Hyperion Development

Task: Machine Learning I

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Introduction

Welcome to The First Machine Learning Task!

The objective of the next few tasks is to give you a holistic understanding of machine learning, covering theory, application, and the inner workings of supervised and unsupervised learning algorithms.

You don't have to take our courses alone! This course has been designed to be taken with an online mentor that marks your submitted code by hand and supports you to achieve your career goals on a daily basis.

To access this mentor support simply navigate to www.hyperiondev.com/support.

A NOTE FROM THE HYPERION TEAM

The terms machine learning and artificial intelligence are often used interchangeably and are responsible for smarter home appliances, self-driving cars to even robots replacing us at our jobs.

But, while AI and machine learning are very much related, they are not quite the same thing. AI is a branch of computer science attempting to build machines capable of intelligent behaviour, while Stanford University defines machine learning as "the science of getting computers to act without being explicitly programmed". You need AI researchers to build the smart machines, but you need machine learning experts to make them truly intelligent.

Introduction to Machine Learning

Throughout history, our imaginations have been captivated by visions of machines that can learn and imitate human intelligence. While visions of general artificial intelligence such as Arthur C. Clarke's *HAL* and Isaac Asimov's *Sonny* or Tony Stark's *Jarvis* are yet to be realised, software programs that can acquire new knowledge and skills through experience are becoming increasingly common. We use such machine learning programs to discover new music that we enjoy and to quickly find what articles might interest us online. Machine learning programs allow us to dictate commands to our smartphones and allow our thermostats to set their own temperatures. Machine learning programs can decipher sloppily-written mailing addresses better than humans, and guard credit cards against fraud more vigilantly. From investigating new medicines to estimating the page views for versions of a headline, machine learning software is becoming central to many industries.

What is Machine Learning?

Machine learning was defined in 1959 by Arthur Samuel as the "field of study that gives computers the ability to learn without being explicitly programmed." This means integrating knowledge into machines without hard-coding it. Throughout the 1950s and 1960s, Samuel developed programs that played checkers. While the rules of checkers are simple, complex strategies are required to defeat skilled opponents. Samuel never explicitly programmed these strategies, but through the experience of playing thousands of games, the program learned complex behaviors that allowed it to beat many human opponents.

In the 50s, machines were quite weak, and in very little supply, which remained very much the case for half a century. Machine Learning was relegated to being mainly theoretical and rarely actually employed. The Support Vector Machine (SVM), for example, was created by Vladimir Vapnik in the Soviet Union in 1963, but largely went unnoticed until the 90s when Vapnik was scooped out the Soviet Union to the United States by Bell Labs. The neural network was conceived in the 1940's, but computers at the time were nowhere near powerful enough to run them well, and have not been until the relatively recent times.

A popular quote from computer scientist Tom Mitchell defines machine learning more formally:

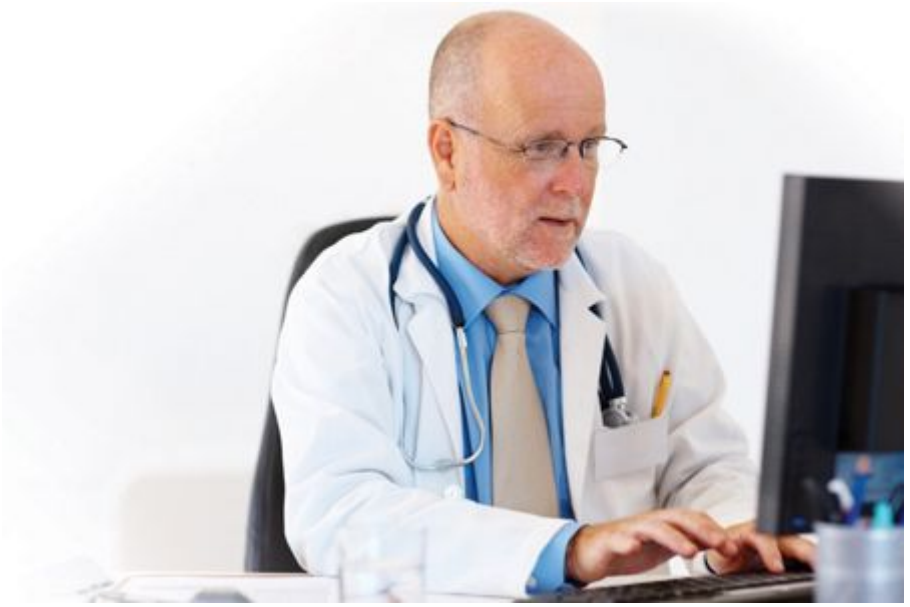
"A program can be said to learn from experience E with respect to some class of tasks T and performance measure P, if its performance at tasks in T, as measured by P, improves with experience E."

For example, assume that you have a collection of pictures. Each picture depicts either a dog or cat. A task could be sorting the pictures into separate collections of dog and cat photos. A program could learn to perform this task by observing pictures that have already been sorted, and it could evaluate its performance by calculating the percentage of correctly classified pictures.

A NOTE FROM CEO
RIAZ MOOLA

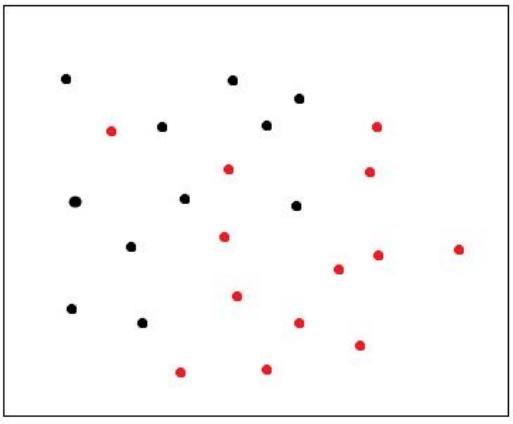
Sorry to interrupt, but did you know that machine learning is used by some medical professionals to make diagnoses? That's right! Given the symptoms exhibited in a patient and a database of anonymized patient records, machine learning is able to predict whether a particular patient is likely to have an illness or not. The ultimate goal of these types of programs is to assist medical practitioners to make near-perfect decisions, rather than being

the sole source of the diagnosis.



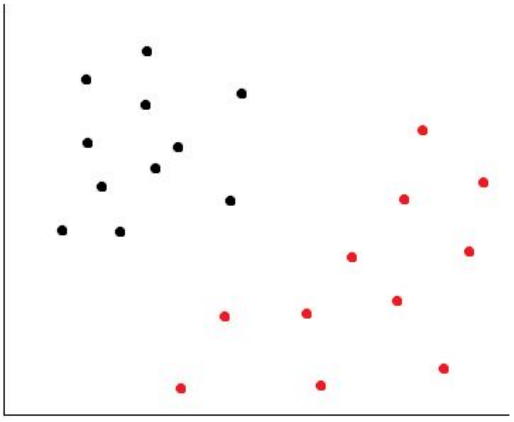
Supervised and Unsupervised Machine Learning

Machine learning systems are often described as learning from experience either with or without supervision from humans. In supervised learning problems, a program predicts an output for an input by learning from pairs of labeled inputs and outputs; that is, the program learns from examples of the right answers. In unsupervised learning, a program does not learn from labeled data. Instead, it attempts to discover patterns in the data. For example, suppose you have two datasets scattered in a 2-dimensional space and you want to find the line that will best separate the two data sets.



The simplest method would be to insert a line that will “accurately” divide the data. Although, this insertion would be unjustified and the accuracy will be disputable. Thus, this is where you can use machine learning. Machine learning can be charged with the task of separating the data for you.

This particular problem would be an example of unsupervised machine learning, where you would use an algorithm to make inferences from data sets. In unsupervised learning, a phenomenon called cluster analysis is used for grouping data. Thus, cluster analysis can be applied here, which will produce the following result:



As you may have already deduced, machine learning involves applying statistical learning techniques to identify patterns in data. These techniques can be used to make highly accurate and objective predictions.

Moving along, assume that you have collected data describing the heights and weights of people. An example of an unsupervised learning problem is dividing the data points into groups. A program might produce groups that correspond to men and women, or children and adults.

Now assume that the data is also labeled with the person's sex. An example of a supervised learning problem is inducing a rule to predict whether a person is male or female based on his or her height and weight. Supervised learning and unsupervised learning can be thought of as occupying opposite ends of a spectrum. Some types of problems, called semi-supervised learning problems, make use of both supervised and unsupervised data; these problems are located on the spectrum between supervised and unsupervised learning. An example of semi-supervised machine learning is reinforcement learning, in which a program receives feedback for its decisions, but the feedback may not be associated with a single decision. For example, a reinforcement learning program that learns to play a side-scrolling video game such as Super Mario Bros. may receive a reward when it completes a level or exceeds a certain score, and a punishment when it loses a

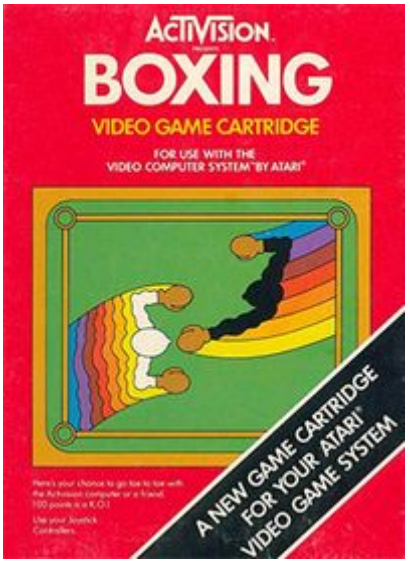
life. However, this supervised feedback is not associated with specific decisions to run, avoid Goombas, or pick up fire flowers.

A supervised learning program learns from labeled examples of the outputs that should be produced for an input. There are many names for the output of a machine learning program. Several disciplines converge in machine learning, and many of those disciplines use their own terminology. In this task, we will refer to the output as the response variable. Other names for response variables include dependent variables, regressions, criterion variables, measured variables, responding variables, explained variables, outcome variables, experimental variables, labels, and output variables. Similarly, the input variables have several names. In this book, we will refer to the input variables as features, and the phenomena they measure as explanatory variables. Other names for explanatory variables include predictors, regressors, controlled variables, manipulated variables, and exposure variables. Response variables and explanatory variables may take real or discrete values. The collection of examples that comprise supervised experience is called a training set. A collection of examples that are used to assess the performance of a program is called a test set. The response variable can be thought of as the answer to the question posed by the explanatory variables. Supervised learning problems learn from a collection of answers to different questions; that is, supervised learning programs are provided with the correct answers and must learn to respond correctly to unseen, but similar, questions.

A NOTE FROM CEO
RIAZ MOOLA

Sorry to interrupt, but did you know that Google DeepMind, a London based subsidiary, has trained an AI gamer to play 49 different video games from an Atari 2600, beating a professional human player's top score in 23 of them. Yes, you read that right!

The software isn't told the rules of the game — instead, it uses an algorithm called a deep neural network to examine the state of the game and figure out which actions produce the highest total score.



One of the most impressive, and probably the most eeriest example is that, in the boxing game, the software learned how to pin it's opponent on the ropes (which is something only seasoned players of the game knew how to do), and release a barrage of punches until it's opponent was knocked out! Extremely ruthless, right?

Compulsory Task

Answer the following questions:

- Create a file called “MLearning.py”.
- Inside it, comment on the differences between supervised and unsupervised machine learning, as well what you think semi-supervised machine learning is.
- Answer the following questions using comments:
    - Write a paragraph on Machine Learning. Try to use your own words (about 8 sentences)
    - Write a paragraph on Supervised Learning. Try to use your own words (about 5 sentences). Also, list at least 4 models in Supervised Learning.
    - Write a paragraph on Unsupervised Learning. Try to use your own words (about 5 sentences). Also, list at least 2 models in Unsupervised Learning.
    - Write a paragraph on 1 interesting trend in Artificial Intelligence that interest you. E.g. self-driving cars, music production, voice recognition, handwritten signature verification, computational biology, etc.

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