Day-1: Assignments and Reading materials

Artificial Intelligence(AI) and Machine Learning(ML) are inter-disciplinary studies. I called them *studies* because they are yet to be acknowledged as an independent branch of natural sciences, math or engineering. The theory and computations behind them come from several original sources.
Roughly speaking, AI concerns itself with the following:

- Reasoning, problem solving (e.g. solve Rubik's cube with a robot hand)
- Knowledge representation (objects, relationships, contents): Databases, ontologies. Content based indexing and information retrieval (Think of ontologies in an e-commerce site or medical dictionaries)
- Expert systems: Domain specific rule-based systems (e.g. Medicine, Marketing)
- Learning: Unsupervised, supervised, reinforcement
- Natural language processing: Text understanding, question answering, machine translation (Alexa, Siri, Google translator)
- Perception: Object recognition, speech recognition, facial recognition, emotion recognition
- Robotics: Motion and manipulation (e.g. Boston Dynamics)
- Human/computer interfaces (e.g. NeuraLink)

In contrast, ML is all about *learning from the data*. You shall come to understand the nuances in time. **Deep Learning** is even more specific: It is a subset of ML, and it employs a specific set of algorithms (Artificial Neural Networks) to solve ML problems. As a mnemonic, you can use the following:

$$\text{DL} \subset \text{ML} \subset \text{AI}$$

Artificial Intelligence: A Modern Approach, 2nd Edition is a good book. It is an encyclopedia of what is what in AI: Subjects, definitions, history, algorithms&methods, etc. I will reference some chapters or some sections throughout the course. **The 1st chapter will be the assignment for our very first day**: *Read it all.* It will be though at the very first. You should read it several times, and look up the references as well. The section 1.2 is especially important as it explains the disciplines that contribute to AI.

The rest of this document is OPTIONAL. It contains some notes, highlights, and thinking materials (some objective, some personal) concerning Day-1:

- **Intelligence**: You should search for and contemplate about various definitions of intelligence. There is still yet not a universal definition of intelligence. A very recent article by Francois Chollet (The Measure of Intelligence, Nov 5 2019) is worth reading about intelligence and its measurement. A particular trap in interpreting the intelligence is an anthropomorphic one: (as in almost all of our endeavours) We define it through the terms and the boundaries of human intelligence. You should try to avoid it and be open to embrace the different forms of intelligence that might exist (The ditto goes for the term "life").

- **Philosophy**:As in other branches of science, Philosophy plays an important role in both understanding its history, and sometimes becomes the source to come up with new ideas. For example, the immortal Aristotle is the original source for the empiricism, the positivism, the scientific method, logic, and inductive thinking. He single-handedly laid the foundation for how to think and act right. A large swath of Western philosophy could be interpreted as variations on themes Aristotle laid out. We saluted the master by giving our company the name Organon, the name of a collection of six of his works on logic. You should learn the connections and contributions of Philosophy with/to AI.

- **Plato vs Aristotle**: You should learn and reason about rationalism vs empiricism, deductive reasoning vs. inductive reasoning, bayesian statistics vs frequentist statistics, even romanticism vs realism. These dualities could all be traced to the differences in the ideas and theses of Plato&Aristotle. One would be in better position to understand them if he/she is in the business of reasoning right.

- **Mathematics**: It is not science, it is not engineering, and it is far from the humanities. It is probably closest to the art as a discipline since it is pure fiction. However, all the others use its language to describe the parts of the reality they are interested in. Read the article "The unreasonable effectiveness of Mathematics in the Natural Sciences" by Eugene Wigner (link: https://www.maths.ed.ac.uk/ v1ranick/papers/wigner.pdf) to understand the connection between this magnificent fiction and the physical reality. It is yet again the tool to understand, and innovate AI and ML. So, one should be sufficiently versed in an already well defined minimum of the theory and the practice of relevant Math (Probability Theory, Linear Algebra, and Optimization Theory) to be called a pupil (possibly a master in the future) in AI&ML.

- **Neuroscience**: I recently have come to realize how neglectful I was of Neuroscience,

and the workings of the brain in specific. The human beings have made tremendous achievements in physical sciences in the last three centuries (which is an amazing feat and of curiosity in itself) to understand and predict the phenomena in visible universe, however we have come short of understanding how that gray matter (and its supporting cast) of ours is itself able to do achieve those feats. The nervous system is comprised of the brain, an electric network and a chemical network at once and at interplay with each other. The brain is an onion-like structure that keeps evolving: The cortex, the new kid on the block makes novel calculations, invents science; and that old guard at the center spins the emotions and on-the-spot reactions of 7+bn people all over the world on a daily basis. Pick a good book on Neuroscience (Mine is *Neuroscience: Exploring the Brain*) and read about that wonderful organ.

- **Computer Science**: I have gradually fallen in love with CS over the years. At the expense of being dubbed as the quintessential geek, I love every aspect of it: Complexity theory, data structures and algorithms, databases, AI, ML, DL, and last but not the least software development. To me, AI&ML is Math and Computations, and CS provides the latter. The latest surge in AI&ML is mostly the result of developments in computer science. As of software development: Though I do not see it as a well established engineering discipline, there has been an enormous body of knowledge accumulated over the years. It is a craft that employs creativity, and matures by tireless repetition and invention&registration of patterns, principles, and practices. One day, it will be engineering once it becomes data rather than text, but i fear it will lose its beauty. OK, I digressed: Every course you have taken in your undergrad classes are valuable. Now, it is the time to mobilize them. You will know your data structures and algorithms. You will know the computational complexity of your methods. You shall know the memory organization, and the flow of the data on modern chips. You shall be organized both in mind and in its manifestation as code. Software development is the game of tidy and organized minds, and it severely punishes those with lax attitudes.