

# Machine Learning Foundations

## أساسيات تعلم الآلة



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# Today's Outline:

- **Artificial Intelligence (AI) Basics**
  - Applications of Artificial Intelligence
- **Machine Learning (ML) Basics**
  - What & Why ML?
  - Machine Learning vs. Data Science
  - Types of Machine Learning
- **Data Science & Machine Learning Process**
  - End-to-end Machine Learning Project
- **Machine Learning Model**
  - What is a ML Model?
  - Simple ML Case-study (Coding)
  - ML Tools
- **Diploma Overview**



# Artificial Intelligence (AI) Basics

“Before we work on artificial intelligence why don’t we do something about natural stupidity?” ~ Steve Polyak

# What is AI?

- What is Internet ? Explained by Bill Gates 1995 | Funny Video
  - [https://youtu.be/gipL\\_CEW-fk](https://youtu.be/gipL_CEW-fk)





# Artificial Intelligence (AI)

- So, What is AI?
  - NOT WHAT IS IN THE MOVIES
  - "The simulation of human intelligence processes by machines" ~ Unknown
- Why?
- Human
  - Think / Act
  - Rational vs. Emotional



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# AI Applications

- **Computer Vision / Pattern Recognition**
  - Image Processing
  - Object Recognition / Detection
  - Facial Recognition
- **Natural Language Processing (NLP)**
  - Natural Language Understanding (NLU) / Natural Language Generation (NLG)
  - Machine Translation
  - Sentiment Analysis
- **Computer Audition**
  - Speech Recognition
  - Speech-to-text
- **Gaming / Entertainments**
- **Robotics**



# Machine Learning (ML) Basics

"A baby learns to crawl, walk and then run. We are in the crawling stage when it comes to applying machine learning." ~ Dave Waters





# Machine Learning (ML)

- **A NEW WAY OF PROGRAMMING**

- ML is the **science** and **art** of programming computers so they can **learn** from data

- Why? Why Now?

- Google Maps Case-study

- Applications:

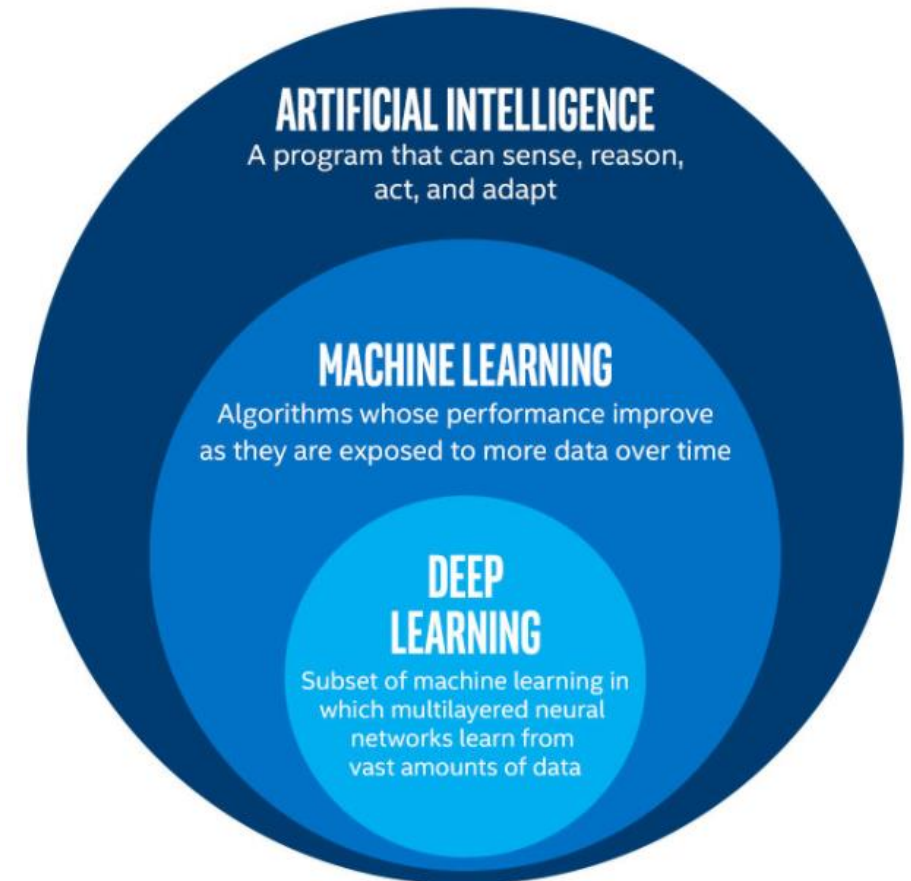
- Personal Assistants (Siri)
- Recommendation (Amazon, Netflix)
- Facial Recognition (Facebook)
- Email Filtering (Gmail)
- Ride Sharing (Uber, Careem)
- Self-Driving Cars (GWaymo)
- Robots





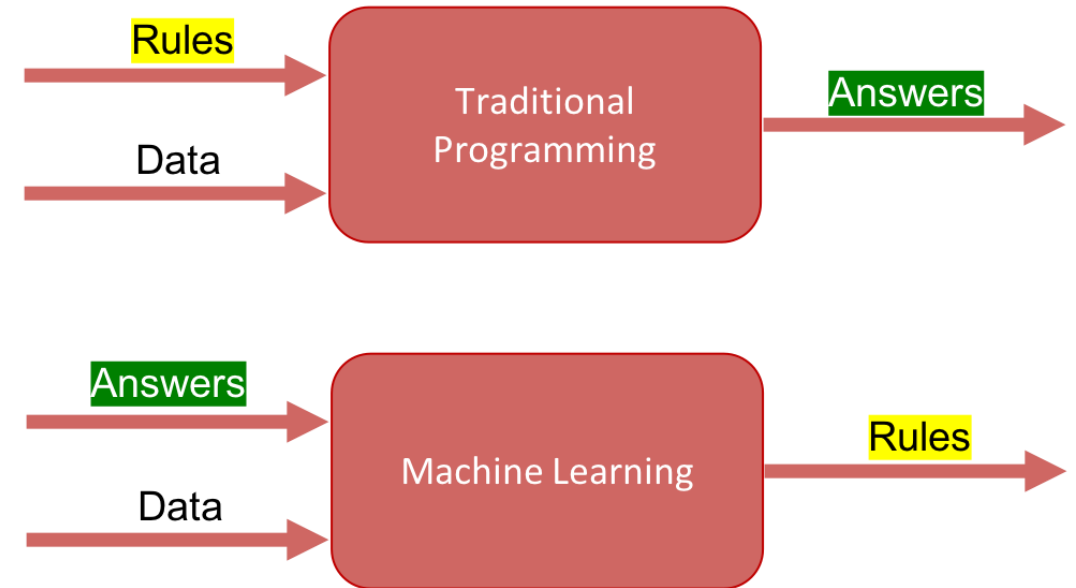
# AI vs. ML vs. DL

- **Artificial Intelligence (AI)** is an umbrella discipline that covers everything related to making machines smarter.
- **Machine Learning (ML)** is commonly used along with AI but it is a subset of AI. ML refers to an AI system that can self-learn based on the algorithm. Systems that get smarter and smarter over time without human intervention is ML.
- **Deep Learning (DL)** is a machine learning (ML) applied to large data sets. Most AI work involves ML because intelligent behavior requires considerable knowledge.



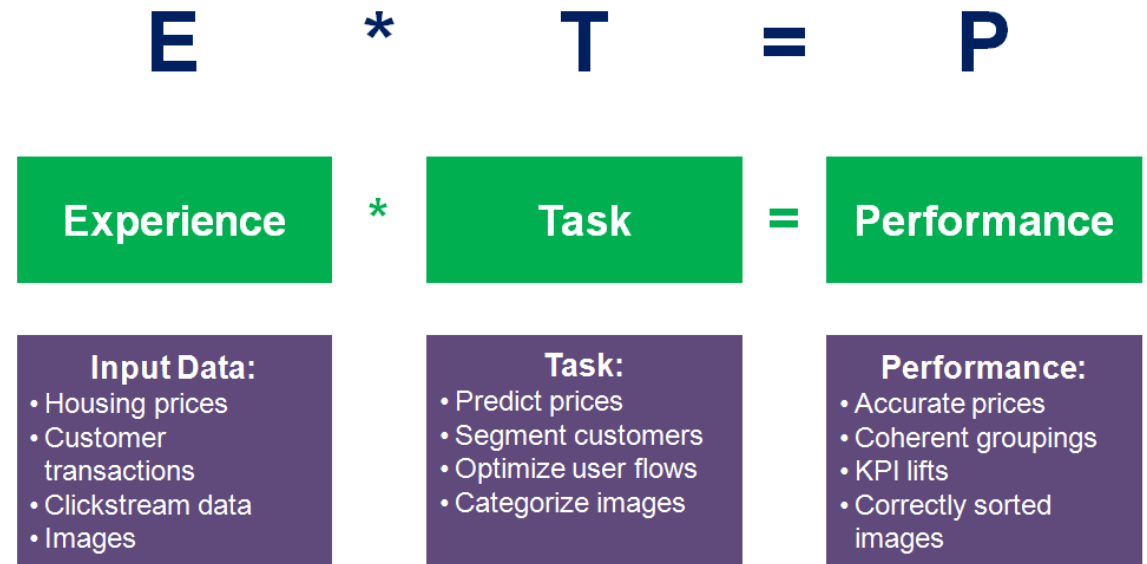
# Machine Learning Definitions (1)

- “ML is the field of study that gives computers the ability to learn without being explicitly programmed” ~ Arthur Samuel, 1959



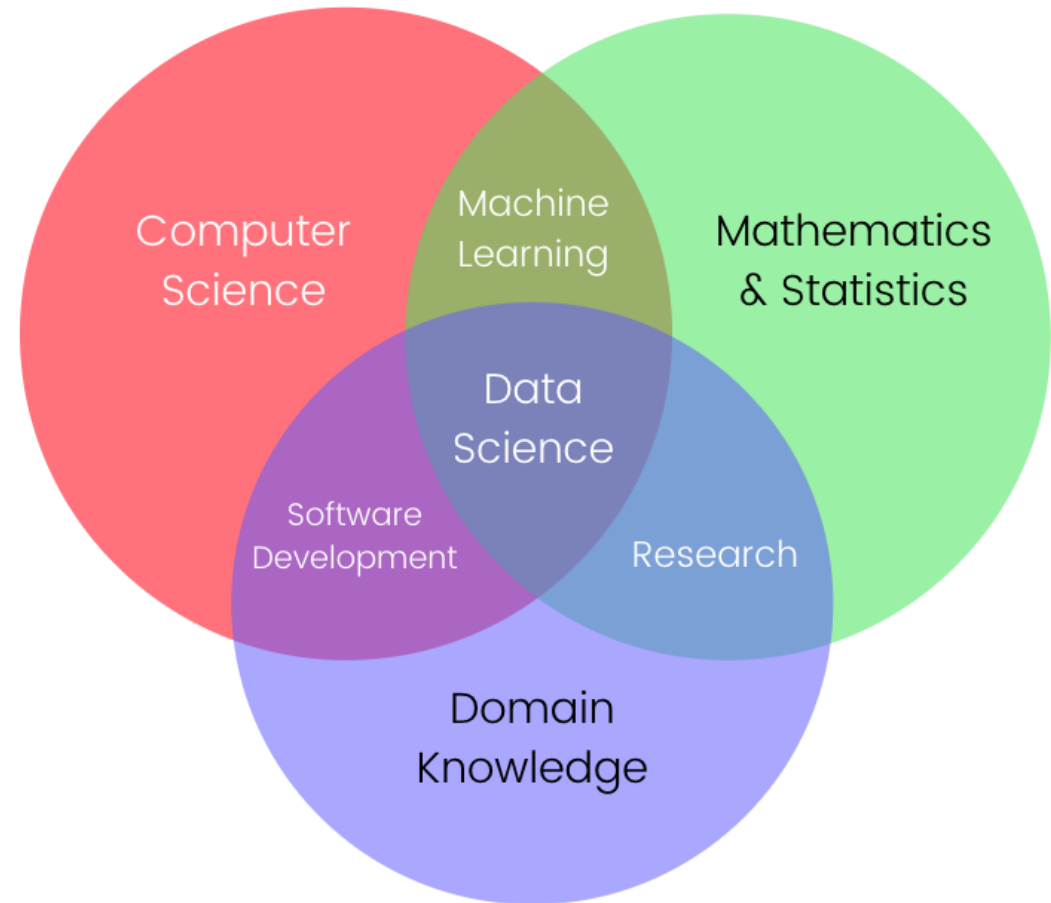
# Machine Learning Definitions (2)

- “A computer program is 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” ~ Tom Mitchell



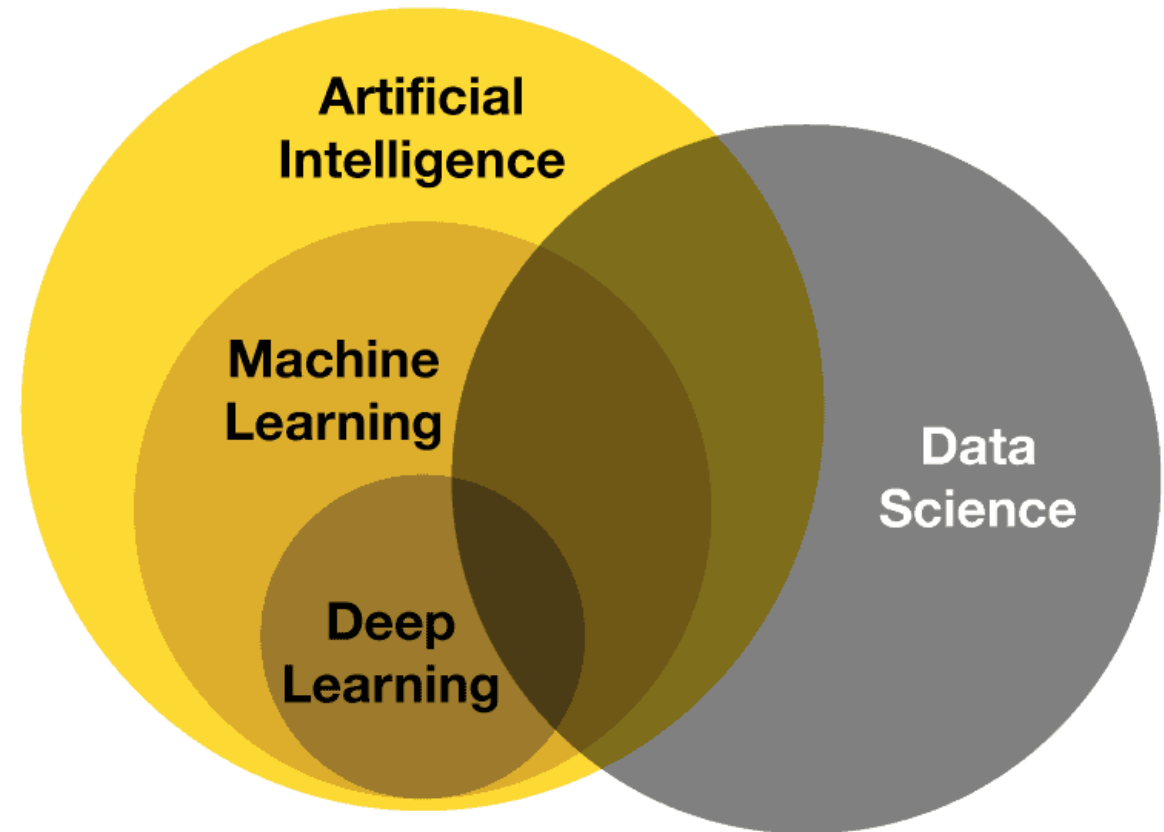
# Data Science Venn Diagram (Definition)

- The appeal of this visualization is pretty obvious. It is easy to understand and it conveys that data science is a **combination of several disciplines**. In this Venn diagram, the three components are **hacking skills**, **math & statistics** knowledge, and **substantive expertise**.
- Now, there are many variations of this Venn diagram on the Internet but, in essence, nearly all of them are based on these same three components.



# ML vs. DS

- **Data Science** helps with creating insights from data that deals with real world complexities
- Artificial Intelligence, and specifically, **Machine Learning** helps in accurately predicting or classifying outcomes for new data points by learning patterns from historical data

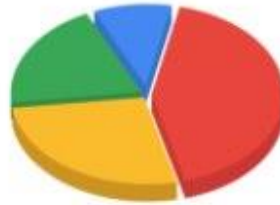


# Machine Learning Purposes

1. Making predictions



2. Categorizing things



3. Spotting something unusual



4. Identifying themes



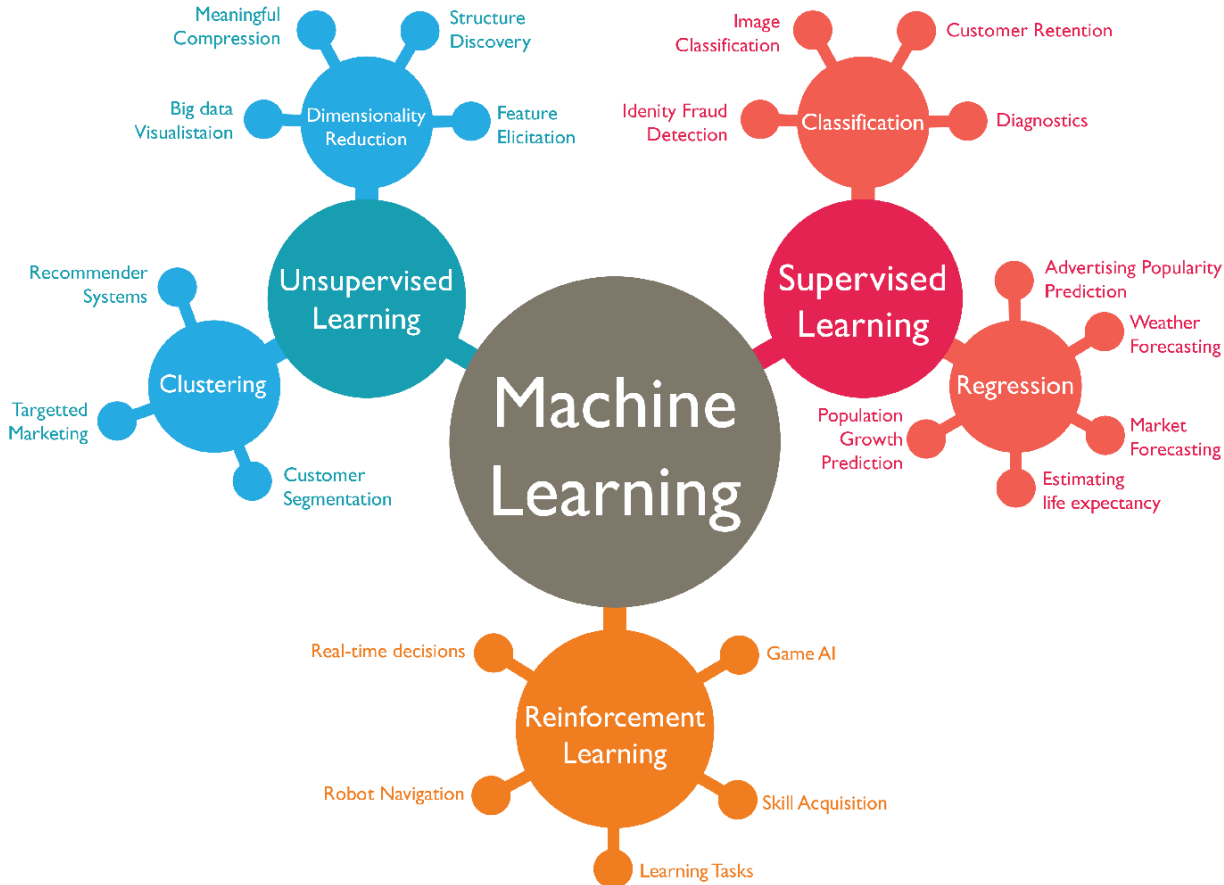
5. Discovering connections



6. Finding patterns



# Machine Learning Types (1)



- **Supervision Learning**
  - Supervised Learning
    - Classification
    - Regression
  - Unsupervised Learning
    - Clustering
    - Dimensionality Reduction
  - Reinforcement Learning (Robots)
- **Batch / Online Learning**
- **Instance-based / Model-based**
- **Active / Passive Learning**

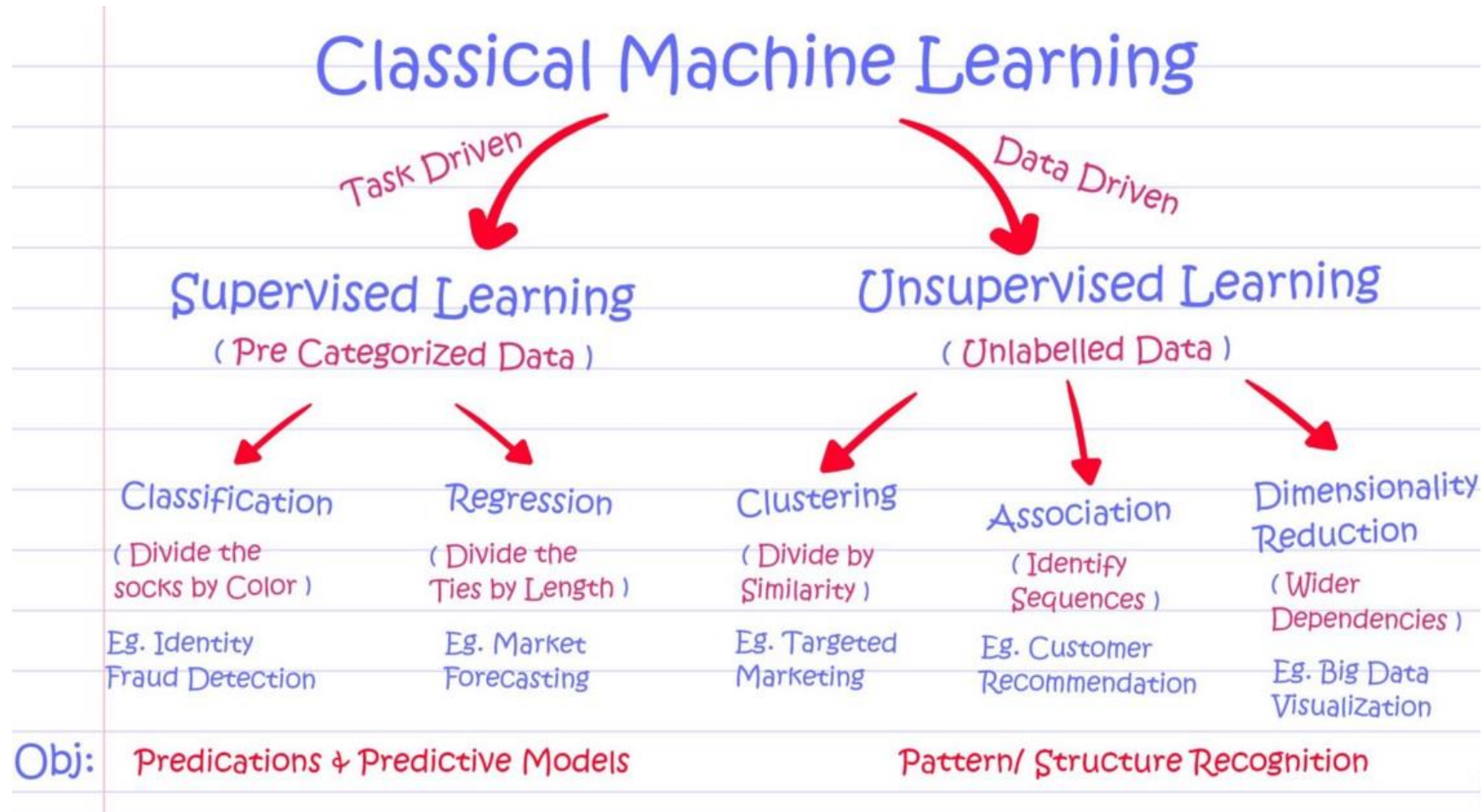


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# Machine Learning Types (2)



# ML Applications / Examples

## Supervised Learning

- **Determining** whether a **tumor is benign** based on a medical image
- **Forecasting** your **company's revenue** next year, based on many performance metrics
- **Identifying** the zip code from **handwritten** digits on an envelope
- Creating a **chatbot**
- Making your app **react** to **voice** commands

## Unsupervised Learning

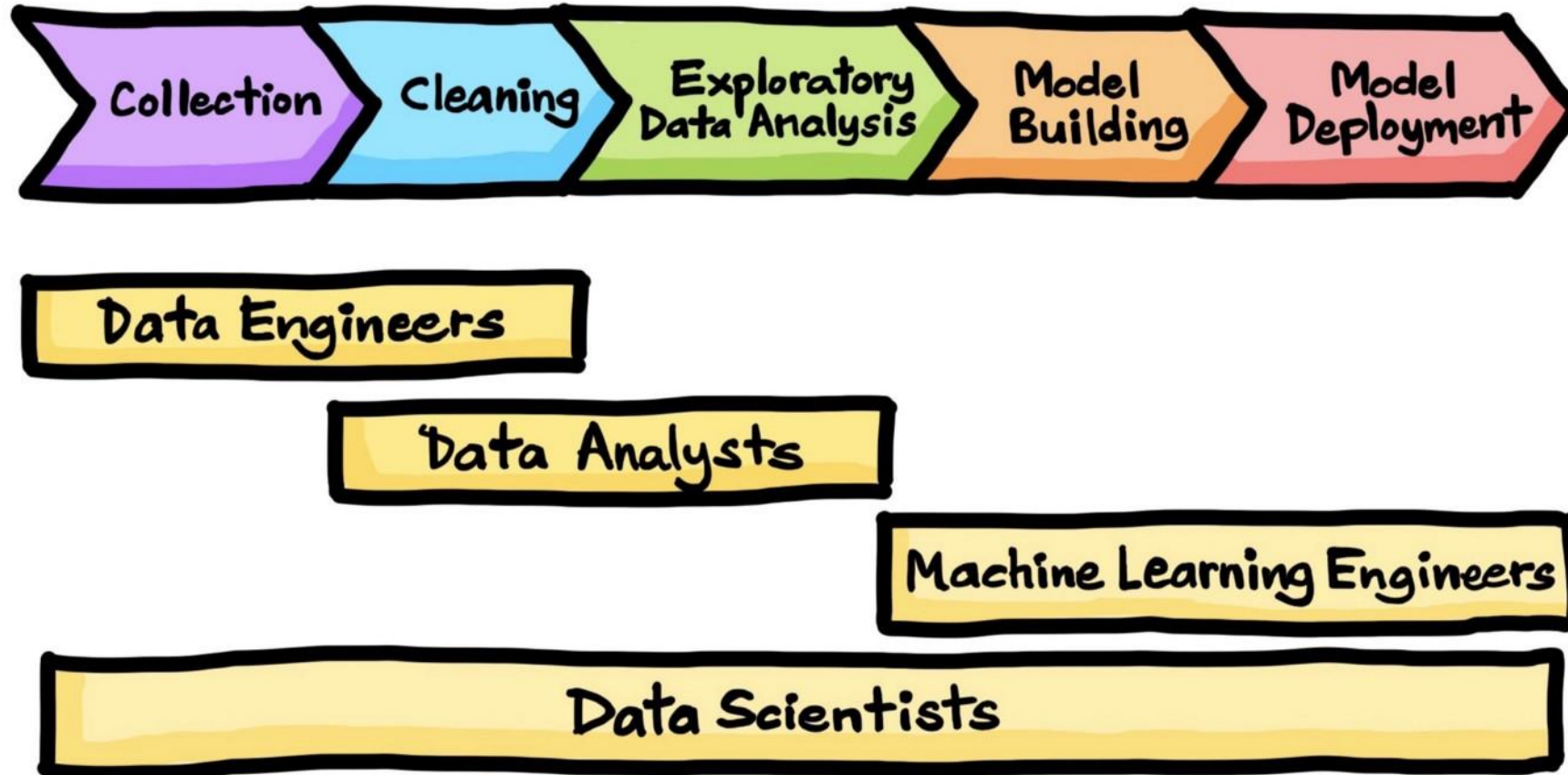
- **Identifying** topics in a set of **blog posts**
- **Segmenting** customers into groups with **similar preferences**
- **Detecting abnormal** access patterns to a website
- **Detecting fraudulent** activity in **credit card transactions**
- **Representing a complex dataset** in a clear and insightful diagram



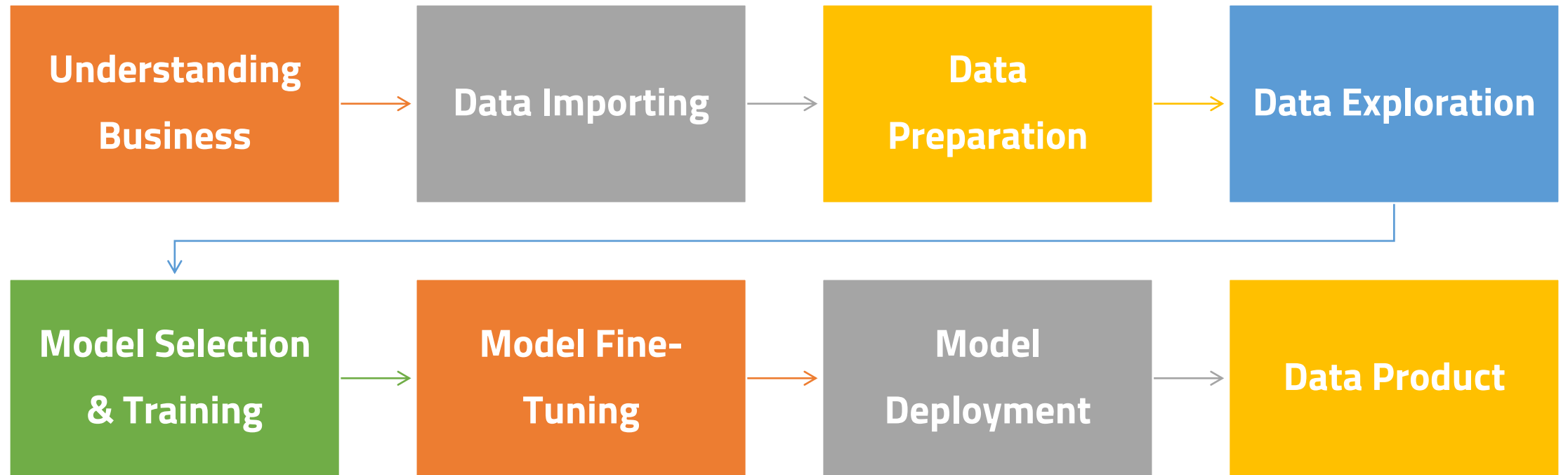
# Machine Learning Process

“The goal is to turn data into information, and information into insight.” ~ Carly Fiorina

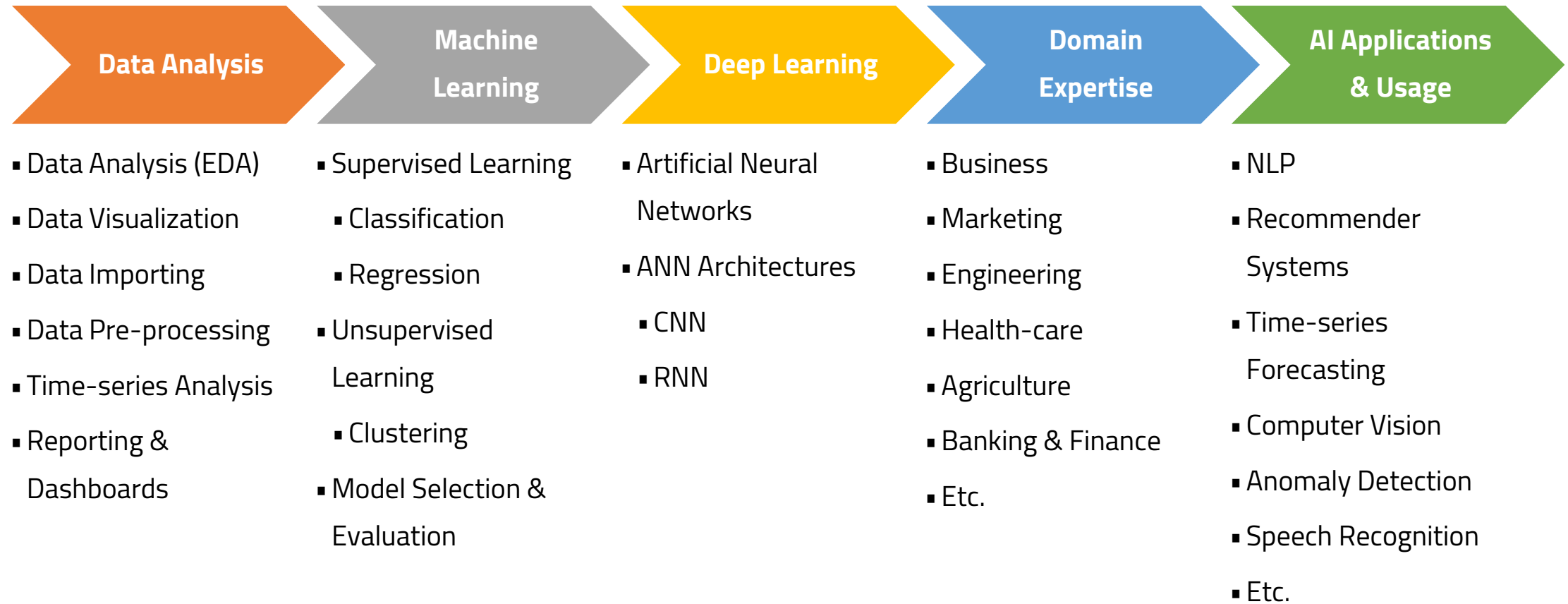
# Data Science Process



# End-to-End Machine Learning Project



# Data Science Road-Map



# Machine Learning Models

"All Models are Wrong, but Some are Useful" ~ George Box



# Algorithm vs. Model (1)

- **ML Algorithm**

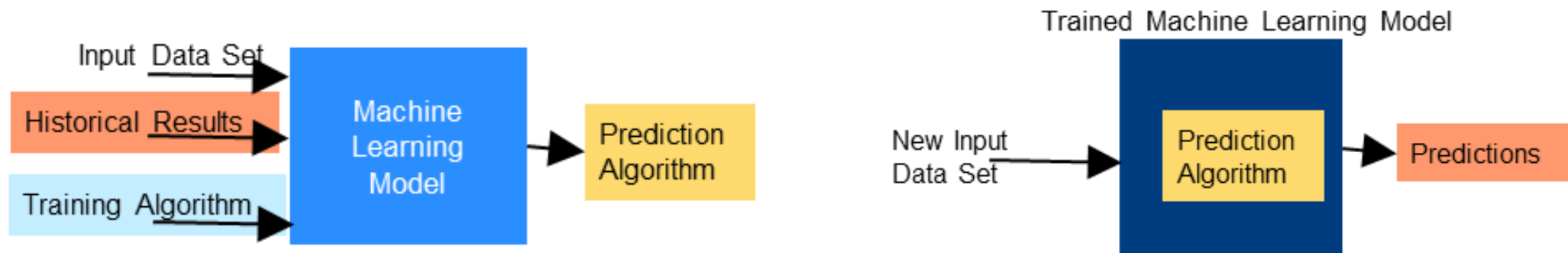
- An “algorithm” in machine learning is a procedure that is run on data to create a machine learning “model.”
- Linear Regression, Logistic Regression, Decision Tree, .. Etc.

- **ML Model**

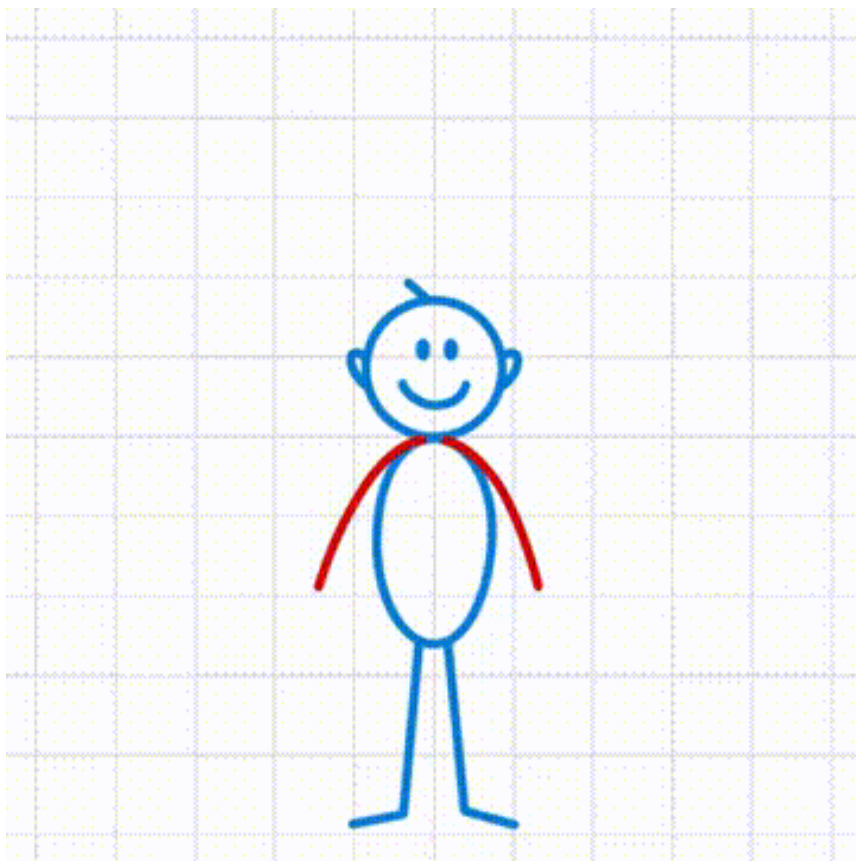
- A “model” in machine learning is the output of a machine learning algorithm run on data.
- **Machine Learning Model = Model Data + Prediction Algorithm**

# Algorithm vs. Model (2)

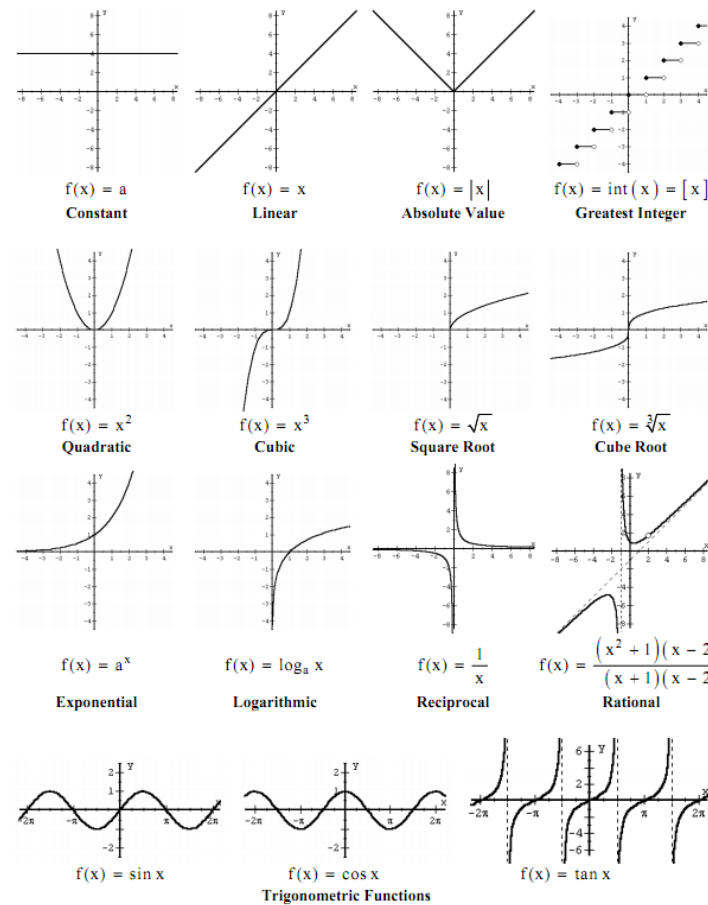
- Linear Regression (Example):
  - Algorithm: Find set of coefficients that minimize error on training dataset
  - Model:
    - **Model Data**: Vector of coefficients
    - **Prediction Algorithm**: Multiple and sum coefficients with input row



# Mathematical Models

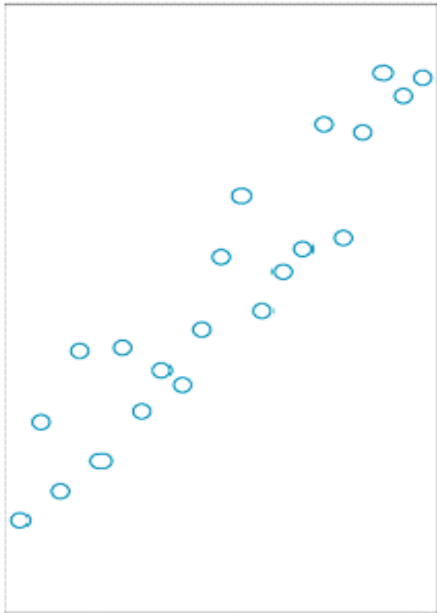


## PARENT FUNCTIONS



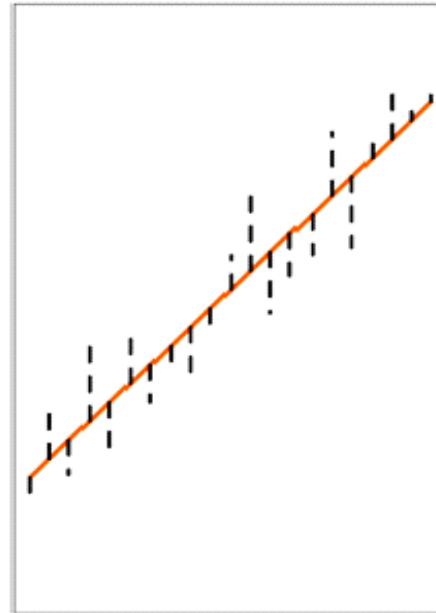
# Model Fitting (1)

Measured data



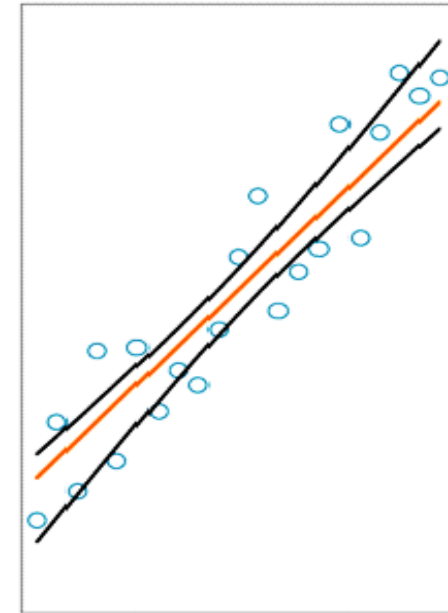
a)

Model fitting



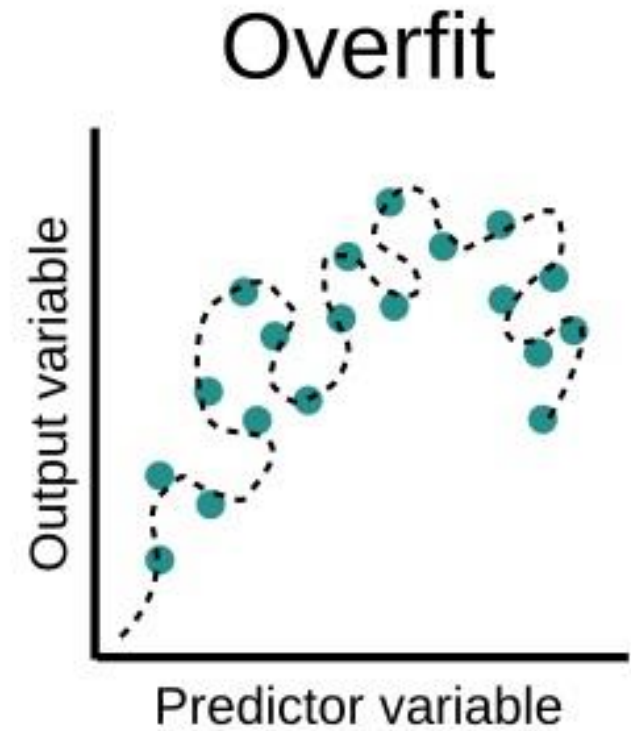
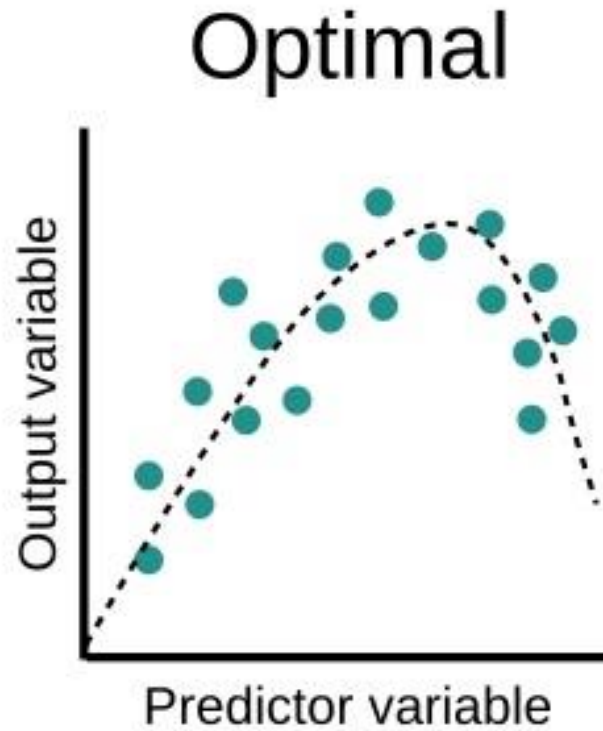
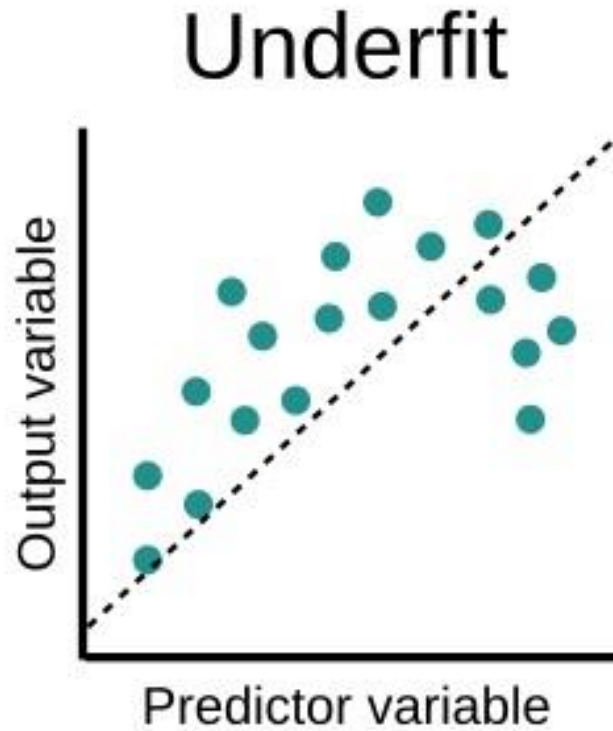
b)

Final model

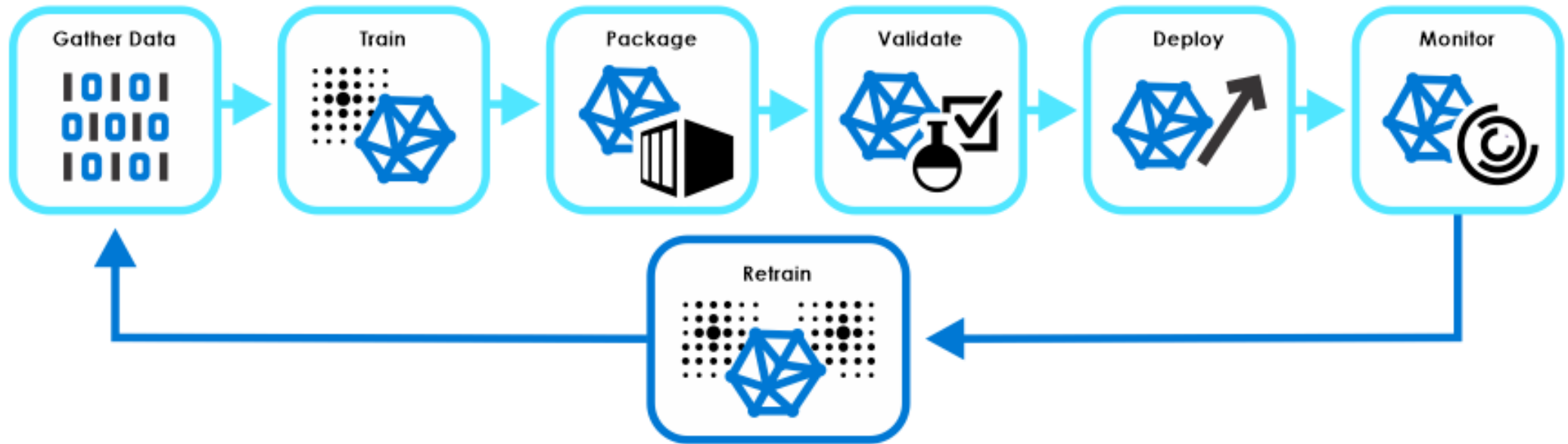


c)

# Model Fitting (2)

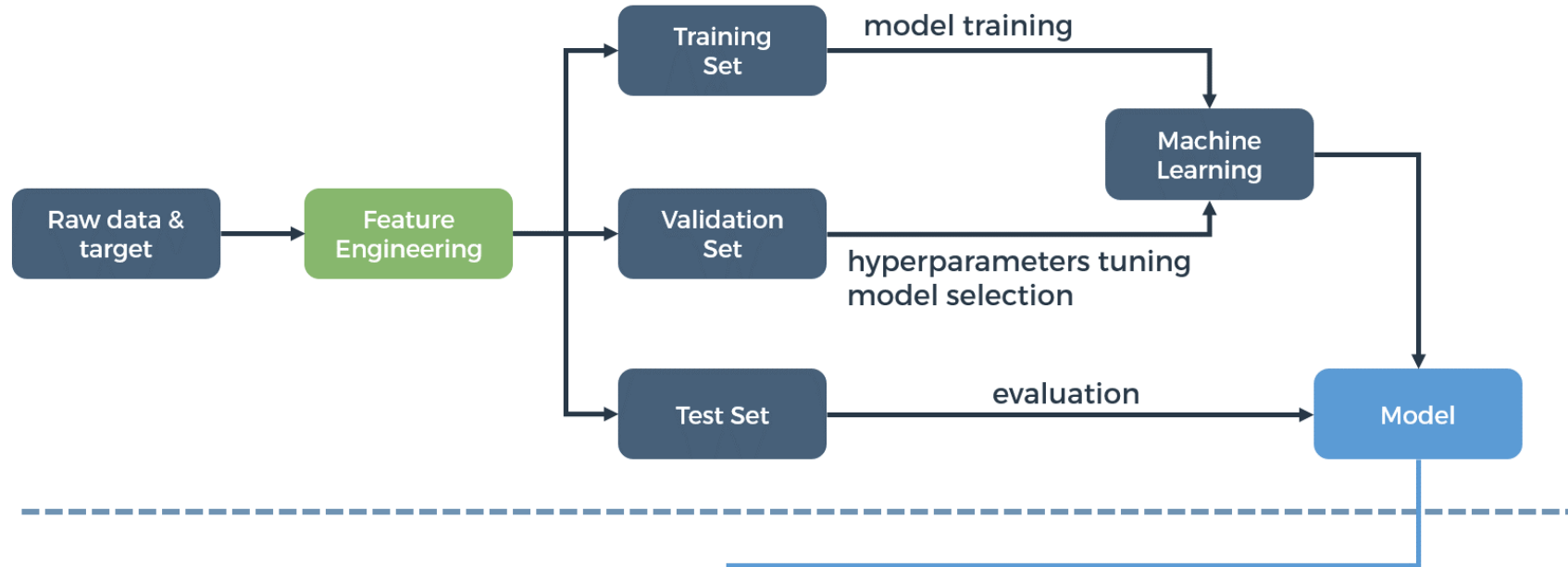


# ML Model Process



# Model Training vs. Model Prediction

## TRAINING

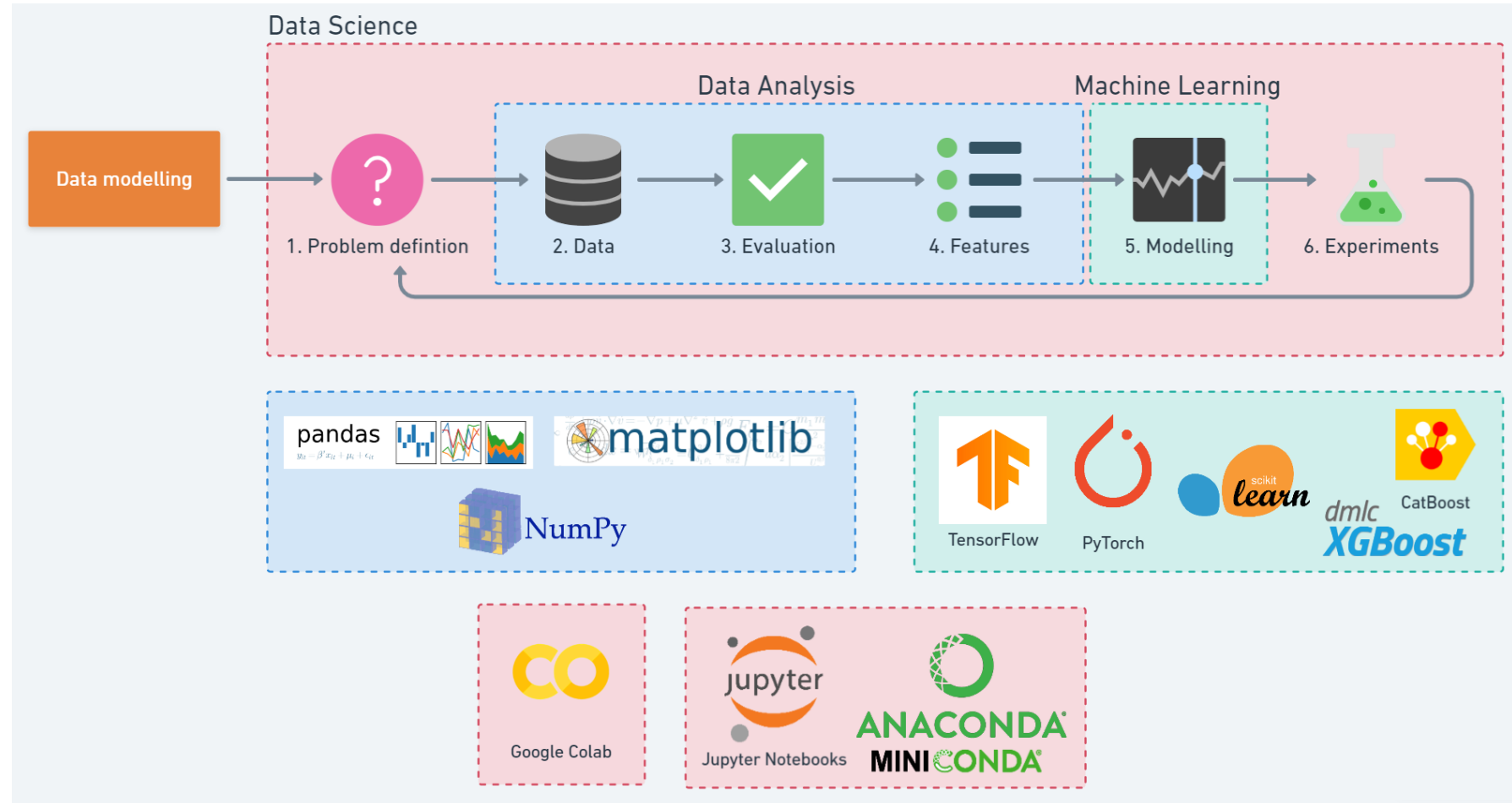


## PREDICTING





# Machine Learning Tools



# Diploma Overview

Python Machine Learning Diploma – Eng. Mustafa Othman

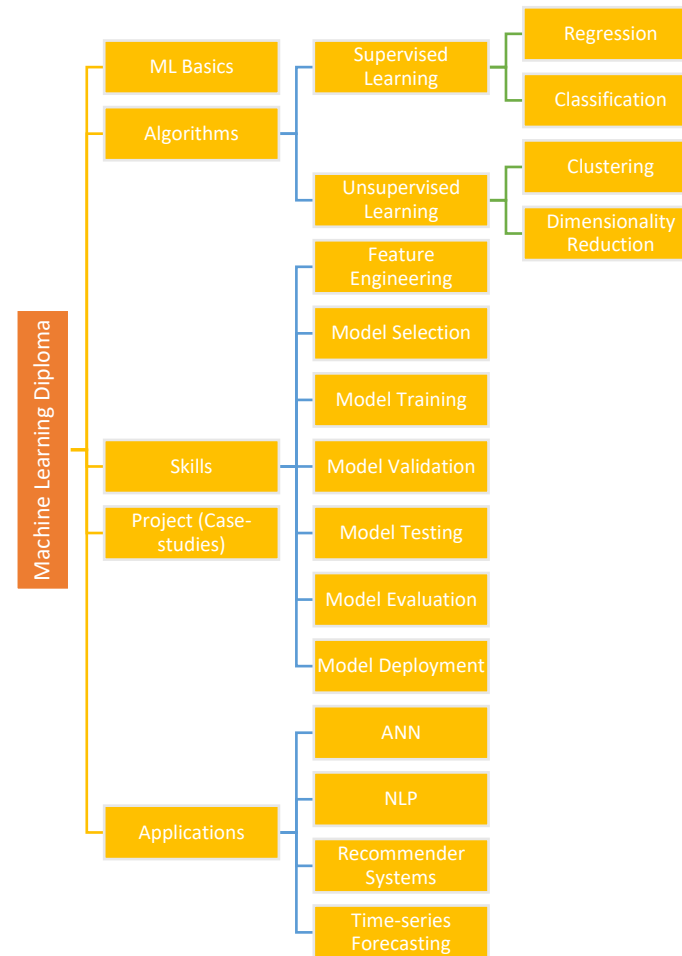


# Python ML Diploma Courses (Topics)

1. Introduction to Machine Learning
2. Data Preprocessing for Machine Learning
3. Supervised Learning (I) - Regression
4. Supervised Learning (II) - Classification
5. Un-Supervised Learning (I) - Clustering
6. Un-Supervised Learning (II) - Dimensionality Reduction
7. Model Selection & Evaluation
8. Model Deployment Basics
9. Machine Learning Case-studies



# Machine Learning Diploma Topics



# Python ML Diploma Prerequisites

- Python Programming Basics
- Python Data Analysis Libraries Basics
  - NumPy, Pandas, Matplotlib, & Seaborn
- Descriptive Statistics Basics



# Python ML Diploma Benefits (Udemy)

- 40+ Hours of Training
- 8 Online Courses in 1
- 5+ Real-World ML Case-studies
- Interactive Explanation
- Telegram Group for Discussion
- Certificate of Completion

Development > Data Science

## دبلومة بايثون لتعلم الآلة | Python Machine Learning Diploma

الدبلومة دي أفضل بداية للي عاوز يتعلم ويحترف مجال "علم البيانات وتعلم الآلة" باستخدام لغة برمجة بايثون (8 كورسات \* 1)

5.0 ★★★★★ (2 ratings) 6 students

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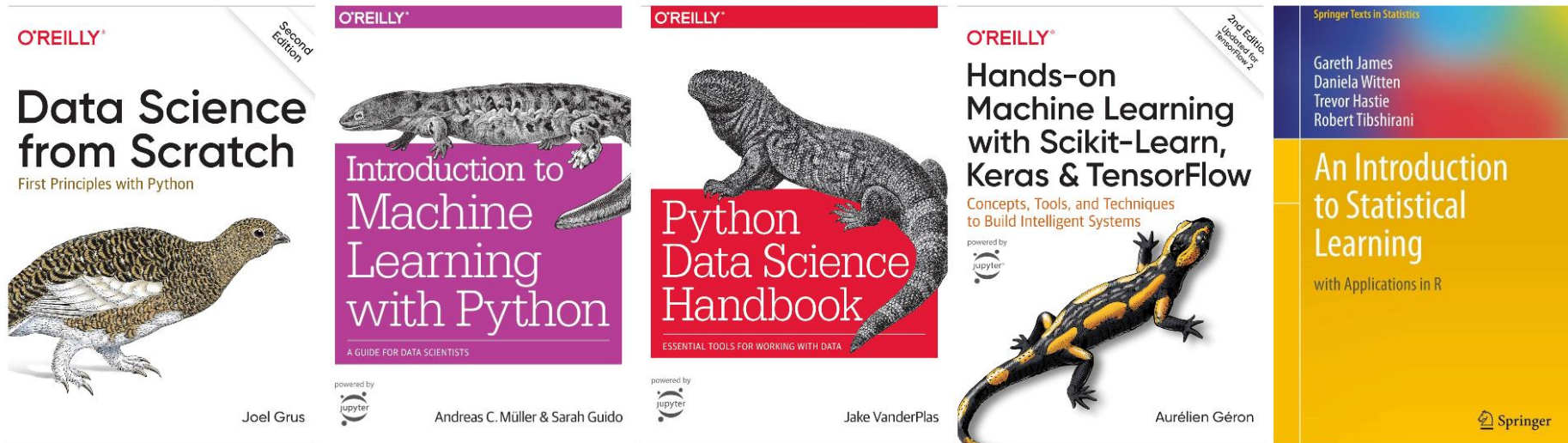
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# Resources

- Websites & YouTube Channels
- Online Courses (Free / Paid)
- Books





# Further Readings

- Hands-on Machine Learning, Aurelien Geron
  - Ch1 (Pg. 1 – 34), Ch2 (Pg. 35 – 84)
- Python Data Science Handbook, Jake VanderPlas
  - Ch5 (Pg. 331 – 359)
- Data Science from Scratch, Joel Grus
  - Ch11 (Pg. 147 – 158)
- Introduction to Machine Learning with Python, Andreas C. Muller
  - Ch1 (Pg. 1 – 24)



# Next Lecture Readings

- Feature Engineering for Machine Learning, Alice Zheng and Amanda Casari
  - Ch1, Ch2, Ch5





# THANKS

Keep Moving Forward! 😊



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