# Mathematics

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# Abstract

People are always curious about mathematics and graphics,they want to set up a relation between them.This short report introduce a mathematics of game.It also include Vectors,Matrices,Transforms and so on.The report has been formatted ,so whether or not you have professional knowledge,you can understand it well.This report has something for you,maybe it will help you to understand how the picture transform.It will set up the relation between mathematics and graphics..It’s not that we necessarily excluded anything from this report.For the sake of practicality, we discuss a variety of important aspects of mathematics, such as, vectors,right (left)handed coordinate system....


**Key words:** mathematics , graphics,vectors

# 1 Introduce

One of the most important and most difficult parts of game design is a finding a good theme. The theme of a game affects the mood of the player. It is important to put some thought into choosing an good theme before jumping into the details of game design and development. Keep the theme of your game in mind as you design game objects, the background and characters, choose sounds, and decide on the order of the action.But all of all need graphic to express.So the mathematics is important.

# 2 2D&3D

3D math is all about measuring locations, distances,and angles precisely and mathematically in 3Dspace.The most frequently used framework to perform such calculations using a computer is

The abstract version of this is called a 2D Cartesian coordinate space.

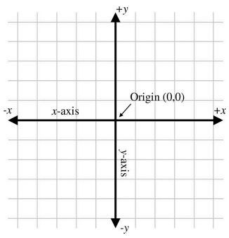


Figure1:artesian coordinate system.

# 3 Angles

The word angle comes from the Latin word angulus, meaning "corner"; cognate words are the Greek (ankylos), meaning "crooked, curved," and the English word "ankle". Both are connected with the Proto-Indo-European root ank-, meaning "to bend" or "bow”[Slocum, Jonathan 2007]

• An angle measures an amount of rotation in the plane.

• Variables for angles are often given the

Greek letter θ.

• The most important units of measure are degrees (°) and radians
(rad).

• Humans usually measure angles using degrees.

• One degree measures 1/360th of a revolution, so 360° is a complete
revolution.

• Mathematicians, prefer to measure angles in radians, which is a unit
of measure based on the properties of a circle.

• When we specify the angle between two rays in radians, we are
actually measuring the length of the intercepted arc of a unit circle,
as shown in the figure on the next slide.

# 4 Vectors and Scalars

• An "ordinary number" is called a scalar.

• Algebraic definition of a vector: a list of scalars in
square brackets. Eg. [1, 2, 3].

• Vector dimension is the number of numbers in the
list (3 in that example).

• Typically we use dimension 2 for 2D work, dimension 3 for 3D work.

• We'll find a use for dimension 4 also, later.

# 5 Radians and Degrees

• The circumference of a unit circle is 2π radians, with π approximately
equal to 3.14159265359.

• Therefore, 2π radians represents a complete revolution.

• Since 360° = 2π rad, 180° = π rad.

• To convert an angle from radians to degrees, we multiply by 180/π ≈
57.29578 and to convert an angle from degrees to radians, we
multiply by π/180 ≈ 0.01745329.

# 6 Matrix

In mathematics, a matrix (plural matrices) is a rectangulararray[1] of numbers, symbols, or expressions, arranged in rows and columns.[Anton (1987, p. 23)] The individual items in a matrix are called its elements or entries . [ Young ] Provided that they are the same size (have the same number of rows and the same number of columns), two matrices can be added or subtracted element by element.

• Algebraic definition of a matrix: a table of scalars in square brackets.

• Matrix dimension is the width and height of the table, w x h.

• Typically we use dimensions 2 x 2 for 2D work, and 3 x 3 for 3D
work.

$$\begin{bmatrix} m_{11} & m_{12} & m_{13} \\ m_{21} & m_{22} & m_{23} \\ m_{31} & m_{32} & m_{33} \end{bmatrix}$$

Figure2:Same number as rows as columns.Entries mii are called the diagonal entries. The others are called nondiagonal entries.

# 7 Question list

**1.What is the difference between a point and a vector?**

•Points are measured relative to the origin.

•Vectors are intrinsically relative to everything.

•Vector can be used to represent a point.

•Vectors don't have a location

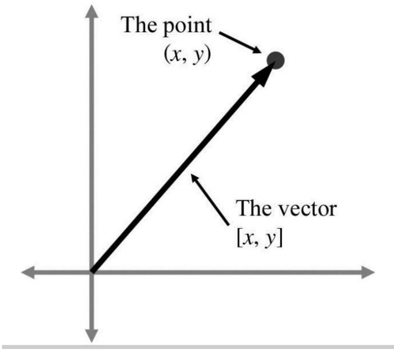


Figure3： The point (x,y) is the point at the head of the vector [x,y] when its tail is placed at the origin.

## 2.What is a right handed coordinate system?

- + z goes “out from” screen
- Use your right hand
- Thumb is +x
- Index finger is +y
- Second finger is +z

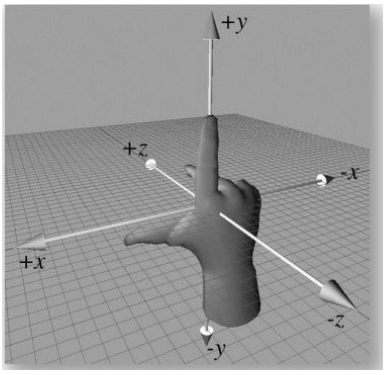


Figure4： Linear algebra books usually use right-handed.

## 3.How do you compute the dot product of two vectors? Informally, what does the dot product do?

Can take the dot product of two vectors of the same dimension. The result is a scalar.

$$\mathbf{a} \cdot \mathbf{b} = \sum_{i=1}^{n} a_i b_i$$

Figure5: dot product of two vectors.

## 4.Give an example where we need the dot product for Computer Graphics applications.

Dot of two vector determine whether two things will collision.And what will happen next.

| $\mathbf{a} \cdot \mathbf{b}$ | $\theta$ | Angle is | a and b are |
|---|---|---|---|
| $> 0$ | $0^\circ \leqslant \theta < 90^\circ$ | acute | pointing mostly in the same direction |
| $0$ | $\theta = 90^\circ$ | right | perpendicular |
| $< 0$ | $90^\circ < \theta \leqslant 180^\circ$ | obtuse | pointing mostly in the opposite direction |

Figure6:This table can determine collision of two things.

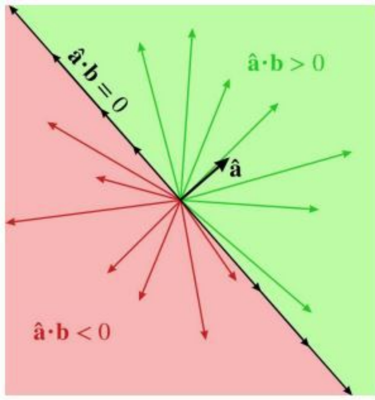


Figure7:The relation between dot and angle.

**5.How do you compute the projection of one vector onto another?**

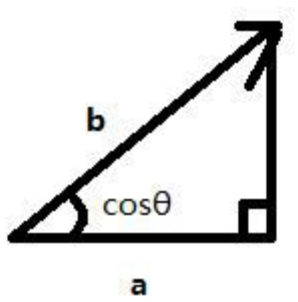


Figure8:a is the projection of b onto another , $a = |b| \bullet \cos\theta$

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