Introduction to Machine Learning

About CloudxLab

Making learning fun and for life

Videos

Quizzes

Hands-On

Projects

Case Studies

Real Life Use Cases

Automated Hands-on Assessments

Learn by doing

Automated Hands-on Assessments

Problem Statement

Hands On

Assessment

Automated Hands-on Assessments

Last Attempt Result: 3 / 87 **Last Attempt:** 1 week, 2 days ago

Getting Started With Linux Console

Please follow these steps:

1. Log into your CloudxLab Account: Open CloudxLab
2. Select the **"Credentials"** tab. You should see your login and passwords. You can copy the login and password using the icons.
3. Click on **"Web Console"** (Alternatively you could use SSH or Putty)
4. Enter your login and password. You can copy-paste from **"My Lab"**
5. If you are successfully logged in, please click on "I am Done! Please Check" button below.

Problem Statement

I am Done! Please Check

Evaluation

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Automated Hands-on Assessments

[Python Assessment]

[Jupyter Notebook]

Automated Hands-on Assessments

[Python Assessment]

[Jupyter Notebook]

Course Objective

Machine Learning Specialization with Python - Scikit Learn, Tensorflow

Course Instructor

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Founder CLOUD x LAB

Loves Explaining Technologies

Software Engineer

amazon INMOBI DE Shaw & Co

Worked On Large Scale Computing

Graduated from IIT Roorkee

What Is Machine Learning?

Field of study that gives "computers the ability to learn without being explicitly programmed"

-- Arthur Samuel, 1959

What Is Machine Learning?

Let us understand it with real use case...

Have You Played Mario?

How much time did it take you to learn & win the princess?

Have You Played Mario?

Did Anyone teach you?

How About Automating it?

How About Automating it?

- Program Learns to Play Mario

How About Automating it?

- Program Learns to Play Mario
- Observes the game & pressed keys

How About Automating it?

- Program Learns to Play Mario
- Observes the game & pressed keys
- Maximises Score

How About Automating it?

How About Automating it?

- So, the program learnt to play
  - Mario
  - And Other games
  - Without any programming

Question

To make this program learn any other games such as PacMan we will have to

1. Write new rules as per the game
2. Just hook it to new game and let it play for a while

Question

To make this program learn any other games such as PacMan we will have to

1. Write new rules as per the game
2. **Just hook it to new game and let it play for a while**

Imagine Doing The Same For Life

Gather data and automatically solve problems

The Machine Learning Tsunami - I

- Self driving cars on the roads

The Machine Learning Tsunami - 2

- Netflix movies recommendations

The Machine Learning Tsunami - 3

- Amazon product recommendations

The Machine Learning Tsunami - 4

- Accurate results in Google Search

The Machine Learning Tsunami - 5

- Speech recognition in your smartphone

Question

What do we need to

- Gather Data
- And automatically solving the problem?

Gather Data

Collect Data - IOT

Phone & Devices
Cheaper, faster and smaller

Connectivity
Wifi, 4G, NFC, GPS

Process Data - Parallel Computing

Distributed

- Groups of networked computers
- Interact with each other
- To achieve a common goal

Process Data - Parallel Computing

Multi Core + GPGPU (General Purpose Graphics Processing Units)

- Many processors or Cores
- Perform tasks and interact using
- Memory or bus

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Process Data - Parallel Computing

	MULTI CORE	GPGPU	DISTRIBUTED
CAN HANDLE HUGE DATA? (DISK READ INTENSIVE)	⊖	⊖	👍
REALLY FAST COMMUNICATION BETWEEN CPUS	👍	👍	⊖
GREAT FOR MATHS/GRAPHICS?	⊖	👍	⊖
TOOLS	Hadoop MR, Apache Spark	Keras, TensorFlow, Caffe, Spark (Exp)	Hadoop MR, Apache Spark

Intelligence - Traditional vs ML.

How you would write a spam filter?

Intelligence - Spam Filter - Traditional Approach

Intelligence - Spam Filter - Traditional Approach

Problems?

Intelligence - Spam Filter - Traditional Approach

Problems?

- Problem is not trivial
  - Program will likely become a long list of complex rules
  - Pretty hard to maintain
- If spammers notice that
  - All their emails containing **"4U"** are blocked
  - They might start writing **"For U"** instead
  - If spammers keep working around spam filter, we will need to keep writing new rules forever

Intelligence - Spam Filter - ML Approach

Intelligence - Spam Filter - ML Approach

- A spam filter based on Machine Learning techniques automatically learns
  - Which words and phrases are good predictors of spam
  - By detecting unusually frequent patterns of words
- The program will be
  - Much shorter
  - Easier to maintain
  - Most likely more accurate than traditional approach

Intelligence - Spam Filter - ML Approach

- Unlike traditional approach, ML techniques automatically notice that
  - **"For U"** has become unusually frequent in spam flagged by users and
  - It starts flagging them without our intervention

Intelligence - Spam Filter - ML Approach

Can help humans learn

- ML algorithms can be inspected to see what they have learned
- Spam filter after enough training
  - Reveals combinations of words that it believes are best predictors of spam
  - May reveal unsuspected correlations or new trend and
  - Lead to a better understanding of the problem for humans

Intelligence - Spam Filter - ML Approach

Can help humans learn

What is AI?

Artificial intelligence (AI):

The intelligence exhibited by machines

What is AI?

- The theory and development of computer systems

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  - Decision Making

What is AI?

- The theory and development of computer systems
- To perform tasks requiring human intelligence such as
  - Visual perception
  - Speech Recognition
  - Decision Making
  - Translation between languages

History - Mythology / Fiction

- In every mythology, there is some form of mechanical man such talos from greek mythology.
- In fiction novels, we have Mary Shelley's Frankenstein
- We are fascinated by the idea of creating things which can behave like human

History - Summer of 1956

- The term artificial intelligence was coined by
  - John McCarthy
  - In a workshop at
  - Dartmouth College in New Hampshire
  - Along with Marvin Minsky, Claude Shannon, and Nathaniel Rochester

Sub-objectives of AI

AI - Represent Knowledge

- Understanding and classifying terms or things in world e.g.
  - What is computer?
  - What is a thought?
  - What is a tool?
- Languages like **lisp** were created for the same purpose

AI - Reasoning

Aja Huang plays the first move for AlphaGo, against Lee Sedol 9 dan in game two.

- Play puzzle game - Chess, Go, Mario
- Prove Geometry theorems
- Diagnose diseases

AI - Navigate

- How to plan and navigate in the real world
- How to locate the destination?
- How to pick path?
- How to pick short path?
- How to avoid obstacles?
- How to move?

AI - Natural Language Processing

- How to speak a language
- How to understand a language
- How to make sense out of a sentence

AI - Perception

- How to we see things in the real world
- From sound, sight, touch, smell

AI - Generalised Intelligence

- With these previous building blocks, the following should emerge:
  - Emotional Intelligence
  - Creativity
  - Reasoning
  - Intuition

AI - How to Achieve

Machine Learning - Types

Machine Learning - Types

Machine Learning - Types

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Machine Learning - Supervised Learning

Whether or not models are trained with human supervision

Machine Learning - Types

CLOUD x LAB

Machine Learning - Supervised Learning

Classification

- The training data we feed to the algorithm includes
  - The desired solutions, called labels
- Classification of **spam filter** is a supervised learning task

Machine Learning - Supervised Learning

Classification

- Spam filter
  - Is trained with many example emails called training data.
  - Each email in the training data contains the label if it is spam or ham(not spam)
  - Models then learns to classify new emails if they are spam or ham

Machine Learning - Supervised Learning

Regression - Predict the price of the car (Value)

Machine Learning - Supervised Learning

Regression

- Predict price of the car
  - Given a set of features called predictors such as
  - Mileage, age, brand etc
- To train the model
  - We have to give many examples of cars
  - Including their predictors and labels(prices)

Machine Learning - Gradient Descent

- Instead of trying all lines, go into the direction yielding better results

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Machine Learning - Gradient Descent

- Imagine yourself blindfolded on the mountainous terrain
- And you have to find the best lowest point
- If your last step went higher, you will go in opposite direction
- Other, you will keep going just faster

Machine Learning - Types

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Machine Learning - Unsupervised Learning

- The training data is unlabeled
- The system tries to learn without a teacher

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Machine Learning - Types

Machine Learning - Unsupervised Learning

Clustering - Detect group of similar visitors in your blog

Machine Learning - Unsupervised Learning

Clustering

- Detect group of similar visitors in blog
  - Notice the training set is unlabeled
- To train the model
  - We just feed the training set to clustering algorithm
  - At no point we tell the algorithm which group a visitor belongs to
  - It find groups without our help

Machine Learning - Unsupervised Learning

Clustering

- It may notice that
  - 40% visitors are comic lovers and read the blog in evening
  - 20% visitors are sci-fi lovers and read the blog during weekends
- This data helps us in targeting our blog posts for each group

Machine Learning - Unsupervised Learning

Hierarchical Clustering - Bring similar elements together

- In the form of a tree
- Nodes closer to each other are similar

Machine Learning - Unsupervised Learning

Anomaly Detection - Detecting unusual credit card transactions to prevent fraud

Machine Learning - Types

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Machine Learning - Reinforcement Learning

Machine Learning - Reinforcement Learning

- The learning system an agent in this context
  - Observes the environment
  - Selects and performs actions and
  - Get rewards or penalties in return
  - Learns by itself what is the best strategy (policy) to get most reward over time

Machine Learning - Reinforcement Learning

Applications

- Used by robots to learn how to walk
- DeepMind's AlphaGo
  - Which defeated world champion Lee Sedol at the game of Go

Machine Learning - Types

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Machine Learning - Batch Learning

Machine Learning - Batch Learning

- Offline learning
- System is incapable of learning incrementally
  - It must be trained offline using all the available data
- Takes lot of time and computing resources
  - everytime training happens on the entire data

Machine Learning - Batch Learning

- Once the system is trained, it gets
  - Pushed to production
  - Runs without learning anymore
  - Just applies what it has learned offline

Machine Learning - Batch Learning

How to train the system with new data?

- We can not train the system incrementally
- We have to train the new system
  - From scratch on the full dataset
  - Stop the old system and
  - Replace it with the newly trained system

Machine Learning - Batch Learning

Limitations

- Since we have to train new system every time new data is available
  - Takes lot of computing resources
  - If the data is huge then
  - Training from scratch is nearly impossible
  - Becomes showstopper for lot of practical use cases

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Machine Learning - Online Learning

Machine Learning - Online Learning

- Train system incrementally
  - By feeding new data sequentially
  - Or in batches
- System can learn from new data on the fly
- Good for systems where data is a continuous flow
  - Stock prices

Machine Learning - Online Learning

Using online learning to handle huge datasets

Machine Learning - Online Learning

Using online learning to handle huge datasets

- Can be used to train huge datasets
  - That can not be fit in one machine
  - The training data gets divided into batches and
  - System gets trained on each batch incrementally

Machine Learning - Online Learning

Challenges in online learning

- System's performance gradually declines
  - If bad data is fed to the system
  - Bad data can come from
  - Malfunctioning sensor or robot
  - Someone spamming your system

Machine Learning - Online Learning

Challenges in online learning

- Closely monitor the system
  - Turn off the learning if there is a performance drop
  - Or monitor the input data and remove anomalies

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Machine Learning - Instance & Model-Based Learning

- Most Machine Learning tasks are about making predictions
- Having a good performance in training data is good
  - But true goal is to perform well on new instances
  - System needs to be able to generalize to examples it has never seen before

Machine Learning - Types

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Machine Learning - Instance-based Learning

CLOUD x LAB

Machine Learning - Instance-Based Learning

- Most trivial form of learning is
  - Learn by heart
- The system learns the examples by heart
- Then generalizes to new cases using a similarity measure

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Machine Learning - Instance-Based Learning

Example

- Spam filter flags emails
  - That are identical to **known spam emails** (emails marked spam by users)
  - Also the emails which are similar to **known spam emails**
  - This requires **measure of similarity** between two emails
  - A basic **similarity measures** between two emails can be
    - Count the number of words they have in common

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Machine Learning - Model-based Learning

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Machine Learning - Model-Based Learning

- Another way to generalize from a set of examples
  - Build a model of these examples
  - And then use model to make predictions
  - This is called **inference**
  - Hope that model will generalize well
  - We will learn more about it in next session

Machine Learning - Artificial Neural Network(ANN)

Computing systems inspired by the biological neural networks that constitute animal brains.

Machine Learning - Artificial Neural Network(ANN)

- Learn (progressively improve performance)
- To do tasks by considering examples
- Generally without task-specific programming
- Example: Based on image - cat or no cat?

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Machine Learning - Deep Learning

Each Neuron is like the knob.

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Machine Learning - Deep Learning

Multiple layers of neutrons

Machine Learning - Who is Using?

Almost Everyone

Google Translate & Auto Draw

More use cases: https://aiexperiments.withgoogle.com/

TensorFlow - Demo

http://playground.tensorflow.org/

Deep Learning Frameworks

TensorFlow

theano

K Keras

Caffe

torch

Machine Learning Frameworks

MLlib - Distributed

Simple

Learn More?

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Questions?

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