA called Gaussian Process (GP), which is based on Baye's rule, is good for determining uncertainty.
  - GPs and Bayesian optimization help automate the task of building an ANN
  - GPs make it easy to understand why an ANN made a particular decision and hep reduce the amount of data needed to learn.
- Evaluation
  - Wired is a professional website aimed at technology enthusiasts.
  - I would consider this a credible source Wired is well respected and I would not expect them to publish false information. Especially on a topic like this.
  - Their evidence comes from quoting several individuals who are all significant researchers in the field of Machine Learning.
  - Link to useful resources are provided throughout the article.
  - The author is a senior staff writer at Wired. He covers other similar topics including Bitcoin, data centers and programming. He seems to be qualified to write on the source
  - The purpose of the source is to show the reader some new technology being used in ANNs and why it is needed and useful.
  - The genre is Journalism
- Usefulness
  - This article does a good job explaining some of the flaws currently holding back ANNs.

- Explains two new MLAs and why and how they are being used.
- It seems a bit fluffed up. I feel like the article could be compressed to this is Baye's rule, this is why AI researchers are using it.
- Did not explain *what* Baye's rule was. Did not explain *what* the Gaussian Process was. Just explains why they are useful and what they do to improve ANNs
- Good for understanding some of the limitations and challenges faced by AI researchers
- Provides links to

http://machinelearningmastery.com/machine-learning-in-python-step-by-step/
Brownlee, Jason. "Your First Machine Learning Project in Python Step-By-Step." Machine Learning Mastery. N.p., 13 Mar. 2017. Web. 21 Mar. 2017.

- Summary
  - This article is a tutorial for a "Hello World" or starter program for Machine Learning.
  - First, install 5 libraries needed to run the code. Check versions of each library to make sure the author and the reader are on the same page.
  - Loading the dataset. The dataset provided for the tutorial is called the Iris Flowers data set. It is used by almost everyone for getting started in Machine Learning.
  - Summarizing the dataset. View and sort the data using the pandas library
  - Visualizing the dataset. Create graphs to visualize the data using the pandas library.
  - Evaluating some algorithms. Test out 6 different MLAs and determine their effectiveness based on accuracy.
  - Making some predictions. Choose the most effective model based on accuracy and then use it to make predictions about the data.
- Evaluation
  - This is a great source for understanding how to get started with Machine Learning. It is simple and easy to follow.
  - It does not explain how to gather data for Machine Learning, which is essential for applying Machine Learning to any problem.
  - The author, Jason Brownlee, seems to be well qualified to write on this topic. In his about page on his website, he claims to have a few higher degrees in AI. He is passionate about helping other professionals get into the world of Machine Learning.
  - The purpose is to teach the reader the absolute basics to build their first Machine Learning program.
  - The intended audience is anyone with programming experience who wants to know more about how to use Machine Learning
  - The genre is a tutorial.
  - Evidence is not relevant to this article. Instead, he provides snippets of code and screenshots of what you should see after running certain pieces of code. In the end, if the code works, that is all the evidence you need to know that whether his tutorial was correct.
- Usefulness
  - This was a good tutorial for helping me understand all the components of Machine Learning and the minimum of what goes into a program that uses MLA.

- The article does not provide any points or arguments so it likely will not be useful as a resource in my research paper.
- I followed the tutorial successfully. I learned how easy it is to apply different MLAs to a data set and determine the best one.
- This actually used an algorithm called "Gaussian Naive Bayes" which was praised by my previous source (the Gaussian Naive Bayes algorithm tied with two others for second most accurate).
- I can now test different algorithms and their effectiveness on a given data set.

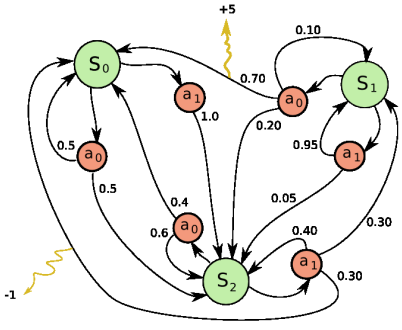
https://www.wired.com/2017/03/alivecor-kardia/
Moynihan, Tim. "Ex-Googlers Build a Neural Network to Protect Your Heart." Wired. Conde Nast, 20 Mar. 2017. Web. 21 Mar. 2017.

- Summary
  - Heart disease is a big problem and the only way to stop it is early detection. The only effective way of detecting it is by using an EKG machine
  - A new device from a company called AliveCor is small (3" x 1.5"), relatively cheap ($100) and accurate.
  - The device uses neural networks to identify signs of heart disease.
  - "They are clearly a leader in this space," says Stanford geneticist Michael Snyder
  - Their ANN uses 4 convolution layers and 300,000 parameters.
  - The technology builds a profile for each user over the course of the month and uploads it to the cloud. It then uses your profile to detect abnormalities that could indicate a medical emergency.

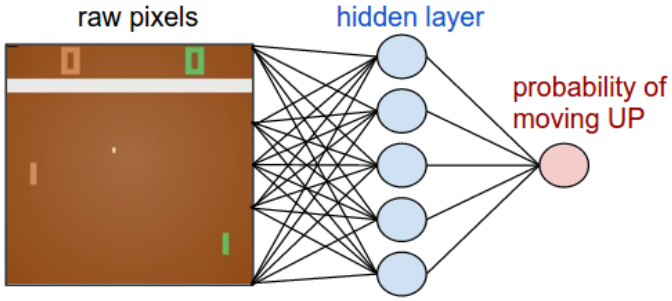
    - The figure above shows an example of a user's data and how the device can detect abnormalities.
    - Currently, the technology only works with proprietary hardware. AliveCor is open to licensing the technology to others which means the same tech can be integrated into smartwatches or phones making checking the condition of your heart easy and accessible for everyone.
- Evaluation
    - The entire article is about AliveCor's new product. It feels a bit like an advertisement.
    - This source provides a good example of how ANNs can be applied in the field of medicine.
    - The author had experience writing for PCWorld, CNET and TechTV. He writes on hardware, virtual reality and miscellaneous technology. He seems qualified to write on this topic.
    - The purpose of this source is to showcase a product that uses popular and new technology.
    - The intended audience are people who are interested in new technology, neural networks and also possibly those who have heart problems.
    - The genre is journalism.
    - The CEO of AliveCor, a Stanford geneticist and the Mayo Clinic are some of the quoted source. There is also a screenshot of example data from the AliveCor's product.
- Usefulness
    - This article is a great example of how ANNs can be applied to medicine instead of more commonly to image recognition or self-driving cars.
    - It also shows how neural networks can adapt to an individual to make a service or experience better for that person.
    - It also shows how machine learning can be applied to solve or improve on difficult problems.

http://karpathy.github.io/2016/05/31/rl/
Karpathy, Andrej. "Deep Reinforcement Learning: Pong from Pixels." Deep Reinforcement Learning: Pong from Pixels. N.p., 31 May 2016. Web. 22 Mar. 2017.

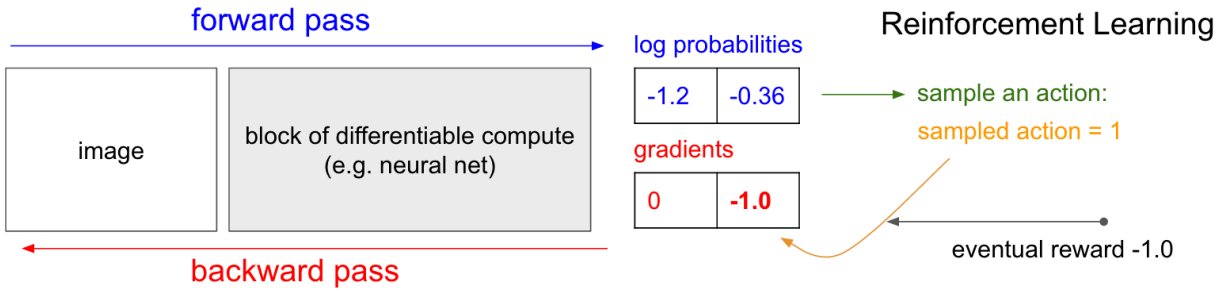
- Summary
    - An explanation of how to apply Reinforcement Learning (RL) to play games
    - There are 4 factors holding back AI: computational power, data, algorithms, infrastructure (software it runs on)
    - Most people do not know that AI can teach learn on its own to play a game like pong by just reading the pixels from the screen.



- Presenting Policy Gradients (PG) instead of DQN (two different algorithms both for reinforcement learning). Policy gradients work better than DQN when tuned well
- The figure above is a visual of the Markov Decision Process. Each circle is a game state and each line is a possible transition. Each transition gives a reward and the goal is to find the optimal way of acting in any state to maximize rewards.
- Pong is a good example because it a very simple game with only 3 objects to process and two outputs (up or down)
- The first step is to create a policy network. This will take in data - a total of 100,800 representing the pixels of the screen and output a single number representing the probability of moving up. The following figure visualizes the policy network



- Then feed two randomized matrices that ultimately determine how to interpret the data and output what to do. The matrices initially will not work and the problem now is to find the matrices that lead to the algorithm to win a game of pong.



- Here is an example of the logic flow from the RL algorithm. This shows how the network learns. It generates probabilities for which action to take, samples the action (executes it, in this case moves the pong paddle down), and then determines the reward, and applies the gradient to the network on the backward pass causing the network to be less likely to move down if it sees that same image again.
- The network learns by playing the game over and over until the neural net always produces the correct move.

- Evaluation
  - The source relevant because it is an in depth explanation of a specific type of machine learning. It goes into some of the mathematics used and provides great diagrams to make it easy to understand the complete structure of a RL algorithm.

- The author, Andrej Karpathy is a PhD student at Stanford University. He appears to be well qualified to write on this topic. He also developed a JavaScript library for building RL networks.
- The purpose of the source is to provide an in depth explanation of Reinforcement learning using pong as an example.
- The intended audience is mainly programmers interested in applying Reinforcement Learning algorithms
- The genre is a blog post. It is very dense but also has a very casual tone.
- The evidence is presented as code snippets and mathematical equations that can be fact checked by any able individual.

- Usefulness
  - This is greatly useful for diving into some of the more complex and in depth aspects of machine learning.
  - There are many useful diagrams and equations presented in this blog post that could be used to help explain certain aspects of machine learning.
  - Reinforcement Learning is a subset of Machine Learning that I am particularly interested in and this post explains almost all there is to know about RL.

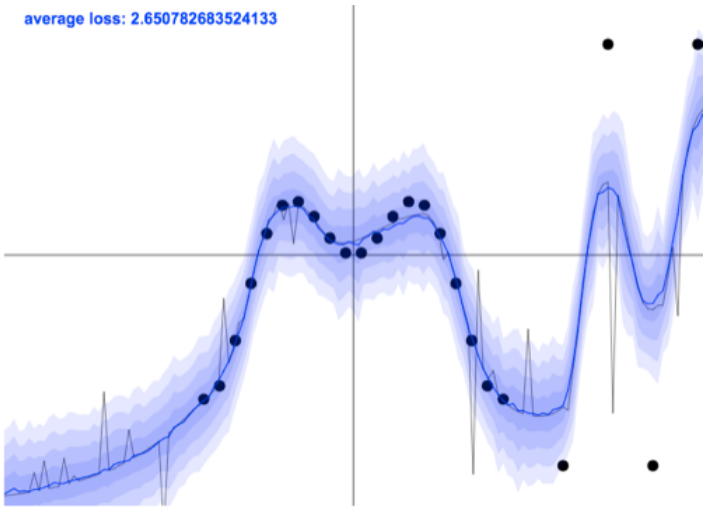
https://en.wikipedia.org/wiki/Machine_learning
"Machine Learning." Wikipedia. Wikimedia Foundation, 22 Mar. 2017. Web. 22 Mar. 2017.

- Summary (Approaches & Applications sections only)
  - Approaches
    - Decision tree: maps observations about an item to reach a conclusion
    - Association rule: for discovering interesting relations in large data sets
    - Artificial Neural Networks: a learning network that is inspired by neural networks in our brains
    - Deep learning: uses multiple ANNs to process light and sound the way the human brain does
    - Inductive logic: given background knowledge and examples, this method will derive a program that entails all positive examples.
    - Support vector: predicts whether an example falls into one category or another
    - Clustering: clusters sets of data into categories. Used for data analysis
    - Bayesian networks: for example could be used to find relationships between diseases and symptoms
    - Reinforcement learning: finds the best way for an agent to take actions in an environment to maximize reward
    - Representation learning: transforms the information inputted into something useful
    - Similarity & metric learning: looks for similarities in objects based on previous examples
    - Sparse dictionary learning: I honestly do not understand this one at all. Its used in removing noise from images
    - Genetic algorithms: mimics the process of natural selection and replicates mutation and crossover to evolve a network.
    - Rule based: learns or evolves a set of rules to store and manipulate.

    - Learning classifier systems: finds a set of context dependent rules to collectively store and apply knowledge.
  - Applications
    - A large list of links to ways machine learning can be applied.
- Evaluation
  - The source is relevant, it provides clear explanations of the many types of machine learning algorithms.
  - Wikipedia cannot be referenced as a highly credible author due to its unrestricted editing. For this purpose however, it is useful for helping clear up some of the many terms tossed around in the topic of Machine Learning
  - The purpose of the source is to provide a well documented accumulation of general knowledge on Machine Learning
  - The article is for the general audience who is interested in learning about Machine Learning.
  - The genre is Wikipedia
  - Evidence is provided in the references section. Some of the sources referenced include IEEE, MIT and Reddit.
- Usefulness
  - This article is useful for understanding the different types of machine learning and how they can be applied.
  - I can use these definitions to explain the differences, as well as the pros and cons of the different algorithms used in Machine Learning.

http://fastml.com/bayesian-machine-learning/
Z., Zygmunt. "FastML." Bayesian Machine Learning - FastML. N.p., 28 Mar. 2016. Web. 22 Mar. 2017.

- Summary
  - Bayesians vs Frequentists: Bayesians think of probability as a measure of beleif. Frequentists think of probability as a reference to past events
  - Baye's Rule: P(A | B) = P(B | A) * P(A) / P(B)
  - Baye's rule is used to infer model parameters in machine learning. A represents the model parameters and B represents the data set.
  - There are two methods of Bayesian learning:
    - Statistical modeling: used when data is scarce
    - Probabilistic machine learning: outputs predictions with a set of probabilities
  - Gaussian process is a Bayesian counterpart you can see a graph of its output here:



- Evaluation
  - The source provides an in depth explanation on the theory of Bayesian Machine Learning.
  - It is unclear how credible the author is. At the beginning of the article there is a disclaimer: "While we have some grasp on the matter, we're not experts, so the following might contain inaccuracies or even outright errors. Feel free to point them out, either in the comments or privately." Which means the article probably contains errors but there is no way of knowing for sure.
  - The purpose of the source is to educate the reader about how Baye's rules relates to machine learning.
  - The intended audience is programmers and practitioners
  - The genre is a blog post
  - Evidence is provided as links to other relevant websites throughout the article.
  - It also has a Resources section at the end linking to other literature to help solidify the readers understanding of Bayesian Learning.
- Usefulness
  - This article was difficult to understand. It used a lot of terms I was not familiar with and did not explain some of the concepts very well.
  - It did however show exactly how Baye's rule was used in MLAs which I thought was particularly useful.
  - The resources section at the end is useful for finding more information on similar topics.

https://www.wired.com/2016/02/ai-is-changing-the-technology-behind-google-searches/
Metz, Cade. "AI Is Transforming Google Search. The Rest of the Web Is Next." Wired. Conde Nast, 04 Feb. 2016. Web. 22 Mar. 2017.

- Summary
  - The day before the article was published, Google acquired a new employee to oversee the search engine
  - John Giannandrea, the new head of the search engine, also oversee Google's AI department.
  - The concern with driving the search engine with a neural net was that it was difficult to understand why the net makes certain decisions and even more difficult to tweak it.
  - An anonymous former Google employee revealed that Google Ads were the first to adopt Machine Learning to drive their software. The search department was reluctant to make the move to AI.
  - "it's hard to explain and ascertain why a particular search result ranks more highly than another result for a given query." And, he added: "It's difficult to directly tweak a machine learning-based system to boost the importance of certain signals over others." - Edmond Lau
  - Today, Google has incorporated deep learning into the search engine.
  - "People understand the linear algebra behind deep learning. But the models it produces are less human-readable. They're machine-readable," Nicholson says. "They can retrieve very accurate results, but we can't always explain, on an individual basis, what led them to those accurate results." - Chris Nicholson.

    - The new system is much better at handling new and unusual search terms
- Evaluation
    - The source is relevant because it shows how deep learning has been applied, along with the pros, cons and controversies along with it.
    - The author is a senior staff writer at Wired. He covers other similar topics including Bitcoin, data centers and programming. He seems to be qualified to write on the source
    - The purpose of the source is to detail the controversy about Google's decision to convert its engine to a new Deep Learning based system
    - The intended audience is technology enthusiasts and people interested in Google and Machine Learning
    - The genre is journalism
    - The evidence is provided by quoting several reputable people relevant to the topic and providing several link throughout the article.
- Usefulness
    - This is great example of the controversies stemming from machine learning
    - It is a real world example of how machine learning is being incorporated into our everyday lives and how it affects us and benefits us.