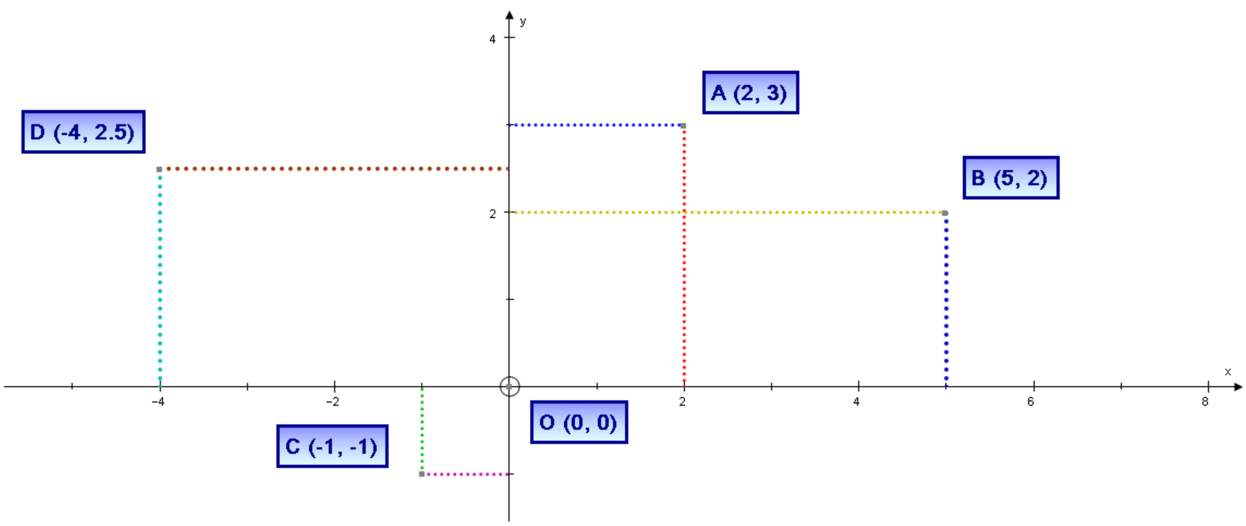
Cartesian System

Cartesian is related to the French mathematician and philosopher René Descartes (Latin: *Cartesius*), who, among other things, worked to merge algebra and Euclidean geometry. This work was influential in the development of analytic geometry, calculus, and cartography.

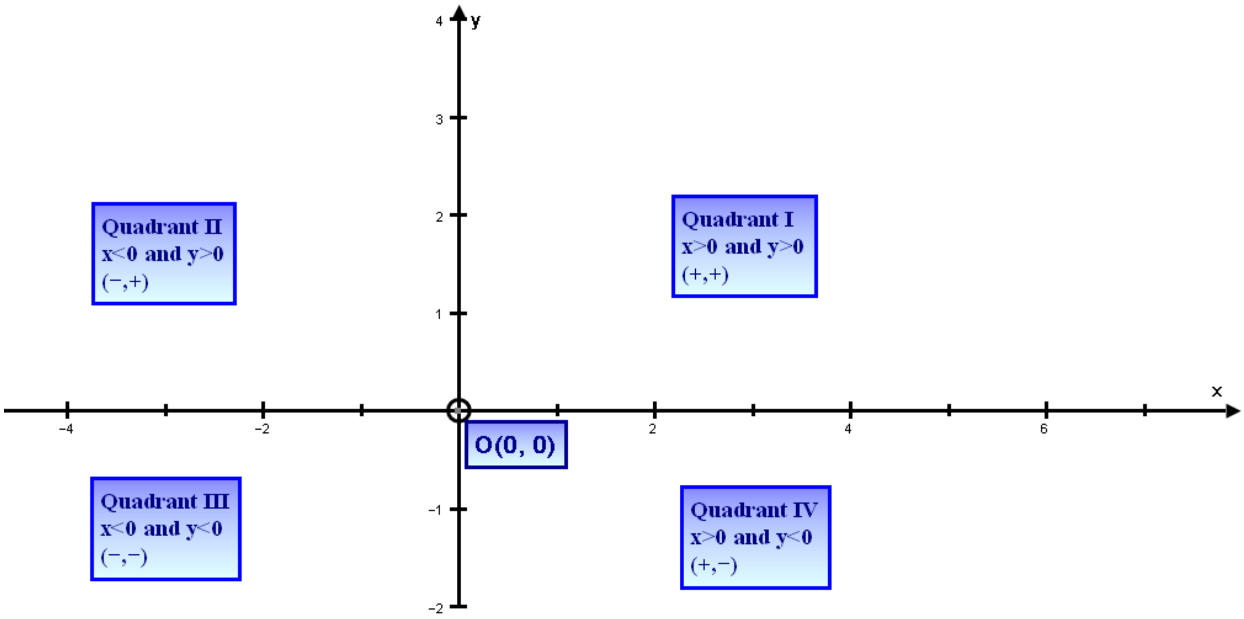
The idea of this system was developed in 1637 in two writings by Descartes. In part two of his Discourse on Method, Descartes introduces the new idea of specifying the position of a point or object on a surface, using two intersecting axes as measuring guides. In "*La Géométrie*", he further explores the above-mentioned concepts.

A Cartesian coordinate system in two dimensions is commonly defined by two axes, at right angles to each other, forming a plane (a *xy*-plane). The horizontal axis is normally labeled *x*, and the vertical axis is normally labeled *y*. The axes are commonly defined as mutually orthogonal to each other (each at a right angle to the other). All the points in a Cartesian coordinate system taken together form a so-called Cartesian plane. Equations that use the Cartesian coordinate system are called Cartesian equations.

The point of intersection, where the axes meet, is called the ***origin*** normally labeled ***O***. The *x* and *y* axes define a plane that is referred to as the *xy* plane. Given each axis, choose a unit length, and mark off each unit along the axis, forming a grid. To specify a particular point on a two dimensional coordinate system, indicate the ***x* unit first (abscissa)**, followed by the ***y* unit (ordinate)** in the form (*x*,*y*), an ordered pair.

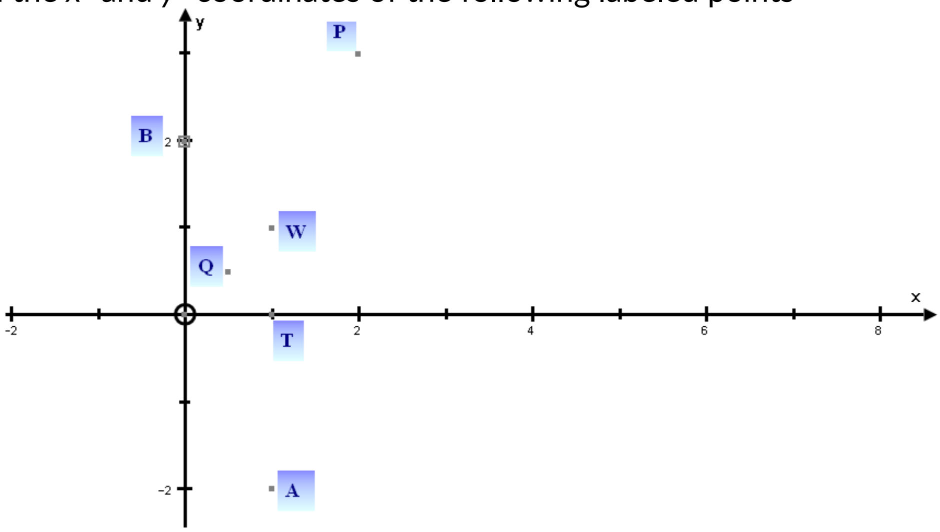


The intersection of the two axes creates four regions, called quadrants, indicated by the Roman numerals I (+,+), II (−,+), III (−,−), and IV (+,−). Conventionally, the quadrants are labeled counter-clockwise starting from the upper right ("northeast") quadrant. In the first quadrant, both coordinates are positive, in the second quadrant *x*-coordinates are negative and *y*-coordinates positive, in the third quadrant both coordinates are negative and in the fourth quadrant, *x*-coordinates are positive and *y*-coordinates negative.



Note: The arrows on the axes indicate that they extend forever in their respective directions (i.e. infinitely).

Example 1: Find the *x*- and *y*- coordinates of the following labeled points



Point A corresponds to 1 on the *x*-axis and -2 on the *y*-axis, then A's ordered pair is (1, -2).

Point B corresponds to 0 on the *x*-axis and 2 on the *y*-axis, then B's ordered pair is (0, 2).

Point Q corresponds to 0.5 on the *x*-axis and 0.5 on the *y*-axis, then Q's ordered pair is (0.5, 0.5).

Point P corresponds to 2 on the *x*-axis and 3 on the *y*-axis, then P's ordered pair is (2, 3).

Point T corresponds to 1 on the *x*-axis and 0 on the *y*-axis, then T's ordered pair is (1, 0).

Point W corresponds to 1 on the *x*-axis and 1 on the *y*-axis, then W's ordered pair is (1, 1).

Definition 1: The *x*-intercept is where the graph crosses the *x*-axis.

What is the *y*-value of the *x*-intercept? No matter where you are on the *x*-axis, *y*'s value is 0, that is a constant.

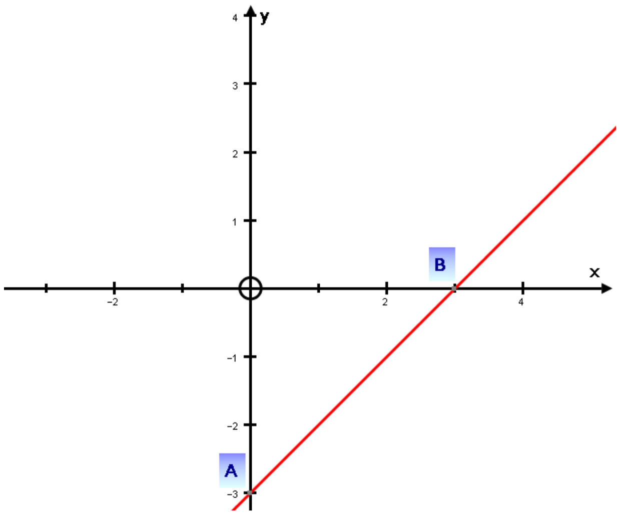
Point A is the x-intercept $\Rightarrow A(x,0)$

Definition 2: The *y*-intercept is where the graph crosses the *y*-axis.

What is the *x*-value of the *y*-intercept? No matter where you are on the *y*-axis, *x*'s value is 0, that is a constant.

Point B is the y-intercept $\Rightarrow B(0,y)$

Below is an illustration of a graph which highlights the *x* and *y* intercepts:



$B(3,0)$ is the x-intercept and $A(0,-3)$ is the y-intercept.

Remark:

Keep in mind that the *x*- and *y*- intercepts are two separate points. There is only one point that can be both an *x*- and *y*- intercepts at the same time; do you know what point is that?

It is the origin (0, 0)