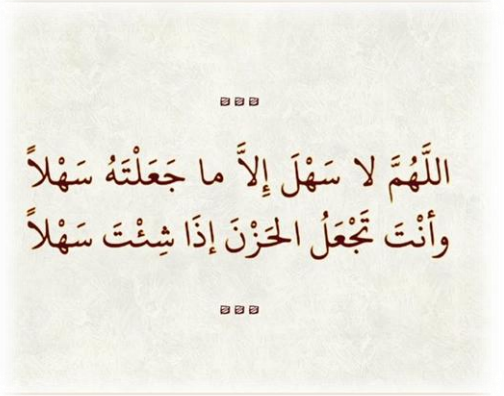
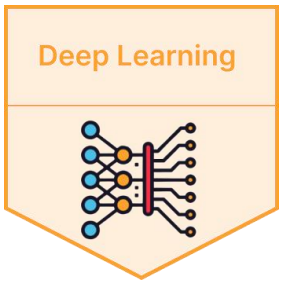


IDSS

PART (2)



Artificial Intelligent

بسم الله الرحمن الرحيم

شبابنا الحلو .. ربنا معاكوا في اخر ترم وفي مشروع التخرج.

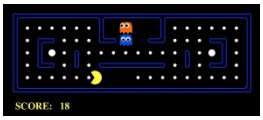
حنكون معاكوا ان شاء الله في ٣ مواد ... متشغلوش بالكوا بيهم و ركزوا في مشروعكوا

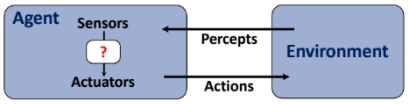
صلي علي سيدنا محمد

Intelligent Agent

- Its ***actions*** are ***appropriate*** for its goals and circumstances.
- It is ***flexible*** to changing environments and goals.
- It ***learns*** from experience.
- It makes ***appropriate choices*** given ***perceptual limitations*** and ***limited resources*** (**bounded rationality** or **bounded optimality**).

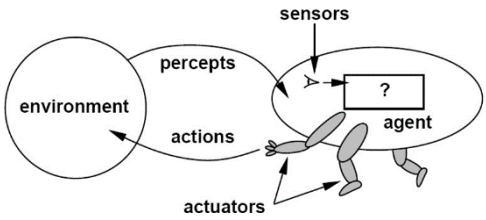
Pac-Man .. as an .. Intelligent Agent



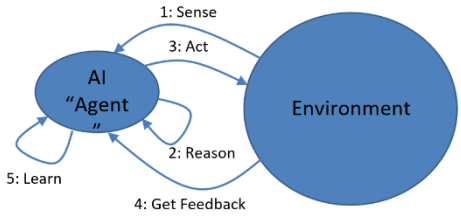


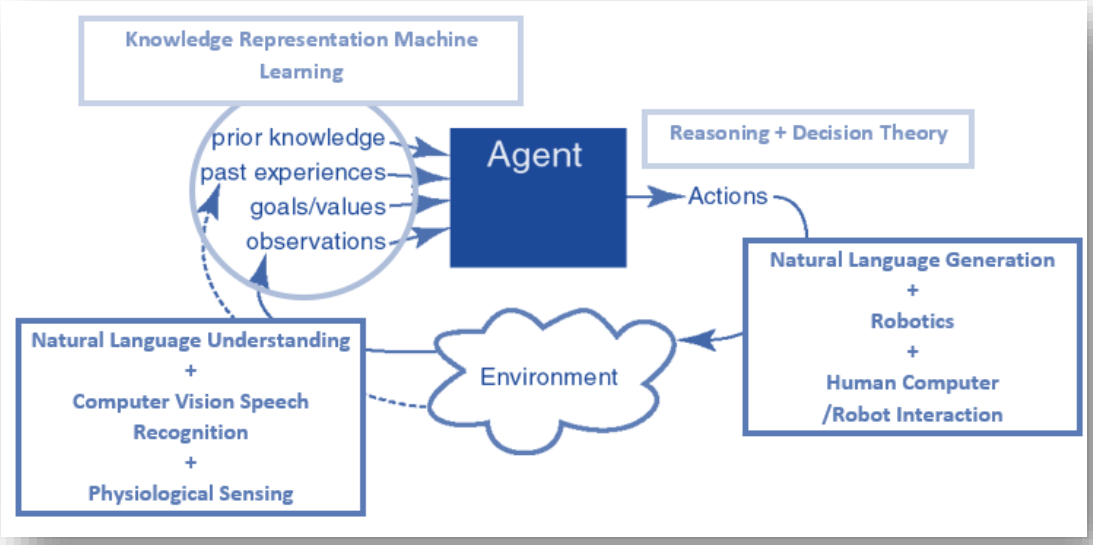
Robots	interface agents
• In AI, artificial agents that have a physical presence in the world are usually known as Robots. • Robotics is the field primarily concerned with the implementation of the physical aspects of a robot	• Another class of artificial agents include interface agents, for either stand alone or Web-based applications (e.g. intelligent desktop assistants, recommender systems, intelligent tutoring systems).

- **<u>Interface agents don't have to worry about interaction with the physical environment</u>**, but share all other fundamental components of intelligent behavior with robots.

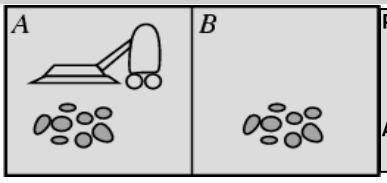


- An agent is anything that can be viewed **as perceiving its environment** through **sensors** and **acting** upon that environment through **actuators**.





Example: Vacuum –Agent



Percepts:
Location and status, e.g., [A, Dirty]

Actions:
Left, Right, Suck, NoOp

function Vacuum_Agent([location, status]) returns an action

if **status = Dirty** *then* return Suck

else if **location = A** *then* return Right

else if **location = B** *then* return Left

Rational Agent

- For each possible percept sequence, a **rational agent** should select an action that is expected to maximize its **performance measure**, *given the evidence provided by the percept sequence and the agent's built-in knowledge.*
- **Performance measure (utility function):** An *objective* criterion for success of an agent's behavior.

- **Goal-based agents: the actions depend on the goal;** *E.g., a mobile robot which should move from room 112 to room 179 in a building takes actions different from those of a robot that should move to room 105.*

- **Cost-based agents: the goal is to minimize the cost of erroneous decisions in the long term;** *E.g., a spam filter is an agent that puts incoming emails into wanted or unwanted (spam) categories & deletes any unwanted emails.*

Example: Spam –Agent

confusion matrix:

Agent 1:

		correct class	
		wanted	spam
spam filter decides	wanted	189	1
	spam	11	799

Agent 2:

		correct class	
		wanted	spam
spam filter decides	wanted	200	38
	spam	0	762

Agent 1 in fact makes fewer errors than Agent 2, but those few errors are severe because the user loses 11 potentially important emails. Because there are in this case two types of errors of differing severity, each error should be weighted with the appropriate cost factor. 23

Note that the false negative is very sever mistake:

FN in agent 1 = 11

FN in agent 2 = 0 (better)

Even if the total Errors :

Errors in agent 1 = 11 + 1 = 12 (better)

Errors in agent 2 = 38 + 0 = 38

Learning Agent

Learning agents, which are capable of changing themselves given training examples or through positive or negative feedback, such that the average utility of their actions grows over time.

PEAS

PEAS: Performance measure, Environment, Actuators, Sensors

P: a Performance function the agent is maximizing (or minimizing);

Assumed given ..In practice, needs to be computed somewhere.

E: a formal representation for *world states*;

For concreteness, a tuple ($var_1 = val_1$, $var_2 = val_2$, … , $var_n = val_n$).

A: actions that change the state according to a *transition model*;

Given a state and action, what is the successor state (or distribution over successor states)?

S: observations that allow the agent to infer the world state; Often come in very different form than the state itself ..

E.g., in tracking, observations may be pixels and state variables 3D coordinates.

Example:

Autonomous Taxi	Spam Filter
○ Performance measure Safe, fast, legal, comfortable trip, maximize profits ○ Environment Roads, other traffic, pedestrians, customers ○ Actuators Steering wheel, accelerator, brake, signal, horn ○ Sensors Cameras, LIDAR, speedometer, GPS, odometer, engine sensors, keyboard	○ Performance measure Minimizing false positives, false negatives ○ Environment A user's email account, email server ○ Actuators Mark as spam, delete, etc. ○ Sensors Incoming messages, other information about user's account

Environment

Fully Observable	vs.	Partially Observable
Deterministic	vs.	Stochastic
	(vs. Strategic)	
Episodic	vs.	Sequential
Static	vs.	Dynamic
	(vs. Semi-Dynamic)	
Discrete	vs.	Continuous
Single-Agent	vs.	Multi-Agent
Known	vs.	Unknown

1) Fully Observable vs. Partially Observable

- Do the agent's sensors give it access to the **complete state of the environment**?
- For any given world state, are the values of **all the variables known** to the agent?

2) Deterministic vs. Stochastic (vs. Strategic)

- Is the **next state** of the environment **completely determined by the current state** and the agent's action?
- Is the transition model deterministic (unique successor state given current state and action) or stochastic (distribution over successor states given current state and action)?
- **Strategic**: the environment is deterministic except for the actions of other agents.

3) Episodic vs. Sequential

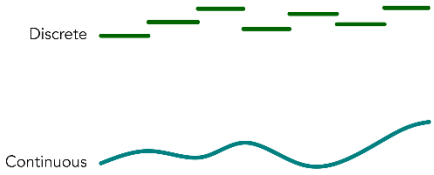
- Is the agent's experience divided into unconnected single decisions/actions, or is it a coherent sequence of observations and actions in which the world evolves according to the transition model?

4) Static vs. Dynamic (vs. Semi-dynamic)

- Is the world changing while the agent is thinking?
- **Semi-dynamic :** the environment does not change with the passage of time, but the agent's performance score does.

5) Discrete vs. Continuous

- Does the environment provide a fixed number of distinct percepts, actions, and environment states?
- Are the values of the state variables discrete or continuous?
- Time can also evolve in a discrete or continuous fashion.



6) Single–Agent vs. Multi–Agent

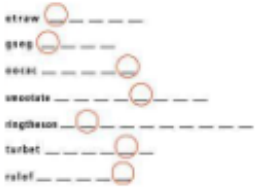
- Is an agent operating by itself in the environment?
- Is the environment of an autonomous taxi driver a **competitive** multiagent environment or a **cooperative** multiagent environment?



7) Known vs. Unknown

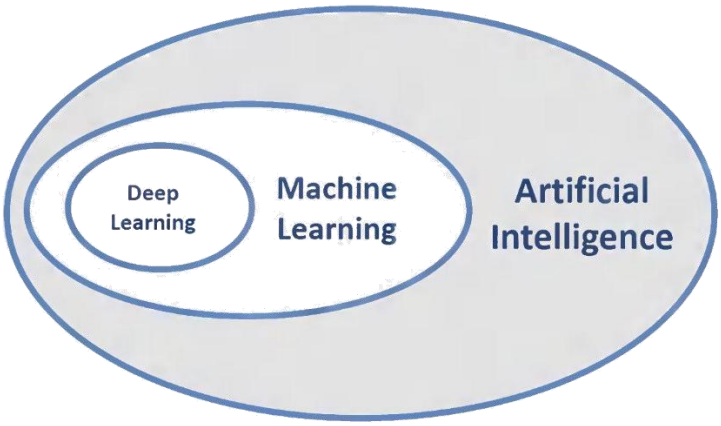
- Are the rules of the environment (transition model and rewards associated with states) known to the agent?
- Strictly speaking, not a property of the environment, but of the agent's state of knowledge

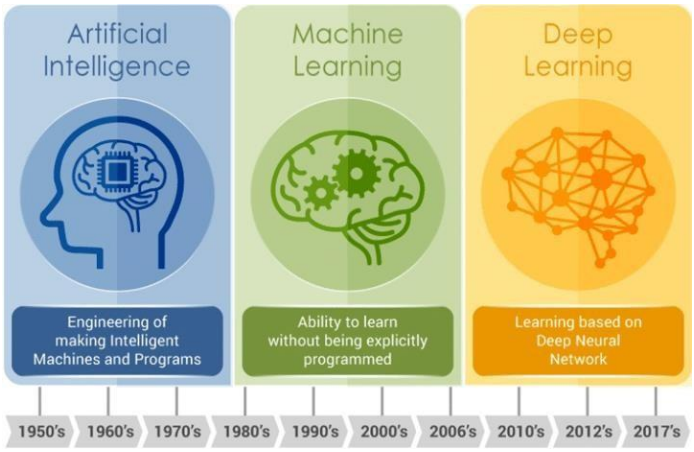
Example: Spam –Agent



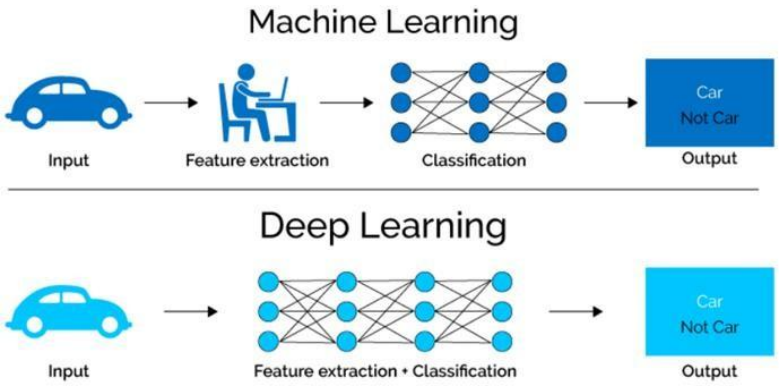

	Word Jumble Solver	Chess with a Clock	Scrabble	Autonomous Driving
Observable	Fully	Fully	Partially	Partially
Deterministic	Deterministic	Strategic	Stochastic	Stochastic
Episodic	Episodic	Sequential	Sequential	Sequential
Static	Static	Semi-dynamic	Static	Dynamic
Discrete	Discrete	Discrete	Discrete	Continuous
Single agent	Single	Multi	Multi	Multi

Artificial Intelligence Vs. Machine Learning Vs. Deep Learning

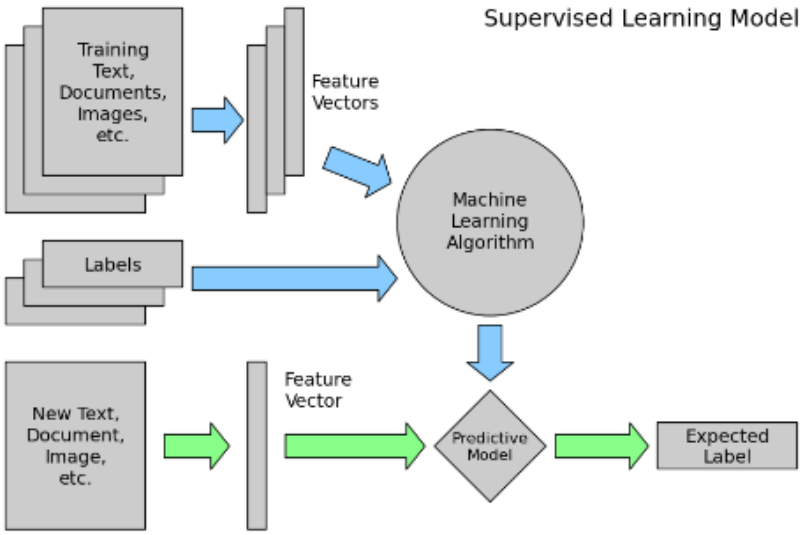


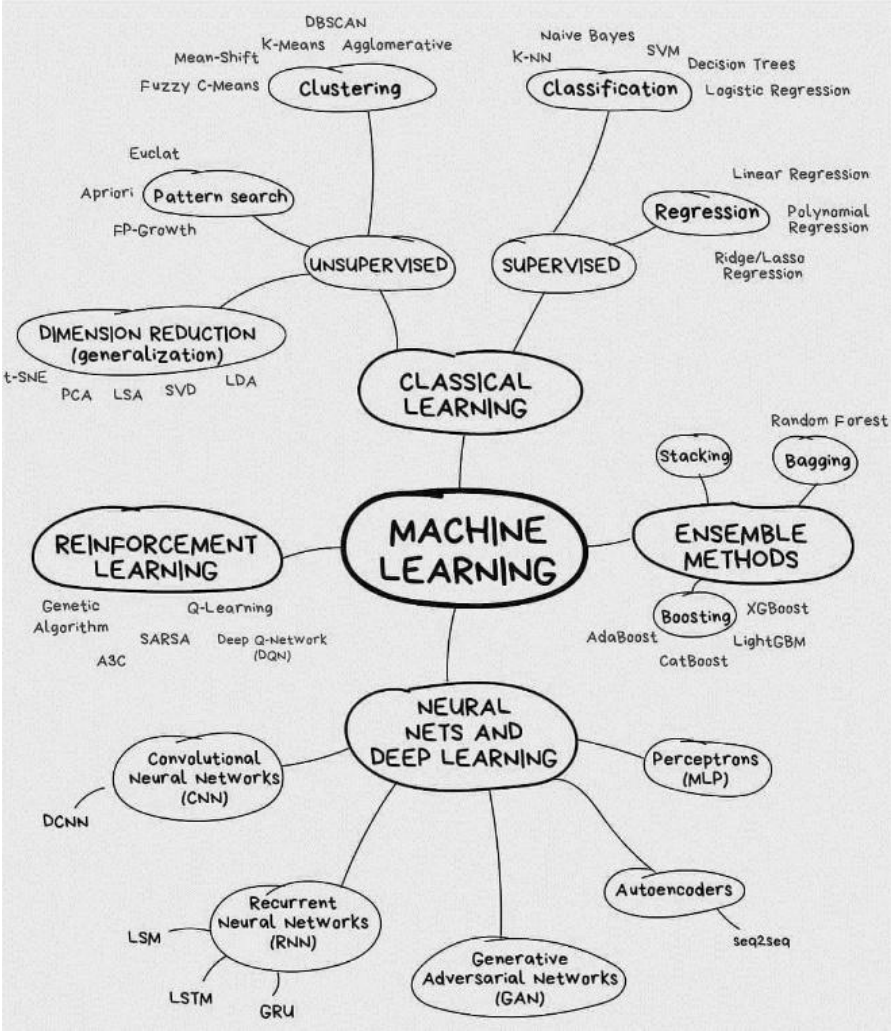


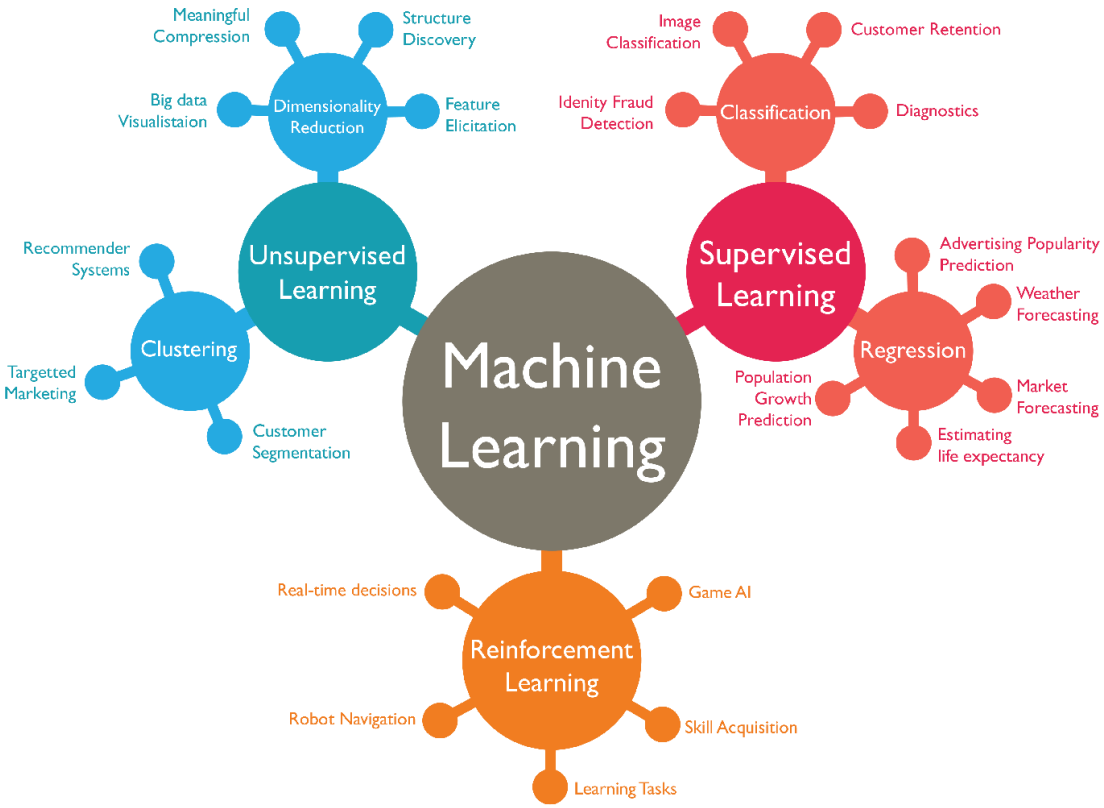
Deep Learning is a part of Machine Learning, which is a part of AI.



Machine Learning?




MACHINE LEARNING
CLASSICAL LEARNING
UNSUPERVISED
SUPERVISED
REINFORCEMENT LEARNING
ENSEMBLE METHODS
NEURAL NETS AND DEEP LEARNING
Clustering
DBSCAN
K-Means
Agglomerative
Mean-Shift
Fuzzy C-Means
Classification
Naive Bayes
K-NN
SVM
Decision Trees
Logistic Regression
Pattern search
Euclat
Apriori
FP-Growth
Regression
Linear Regression
Polynomial Regression
Ridge/Lasso Regression
DIMENSION REDUCTION (generalization)
t-SNE
PCA
LSA
SVD
LDA
Stacking
Bagging
Random Forest
Boosting
XGBoost
AdaBoost
LightGBM
CatBoost
Genetic Algorithm
Q-Learning
SARSA
Deep Q-Network (DQN)
A3C
Convolutional Neural Networks (CNN)
DCNN
Perceptrons (MLP)
Recurrent Neural Networks (RNN)
LSM
LSTM
GRU
Autoencoders
seq2seq
Generative Adversarial Networks (GAN)


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

Data Mining Vs. Machine Learning

Machine learning and data mining often the same employ methods and overlap significantly.

Roughly can be distinguished as:

- Machine learning focuses on prediction, based on known properties learned from the training data.
- Data mining focuses on the discovery of (previously) unknown properties in the data. This is the analysis step of Knowledge Discovery in Databases.

Much of the confusion between these two research communities comes from the basic assumptions they work with: **in machine learning, performance is usually evaluated with respect to the ability to reproduce known knowledge**, while **in Knowledge Discovery and Data Mining (KDD) the key task is the discovery of previously unknown knowledge**.

Artificial Intelligence Vs. Data-Science

Data Science is the science which uses **computer science, statistics and machine learning, visualization** and **human- computer interactions** to collect, clean, integrate, analyze, visualize, interact with data to create data products.

Data science = statistics + data processing + machine learning + scientific inquiry + visualization + business analytics + big data + …

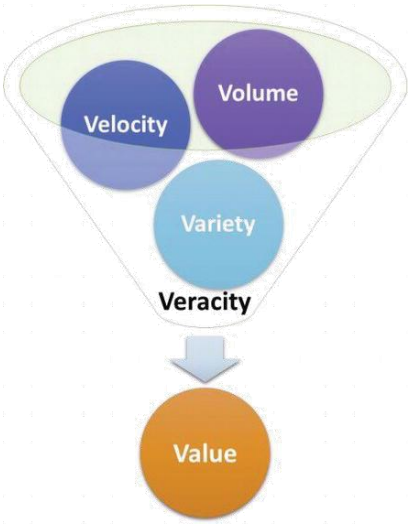
- **Deductive** versus **empirical** ..
- Solutions **deduced mostly from theory** versus solutions **deduced from mostly from data ..**

Engineering and Computer Science played key role:

- Cars
- Airplanes
- Power grid
- Television
- Air conditioning and central heating
- Nuclear power
- Digital computers
- The internet

Big Data

To understand the phenomenon that is big data, it is often described using five Vs: *Volume*, *Velocity*, *Variety*, *Veracity*, **and** *Value*.



Recently, Visualization, Virality, & Viscosity were added (thus, Eight V's) ..

- **Volume** refers to the vast amounts of data generated every second.
- **Velocity** refers to the speed at which new data is generated and the speed at which data moves around.
- **Variety** refers to the different types of data we can now use. In fact, 80% of the world's data is now unstructured, and therefore can't easily be put into tables (think of photos, video sequences or social media updates).
- **Veracity** refers to the messiness or trustworthiness of the data. With many forms of big data, quality and accuracy are less controllable.
- **Value**: It is all well and good having access to big data but unless we can turn it into value it is useless.