MACHINE LEARNING STUDYGROUP INTRODUCTION

INSTRUCTOR:
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OBJECTIVES

- To promote the learning of ML among students of IUMW.
- To work as a knowledge sharing platform on the applications of ML.
- To build an active ML community within IUMW.

Housekeeping Rules!

In order to have an effective learning in this Group, a few rules to be adhere to at all times:

- Be punctual on all occasions.
- Do not take things for granted; learning works in both directions.
- Do not shy away in class, afterall everyone is here to learn something.
- Be proactive in learning; the scope for ML is too broad and not everything can be covered in class.


expec?ations

What do you think of when you heard of machine learning?

Machine Learning is…

Ethem Alpaydin

Machine learning is programming computers to optimize a performance criterion using example data or past experience.

Andrew Ng

The science of getting computers to act without being explicitly programmed.

Kevin P. Murphy

The goal of machine learning is to develop methods that can automatically detect patterns in data, and then to use the uncovered patterns to predict future data or other outcomes of interest.

In a nutshell, Machine Learning is …

Types of Machine Learning

At a glance

Supervised Learning

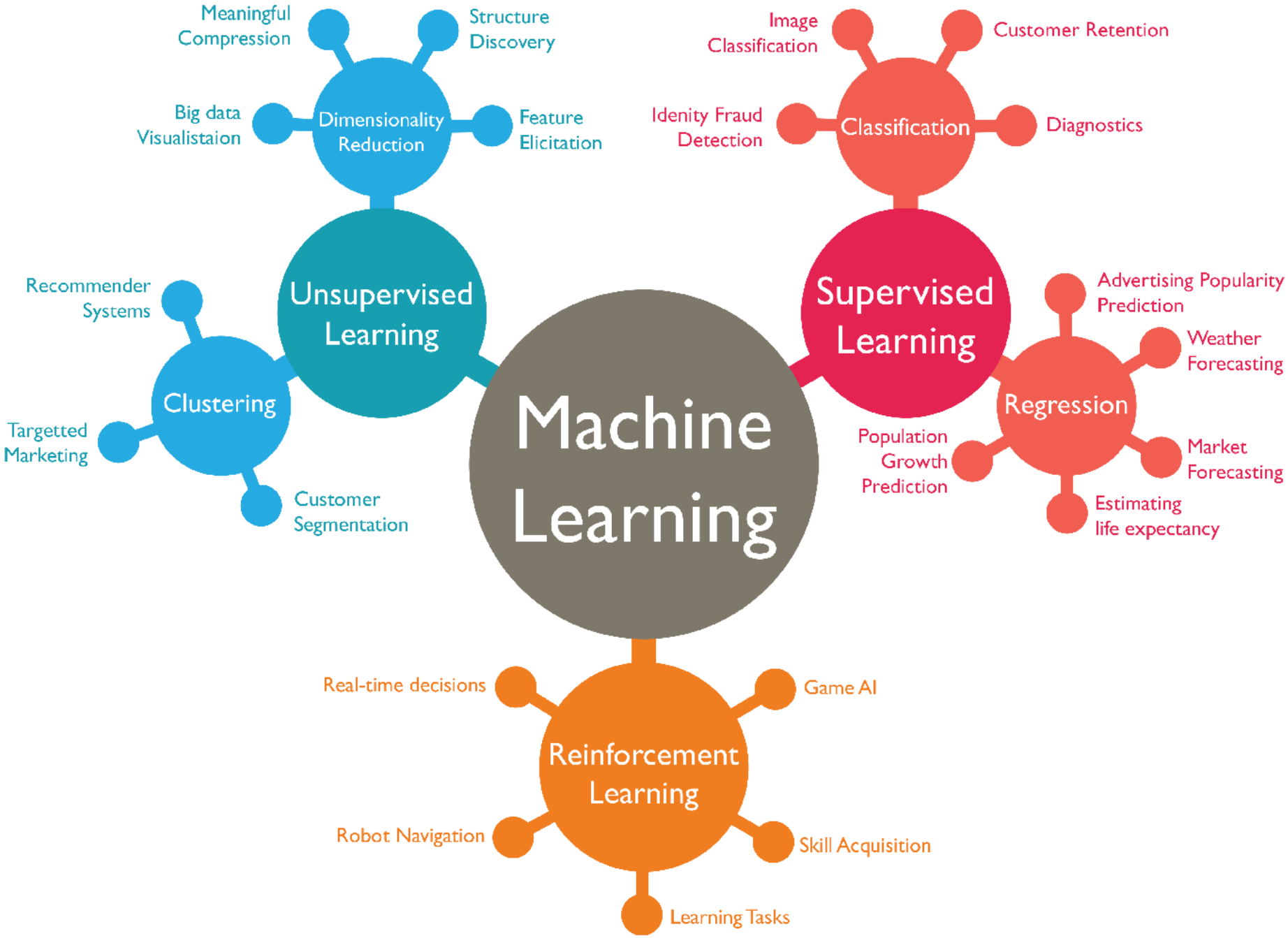
- Makes machine learn explicitly
- Data with clearly defined output is given
- Direct feedback is given
- Predicts outcome/future
- Resolves classification & regression problems

Unsupervised Learning

- Machine understand the data (identifies patterns/structures)
- Evaluation is qualitative or indirect
- Does not predict/find anything specific

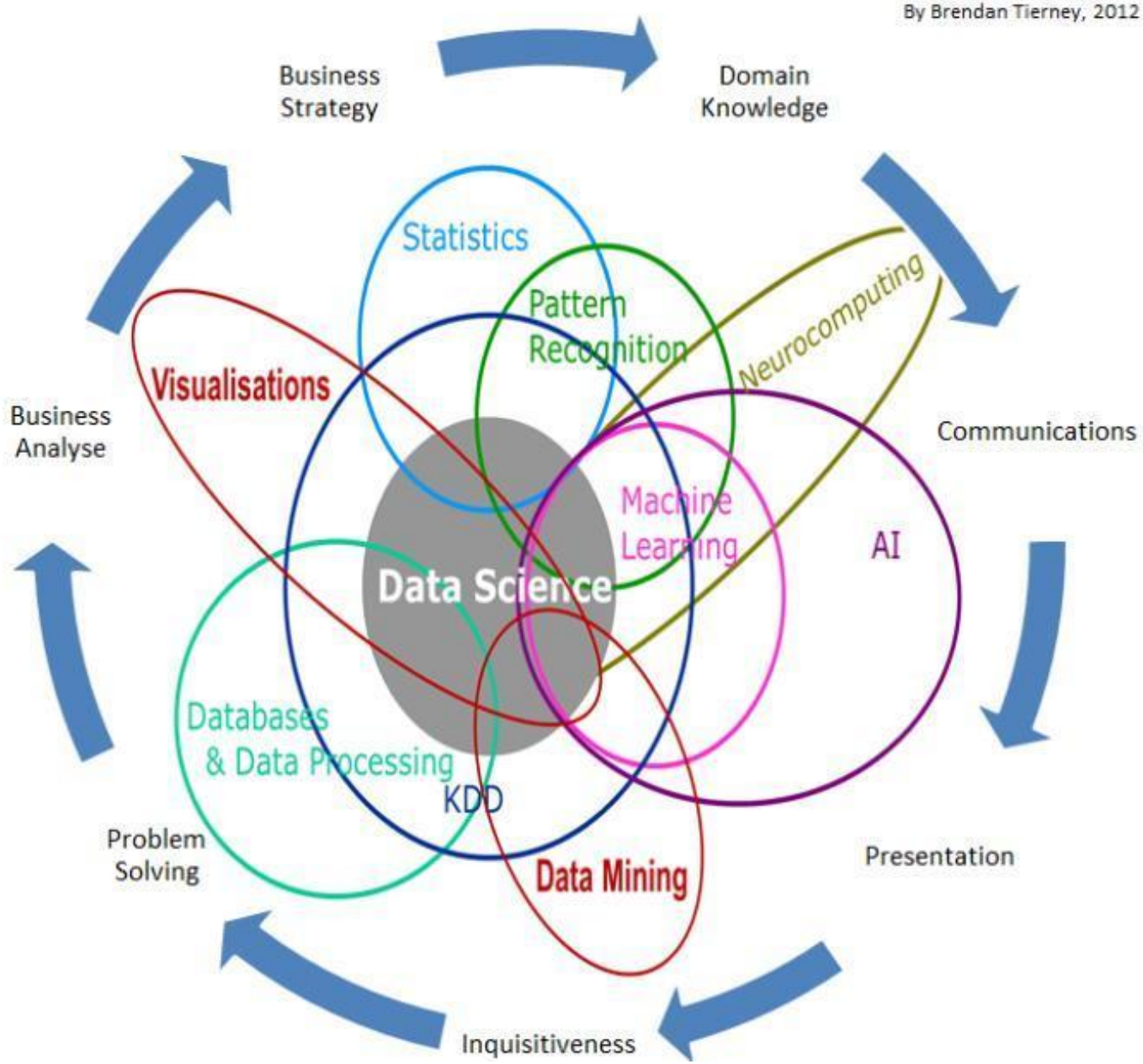
Reinforcement Learning

- An approach to AI
- Reward based learning
- Learning from +ve & -ve reinforcement
- Machines learns how to act in certain environment
- To maximize rewards


Machine Learning
Unsupervised Learning
Supervised Learning
Reinforcement Learning
Dimensionality Reduction
Clustering
Classification
Regression
Meaningful Compression
Structure Discovery
Big data Visualistaion
Feature Elicitation
Recommender Systems
Targetted Marketing
Customer Segmentation
Image Classification
Customer Retention
Idenity Fraud Detection
Diagnostics
Advertising Popularity Prediction
Weather Forecasting
Population Growth Prediction
Market Forecasting
Estimating life expectancy
Real-time decisions
Game AI
Robot Navigation
Skill Acquisition
Learning Tasks

Data Science Is Multidisciplinary

By Brendan Tierney, 2012




Machine Learning Algorithms
Bayesian
Naive Bayes
Averaged One-Dependence Estimators (AODE)
Bayesian Belief Network (BBN)
Gaussian Naive Bayes
Multinomial Naive Bayes
Bayesian Network (BN)
Decision Tree
Classification and Regression Tree (CART)
Iterative Dichotomiser 3 (ID3)
C4.5
C5.0
Chi-squared Automatic Interaction Detection (CHAID)
Decision Stump
Conditional Decision Trees
M5
Dimensionality Reduction
Principal Component Analysis (PCA)
Partial Least Squares Regression (PLSR
Sammon Mapping
Multidimensional Scaling (MDS)
Projection Pursuit
Principal Component Regression (PCR)
Partial Least Squares Discriminant Analysis
Mixture Discriminant Analysis (MDA)
Quadratic Discriminant Analysis (QDA)
Regularized Discriminant Analysis (RDA)
Flexible Discriminant Analysis (FDA)
Linear Discriminant Analysis (LDA)
Instance Based
k-Nearest Neighbour (kNN)
Learning Vector Quantization (LVQ)
Self-Organizing Map (SOM)
Locally Weighted Learning (LWL)
Clustering
k-Means
k-Medians
Expectation Maximization
Hierarchical Clustering
Deep Learning
Deep Boltzmann Machine (DBM)
Deep Belief Networks (DBN)
Convolutional Neural Network (CNN)
Stacked Auto-Encoders
Ensemble
Random Forest
Gradient Boosting Machines (GBM)
Boosting
Bootstrapped Aggregation (Bagging)
AdaBoost
Stacked Generalization (Blending)
Gradient Boosted Regression Trees (GBRT)
Neural Networks
Radial Basis Function Network (RBFN)
Perceptron
Back-Propagation
Hopfield Network
Regularization
Ridge Regression
Least Absolute Shrinkage and Selection Operator (LASSO)
Elastic Net
Least Angle Regression (LARS)
Rule System
Cubist
One Rule (OneR)
Zero Rule (ZeroR)
Repeated Incremental Pruning to Produce Error Reduction (RIPPER)
Regression
Linear Regression
Ordinary Least Squares Regression (OLSR)
Stepwise Regression
Multivariate Adaptive Regression Splines (MARS)
Locally Estimated Scatterplot Smoothing (LOESS)
Logistic Regression

Applications of Machine Learning

Manufacturing

- Predictive maintenance or condition monitoring
- Warranty reserve estimation
- Propensity to buy
- Demand forecasting
- Process Optimization
- Telematics

Retail

- Predictive inventory planning
- Recommendation engines
- Upsell and cross-channel marketing
- Market segmentation and targeting
- Customer ROI and lifetime value

Healthcare Life Sciences

- Alert and diagnostics from real-time patient data
- Disease identification and risk stratification
- Patient triage optimization
- Proactive health management
- Healthcare provider sentiment analysis

Applications of Machine Learning

Travel and Hospitality

- Aircraft scheduling
- Dynamic pricing
- Social media – consumer feedback and interaction analysis
- Customer complaint resolution
- Traffic patterns and congestion management

Financial Services

- Risk analytics and regulation
- Customer segmentation
- Cross selling and up-selling
- Sales and marketing campaign management
- Credit worthiness evaluation

Energy, Feedstock and Utilities

- Power usage analytics
- Seismic data processing
- Carbon emission and trading
- Customer-specific pricing
- Smart grid management
- Energy demand and supply optimization.

Applications of Machine Learning

1 SPAM DETECTION

- Given email in an inbox, identify message that are spam and those that are not.
- Having a model of this problem would allow a program to leave non-spam emails in the inbox and move spam emails to spam folder

Applications of **Machine Learning**

2 CREDIT CARD FRAUD DETECTION

- Given credit card transactions for a customer in a month, identify transaction that were made by the customer and those that were not.
- A program with a model of this decision could refund transactions that were fraudulent.

Applications of **Machine Learning**

3 DIGIT RECOGNITION

- Given ZIP code handwritten on envelopes. Identify the digit for each handwritten character.
- A model of this problem would allow a computer program to read and understand handwritten ZIP codes and sort envelop by geographic region.

Applications of **Machine Learning**

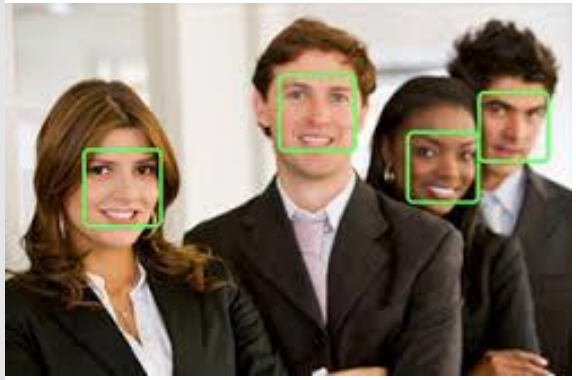
4 SPEECH UNDERSTANDING

- Given an utterance from a user, identify the specific request made by the user.
- A model of this problem would allow a program to understand and make an attempt to fulfill that request. The iPhone with Siri has this capability

Applications of **Machine Learning**

5 FACE DETECTION

- Given a digit photo album of many hundreds of digital photographs, identify photos that include a given person.
- A model of this decision process would allow a program to organize photos by person. Some digital cameras and software like iPhoto have this capability.



Applications of **Machine Learning**

6 PRODUCT RECOMMENDATION

- Given the purchase history for a customer and a large inventory of products, identify products that the customer will be interested in and likely to purchase.
- A model of this decision process would allow a program to make recommendations to a customer and motivate product purchase.
- Amazon has this capability. Also think of Facebook and Google+, which recommend users for you to connect with.

Applications of **Machine Learning**

7 MEDICAL DIAGNOSIS

- Given the symptoms exhibited in a patient and a database of anonymized patient records, predict whether the patient is likely to have an illness.
- A model to this decision problem could be used by a program to provide decision support to medical professionals.

Applications of **Machine Learning**

8 STOCK TRADING

- Given the current and past price movements for a stock, determine whether the stock should be bought, held, or sold.
- A model of this decision problem could provide decision support to finance analysts.

Applications of **Machine Learning**

9 CUSTOMER SEGMENTATION

- Given the pattern of behavior by a user during a trail period and the past behavior of all users, identify users who will convert to the paid version of the product and those that will not.

- A model of this decision problem would allow a program to trigger customer interventions to persuade the customer to convert early or better engage in a limited trail.

Applications of **Machine Learning**

10 SHAPE DETECTION

- Given a user hand-drawing a shape on a touch screen and a database of know shape, determine which shape the user was trying to draw.
- A model of this decision would allow a program to show the platonic version of that shape to make crisp diagrams. The Instaviz iPhone app does this.

Core Concepts and Terminology

- In general, for performing Machine learning, there are primarily two types of datasets required. The first dataset is usually manually prepared, where the input data and the expected output data are available and prepared.
- It is important that every piece of input data has an expected output data point available as this will be used in a supervised manner to build the rule.
- The second dataset is where we have the input data, and we are interested in predicting the expected output.

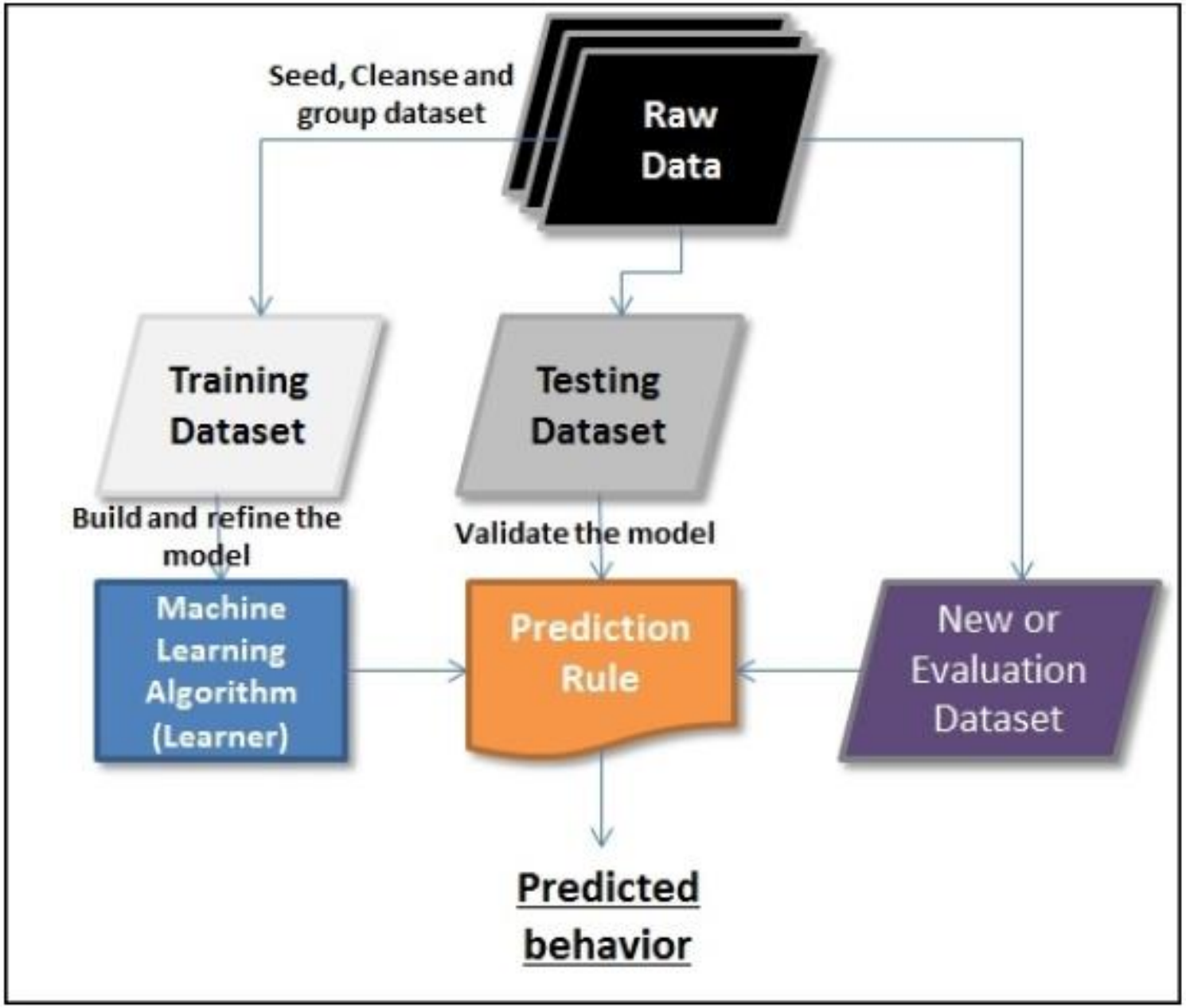
Core Concepts and Terminology

- As a first step, the given data is segregated into three datasets: training, validation, and testing. There is no one hard rule on what percentage of data should be training, validation, and testing datasets. It can be 70-10-20, 60-30-10, 50-25-25, or any other values.
- The training dataset refers to the data examples that are used to learn or build a classifier, for example. The validation dataset refers to the data examples that are verified against the built classifier and can help tune the accuracy of the output. The testing dataset refers to the data examples that help assess the performance of the classifier.

Core Concepts and Terminology

There are typically three phases for performing Machine learning:

- **Phase 1—Training Phase**: This is the phase where training data is used to train the model by pairing the given input with the expected output. The output of this phase is the learning model itself.
- **Phase 2—Validation and Test Phase**: This phase is to measure how good the learning model that has been trained is and estimate the model properties, such as error measures, recall, precision, and others. This phase uses a validation dataset, and the output is a sophisticated learning model.
- **Phase 3—Application Phase**: In this phase, the model is subject to the real-world data for which the results need to be derived.


Seed, Cleanse and group dataset
Raw Data
Training Dataset
Testing Dataset
Build and refine the model
Validate the model
Machine Learning Algorithm (Learner)
Prediction Rule
New or Evaluation Dataset
Predicted behavior

Activity: Refresher on Python Programming

In a breakfast menu, there consists of eggs, pancakes, waffles and oatmeal. Apart from this, customer can choose one topping from syrup, strawberries and powdered sugar.

Write a program to ask what the customer would like to eat for breakfast and their preferred topping. At the end, print out the statement of the customer's choice.


Thank You !