THE BIG BANG OF DATA SCIENCE

-from academia to industry

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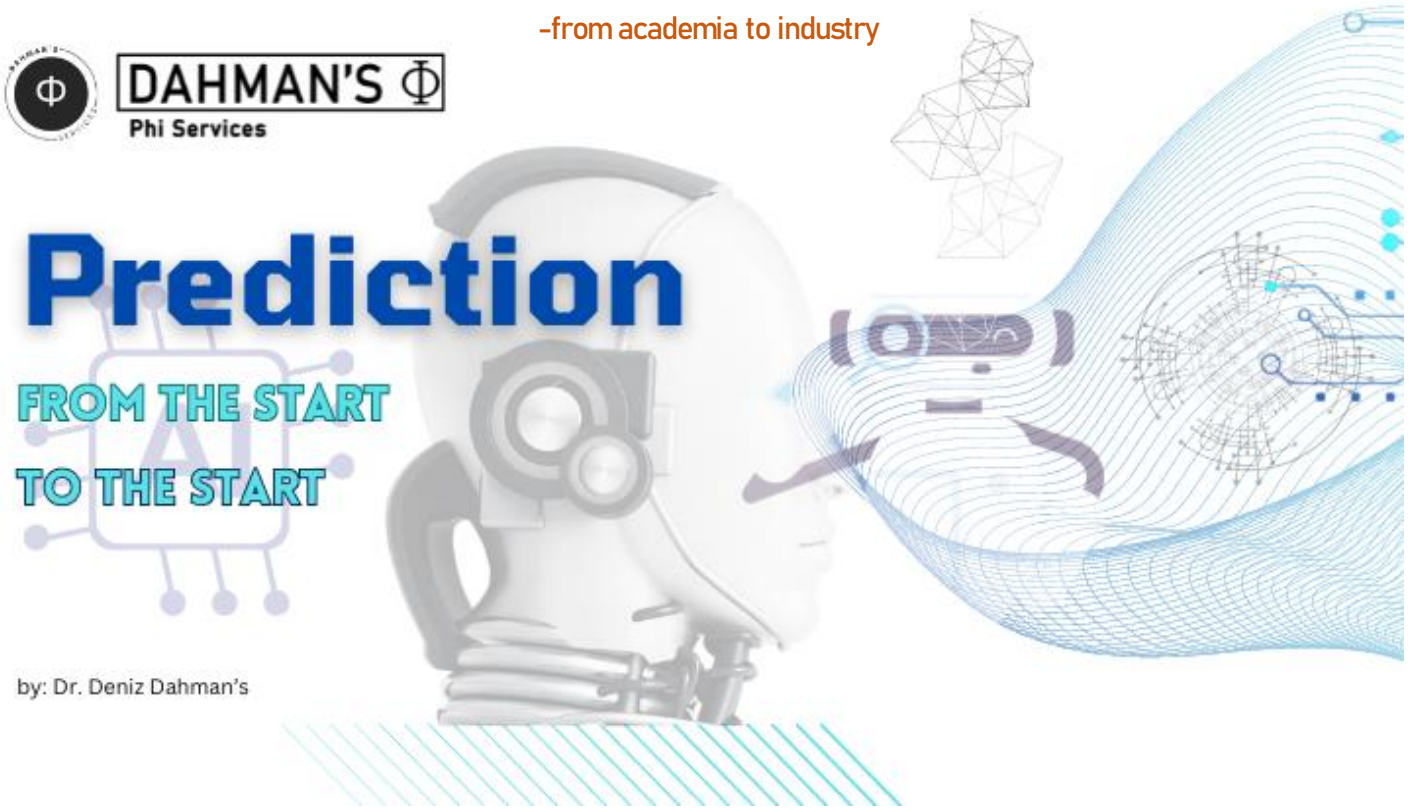

BOOK THREE

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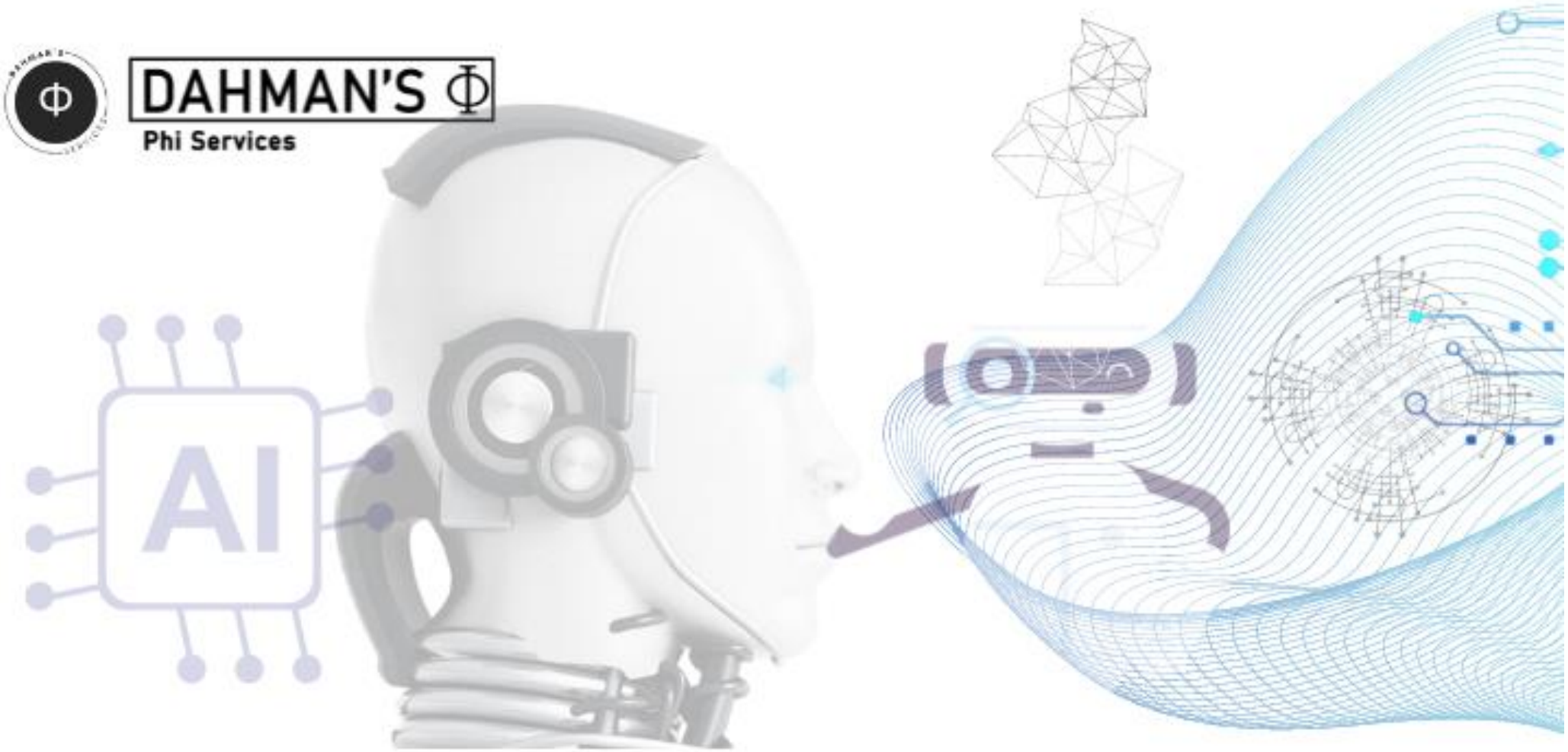

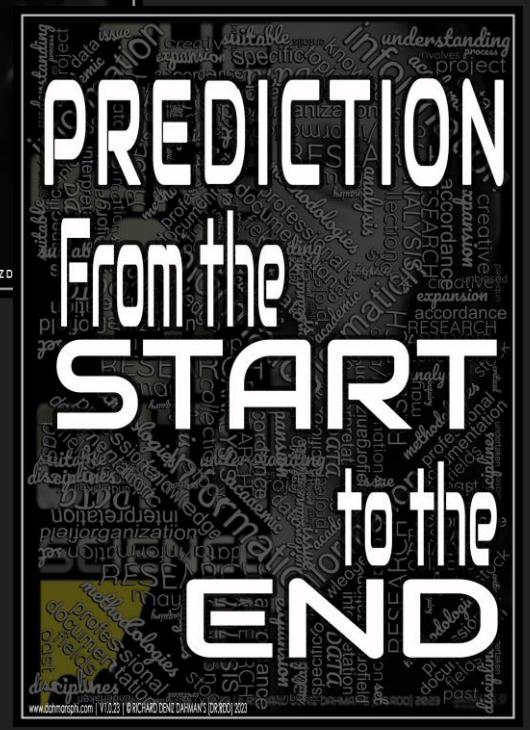

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INTRODUCTION

- ✓ COURSE STRATEGY
- ✓ PRINCIPLE OF DATA
- ✓ DATA PLATFORM
- ✓ TIMELINE REPRESENTATIVE

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STORY OF MATH

- ✓ PHILOSOPHY OF MATH
- ✓ AREA OF MATHEMATICS

- Number Theory
- Geometry
- Algebra
- Calculus & Analysis
- Discrete Mathematics
- Math Logic
- Decision Science
- Computational Math

Chapter One

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Chapter Seven

YOU MUST KNOW

- ✓ Number Properties
- ✓ The universe of polynomial
- ✓ Equation & Function & System
- ✓ Trigonometry
- ✓ e & Natural Logarithm ln
- ✓ Exponential Function & Logarithm
- ✓ Derivatives & Integrals
- ✓ Matrix, Eigenvalue, Eigenvector
- ✓ combination and permutation

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WORLD OF PREDICTION

- ✓ Introduction to Prediction
- ✓ Map of prediction
- ✓ Elaboration on the map from left
- ✓ Elaboration on the map from right
- ✓ Elaboration on the map from source

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Prediction by Probability

- ✓ Introduction to Probability
- ✓ Univariate concept of probability
- ✓ Bivariate concept of probability
- ✓ Multivariate concept of probability

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Prediction by RCC

- ✓ Introduction to RCC
- ✓ Prediction by regression
- ✓ Prediction by classification
- ✓ Prediction by clustering

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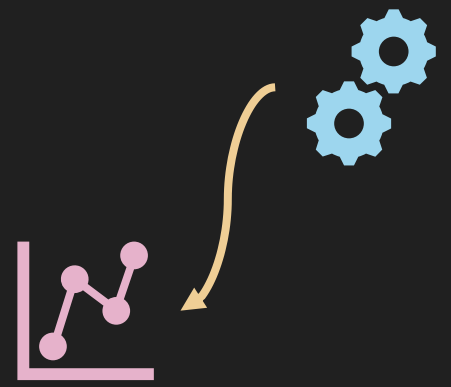
Python from the start to the end

- ✓ Introduction
- ✓ Setup environment
- ✓ Informal introduction to python
- ✓ Control flow tool kit
- ✓ Data structure
- ✓ Modules
- ✓ Input & output
- ✓ Errors & exceptions
- ✓ Classes
- ✓ Tour of the standard libraries
- ✓ Development tips
- ✓ NumPy package
- ✓ Pandas package
- ✓ Tensor Flow basics

Chapter One

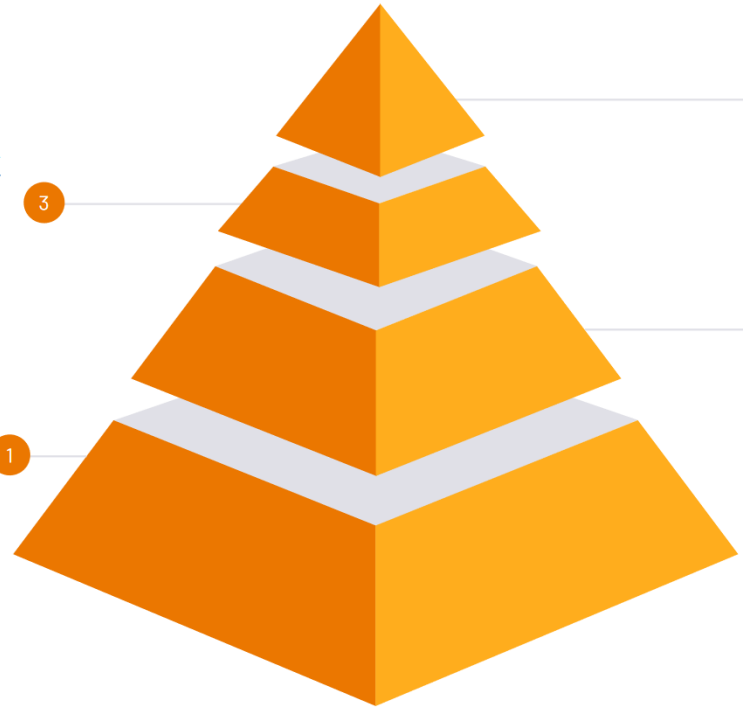
INTRODUCTION

- ✓ COURSE STRATEGY
- ✓ PRINCIPLE OF DATA
- ✓ DATA PLATFORM
- ✓ TIMELINE REPRESENTATIVE



COURSE STRATEGY

✓ The four steps towards accomplishment

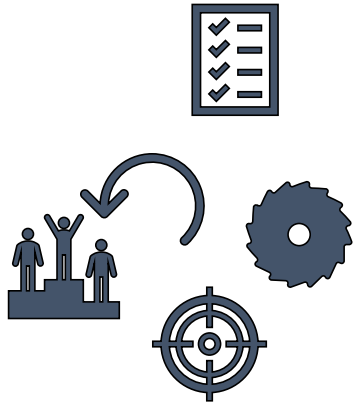


Implementation Framework
4 At this stage we start the exploration on the available solutions and tools on the subject at hand.

Conceptual Framework
At this stage we start to construct our own conceptual image on the subject and discuss the existing models. 3

Perceptual Framework
2 At this stage we establish a perceptual representation from our theoretical understanding.

Theoretical Framework
1 At this stage we establish the discussion on the theoretical discussion on the subject.



PRINCIPILE OF DATA

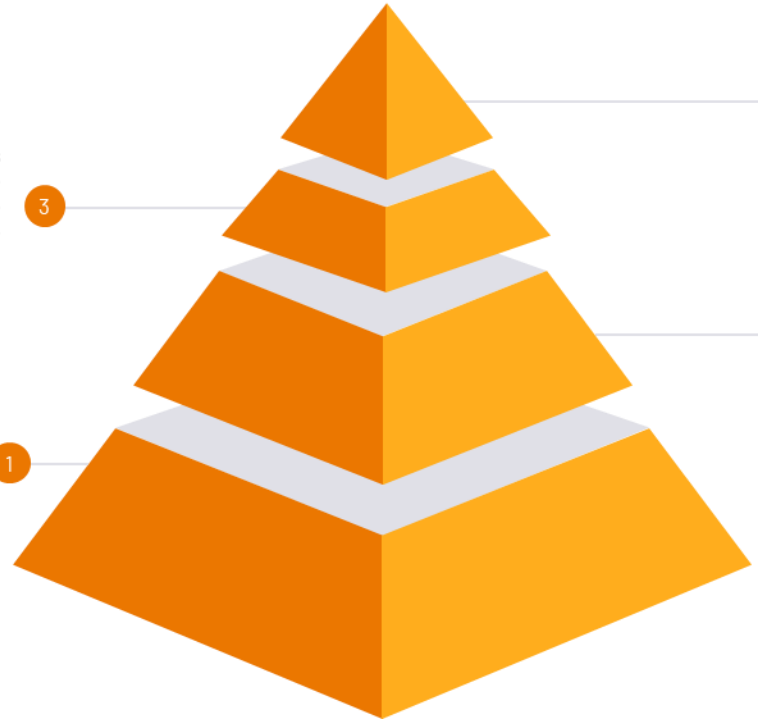
✓ Academic Review

- Data are individual facts, statistics, or items of information, often numeric, that are collected through observation.
- In a more technical sense, data are a set of values of qualitative or quantitative variables about one or more persons or objects

DATA PLATFORM

KNOLWLEDGE
Creating the first data analysis helps you to gain much knowledge about the subject at hand, and more importantly, is giving you the knowledge about the data.

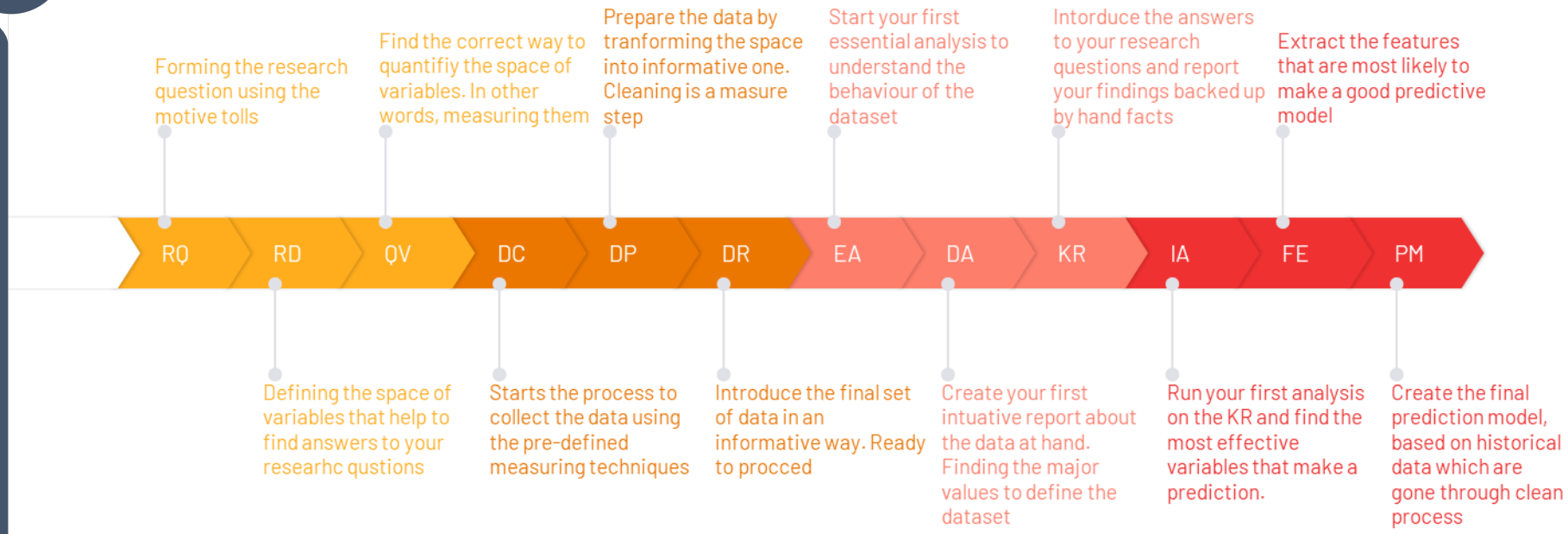
DATA
Bulding up the complete fundamental and essentails framework. Considering, directionality, motive, measures.



INTELLEGENCE
Steps where you touch the future. Having you designed and developed a strong knowledge about the subject at hand, your next step can be prediction of events, that's the intellegence.

INFORMATION
Creating the space of variables. Defining all the lable of the raw data is the step to define the essentail termmenology of information.

TIMELINE REPRESENTATIVE



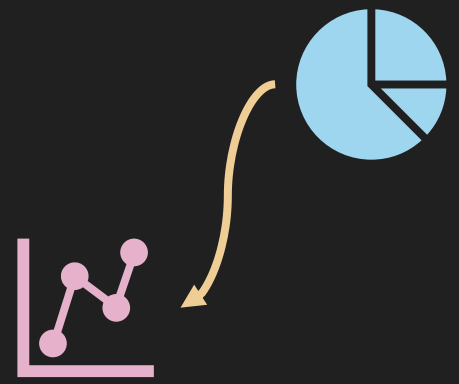
RQ: RESEARCH QUESTION	DC: DATA COLLECTION	DA: ESSENTIAL ANALYSIS	IA: INTELLEGENCE ANALYSIS
RD: RESEARCH DATA	DP: DATA PROCSSING	DA: DATA ANALYSIS	FE: FEATURE EXTRACTION
QV: QUANTIFING VARIABLES	DR: DATA REPORTING	KR: KNOWLEDGE REPORT	PM: PREDICTIVE MODELING

Chapter Two

STORY OF MATH

- ✓ PHILOSOPHY OF MATH
- ✓ AREA OF MATHEMATICS

  - Number Theory
  - Geometry
  - Algebra
  - Calculus & Analysis
  - Discrete Mathematics
  - Math Logic
  - Decision Science
  - Computational Math



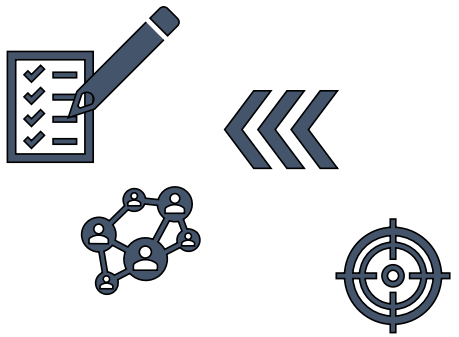
PHILOSOPHY OF MATH

- ✓ Mathematics is an area of knowledge that includes the topics of
  - numbers,
  - formulas and related structures,
  - shapes and the spaces in which they are contained,
  - and quantities and their changes.
- ✓ These topics are represented in modern mathematics with the major subdisciplines of:
  - number theory,
  - algebra,
  - geometry,
  - and analysis.
- ✓ There is no general consensus among mathematicians about a common definition for their academic discipline.

AREA OF MATHEMATICS

- ✓ Perhaps the intimidating image of math is all over the place, however, in order for you to overcome this trauma, you should see the big picture distilled in pieces
- ✓ We are going to see 8 different areas to perceive the use of the language of mathematics
  - Number Theory
  - Geometry
  - Algebra
  - Calculus & Analysis
  - Discrete Mathematics
  - Math Logic
  - Decision Science
  - Computational Math

Number Theory
Geometry
Algebra
Calculus & Analysis
Discrete Mathematics
Decision Science
Computational Math

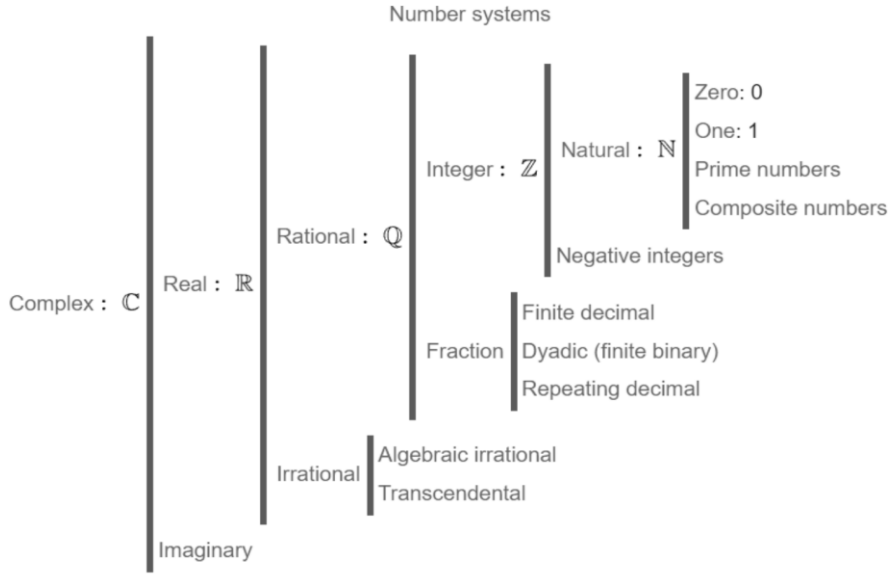


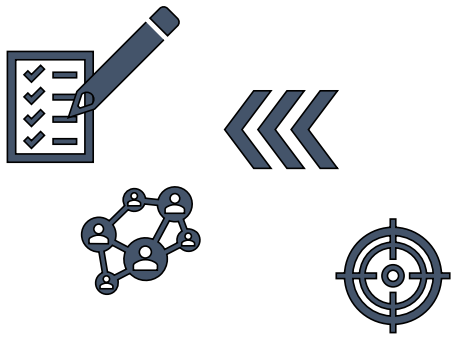
AREA OF MATHEMATICS

$\mathbb{N}$	**Natural numbers**	0, 1, 2, 3, 4, 5, ... or **1**, 2, 3, 4, 5, ... $\mathbb{N}_0$ or $\mathbb{N}_1$ are sometimes used.
$\mathbb{Z}$	**Integers**	..., −5, −4, −3, −2, −1, 0, 1, 2, 3, 4, 5, ...
$\mathbb{Q}$	**Rational numbers**	$\frac{a}{b}$ where *a* and *b* are integers and *b* is not 0
$\mathbb{R}$	**Real numbers**	The limit of a convergent sequence of rational numbers
$\mathbb{C}$	**Complex numbers**	*a* + *bi* where *a* and *b* are real numbers and *i* is a formal square root of −1

- Number Theory
- Geometry
- Algebra
- Calculus & Analysis
- Discrete Mathematics
- Decision Science
- Computational Math

✓ Each of these number system is a subset of the next one. So, for example, a rational number is also a real number, and every real number is also a complex number. This can be expressed symbolically as $\mathbb{N} \subset \mathbb{Z} \subset \mathbb{Q} \subset \mathbb{R} \subset \mathbb{C}$

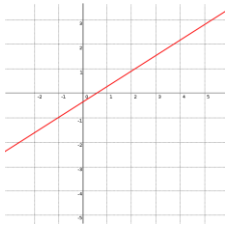


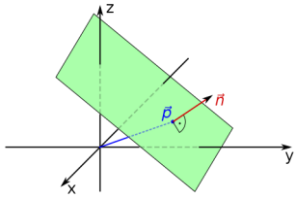


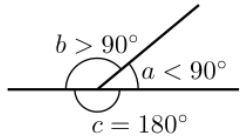
AREA OF MATHEMATICS

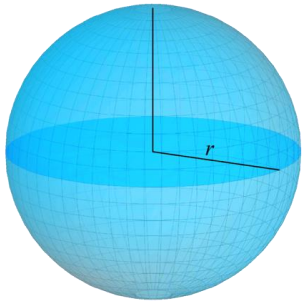
✓ The following are some of the most important concepts in geometry

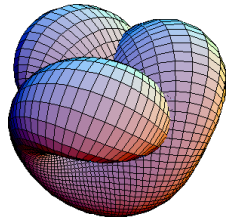
- Objects
  - Points
  - Lines
  - Planes
  - Angles
  - Curves
  - Surfaces
  - Manifolds
- Lengths, Area & Volumes
  - Metrics & Measures
- Congruence and similarity
- Dimension

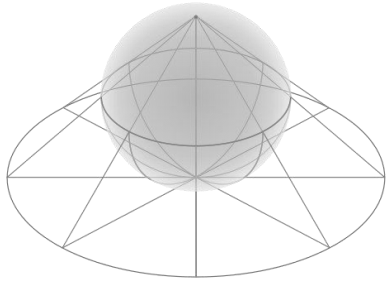












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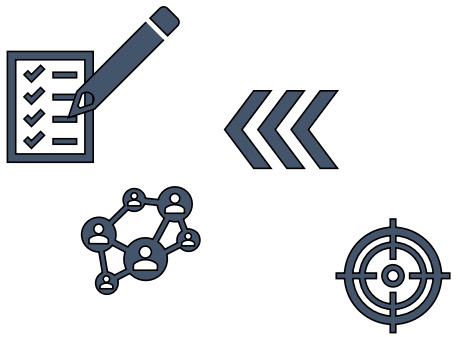
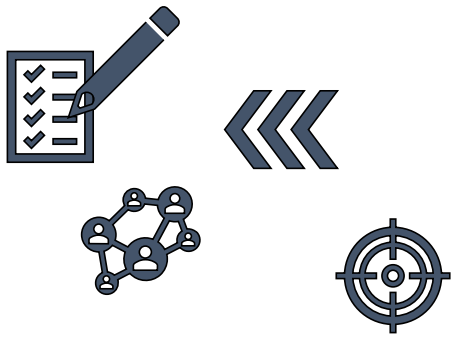
AREA OF MATHEMATICS

- ✓ Algebra is the study of variables and the rules for manipulating these variables in formulas; it is a unifying thread of almost all of mathematics
- ✓ Areas with the concept of Algebra:
  - Elementary Algebra with polynomial
  - Abstract algebra
  - Boolean algebra
  - Commutative algebra
  - Computer algebra
  - Algebraic number theory
  - Algebraic geometric theory



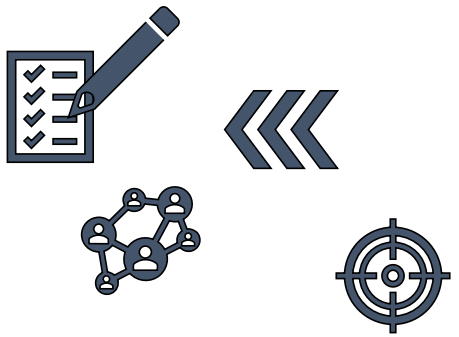
AREA OF MATHEMATICS

- ✓ Calculus, originally called infinitesimal calculus or "the calculus of infinitesimals", is the mathematical study of continuous change, in the same way that geometry is the study of shape, and algebra is the study of generalizations of arithmetic operations
  - Limits and infinitesimals
  - Differential calculus
  - Integral calculus
- ✓ Analysis is the branch of mathematics dealing with continuous functions, limits, and related theories, such as differentiation, integration, measure, infinite sequences, series, and analytic functions.



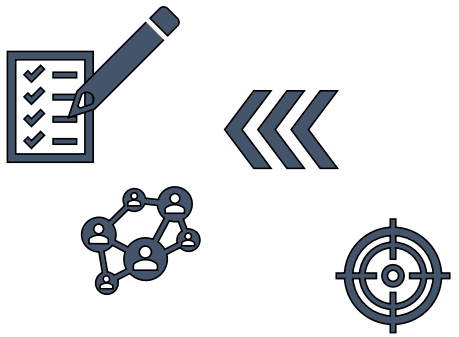
AREA OF MATHEMATICS

- ✓ Discrete mathematics is the study of mathematical structures that can be considered "discrete" (in a way analogous to discrete variables) rather than "continuous" (analogously to continuous functions).
- ✓ Objects studied in discrete mathematics include:
  - ➢ Logic
  - ➢ Set theory
  - ➢ Combinatoric
  - ➢ Graph theory
  - ➢ Number theory
  - ➢ Algebraic structure
  - ➢ Calculus for finite



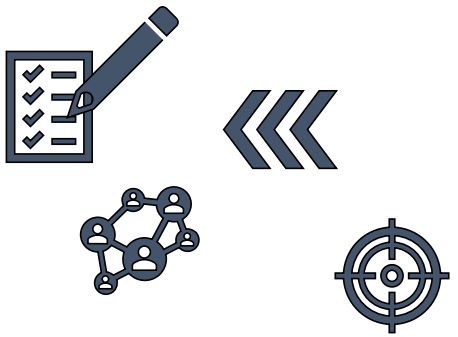
AREA OF MATHEMATICS

- ✓ Statistical theory studies decision problems such as minimizing the risk (expected loss) of a statistical action, such as using a procedure in, for example, parameter estimation, hypothesis testing, and selecting the best. In these traditional areas of mathematical statistics, a statistical-decision problem is formulated by minimizing an objective function, like expected loss or cost, under specific constraints. For example, designing a survey often involves minimizing the cost of estimating a population mean with a given level of confidence
- ✓ Probability theory is the branch of mathematics concerned with probability. Although there are several different probability interpretations, probability theory treats the concept in a rigorous mathematical manner by expressing it through a set of axioms



AREA OF MATHEMATICS

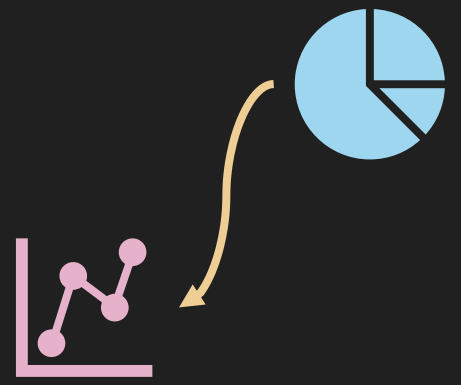
- ✓ Computational mathematics is an area of mathematics devoted to the interaction between mathematics and computer computation
- ✓ Areas of computational mathematics
  - Computational Science
  - Stochastic Methods
  - Computational statistics
  - Computational geometry
  - Computational group theory
  - Algorithmic information theory
  - Mathematical economics



Chapter Three

YOU MUST KNOW

- ✓ Number Properties
- ✓ The universe of polynomial
- ✓ Equation & Function & System
- ✓ Trigonometry
- ✓ e & Natural Logarithm ln
- ✓ Exponential Function & Logarithm
- ✓ Derivatives & Integrals
- ✓ Matrix, Eigenvalue, Eigenvector
- ✓ combination and permutation



Number Property

✓ Here are the most fundamental properties when it comes to numbers. Having you to visualize and understand those properties, it means that you can handle the big pictures when it comes to deal with equations and functions.

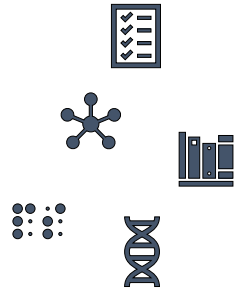
Number Properties	Operations	
	Addition	Multiplication
Commutative Property	$a+b=b+a$	$a\times b=b\times a$
Associative Property	$(a+b)+c=a+(b+c)$	$(a\times b)\times c=a\times(b\times c)$
Identity Property	$a+0=0+a=a$	$a\times 1=1\times a=a$
Distributive Property	$a\times(b+c)=a\times b+a\times c$	

The universe of polynomial

- ✓ a polynomial is an expression consisting of **indeterminates** (also called **variables**) and *coefficients*, that involves only the operations of *addition, subtraction, multiplication, and positive-integer powers of variables*.
- ✓ An example of a polynomial of a **single** indeterminate x is $(x^2 - 4x + 7)$.
- ✓ An example with **three indeterminates** is $(x^3 + 2xyz^2 - yz + 1)$.
- ✓ What you must visualize and understand:
  - ➢ Classification
  - ➢ Arithmetic
  - ➢ function graph

Equation & Function & System

- ✓ An equation is analogous to a weighing scale, balance, or seesaw.
- ✓ Each side of the equation corresponds to one side of the balance.
- ✓ Different quantities can be placed on each side: if the weights on the two sides are equal, the scale balances, and in analogy, the equality that represents the balance is also balanced (if not, then the lack of balance corresponds to an inequality represented by an inequation)
  - linear equation for degree one
  - quadratic equation for degree two
  - cubic equation for degree three
  - quartic equation for degree four
  - quintic equation for degree five
  - sextic equation for degree six
  - septic equation for degree seven
  - octic equation for degree eight
- ✓ A function from a set X to a set Y is an assignment of an element of Y to each element of X. The set X is called the domain of the function and the set Y is called the codomain of the function



- Number Property
- The universe of polynomial
- Equation & Function & System
- Trigonometry
- e (mathematical constant) Natural Logarithm ln
- Exponential Function Logarithm
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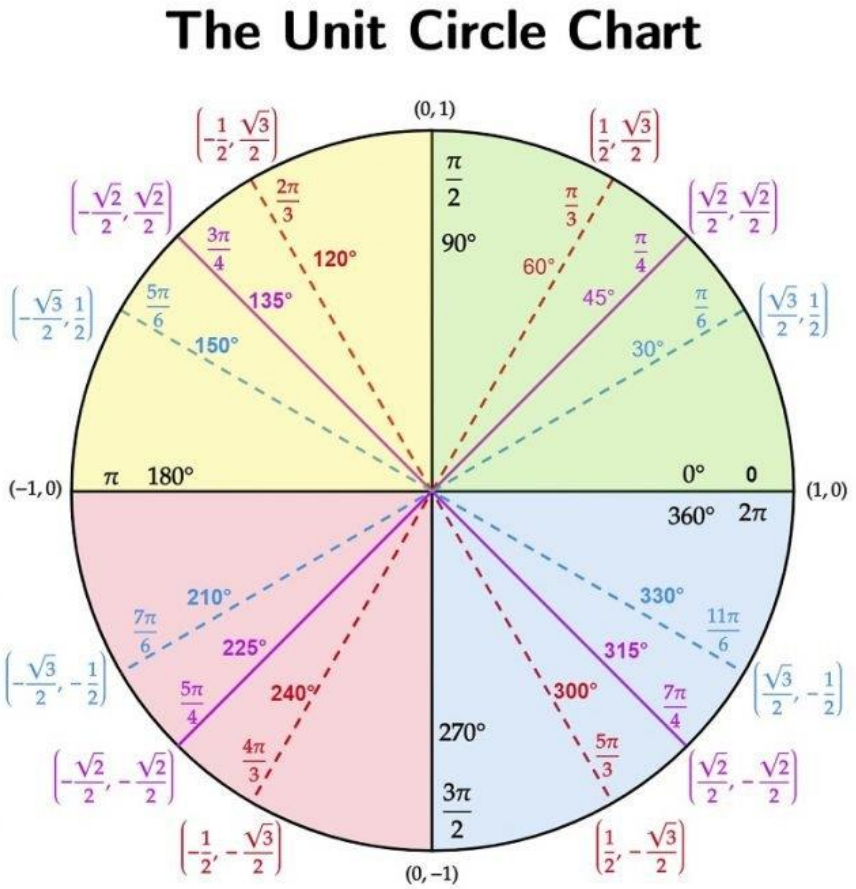
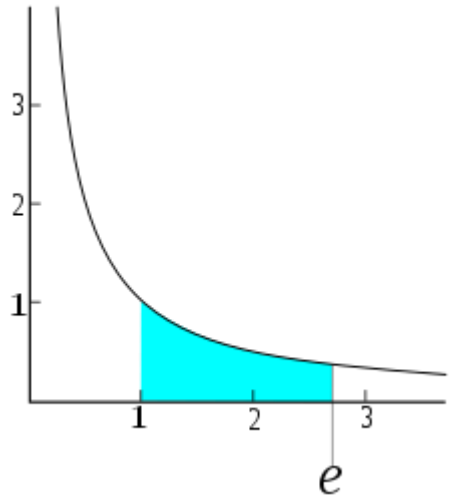
Trigonometry

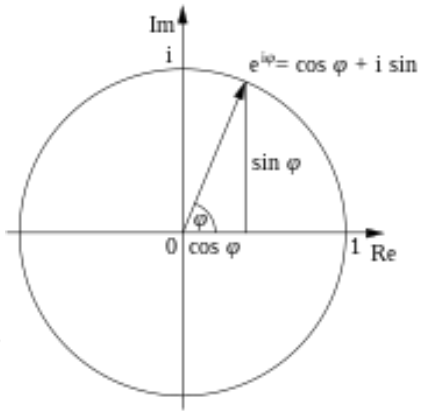
✓ concerned with relationships between angles and ratios of lengths.

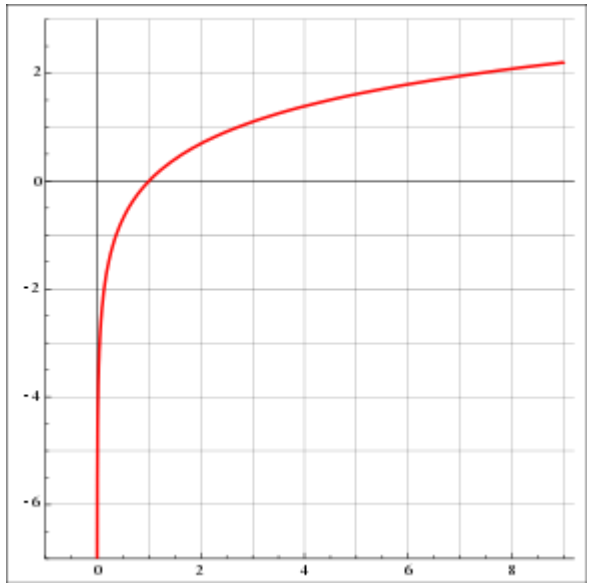


e & Natural Logarithm ln

- ✓ The number e, also known as Euler's number, is a mathematical constant approximately equal to 2.71828 that can be characterized in many ways.
- ✓ It is the base of the natural logarithms. It is the limit of (1 + 1/n)n as n approaches infinity, an expression that arises in the study of compound interest.
- ✓ It can also be calculated as the sum of the infinite series

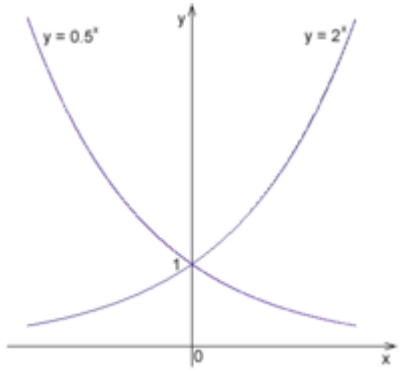


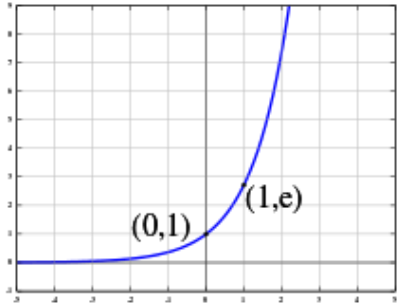


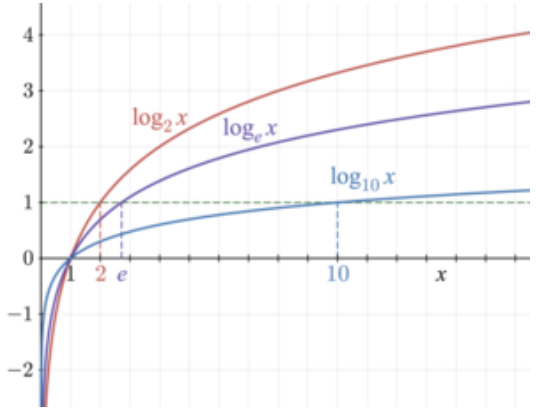


Exponential Function & Logarithm

- ✓ The exponential function is a mathematical function denoted by $f(x) = \exp(x)$ or e^x
- ✓ (where the argument *x is written as an exponent*). Unless otherwise specified,
- ✓ the term generally refers to the positive-valued function of a real variable, although it can be extended to the complex numbers or generalized to other mathematical objects like matrices.

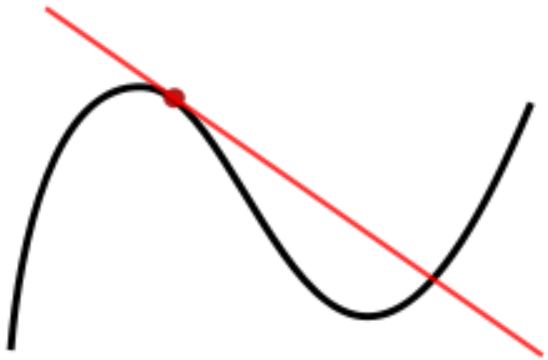


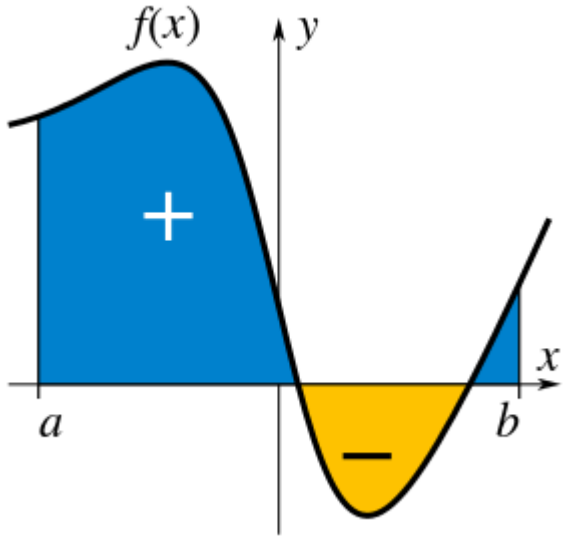




Derivatives & Integrals

- ✓ the derivative of a function of a real variable measures the sensitivity to change of the function value (output value) with respect to a change in its argument (input value). Derivatives are a fundamental tool of calculus.
- ✓ an integral is the continuous analog of a sum, which is used to calculate areas, volumes, and their generalizations. Integration, the process of computing an integral, is one of the two fundamental operation of calculus





Matrix, Eigenvalue, Eigenvector

✓ The study of matrix and operations on them are very important skill that one must have in order to master the idea of prediction. Here are some titles you may want to consider:

- **dot product**: done between the rows of the first matrix and the columns of the second matrix
- **Basis & independency**: a set B of vectors in a vector space V is called a basis if every element of V may be written in a unique way as a finite linear combination.
- **Change of basis**: is the change-of-basis matrix (also called transition matrix), which is the matrix whose columns are the coordinate vectors of the new basis vectors on the old basis
- **Determinant & Inverse**: matrix A is a matrix that, when multiplied by A results in the identity. The notation for this inverse matrix is A−1.
- **Magic or orthogonality**: orthogonal matrix, or orthonormal matrix, is a real square matrix whose columns and rows are orthonormal vectors
- **eigenvalue & eigenvectors**: special set of scalars associated with a linear system of equations (i.e., a matrix equation) that are sometimes also known as characteristic roots.

$$\begin{array}{c} \\ 1 \\ 2 \\ 3 \\ \vdots \\ m \end{array} \begin{array}{c} \begin{array}{cccc} 1 & 2 & \dots & n \end{array} \\ \begin{bmatrix} a_{11} & a_{12} & \dots & a_{1n} \\ a_{21} & a_{22} & \dots & a_{2n} \\ a_{31} & a_{32} & \dots & a_{3n} \\ \vdots & \vdots & \vdots & \vdots \\ a_{m1} & a_{m2} & \dots & a_{mn} \end{bmatrix} \end{array}$$

combination and permutation

✓ a **combination** is a selection of items from a set that has distinct members, such that the order of selection does not matter.

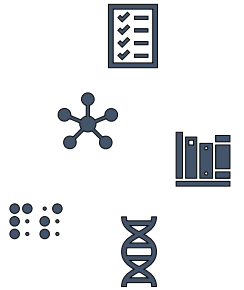
- For example, given three fruits, say an apple, an orange and a pear, there are three combinations of two that can be drawn from this set: an apple and a pear; an apple and an orange; or a pear and an orange. More formally, a k-combination of a set S is a subset of k distinct elements of S

$$\binom{n}{k} = \frac{n(n-1)\cdots(n-k+1)}{k(k-1)\cdots 1}$$

✓ a **permutation** of a set is, loosely speaking, an arrangement of its members into a sequence or linear order, or if the set is already ordered, a rearrangement of its elements. The word "permutation" also refers to the act or process of changing the linear order of an ordered set

- For example, written as tuples, there are six permutations of the set {1, 2, 3}, namely (1, 2, 3), (1, 3, 2), (2, 1, 3), (2, 3, 1), (3, 1, 2), and (3, 2, 1). These are all the possible orderings of this three-element set.

$${}_nP_r = \frac{n!}{(n-r)!}$$



Chapter Four

WORLD OF PREDICTION

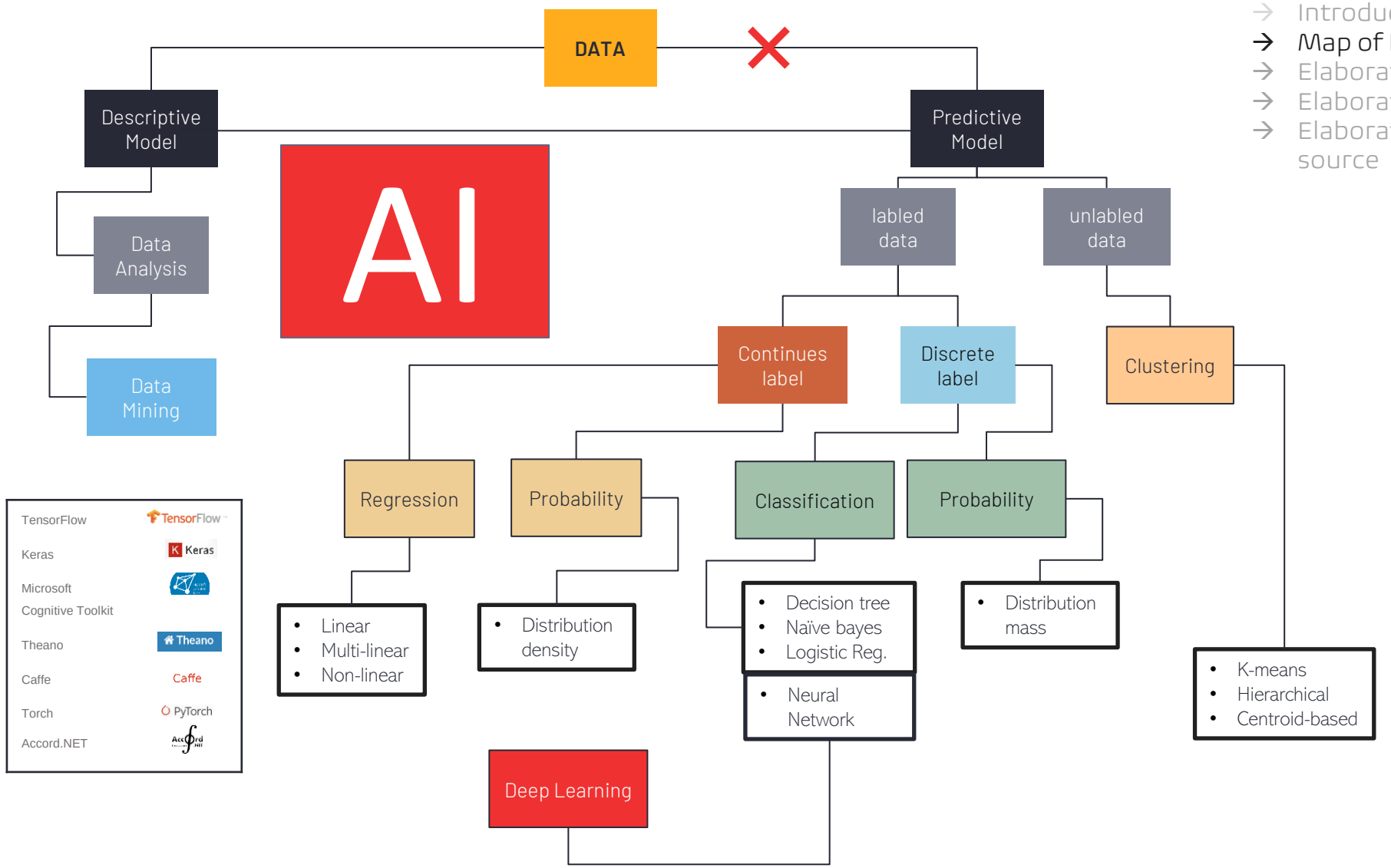
- ✓ Introduction to Prediction
- ✓ Map of prediction
- ✓ Elaboration on the map from left
- ✓ Elaboration on the map from right
- ✓ Elaboration on the map from source

Introduction to Prediction

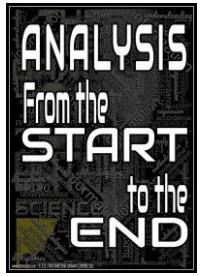
STATISTICS, PROBABILITY, PREDICTION

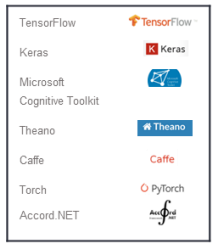
- ✓ Prediction is to assume something about the future. The question is how to do that with relation to the issue of accuracy.
- ✓ Pillars of prediction,
- ✓ Data as the source of start
- ✓ Have no data what does that real mean

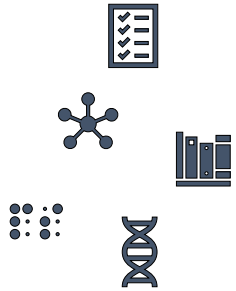
Map of Prediction



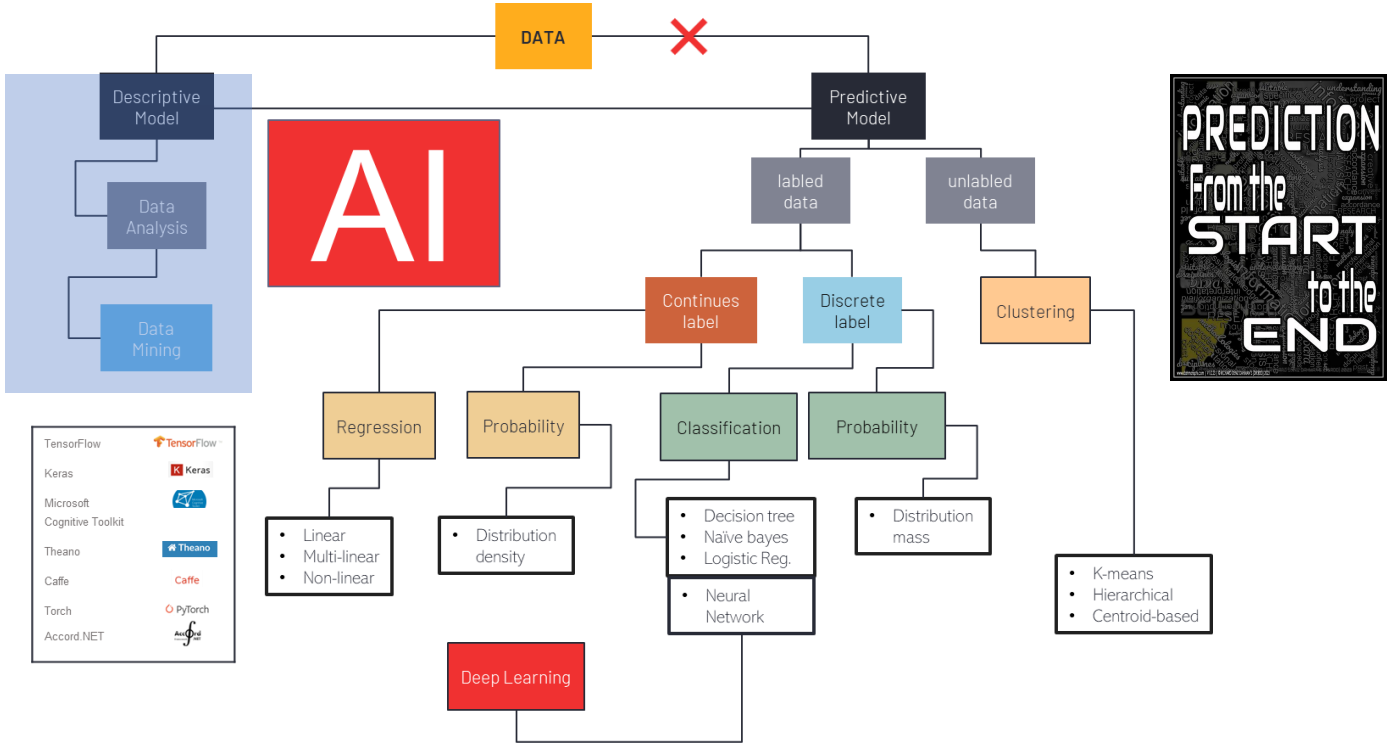
Elaboration on the map from left



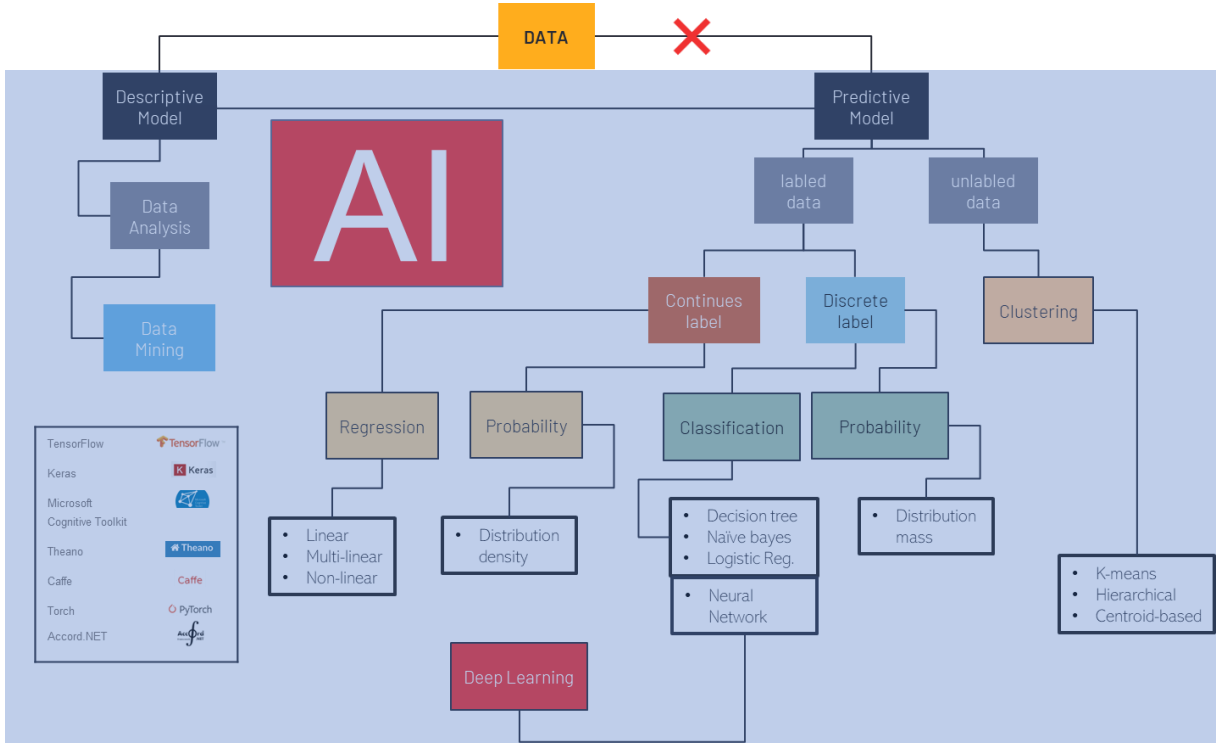




Elaboration on the map from right



Elaboration on the map from source



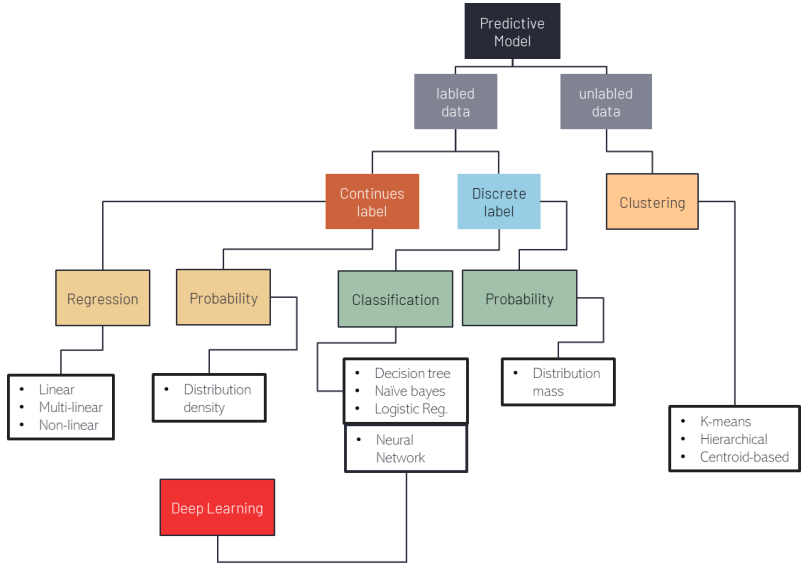
Chapter Five

Prediction by Probability

- ✓ Introduction to Probability
- ✓ Univariate concept of probability
- ✓ Bivariate concept of probability
- ✓ Multivariate concept of probability

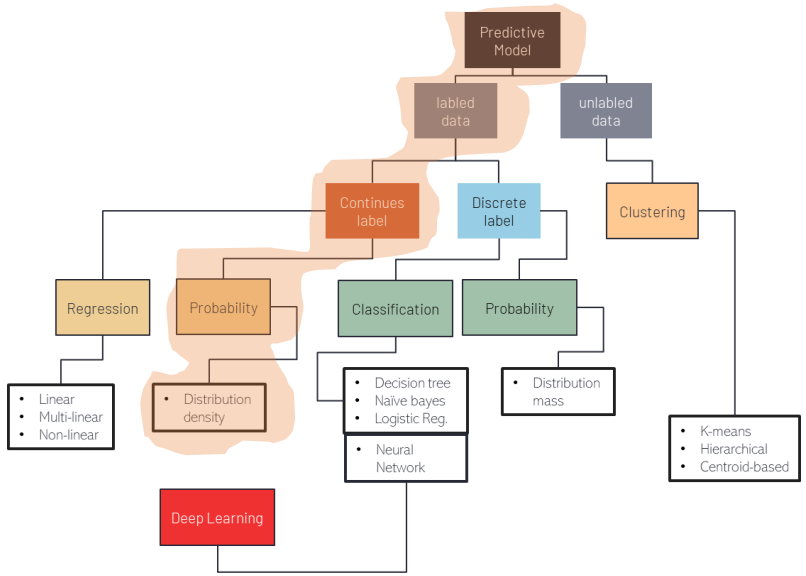
Introduction to Probability

- ✓ Probability is the branch of mathematics concerning numerical descriptions of how likely an event is to occur, or how likely it is that a proposition is true.
- ✓ The probability of an event is a number *between 0 and 1,* where, roughly speaking, **0 indicates** *impossibility* of the event and **1 indicates** *certainty*.
- ✓ Perception of probability from a univariate perspective
- ✓ Relation to randomness and probability in quantum mechanics,



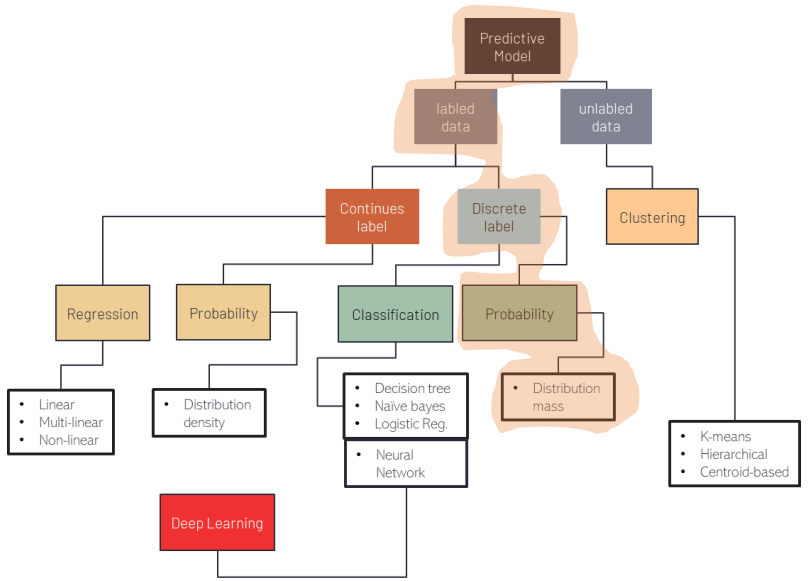
Univariate concept of probability

- ✓ The probability density function (pdf) and the cumulative distribution function (CDF) are used to describe the probabilities associated with a continuous random variable
- ✓ Popular distributions of continues value:
  - Uniform distribution (pdf/cdf)
  - Normal distribution (pdf/cdf)
  - Triangular distribution (pdf/cdf)
  - Logistic Cauchy distribution (pdf/cdf)
  - Exponential distribution (pdf/cdf)



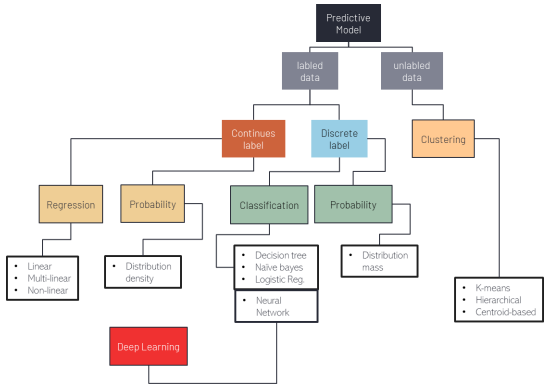
Univariate concept of probability

- ✓ A discrete random variable is a variable that can take any whole number values as outcomes of a random experiment.
- ✓ The discrete random variable takes a countable number of possible outcomes and it can be counted as 0, 1, 2, 3, 4, ...
- ✓ The probability mass function (pmf) and the cumulative distribution function (CDF) are used to describe the probabilities associated with a discrete random variable
- ✓ Types of discrete value distribution:
- ✓ Uniform distribution (pmf/cdf)
- ✓ Binomial distribution (pmf/cdf)
- ✓ Geometric distribution (pmf/cdf)
- ✓ Bernoulli distribution (pmf/cdf)
- ✓ Poisson distribution (pmf/cdf)



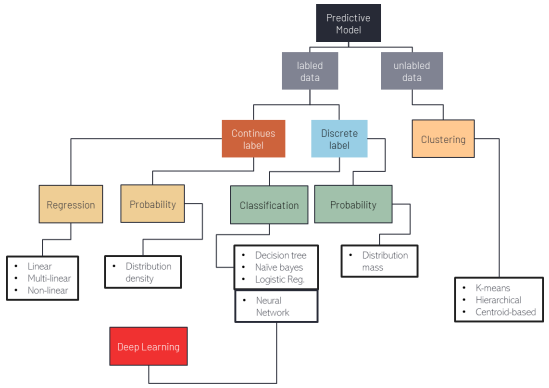
Bivariate concept of probability

- ✓ Given two random variables that are defined on the same probability space, *the joint probability distribution* is the corresponding probability distribution on all possible pairs of outputs.
- ✓ The joint distribution can just as well be considered for any given number of random variables.
- ✓ An example of a bivariate normal distribution would be rolling two fair dice
- ✓ Keep in mind that the variables could be in (continues or discrete) forms

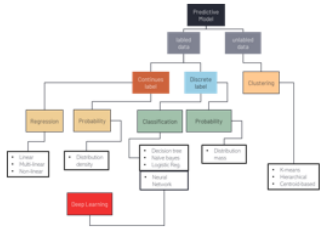


Multivariate concept of probability

- ✓ Multivariate distributions are used to characterize the joint distribution of a collection of N random variables
- ✓ The mathematical formulation of this joint distribution can be quite complex and typically makes use of matrix algebra
- ✓ Once again we can consider the action of continues and discrete kind of variables.



Introduction to Probability – Lab Discussion



Chapter Five

PREDICTION BY PROBABILILTY

Discrete

Dist.	PMF	CDF	E(X)	Var(X)
Bernoulli	$p(x)=\begin{Bmatrix} p, x=1 \\ 1-p, x=0 \\ 0, else \end{Bmatrix}$	$F(x)=\begin{Bmatrix} 0, x<0 \\ 1-p, 0\le x<1 \\ 1, x\ge 1 \end{Bmatrix}$	p	$p(1-p)$
Binomial	$p(k)=\left\{\binom{n}{k}p^k(1-p)^{n-k}\right\}$, $k=0,1,2,\dots,n$	$F(x\le k)=\sum_{r=0}^{k}p(x=r)$	np	$np(1-p)$
Geometric Dist.	$p(k)=\begin{Bmatrix} p(1-p)^{k-1} \\ 0, else \end{Bmatrix}$, $k=1,2,\dots$	$F(x\le k)=1-(1-p)^k$	$\frac{1}{p}$	$\frac{1-p}{p^2}$
Pascal Dist.	$p(k)=\left\{\binom{k-1}{m-1}p^m(1-p)^{k-m}\right\}$, $k=m,m+1,m+2,m+3,\dots,$	$F(x\le k)=\sum_{i=m}^{k}p(x=i)$	$\frac{m}{p}$	$\frac{m}{p^2}$
Hypergeometric Distribution	$p(x=k)=\left\{\frac{\binom{M}{k}\binom{N-M}{n-k}}{\binom{N}{n}}\right\}, k=0,1,2,\dots,n$	$F(x\le k)=\sum_{i=n}^{k}p(x=i)$	$\frac{nM}{N}$	$\frac{nM}{N}\left(1-\frac{M}{N}\right)\left(\frac{N-n}{N-1}\right)$

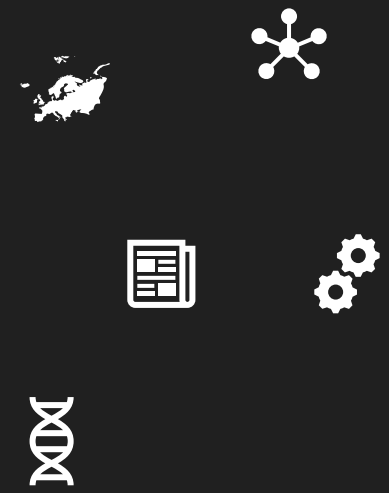
Continues

Dist.	PDF	CDF	E(X)	Var(X)
Uniform	$p(x)=\begin{Bmatrix} \frac{1}{b-a}, a<x<b \\ 0, x<a; x>b \end{Bmatrix}$	$F(x)=\begin{Bmatrix} 0, x<a \\ \frac{x-a}{b-a}, a\le x\le b \\ 1, x>b \end{Bmatrix}$	$\frac{a+b}{2}$	$\frac{(b-a)^2}{12}$
Exponential Dist.	$p(x)=\begin{Bmatrix} \lambda e^{-\lambda x}, x>0 \\ 0, else \end{Bmatrix}$	$F(x)=\{1-e^{-\lambda x}, x>0\}$	$\frac{1}{\lambda}$	$\frac{1}{\lambda^2}$
Normal Dist.	$p(z)=\left\{\frac{1}{\sqrt{2\pi}}e^{-\frac{z^2}{2}}\right\}$	$F(z)=\left\{\frac{1}{\sqrt{2\pi}}\int_{-\infty}^{z}e^{\frac{u^2}{2}}du\right\}$	0	1
Gamma Dist.	$p(x)=\begin{Bmatrix} \frac{\lambda^\alpha x^{\alpha-1}e^{-\lambda x}}{\Gamma(\alpha)}, x>0 \\ 0, else \end{Bmatrix}$	$F(z)=X\ge x$	$\frac{\alpha}{\lambda}$	$\frac{\alpha}{\lambda^2}$
Cauchy Dist.	$p(x)=\left(\frac{1}{\pi\mu\left[1+\frac{x-\mu^2}{\lambda}\right]}\right)$	$F(x)=\frac{1}{\pi}tan^{-1}\left(\frac{x-\mu}{\lambda}\right)+0.5$	∞	∞

Chapter Six

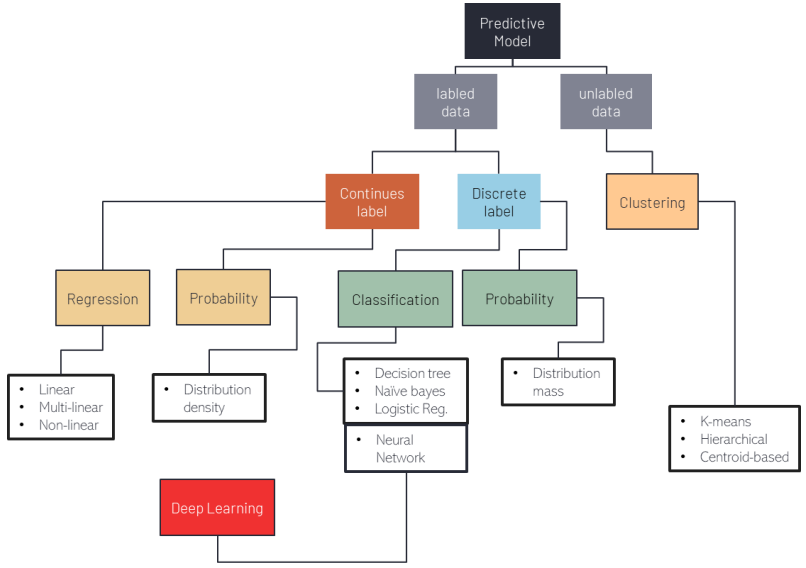
Prediction by RCC

- ✓ Introduction to RCC
- ✓ Prediction by regression
- ✓ Prediction by classification
- ✓ Prediction by clustering



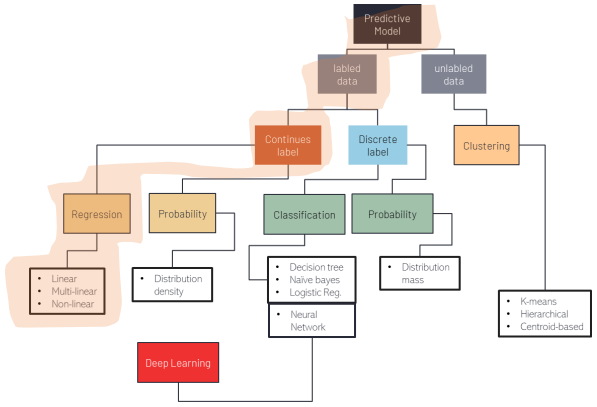
Introduction to RCC

- ✓ Looking at the prediction tree from labeled and unlabeled perspective
- ✓ Sides of Regression, Classification and Clustering
- ✓ The idea of modeling based on the RCC concept
- ✓ Integrating the concept of univariate, bivariate and multivariate before the choice of model



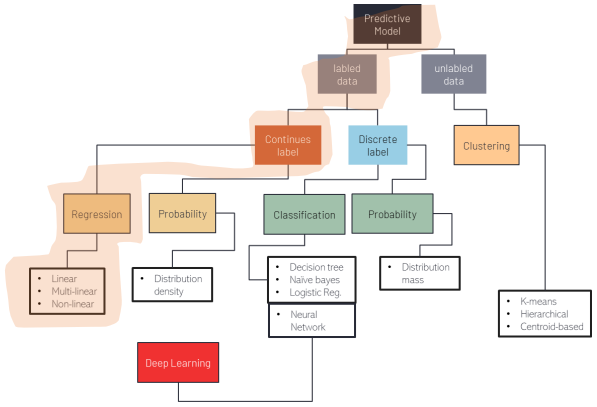
Prediction by Regression

- ✓ The idea of regression
- ✓ The concept of dependency and independency
- ✓ Reflection from mathematics
- ✓ How that can fit all together



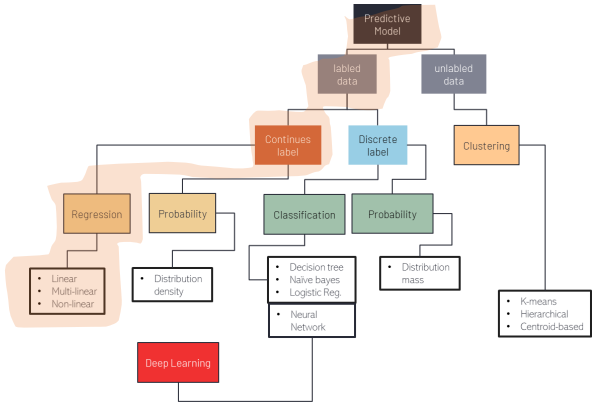
Prediction by Regression

- ✓ Presentation on the concept of SLR
- ✓ The least squares model fitting
- ✓ Finding parameter via optimization
- ✓ The RSS and its minimization problem



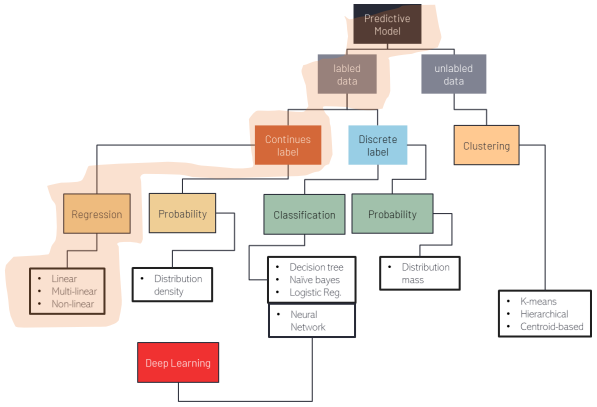
Prediction by Regression

- ✓ The matrix presentation
- ✓ The least square model fitting into the MLR
- ✓ Variants of RSS
- ✓ Goodness of Fit
- ✓ Simple vs multiple



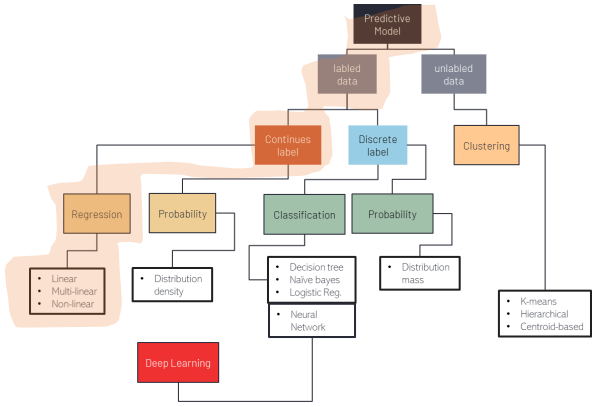
Prediction by Regression

- ✓ The idea of LASSO & Ridge in principle
- ✓ The concept of regulization & penalty
- ✓ The L1 & L2 norms



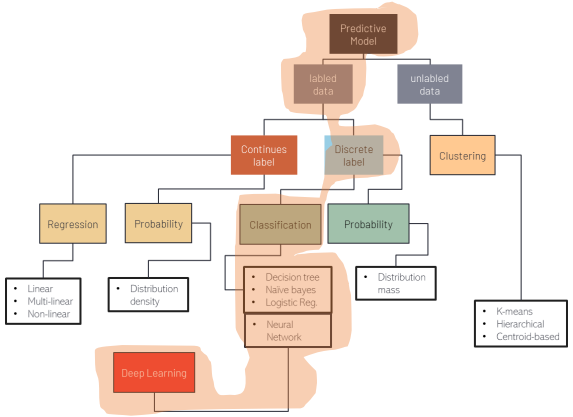
Prediction by Regression

- ✓ Transforming the linear model
- ✓ Fitting the transformed linear model
- ✓ The concept from mathematical perspective
- ✓ Choosing the model order and the polynomial fitting
- ✓ Bias & variance problem & the tradeoff
- ✓ The objective function, the gradient descent & convex



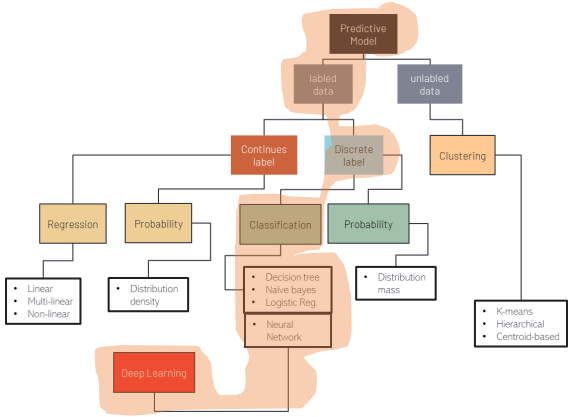
Prediction by Classification

- ✓ The concept of classification
- ✓ The principle from mathematical perspective
- ✓ From multivariate perspective the idea by rows and columns



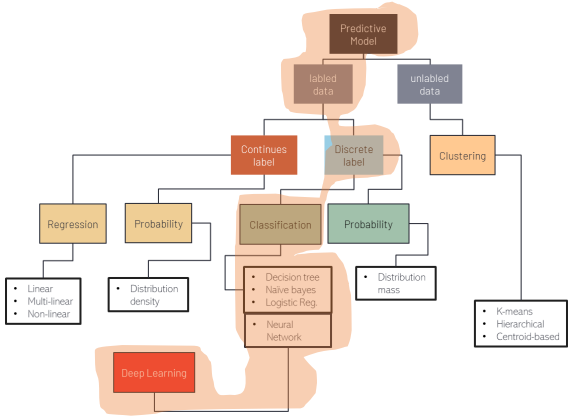
Prediction by Classification

- ✓ Principle of classification
- ✓ Linear vs. nonlinear
- ✓ Hard and soft decision classifiers
- ✓ LR for binary classification
- ✓ Multi class logistic regression aka softmax
- ✓ Logistic regression on transformed features
- ✓ Fitting the model



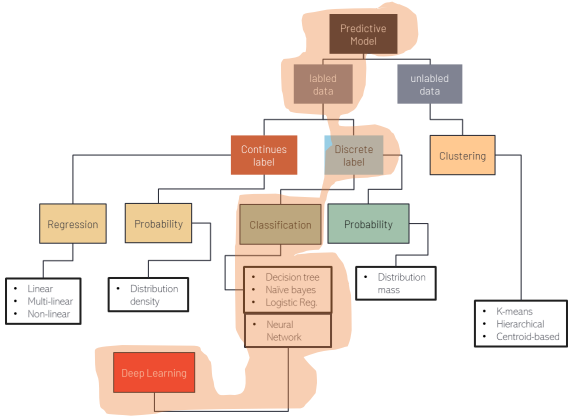
Prediction by Classification

- ✓ Principle of the algorithm
- ✓ Parameter selection
- ✓ Data reduction
- ✓ Feature extraction
- ✓ Decision boundary



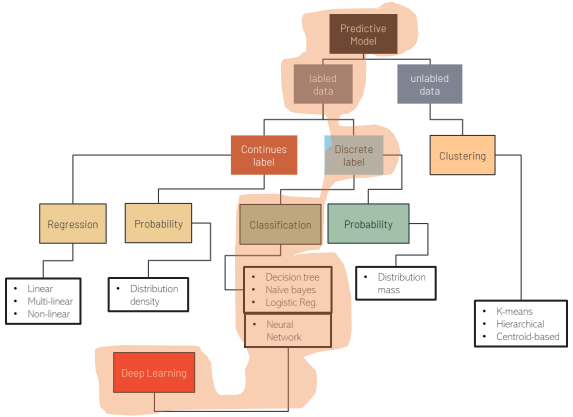
Prediction by Classification

- ✓ Building blook
- ✓ Decision tree elements
- ✓ Decision rules
- ✓ implementation



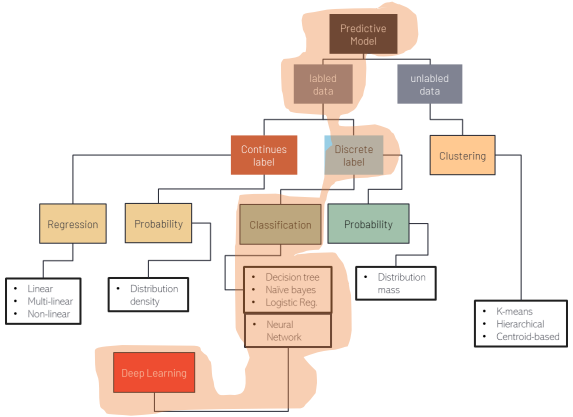
Prediction by Classification

- ✓ The classifier
- ✓ Linear and the nonlinear kernel
- ✓ The computation
- ✓ The implementation



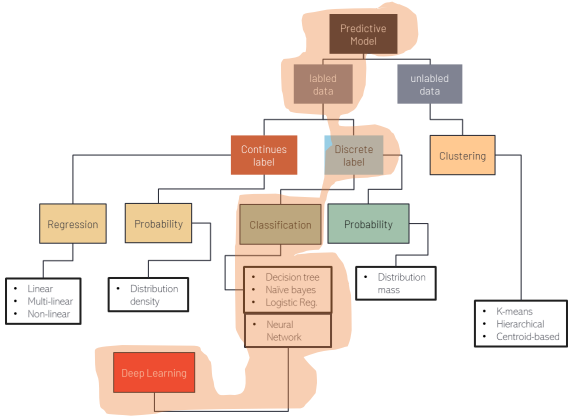
Prediction by Classification

- ✓ Just refresh from the probabilistic principle
- ✓ Constructing the classifier
- ✓ The decision rule
- ✓ Implementation



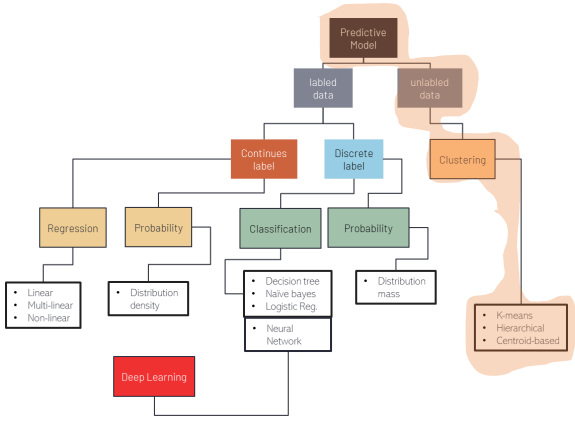
Prediction by Classification

- ✓ The principle of Neural Network
- ✓ The problem from mathematical perspective
- ✓ The idea of DL
- ✓ The implementation



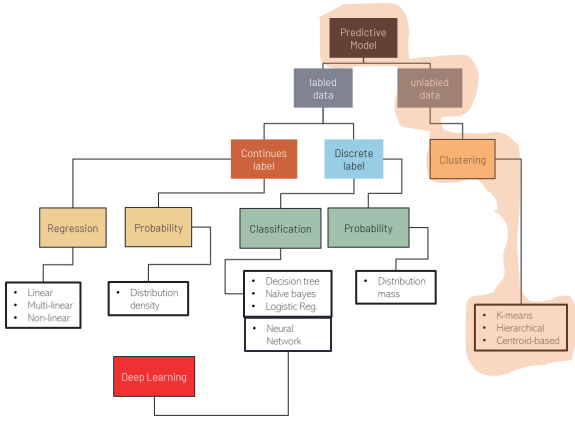
Prediction by clustering

- ✓ The principle of clustering
- ✓ Visual presentation
- ✓ Mathematical principle



Prediction by clustering

- ✓ Initialization method
- ✓ Steps of implementation
- ✓ Principle for the algorithm



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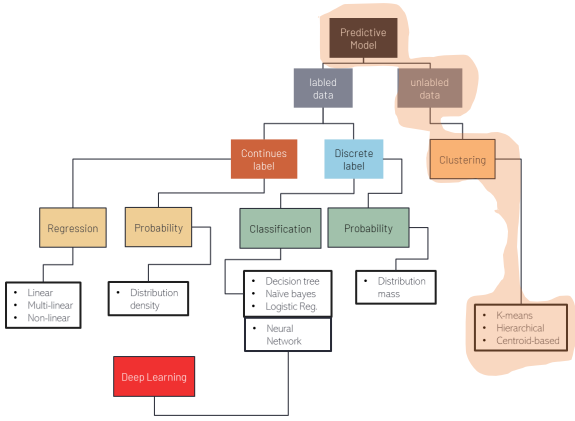
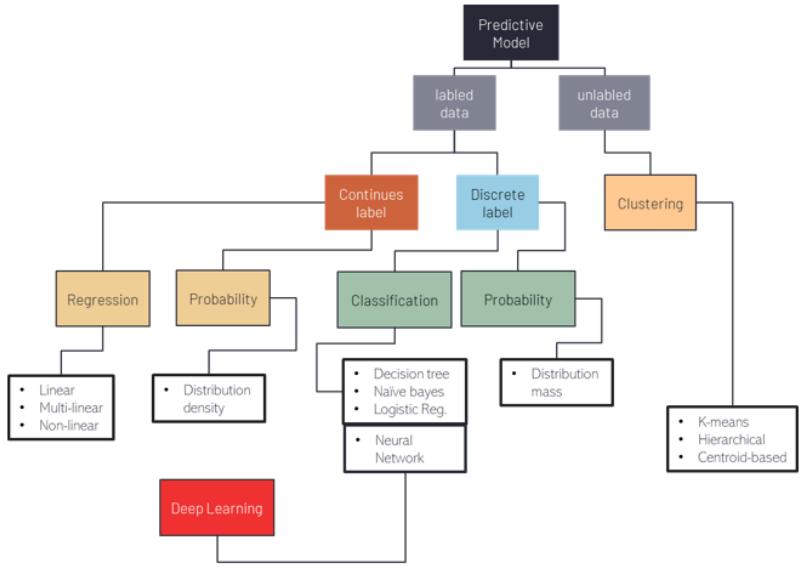


Feature Engineering

✓ Data preparation

✓ Dimension reduction

no	55	no	nurse	pain	40s	133000
no	71	no	admin	beta blockers, pain	20s	34000
yes	89	yes	nurse	beta blockers	50s	40000
no	67	no	doctor	none	50s	120000



Book Appendix

Python from the start to the end

- ✓ Introduction
- ✓ Setup environment
- ✓ Informal introduction to python
- ✓ Control flow tool kit
- ✓ Data structure
- ✓ Modules
- ✓ Input & output
- ✓ Errors & exceptions
- ✓ Classes
- ✓ Tour of the standard libraries
- ✓ Development tips
- ✓ NumPy package
- ✓ Pandas package
- ✓ Tensor Flow basics