Calculus

For Machine Learning

What is Calculus

- Calculus is the study of how things change.
- It provides a framework for modeling systems in which there is change, and a way to deduce the predictions of such models.

Calculus For ML

- Calculus is an important field in mathematics and it plays an integral role in many machine learning algorithms.
- If you want to understand what's going on under the hood in your machine learning work as a data scientist, you'll need to have a solid grasp of the fundamentals of calculus.

http://www-math.mit.edu/~djk/calculus_beginners/chapter00/section02.html

Functions

An expression which specify the relationship between two variables, where one is independent another is dependent variable.

Function Notation:

For Example:

F(x)=4x+3
Suppose, x=2

Y=F(2)=4(2)+3
Y=F(2)=8+3
Y=F(2)=11

Linear Functions

- A function is said to be Linear if it produces a graph in a straight line representing on rectangular coordinate Plane.
- The equation of any linear function can be written as $y = ax + b$ where a and b are any two constants.
- Simplest form of linear function is $y = ax$, means y is directly proportional to x.

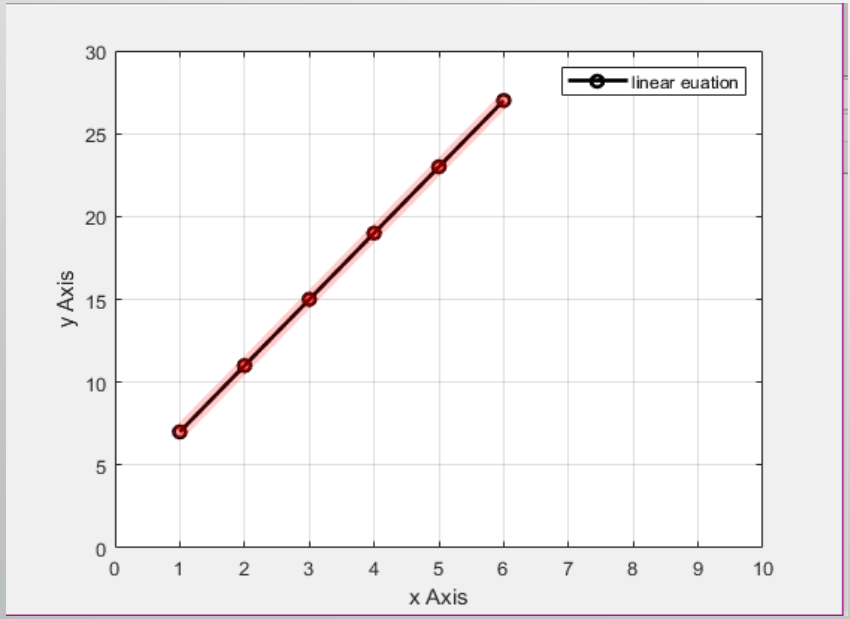
Linear Functions cont.…

Taking a Linear Equation F(x)=4x+3

Solution table:

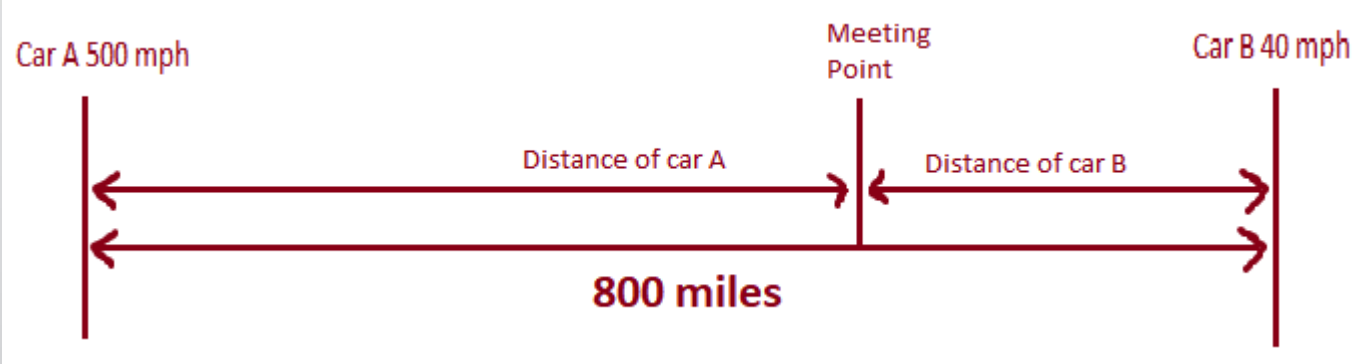
Values of x	1	2	3	4	5	6
Values of y	7	11	15	19	23	27

Solution graph:



Real life Example of Linear Functions

There are two cars moving towards each other and are 800 miles apart. One car is moving at a speed of 500 mph and the other is moving at 40 mph. Assuming that the cars start moving at the same time how long does it take for the two cars to meet?



Here is the linear equation in two separate forms.

The distance of Car A + Distance of Car B =800

Rate of Car A * Time of Car A + Rate of Car B * Time of Car B = 800

Real life Example of Linear Functions cont..

We know that Car A travels at 500 mph for t hours and that Car B travels at 40 mph for t hours as well. Plugging these into the linear equation and solving it gives us,

$500t+40t=800$

$540t=600$

$t=800/540$

$t=1.48$ hrs.

So, the Cars travel 1.48 hrs. to meet

Non Linear Functions

- Nonlinear functions are functions that are not linear by definition.

- A nonlinear function's graph is not a straight line.

- Non Linear function Includes:

- A quadratic functions
- A rational functions
- An exponential and logarithmic functions.

https://www.math.uh.edu/~bekki/NonlinearFunctions.pdf

Quadratic Functions

- A polynomial function of degree 2, is known as a quadratic function.
- The general form of a quadratic function:

$$f(x) = ax^2 + bx + c$$

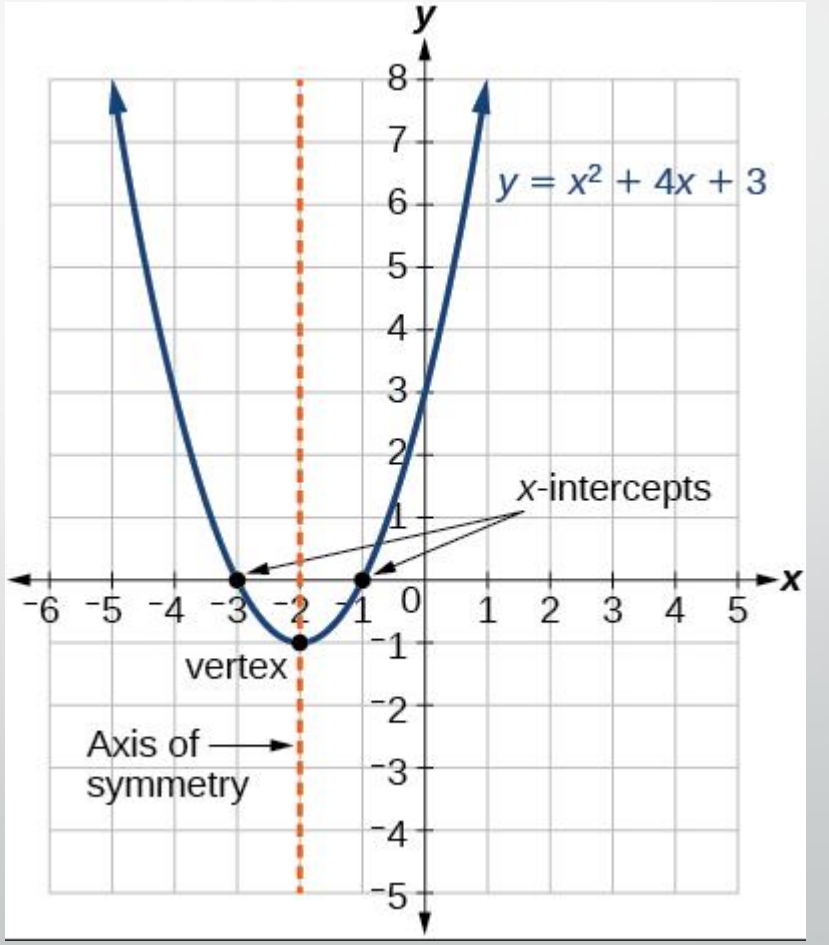
where a, b, and c are real numbers and a≠0.

- The vertex form of a quadratic function:

$$f(x) = a(x-h)^2 + k$$

- The axis of symmetry is:

$$x = -\frac{b}{2a}$$



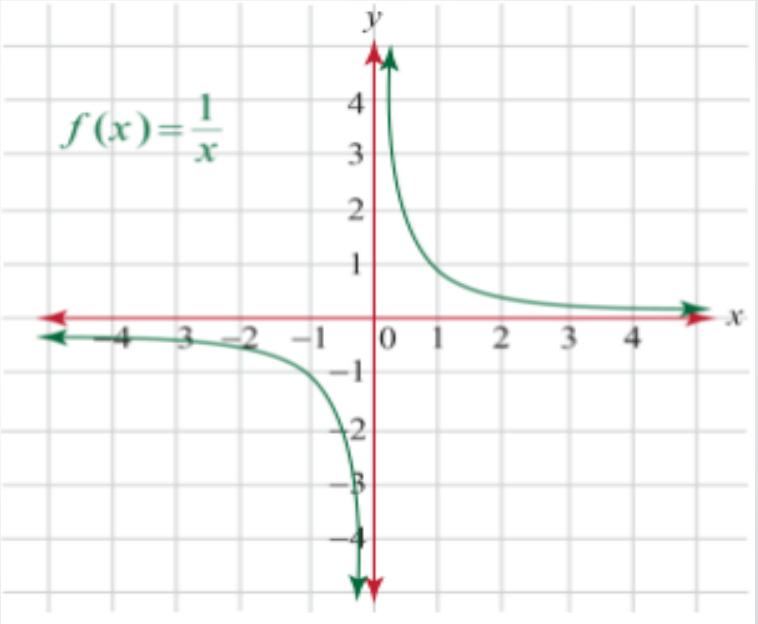
https://math.libretexts.org/Courses/Western_Connecticut_State_University/Draft_Custom_Version_MAT_131_College_Algebra/05%3A_Polynomial_and_Rational_Functions/5.01%3A_Quadratic_Functions

Rational Functions

- A rational function is simply the ratio of polynomials.
- The general form of a rational function:

$$\frac{p(x)}{q(x)}$$

where p(x) and q(x) are polynomials and $q(x) \neq 0$



Values of x	-4	-2	-1	4	2	1
Values of f(x)	-0.25	-0.5	-1	0.25	0.5	1

https://www.cuemath.com/

Logarithmic Functions

- The logarithm is an exponent or power to which a base must be raised to obtain a given number.
- Mathematically, logarithms are expressed as, m is the logarithm of n to the base b if $b^m = n$, which can also be written as $m = \log_b n$.