BASIC GEOMETRY

Link to ISRO Education portal for Videos on Maths on Coordinate Geometry

"There is no royal road to mathematics" .
Euclid,- the greatest of Greek geometers.

- Mathematics is a Perfect Science
- Pure Mathematics is a religion

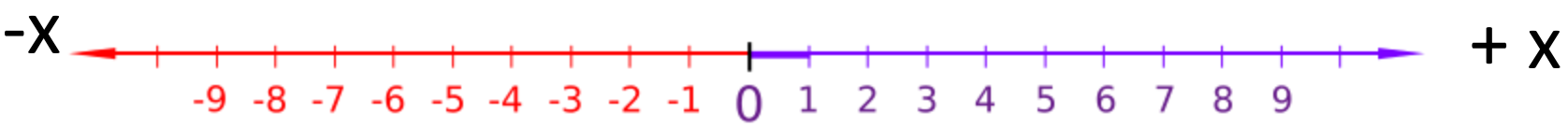
2nd Dimension of Numbers is studied in Geometry

- Numbers can be classified as:
- a) Concrete numbers : 7, 5+i (Arithmetic)
- b) Generalised numbers : a, c, p (Geometry)
- c) Unknown numbers: x, y, z, (Algebra)
- d) Variable numbers : y = f(x) ;

z= 5y + 3x (Economics)

One (1) can be used as a coefficient attached to any real number 38i, i5, i38,

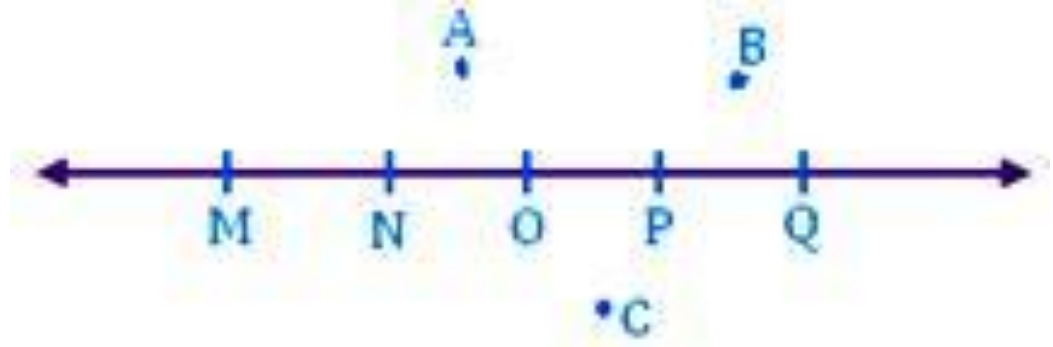
Number Line in horizontal position is the X axis on which Integers of real numbers – positive and negative - exist.

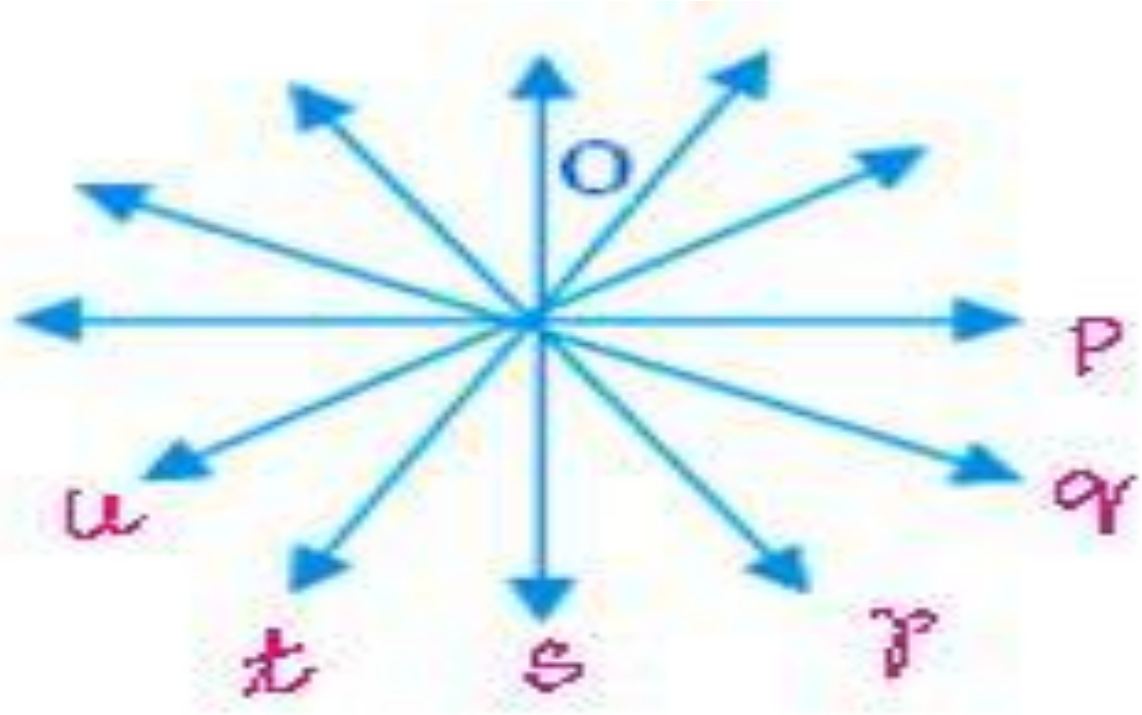


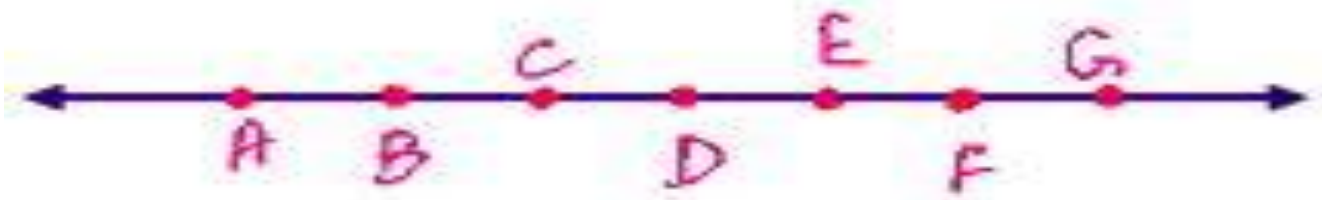
The Vertical Number Line is the Y axis on which all the Imaginary Number exist : both Positive and Negative imaginary numbers. They together create the 'Number Plane' .

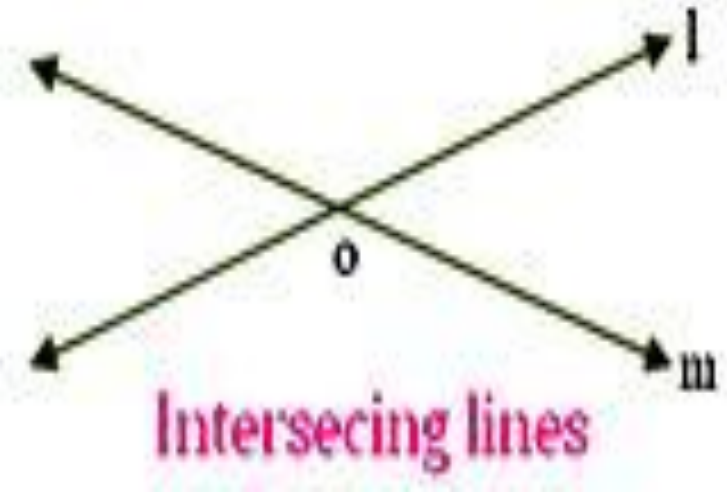
Points have a position, but no size or dimension.

Points M to Q are collinear points. ABC are non-collinear. Lines p to u are concurrent lines as they pass through the same point O.



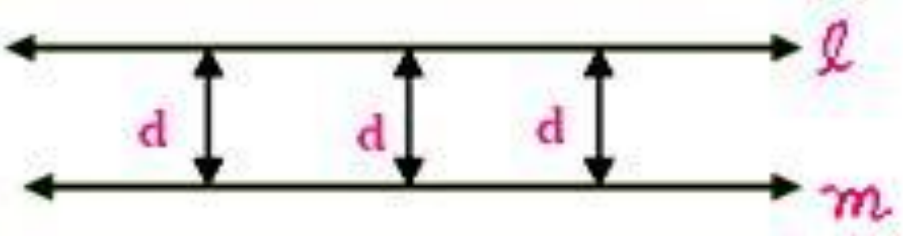






Intersecing lines

Parallel lines



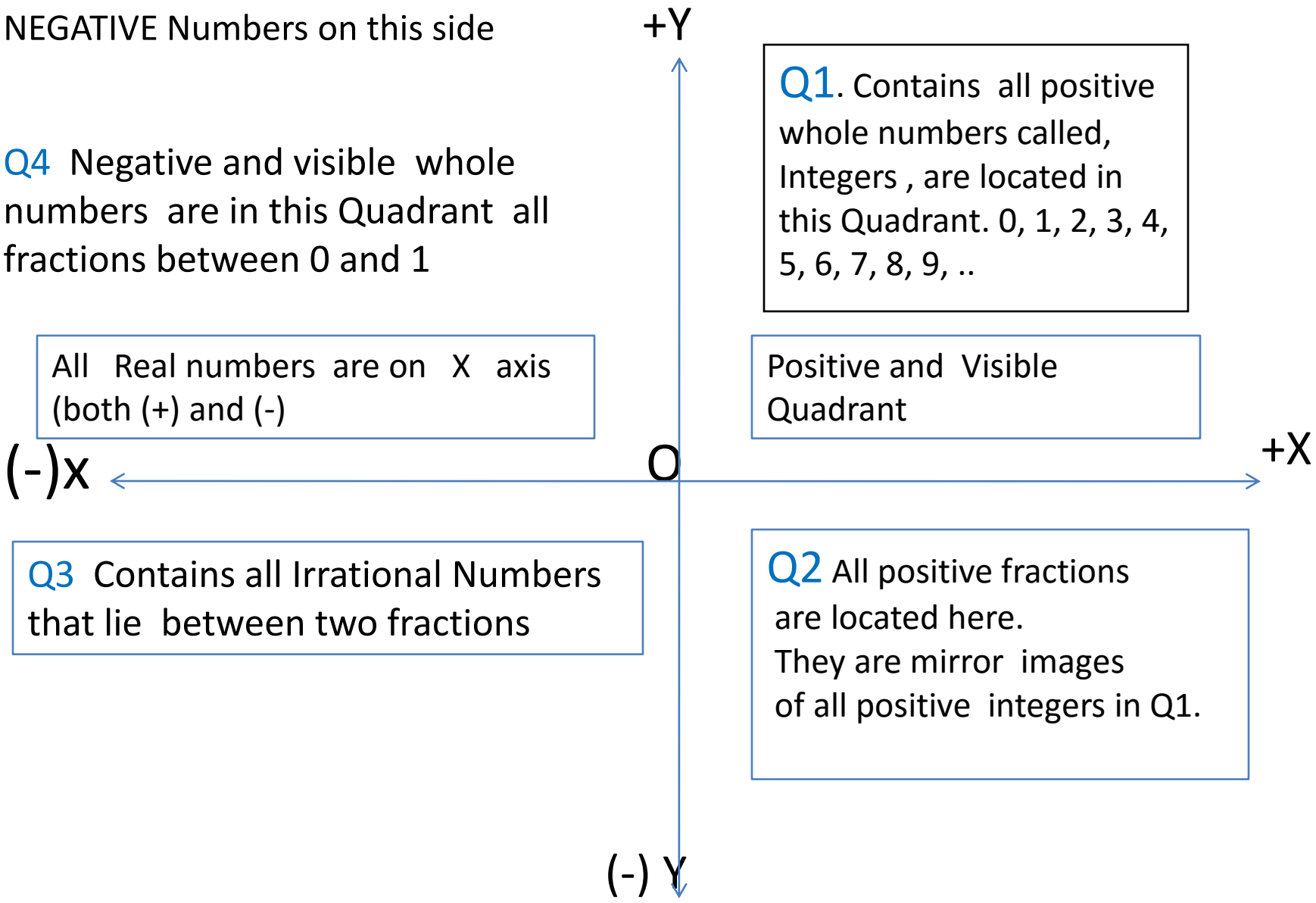
Infinite number of points lie on a plane. Two lines either intersect, or are parallel. The distance between parallel lines is constant throughout.

The Number Line and Integers

- In basic mathematics, a number line is a picture of a straight line on which every point is assumed to correspond to a real and every real number to a point.
- Although this Number Line Plane only shows the integers from –9 to 9, the line includes all real numbers, continuing forever in each direction.
- All fractions lie between 0 and 1. The smallest of small fraction is bigger than zero.

The Number Plane – Q1 onwards clockwise

NEGATIVE Numbers on this side



Q4 Negative and visible whole numbers are in this Quadrant all fractions between 0 and 1

Q1. Contains all positive whole numbers called, Integers , are located in this Quadrant. 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, ..

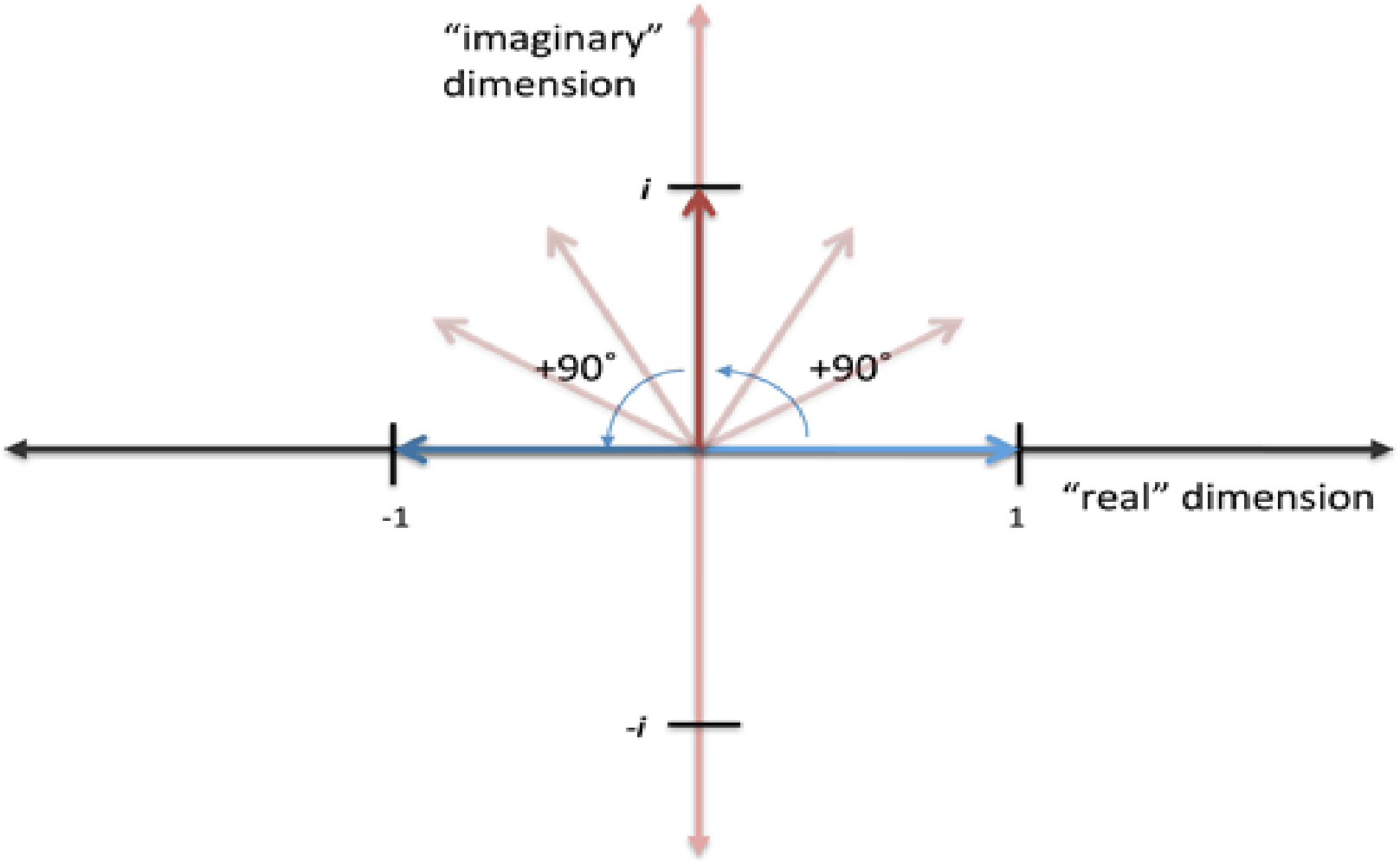
All Real numbers are on X axis (both (+) and (-)

Positive and Visible Quadrant

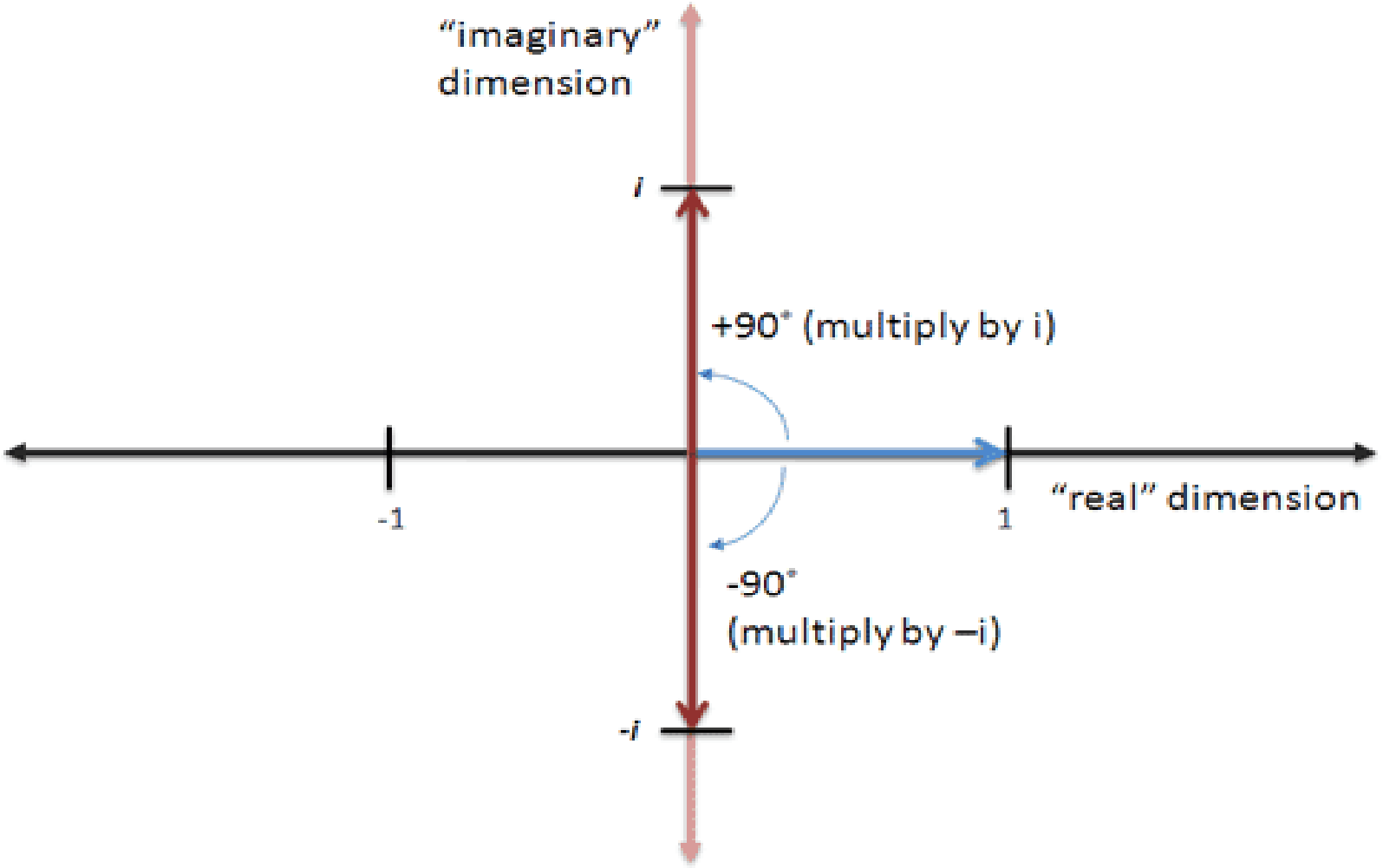
Q3 Contains all Irrational Numbers that lie between two fractions

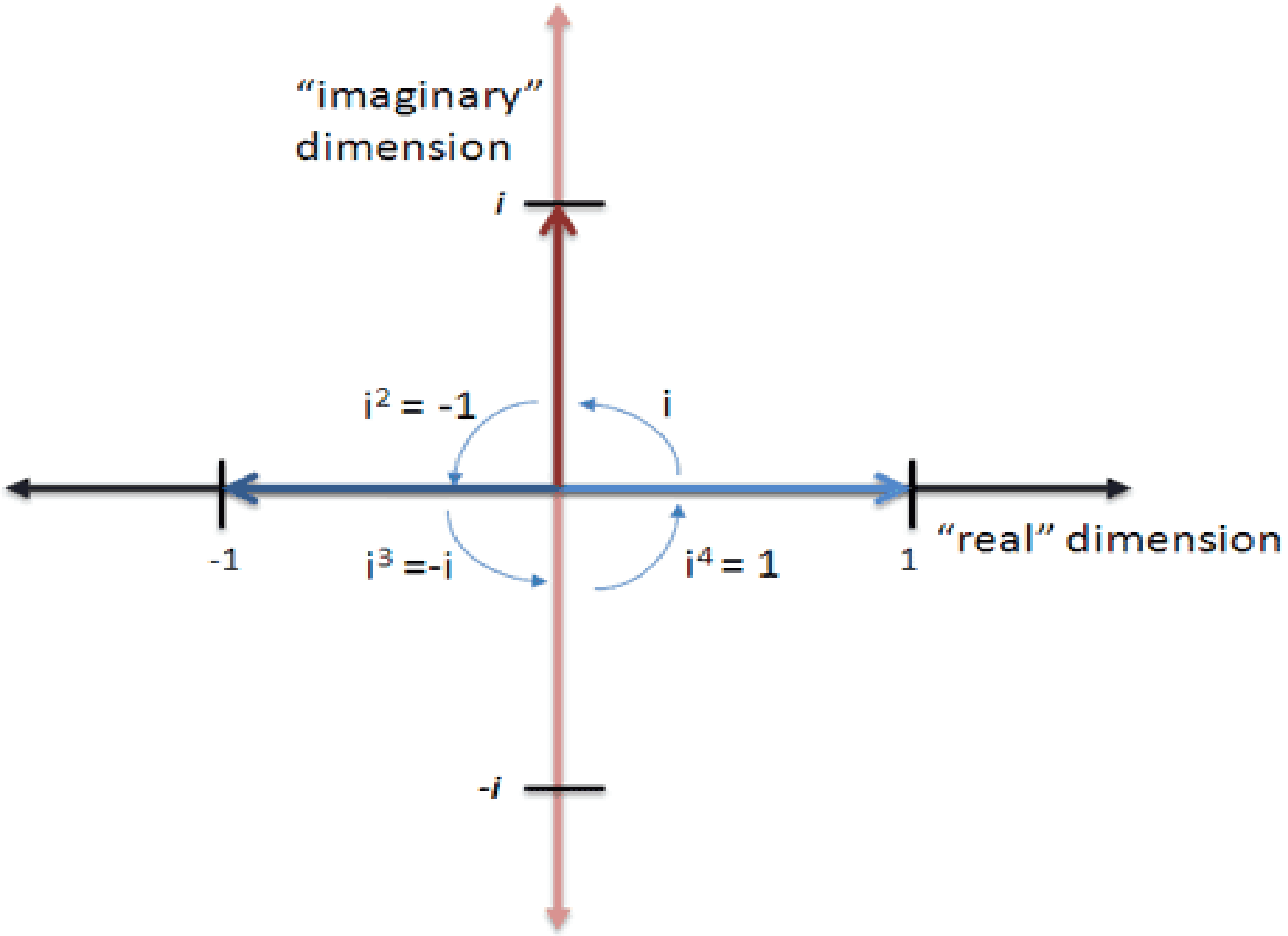
Q2 All positive fractions are located here.
They are mirror images of all positive integers in Q1.

Rotate 1 to -1

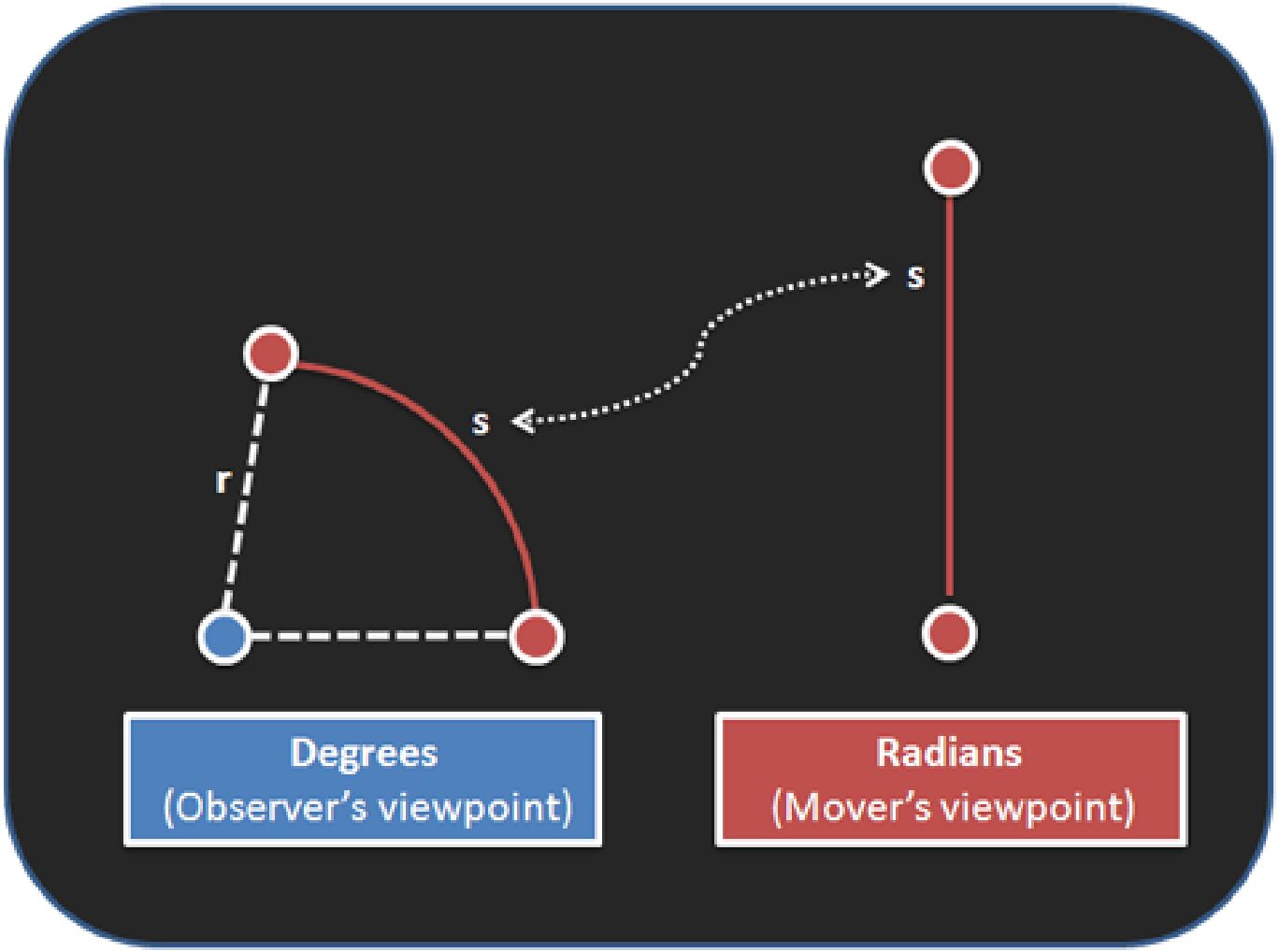


Positive & Negative Rotation



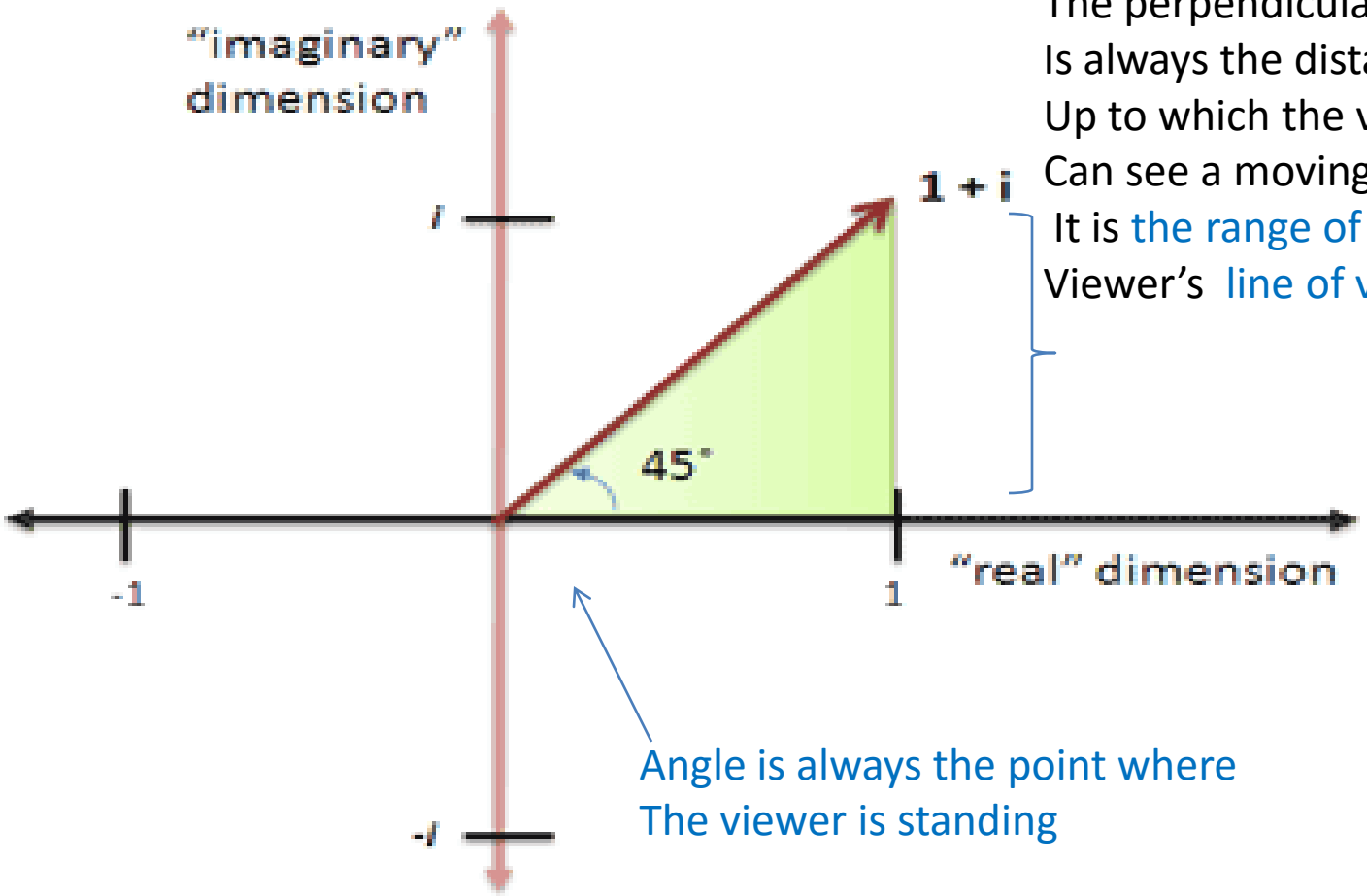


Degrees vs. Radians



Small i helps to multiply to get to the new angle as an output. It is a Multidimensional number and help In calculation of Space and Geography

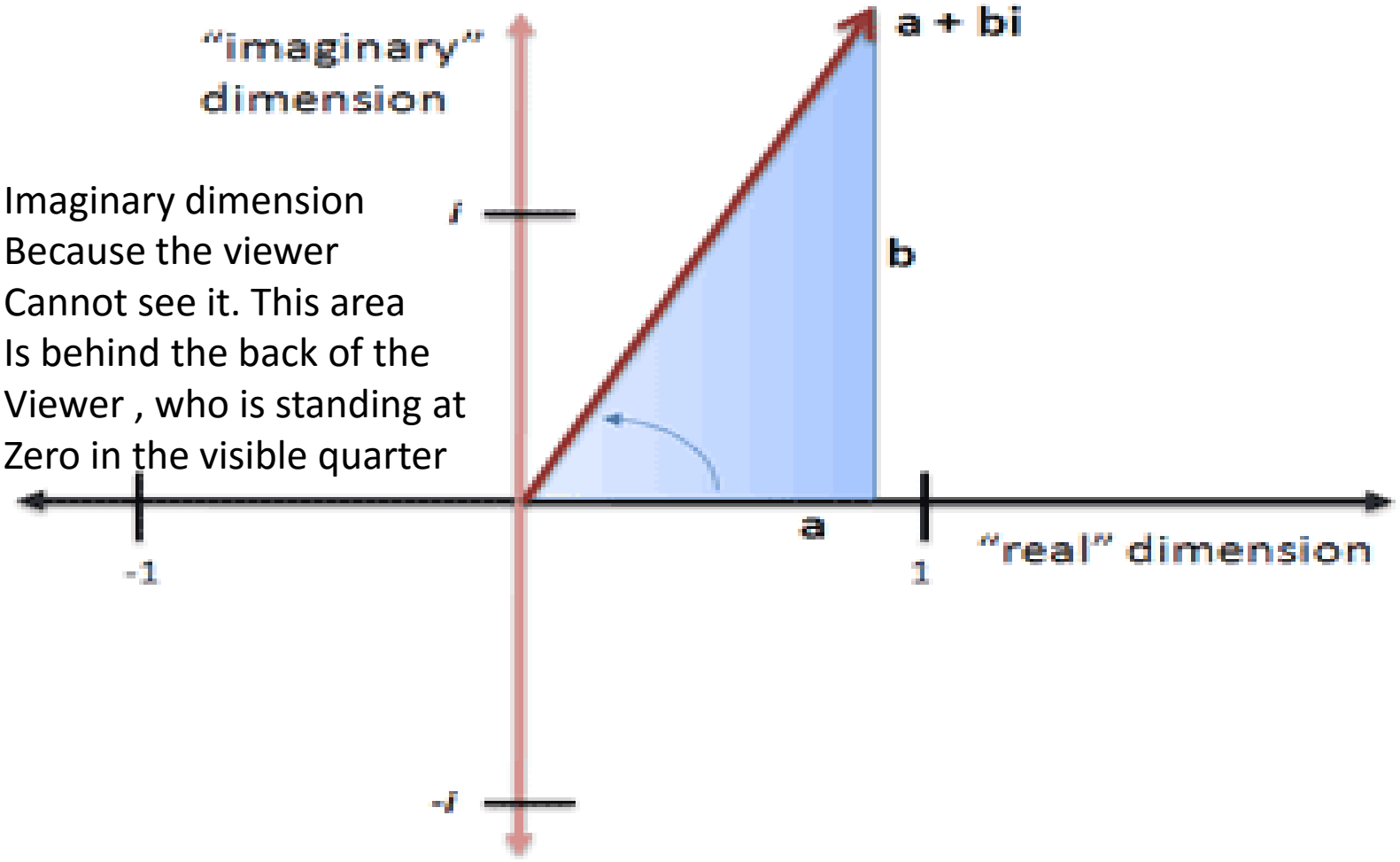
$1 + i$



The perpendicular
Is always the distance
Up to which the viewer
Can see a moving object
It is the range of the
Viewer's line of vision

Angle is always the point where
The viewer is standing

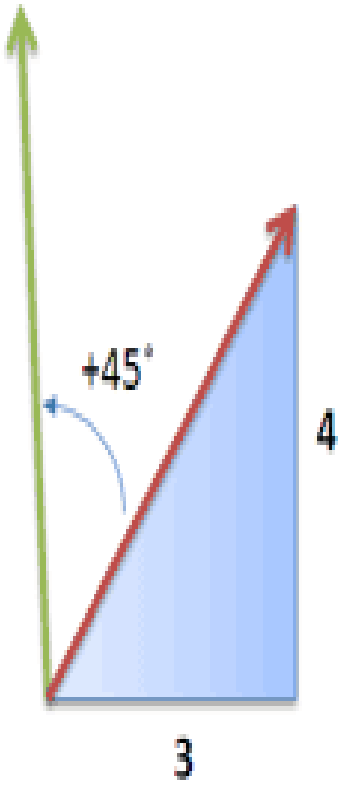
a + bi



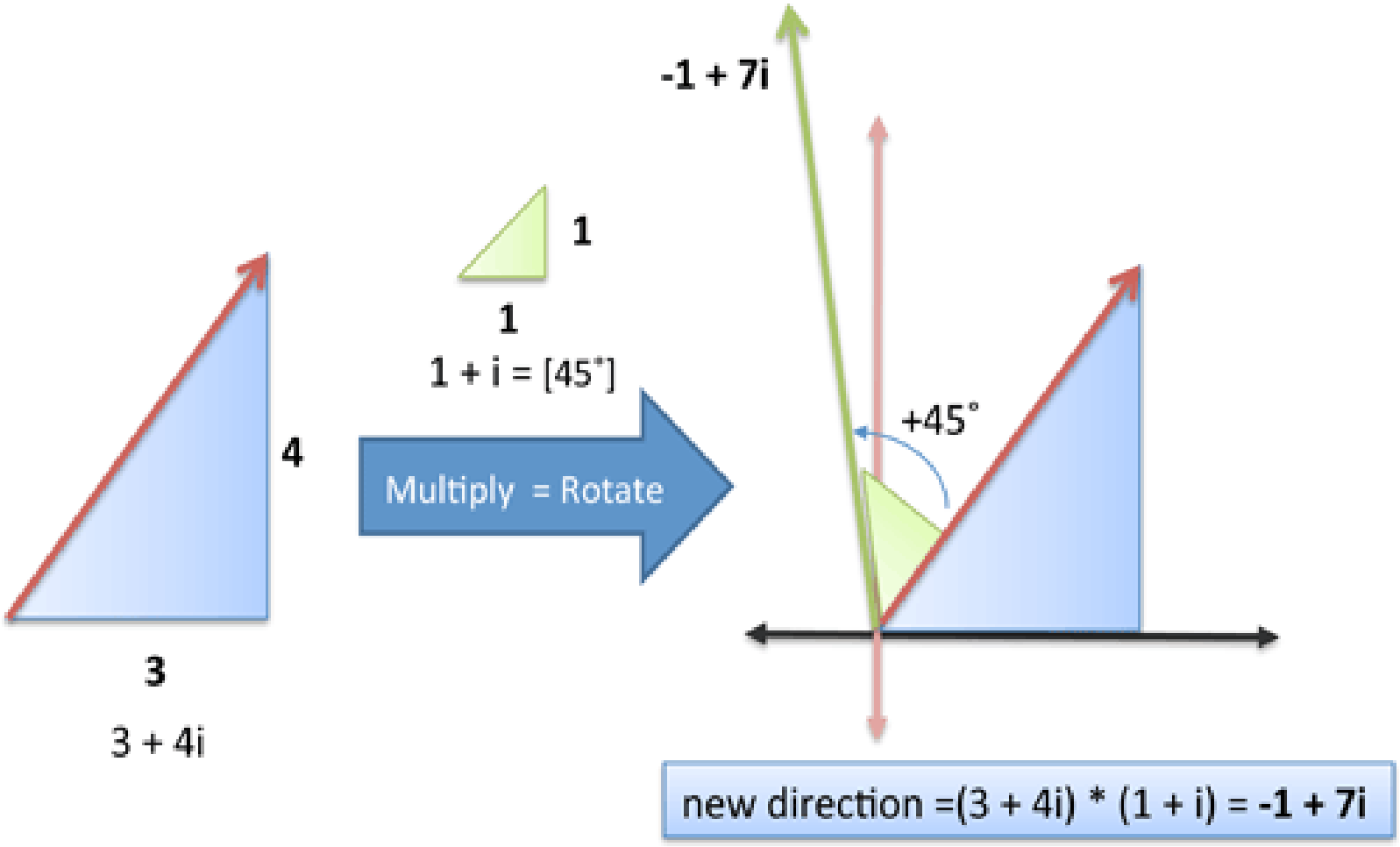
Imaginary dimension
Because the viewer
Cannot see it. This area
Is behind the back of the
Viewer , who is standing at
Zero in the visible quarter

Find the heading

Here the viewer is
Moving anti clockwise
Thereby changing
The angle of his vision
Towards his left hand
side



Applying Complex Numbers



Small (i) Is a multi dimensional number. It helps in thinking about numbers in three or four dimensions and is therefore, very useful in study of Space and for Geography .

Refers to graph on last slide.

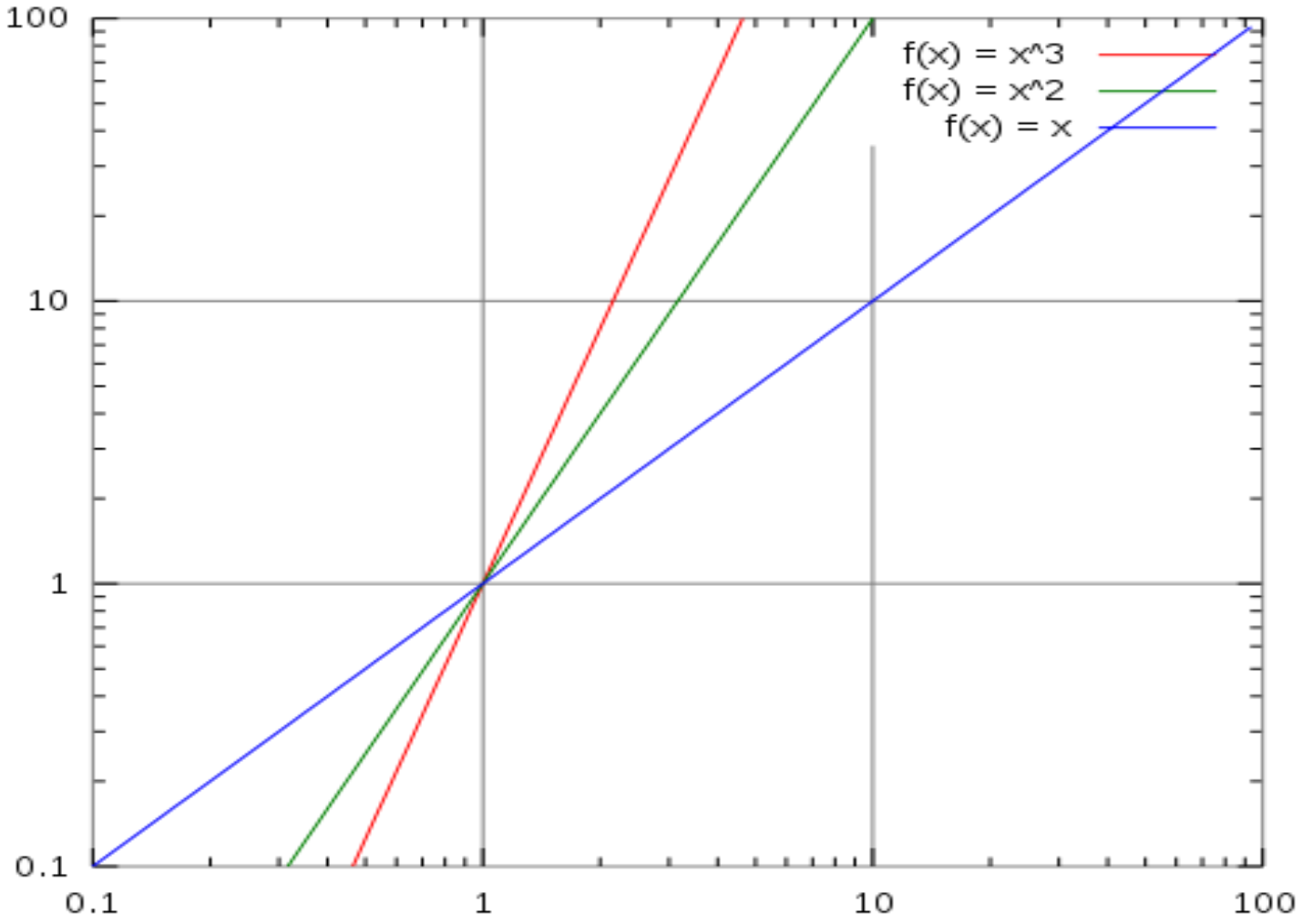
- Here's the idea:
- Original heading: 3 units East, 4 units North = 3 + 4i
- Rotate counter-clockwise by 45 degrees = multiply by 1 + i
- If we multiply them together we get as worked out
- So our new orientation is 1 unit West (-1 East), and 7 units North, which you could draw out

$$(3+4i)\cdot(1+i) = 3+3i+4i+4i^2$$

$$= 3+7i \quad +4(-1)$$

$$= -1+7i$$

A log-log plot of $y = x$ (blue), $y = x2$ (green), and $y = x3$ (red). Note the logarithmic scale markings on each of the axes, and that the log x and log y axes (where the logarithms are 0) are where x and y themselves are 1.



Cartesian coordinate system, and any point in the Cartesian plane denotes the values of a pair of real numbers.

- One real number line can be drawn horizontally to denote potential values of one real number, commonly called *x*,
- Another real number line can be drawn vertically to denote potential values of another real number, commonly called *y*.
- the Cartesian coordinate system can itself be extended by visualizing a third number line "coming out of the screen (or page)", measuring a third variable called *z*.

Fun Fact	Negative Numbers (-x)	Complex Numbers (a +bi)
Invented to answer	"What is 3 – 4?"	"What is sqrt(-1)?"
Strange because…	*How can you have less than nothing?*	*How can you take the square root of less than nothing?*
Intuitive meaning	"Opposite"	"Rotation"
Considered absurd until	1700s	Today ☺
Multiplication cycle [& general pattern]	`1, -1, 1, -1…` `X, -X, X, -X…`	`1, i, -1, -i…` `X, Y, -X, -Y…`
Use in coordinates	Go backwards from origin	Rotate around origin
Measure size with	Absolute value $\sqrt{(-x)^2}$	Pythagorean Theorem $\sqrt{a^2+b^2}$

Degrees are rotational measures from observer's viewpoint. This formula converts angles into radiant to know the linear speed.

- Degrees measure angles by how far we tilted our heads.
- Radians measure angles by distance travelled.
- Angle in radians (theta) is arc length (s) divided by radius (r).

$$Radian = \frac{distance\ \ traveled}{radius}$$

$$\theta = \frac{s}{r}$$

Graphical Method for solving Equation

- Step 1. Covert the equation into a function of x
- Step 2. Give x a range of values differing by equal steps and find the corresponding value of y
- Step 3. Plot points on the curve
- Step 4. Decrease near the points where curve is near the x axis

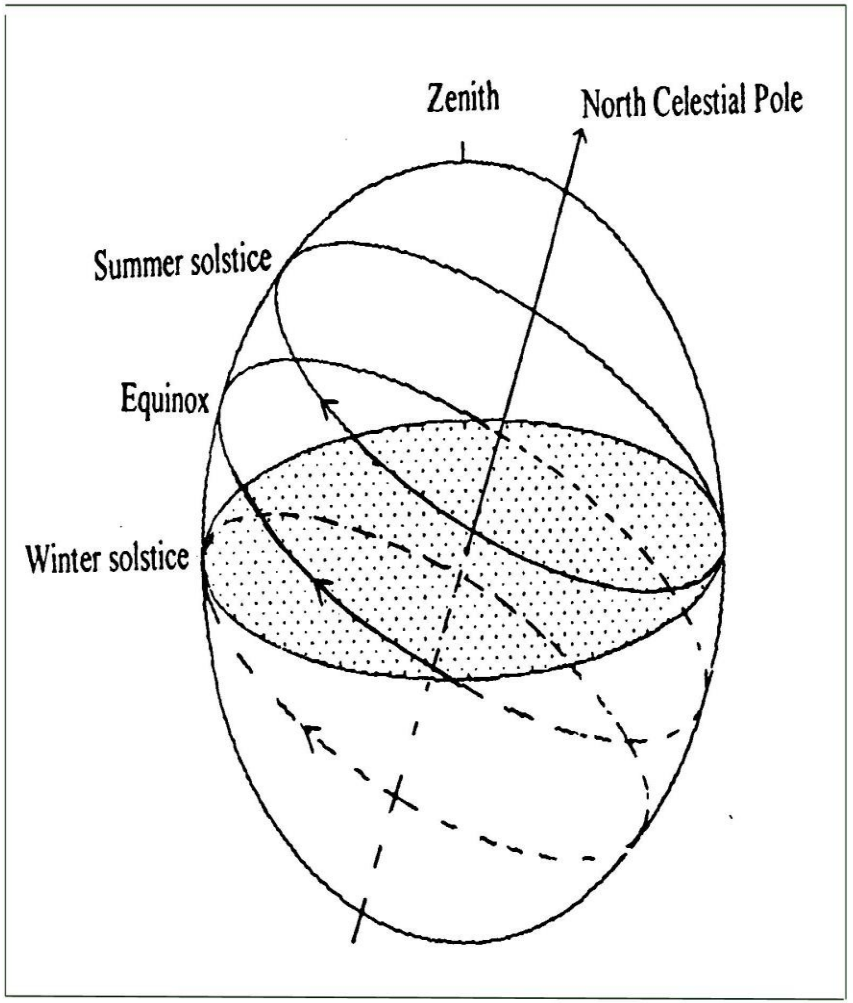
Scope of Coordinated Geometry

- A circle is a curve of the second degree

- Problems of finding intersections of two curves
- Finding equations of ‘tangent’ to curves
- A function expresses a law, a physical relationship between two quantities.

Placement of real and imaginary numbers

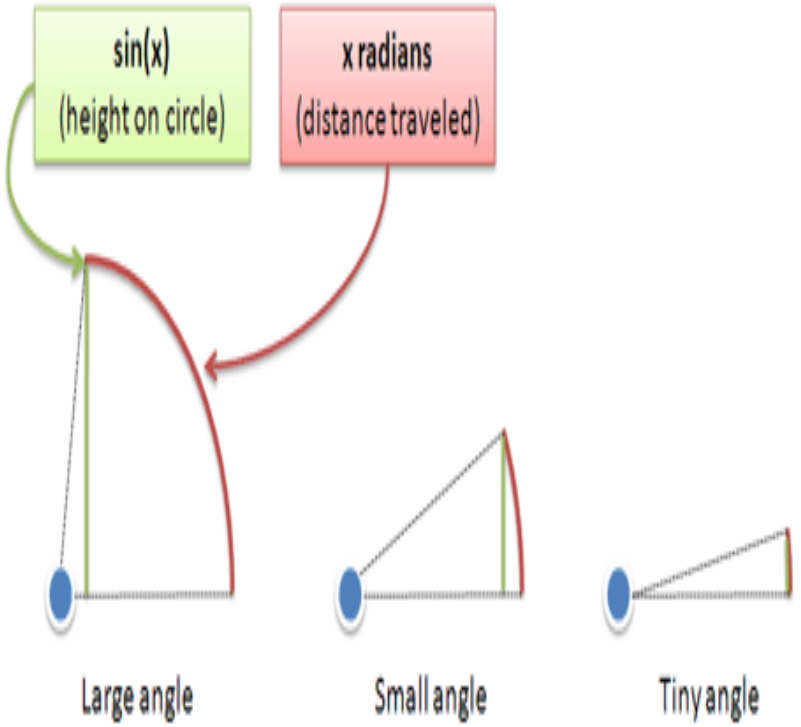
- Positive numbers are closer to the viewer's eyes than the screen is.
- Negative numbers are "behind the screen";
- Larger number are farther from the screen.
- Then any point in the three-dimensional space that we live in represents the values of a trio of real numbers.
- 3D numbers can be indicated by x, y, z.



Angles

- x is how far you travelled along a circle
- sin(x) is how high on the circle you are.
- So sin(x)/x is the ratio of how high you are to how far you've gone: the amount of energy that went in an "upward" direction.
- If you move vertically, that ratio is 100%. If you move horizontally, that ratio is 0%.

sin(x)/x



In Sum

Geometry studies the 2nd Dimension of Numbers.

The generalised numbers a, b, c, that are visible or that can be imagined, in the space around the viewer, on any point of Earth, are studied in Geometry.