Mathmation

Compendium of Mathematics Information

Volume-4 January-December 2016

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PG & Research Department of Mathematics
Jamal Mohamed College (Autonomous)
College with Potential for Excellence
Reaccredited (3rd cycle) with 'A' Grade by NAAC
(Affiliated to Bharathidasan University)
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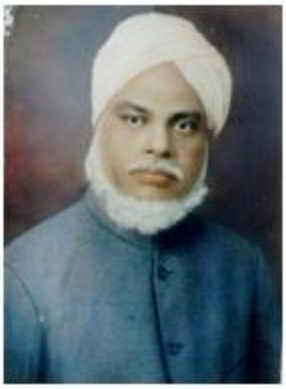
Founders



Hajee M. Jamal Mohamed

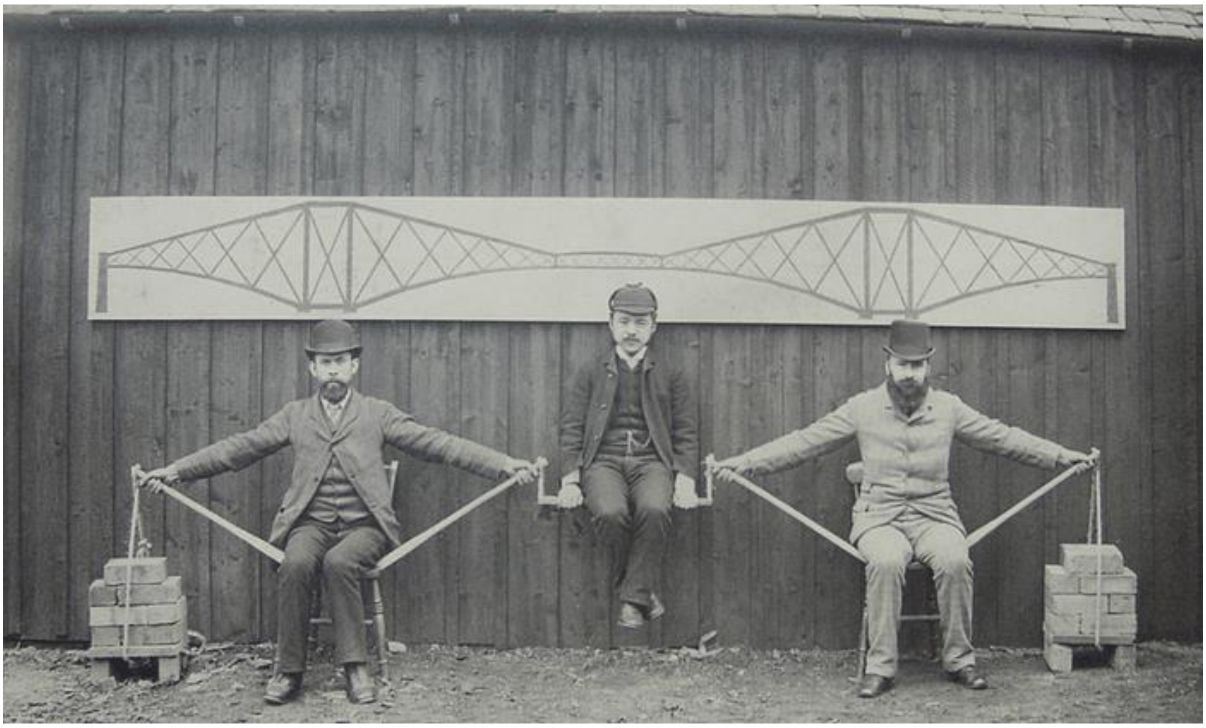
Janab N.M.Khajamian Rowther

Our hearty thanks to Janab M.J. Jamal Mohamed Bilal, President, **Dr. A. K. Khaja Nazemudeen,** Secretary and Correspondent, Hajee K.A Khaleel Ahamed, Treasurer, Hajee M.J Jamal Mohamed, Assistant Secretary, Dr. S. Mohamed Salique, Principal, Head and staff members of the Department of Mathematics.

Editorial Board

Introduction

This booklet is the brainchild of motivated Mathematics students & Scholars who wish to disseminate mathematical information regarding the reputed Mathematical Institutions, current events, unsolved problems, Millennium prize problems, puzzles, solutions etc.,



A demonstration of the mathematical principles of the original Forth Bridge in Scotland performed at Imperial College in 1887. The central 'weight' is Kaichi Watanabe, one of the first Japanese engineers to study in the UK, while Sir John Fowler and Benjamin Baker provide the supports. Photograph: Imperial College

PG and Research Department of Mathematics

Vision

To assist students in acquiring a conceptual understanding of the nature and structure of Mathematics, its processes and applications.

Mission

To provide quality Mathematical course work which supports and enhances all programmes at the College.

Profile of the Department

The Department of the Mathematics is one of the oldest departments which maintain a good record of service from its inception in 1951 the year in which the institution was established. B.Sc and M.Sc. Mathematics Programmes were started in 1957 and 1963 respectively. The department was elevated into a research department in the year 2002 by offering M.Phil (Full Time & Part Time) and Ph.D. (Full Time & Part Time) Programmes. B.Sc. Mathematics (Self Financing Section) was started for Women in 2003 and M.Sc. Mathematics (Self Financing Section) was started for Women and Men in 2005 and 2010 respectively.

In the year 2008, the department was Nationally Identified as a Department with Potential for award of FIST Grant by the Ministry of Science and Technology of Government of India.

The department feels proud of having highly qualified faculty members actively engaged in Teaching, Research, Continuing education programmes and Consultancy. In the last fifteen years, the members of the department have written 10 books, 59 research scholars were awarded Ph.D. Degrees, Published more than 572 research papers in National and International Journal and presented many research papers in National and International Conferences.

Unique Features

- DST-FIST Sponsored Department (2009-2014) : Total Grants received 13 Lakhs
- 53 Ph.Ds Awarded (From 2002 to 2016)
- Department Library with 8042 Books.
- CSIR / NET Coaching Class (initiated in 2016)
- VIPNET – Dr. A.P.J. Abdul Kalam Club (affiliated to Vigyan Prasar Network of Science Clubs, DST-Government of India) (established in 2016)
- Ramanujan Centre for Mathematic Excellence (established in 2017)

Thrust Areas of Research

- Algebra
- Fuzzy Graphs
- Fuzzy Groups
- Fuzzy Optimization
- Graph Theory
- Mathematical Modelling
- Network Optimization
- Operations Research
- Stochastic Process

Significant Achievements

- No. of Books Published : 10
- Papers Published in National and International Journals more than 502
- Presented many research papers in Conferences and Seminars
- No. of UGC Minor Research Projects completed: 6
- International Conferences organized: 3
- Regularly organizing Conferences / Seminars / Workshops
- Staff members are acting as reviewers of National / International Journals
- Our students have won many shields for overall first position in Inter-Collegiate Competitions
- Our students attended advanced learning programmes in Mathematics organized by NBHM

Best Practices

- Publishing Mathmation Magazine (started in 2013)
- Remedial Classes by Research Scholars (Student Faculty) (started in 2016)
- Advanced Learners Forum : Students are encouraged to participate in the Seminars / Competitions by the Senior Students. (initiated in 2016)
- Organized Inter-Department Competition (Maths- Intelligentsia) (initiated in 2017)
- Lectures through web NPTEL-Web and Video Courses
- State Level Inter-Collegiate Meet – JAMATICS- Annual Events
- Mathematics Association organizing Special Lecture Programmes
- Our students actively participating in Co-curricular and Extra-curricular activities
- Loan facility by the department to economically backward students
- Providing scholarship through helping hearts club
- Online Competitive Examination Software

ACADEMIC TRANFORMATION

YEAR	COURSES	STREAM	SANCTIONED STRENGTH
1957	B.Sc. Mathematics	Aided	60
1963	M.Sc. Mathematics	Aided	35
2002	M.Phil. & Ph.D. Mathematics	Self Finance	As per availability of Research Advisors
2003	B.Sc. Mathematics (Addl.Sec-I)	Self Finance (Women)	60
2005	M.Sc. Mathematics (Addl.Sec-I)	Self Finance (Women)	35
2009	B.Sc. Mathematics (Addl.Sec-II)	Self Finance (Women)	60
2009	UGC Sponsored COP – E-Mathematical Tools	Self Finance	60
2010	M.Sc. Mathematics (Addl.Sec-II)	Self Finance (Men)	35
2015	B.Sc. Mathematics (Addl.Sec-III)	Self Finance (Women)	60

A graph Theoretical Network Model on Human Heart

Basavaprasad B. and Ravindra S. Hegadi

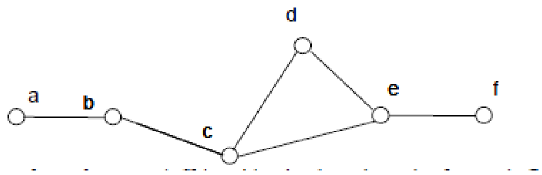
Graph theory is one of the most important branches of mathematics particularly discrete mathematics which is also called as the mathematics of network. In computers it has many applications such as syntactic analysis, fault detection etc. It plays a very important role in engineering and technology. The development of many tools such as medical imaging, face recognition system, remote sensing, optical character recognition system (OCR) and many more are the examples of its application. From the past two decades graph theory is playing a vital part in image segmentation techniques especially in medical image processing which is the most active research topic nowadays. In this article the techniques of graph theory and developed a model for micro cardiac network system. The main concept is to get the blood flow system in human heart with respect to oxygenated and deoxygenated blood circulation using the network graph theory. The crossing numbers are the most important parameters for obtaining exact results in an electrical circuit represented by a planar graph. This concept may help in blood flow system in human heart. The stereographic projection of a graph is presented with an algorithm in order to improve the performance of the model.

Graph Terminology

The basic idea of graph theory is the graph. It is best thought of as a mathematical object moderately than a diagram, although graphs have a very usual graphical representation. A graph typically denoted $G(V,E)$ or $G=(V,E)$ consists of set of vertices V togeather with a set of edges E. Vertices are also known as points, nodes and as actors in social networks, players or representatives. Edges are also called as curves or lines and as ties or links in social networks. An edge $g=(u,v)$ is defined as the vertices of unordered pair that serve as its end points. Two vertices u and v are adjacent if there exists an edge (u,v) that connects them. An edge $g=(u,v)$ that connects a vertex to itself is known as a *loop*. The total number of vertices in a graph is generally denoted n whereas the number of edges is generally denoted by m. When looking at visualizations of graphs such as the following figure, it is important to understand that the diagram contains adjacency information only. The nodes are located as represented in the plane and hence the length of lines is subjective except or else specified.

Graph:

A Graph is ordered pair of vertex set V and edge set $G = (V, E)$ i.e. Where the set V contains all the vertices of V and edge set E contains the edges which join any two vertices i.e., an edge is an ordered pair of vertices $e = (v_i, v_j)$ As an example, the graph depicted in the following figure has vertex set $V = \{a, b, c, d, e, f\}$ and edge set $E = \{(a, b), (b, c), (c, d), (c, e), (d, e), (e, f)\}$



***Subgraph*:**

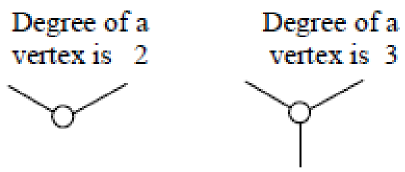
A graph is said to be the subgraph of a graph if H contains all the vertices of G but not all the edges of G.

Order of graph:

Order of a vertex is the number of edges which are incident with it.

Degree of a vertex:

The number of edges that coincides (both joining and leaving the vertex) with the vertex is called the degree of a vertex. The degree of a vertex may range from zero to any finite number.



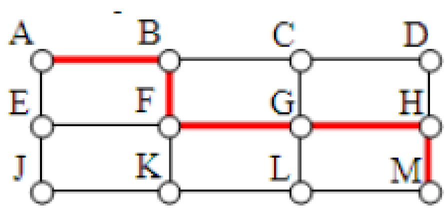
Walk:

A *walk* in a graph G is a limited sequence of edges which includes vertices (e_1, e_2,…,e_n) in which any two successive edges are adjacent of similar.

Trail:

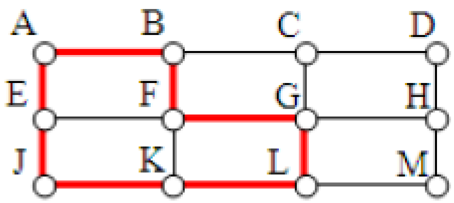
A walk in which no one edge is not repeated twice is called a *trail*.

Path: A trail in which no one vertex is repeated twice (excluding the initial and final vertex maybe coincided), then that trail is called as a *path*.



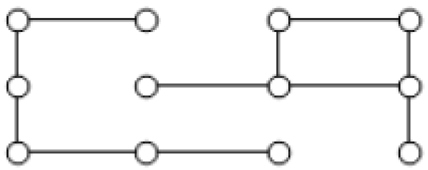
Cycle (Circuit):

A path which begins and ends at the same vertex is called as cycle or circuit. An example of a cycle or circuit is shown below.



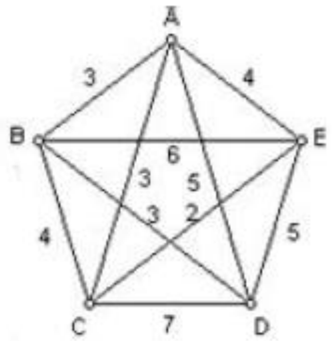
Connected graph:

A graph is said to be connected if there exists a path from each vertex to any other vertices. All graphs shown in the above examples so far are all connected. Below we have shown the graph which is disconnected; there are two components of a graph showing the disconnected graph.



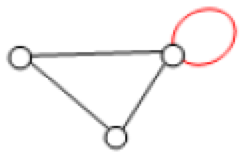
Weights:

Sometimes weights are assigned to the edges to solve some problems. The weights represent the distance between two places, the travel cost or the travel time. It is significant to notice that the distance between vertices in a graph need not corresponds to the weight of an edge of a graph.



Loop:

If in a graph G the vertex v joins itself then that edge is called a loop.

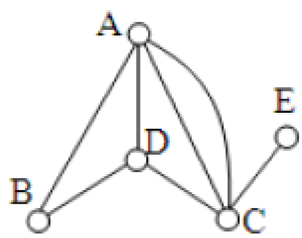


Multiple edges:

If in a graph, two or more edges join the same ordered pair of vertices (v_i, v_j) then those edges are called multiple edges and the graph is called multi-graph.

Psuedograph:

A graph G with loops and multiple edges is called pseudograph.



Simple graph:

A graph with no loops and no multiple edges is called a simple graph.

Spanning subgraph:

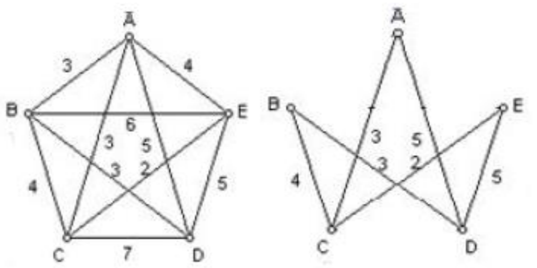
Consider a graph G. A subgraph which is a connected graph with no circuit i.e., a tree is said to be a spanning subgraph of if it contains all the vertices of G.

Bipartite graph:

Consider a graph $G = (V, E)$. Bipartite graph is a subgraph of Gin which the vertex set V is divided into two disjoint subsets v_1 and v_2 such that if we join an edge, one vertex from the set v_1 and another vertex from the set v_2.

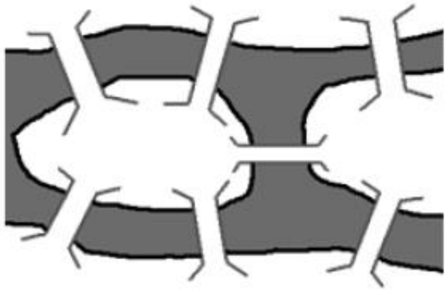
Complete Bipartite graph:

It is a bipartite graph in which every pair of vertices of v_1 and v_2 is joined. A complete graph with n vertices is denoted K_n.



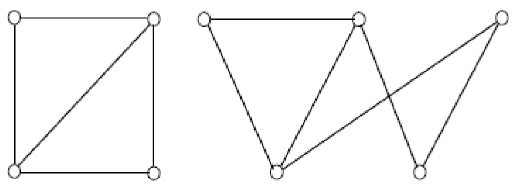
Eulerian Graph:

In a connected graph G if there exists a closed trail which comprises of each edge of G then that graph is called as Eulerian graph. A non-Eulerian graph G is said to be semi-Eulerian if there exists a trail which contains every edge of . The name "Eulerian" comes up from the information that Euler was the first and main person to explain the solution for famous Konigsberg bridges problem. The problem investigates whether one can pass every seven bridges exactly once and return to the starting point without repeating the path.



Hamiltonian graph:

If in a graph G, there exists a cycle which passes across each vertex without repetition in G, then the graph is called Hamiltonian. This cycle is called Hamiltonian cycle of G. A non-Hamiltonian graph G is said to be semi-Hamiltonian if there exists a path which passes through each vertex of G. This path is called Hamiltonian path of G.



Human Heart

The human heart is a muscular organ which is about the size of a closed palm which performs the pumping function of body's blood circulatory system. It receives deoxygenated blood inside through the veins and transports it to the lungs for oxygenation earlier than pumping it into the various arteries which provides nutrients and oxygen to tissues of the body by transferring the blood right through the body. The heart is positioned in the thoracic cavity medial in the direction of the lungs and posterior to the sternum. On its better end, the base of the heart is attached to the aorta, and veins, the vena cava and pulmonary arteries. The lower tip of the heart, known as the apex, rests just superior to the diaphragm. The bottom portion of the heart is situated at the body's midline with the peak pointing toward the left side. Since the heart exists to the left, about 2/3rd of the heart's mass is originated on the left side of the body and the other 1/3rd is on the right. The different parts of human heart are shown in Figure 1(a).

Crossing Numbers

The crossing number $n(G)$ of a graph G is defined as the minimum number of crossings of its edges among all drawings of G in the plane. The crossing numbers are the most important parameters for obtaining exact results in an electrical circuit represented by a planar graph. Much effort has been made on investigating the crossings numbers of complete graphs and complete bipartite graphs. In this article crossing numbers have been used for the observation of thickness of a graph and stereographic projection graph. The graphs with one crossing, two crossings and three crossings were shown in Figure 1(d), (e) and (f).

Algorithm:

Step 1: Consider a graph K_6 in the plane with $C = n(K_6)$ crossings

Step 2: Fig (3) assume the two edge cross at most once and then two edge cross at the same point.

Step 3: Since K_6, is co-planar, $C \geq 1$.

Step 4: At each crossing we introduce a new vertex and produce connected Plane graph G having $6 + C$ vertices and $15 + 2C$ edges then, we have

$$15 + 2C \leq 3(6 + C) - 6$$

$$C \geq 3$$

$$C = n(K_6) > 3$$

Step 5: Now we observer that existing a drawing of K_6 with only three crossing.

Concluded $n(K_6) = 3$

Where K_6 is a complete graph with 6 vertices

C is the number of crossings.

Thickness of a Graph

If G is non-planar, it is natural to question that what is the minimum number of planar necessary for embedding G? The least number of planar sub graphs whose union is the given graph G is called the thickness of a graph. The thickness of complete graph of eight vertices is two, while the thickness of complete graph of nine vectors is three. Although several experimental results available on the thickness of an arbitrary graph is in general, difficult to determine.

Stereographic Projection of a Graph

Embedding a graph in the plane is equivalent to embedding it on the sphere. This equivalence can be seen with the aid of Stereographic Projection. Euler discovered the formula for simply connected graph in 1752 and therefore connected planar graph is named after him. The Stereographic Projection is shown in Fig. 1(g)

Algorithm: Euler's formula $p - q + s = 2$

1. We proceed by induction in.
2. If $q = 0$, then $p = 1, s = 1$ and $p - q + s = 2$. Therefore the result is true for $q = 0$
3. Now we assume that the result is true for all connected graphs with $k - 1$ edges where $K \geq 1$.
4. Suppose if G has p vertices and s regions and k edges then we prove that $p = k + 2$.
5. If G is a tree, then $p = k + 1$, since $s = 1$, then $p - k + s = (k + 1) - (k) + 1 = 2$, and we get the desired result.
6. If G is not tree, then some edge g of G is on a cycle. Hence $G - g$ is a connected plane graph having order p and size $k - 1$ and $s - 1$ region.
7. $p - (k - 1) + (s - 1) = 2$ this verifies the result.

Human Micro Cardiac Network system

The circulation of blood in human cardiac system is itself planned by the nature. So we have observed and studied planarity and the Hamiltonian or Eulerian graphs in cardiac network system. We modified the blood circulation system of heart with applications show in Figure 1(h). We collected infrastructure connectivity graphs in human body with the blood circulation system in the heart and we called them as *"Micro-Cardiac Network Graph"*. Further we studied this concept in terms of network graphs. Our attempt is to show that there is a Hamiltonian or Eulerian path system in human heart functioning and we came to conclusion to give sketches of this system. Our investigations allow solving the problems of the thickly crowded dense micro cardiac network system which is shown in the Figure 1(i). The extended edge connectivity may help the cardiac network system.

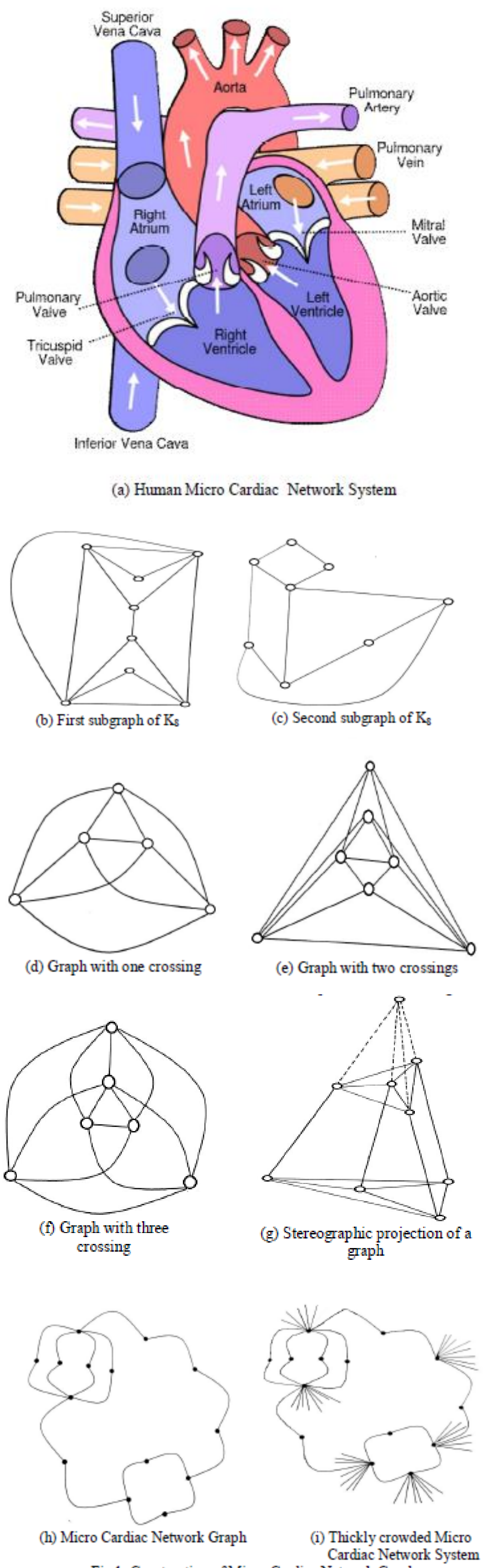


Fig 1: Construction of Micro-Cardiac Network Graph

Conclusions and Discussions

The recent results and application techniques of network graph theory in micro cardiac system is illustrated by *Graph Theory* with advance era of application trends. In the present application of the Network graph theory layouts the importance in the model of cardiac system gives effective solution in human cardiac system and stereographic network models. The objective of this investigation is to study the effort of application of network graph .many useful results were carried out using this method .To achieve the objective the investigation implemented cross numbering and stereographic projection provided most important result for obtaining solutions in electric circuits. Results on application techniques of graph on cardiac system, which we obtained, are most useful in solving the blood flow system in human heart. This application of the concepts of graph, we have tool to scope with imprecision or generality, through the graph and our extended edge concavity of network may helpful for developing a tool which may be used in cardiac blood flow system analysis.

Source: Basavaprasad B. and Ravindra S. Hegadi, International Journal of Applied Engineering Research, ISSN 0973-4562 Vol. 9 No. 20, 2014

Medicine and Math

Natasha Glydon

Doctors and nurses use math every day while providing health care for people around the world. Doctors and nurses use math when they write prescriptions or administer medication. Medical professionals use math when drawing up statistical graphs of epidemics or success rates of treatments. Math applies to x-rays and CAT scans. Numbers provide an abundance of information for medical professionals. It is reassuring for the general public to know that our doctors and nurses have been properly trained by studying mathematics and its uses for medicine.

Prescriptions and Medication

Regularly, doctors write prescriptions to their patients for various ailments. Prescriptions indicate a specific medication and dosage amount. Most medications have guidelines for dosage amounts in milligrams (mg) per kilogram (kg). Doctors need to figure out how many milligrams of medication each patient will need, depending on their weight. If the weight of a patient is only known in pounds, doctors need to convert that measurement to kilograms and then find the amount of milligrams for the prescription. There is a very big difference between mg/kg and mg/lbs, so it is imperative that doctors understand how to accurately convert weight measurements. Doctors must also determine how long a prescription will last. For example, if a patient needs to take their medication, say one pill, three times a day. Then one month of pills is approximately 90 pills. However, most patients prefer two or three month prescriptions for convenience and insurance purposes. Doctors must be able to do these calculations mentally with speed and accuracy.

Doctors must also consider how long the medicine will stay in the patient's body. This will determine how often the patient needs to take their medication in order to keep a sufficient amount of the medicine in the body. For example, a patient takes a pill in the morning that has 50mg of a particular medicine. When the patient wakes up the next day, their body has washed out 40% of the medication. This means that 20mg have been washed out and only 30mg remain in the body. The patient continues to take their 50mg pill each morning. This means that on the morning of day two, the patient has the 30mg left over from day one, as well as another 50mg from the morning of day two, which is a total of 80mg. As this continues, doctors must determine how often a patient needs to take their medication, and for how long, in order to keep enough medicine in the patient's body to work effectively, but without overdosing.

The amount of medicine in the body after taking a medication decreases by a certain percentage in a certain time (perhaps 10% each hour, for example). This percentage decrease can be expressed as a rational number, 1/10. Hence in each hour, if the amount at the end of the hour decreases by 1/10 then the amount remaining is 9/10 of the amount at the beginning of the hour. This constant rational decrease creates a geometric sequence. So, if a patient takes a pill that has 200mg of a certain drug, the decrease of medication in their body each hour can be seen in the folowing table. The **Start** column contains the number of mg of the drug remaining in the system at the start of the hour and the **End** column contains the number of mg of the drug remaining in the system at the end of the hour.

Hour	Start	End
1	200	9/10 x 200 = 180
2	180	9/10 x 180 = 162
3	162	9/10 x 162 = 145.8

The sequence of numbers shown above is geometric because there is a common ratio between terms, in this case 9/10. Doctors can use this idea to quickly decide how often a patient needs to take their prescribed medication.

Ratios and Proportions

Nurses also use ratios and proportions when administering medication. Nurses need to know how much medicine a patient needs depending on their weight. Nurses need to be able to understand the doctor's orders. Such an order may be given as: 25 mcg/kg/min. If the patient weighs 52kg, how many milligrams should the patient receive in one hour? In order to do this, nurses must convert micrograms (mcg) to milligrams (mg). If 1mcg = 0.001mg, we can find the amount (in mg) of 25mcg by setting up a proportion.

$$\frac{1}{0.001} = \frac{25}{X}$$

By cross-multiplying and dividing, we see that 25mcg = 0.025mg. If the patient weighs 52kg, then the patient receives 0.025(52) = 1.3mg per minute. There are 60 minutes in an hour, so in one hour the patient should receive 1.3(60) = 78mg. Nurses use ratios and proportions daily, as well as converting important units. They have special "shortcuts" they use to do this math accurately and efficiently in a short amount of time.

Numbers give doctors much information about a patient's condition. White blood cell counts are generally given as a numerical value between 4 and 10. However, a count of 7.2 actually means that there are 7200 white blood cells in each drop of blood (about a microlitre). In much the same way, the measure of creatinine (a measure of kidney function) in a blood sample is given as X mg per deciliter of blood. Doctors need to know that a measure of 1.3 could mean some extent of kidney failure. Numbers help doctors understand a patient's condition. They provide measurements of health, which can be warning signs of infection, illness, or disease.

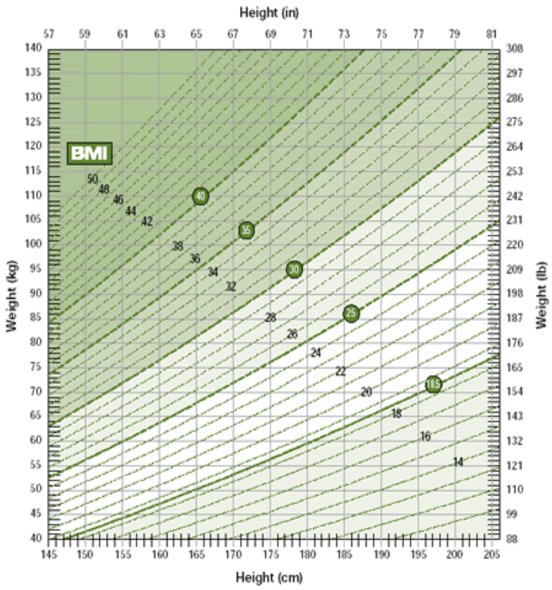
Body Mass Index

In terms of medicine and health, a person's Body Mass Index (BMI) is a useful measure. Your BMI is equal to your weight in pounds, times 704.7, divided by the square of your height in inches. This method is not always accurate for people with very high muscle mass because the weight of muscle is greater than the weight of fat. In this case, the calculated BMI measurement may be misleading. There are special machines that find a person's BMI. We can find the BMI of a 145-pound woman who is 5'6" tall as follows.

First, we need to convert the height measurement of 5'6" into inches, which is 66". Then, the woman's BMI would be:

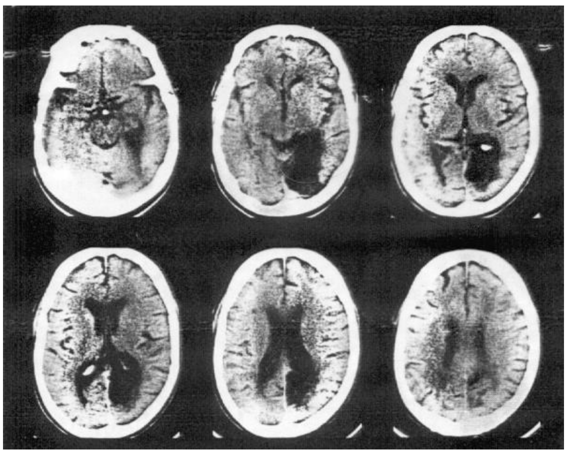
$$\frac{145 * 704.7}{66^2} = 23.4576$$

This is a normal Body Mass Index. A normal BMI is less than 25. A BMI between 25 and 29.9 is considered to be overweight and a BMI greater than 30 is considered to be obese. BMI measurements give doctors information about a patient's health. Doctor's can use this information to suggest health advice for patients. The image below is a BMI table that gives an approximation of health and unhealthy body mass indexes.



CAT Scans

One of the more advanced ways that medical professionals use mathematics is in the use of CAT scans. A CAT scan is a special type of x-ray called a Computerized Axial Tomography Scan. A regular x-ray can only provide a two-dimensional view of a particular part of the body. Then, if a smaller bone is hidden between the x-ray machine and a larger bone, the smaller bone cannot be seen. It is like a shadow.



It is much more beneficial to see a three dimensional representation of the body's organs, particularly the brain. CAT scans allow doctors to see *inside* the brain, or another body organ, with a three dimensional image. In a CAT scan, the x-ray machine moves around the body scanning the brain (or whichever body part is being scanned) from hundreds of different angles. Then, a computer takes all the scans together and creates a three dimensional image. Each time the x-ray machine makes a full revolution around the brain, the machine is producing an image of a thin slice of the brain, starting at the top of the head and moving down toward the neck. The three-dimensional view created by the CAT scan provides much more information to doctors that a simple two-dimensional x-ray.

Mathematics plays a crucial role in medicine and because people's lives are involved, it is very important for nurses and doctors to be very accurate in their mathematical calculations. Numbers provide information for doctors, nurses, and even patients. Numbers are a way of communicating information, which is very important in the medical field.

The Propounder of Algebra

Muhammad ibn musa al-khwarizmi

A major impetus for the flowering of mathematics as well as Astronomy in medieval Islam came from religious observances, which presented an assortment of problems in astronomy and mathematics, specifically in Trigonometry, spherical geometry, algebra, and arithmetic.

The Islamic law of inheritance served as an impetus behind the development of algebra (derived from the Arabic **al-jabr**) by Muhammad ibn musa al-khwarizmi and other medieval Islamic mathematicians.

Allah commands you as regards your children's (inheritance); to the male a portion equal to that of two females' if (there are) only daughters, two or more, their share is two thirds of the inheritance; if only one her share is half. For parents a sixth share of inheritance to each if the deceased left children; if no children and the parents are the (only) heirs, the mother has a third; if the deceased left brothers or (sisters), the mother has a sixth. (The distribution in all cases is) after the payment of legacies he may have bequeathed or debts. You know not which of them, whether your parents or your children, are nearest to you in benefit, (these fixed shares) are ordained by Allah. And Allah is Ever All-Knower, All – wise.

Al-Quran (4 - 11)

Khwarizmi Hisab al-jabr devoted a chapter on the solution to the Islamic law of inheritance using algebra. He formulated the rules of inheritance as linear equations, hence his knowledge of quadratic equations was not required. Later mathematicians who specialized in the Islamic law of inheritance included Al-Hassar, who developed the modern symbolic mathematical notation for fractions in the 12th century, and Abu al-Hasan ibn Ali al-Qalasadi, who developed an algebraic notation which took "the first steps toward the introduction of algebraic symbolidm" in the 15th century.

J.J.O'Conner and E.F.Robertson wrote in the MacTutor History of Mathematics archive:

"Recent research paints a new picture of the debt that we owe to Islamic mathematics. Certainly many of the ideas which were previously thought to have been brilliant new conceptions due to European

mathematicians of the 16th , 17th, and 18th centuries are now know to have been developed by Arabic / Islamic mathematicians around four centuries earlier. In many respects, the mathematics studied today is far closer in style to that of Islamic mathematics than to that of Greek mathematics."

R.Rashed wrote in the development of Arabic mathematic; between arithmetic and algebra:

"Al-Khwarizmi's successors undertook a systematic application of arithmetic to algebra, algebra to arithmetic, both to trigonometry, algebra to the Euclidean theory of numbers, algebra to geometry, and geometry to algebra. This was how the creation of polynomial algebra, combinatorial analysis, numerical analysis, the numerical solution of equation, the new elementary theory of numbers, and the geometric construction of equations arose,"

The term algebra is derived from the Arabic term al-jabr in the title of Al-Khwarizmi's Al-jabr wa'l muqabalah. He originally used the term al-jabr to describe the method of "reduction" and "balancing", referring to the transposition of subtracted terms to the other side of an equation, that is the cancellation of like terms on opposite sides of the equation.

There are three theories about the origins of Islamic algebra. The first emphasizes Hindu influence, the second emphasizes Mesopotamian or Persian – Syriac influence, and the third emphasizes Greek influence. Many scholars believe that it is the result of a combination of all three sources.

Throughout their time in power, before the fall of Islamic civilization, the Arabs used a fully rhetorical algebra, where sometimes even the numbers were spelled out in words. The Arabs would eventually replace spelled out numbers (e.g.twenty-two) with Arabic numeral, but the Arabs never adopted or developed a syncopated or symbolic algebra, until of Ibn al-Babba al-marrakuahi in the 13th century and Abu al-Hasan ibn Ali al-Qalasadi in the 15th century.

There were four conceptual stages in the development of algebra, three of which either began in, or were significantly advanced in, the Islamic world. These four stages were as follows;

- **Geometric stage,** where the concepts of algebra are largely geometric. This dates back to the

Babylonians and continued with the Greeks, and was revived by Omar Khayyam.

- **Static equation – solving stage,** where the objects is to find numbers satisfying certain relationships. The move away form geometric algebra dates back to Diophantus and Brahmagupts, but algebra didn't decisively move to the static equation _solving stage until Al khawarizmi al jabr.

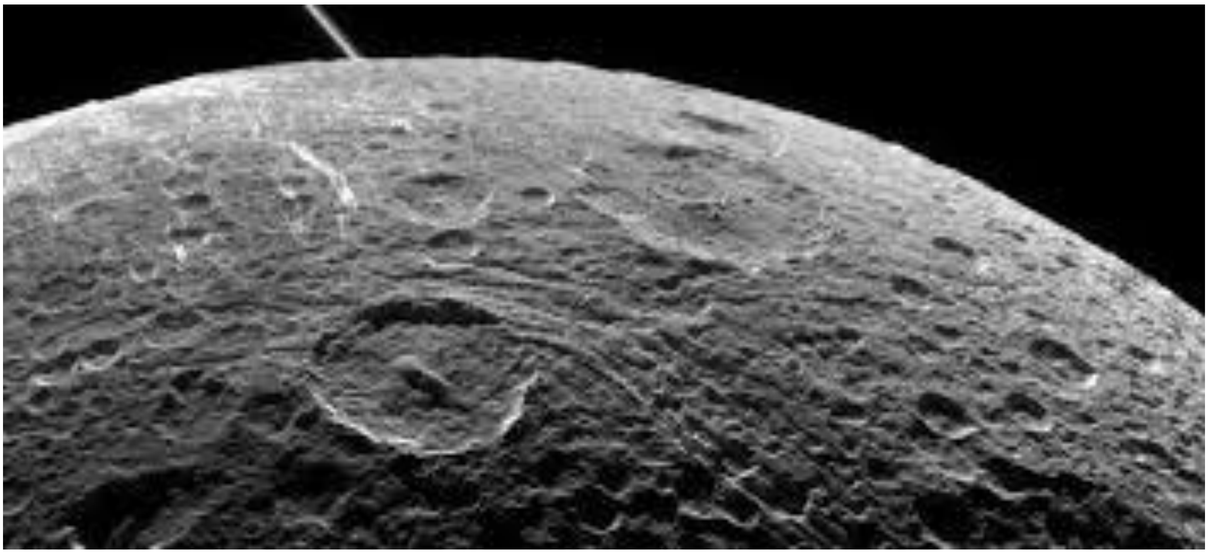
- **Dynamic function stage,** where motion is an underlying idea. The idea of a function began emerging with sharaf al din al Tusi, but algebra didn't decisively move to the dynamic function stage until Gottfrieg Leibniz.

- **Abstract stage,** where mathematical structure plays a central role. Abstract algebra is largely a product of the 19th and 20th centuries

The Muslim Persian mathematician Muhammad ibn musa al-khawarizmi (780-850) was a faculty member of the "House of wisdom" (bait al-hikma) in Baghdad, which was established by Al-Mamun. Al-khwarizmi, who died around 850 A.D., wrote more than half a dozen mathematical and astronomical works; some of which were based on the Indian sindhind. One of Al-khwarizmi's most famous books is entitled Al-jabr or The Compendious Book on Calculation by Completion and Balancing, and it gives an exhaustive account of solving polynomials up to the second degree. The book also introduced the fundamental method of " reduction" and "balancing", referring to the transposition of subtracted terms to the other side of an equation, that is, the cancellation of like terms on opposite sides of the equation. This is the operation which Al-khwarizmi originally described as Al-jabr.

Al-jabr is described into six chapters each of which deals with a different type of formula. The first chapter of Al-jabr deals with equations whose squares equal its roots ($ax^2=bx$), the second chapter deals with squares equal to number ($ax^2=c$), the third chapter deals with roots equal to a number ($bx=c$), the fourth chapter deals with squares and roots equal a number ($ax^2+bx=c$), the fifth chapter deals with squares and numbers equal roots ($ax^2+c=bx$), and the sixth and final chapter deals with roots and numbers equal to squares ($bx+c=ax^2$).

The Moon and Mathematics



The Moon has no atmosphere due to its weak gravity. It is composed of a 800 km thick lithosphere, covering a core of thin magma. The moon is a complex body in the solar system. Moon rocks are composed of minerals including aluminum, calcium, magnesium, oxygen, silicon, and titanium. Some gases are also trapped in these rocks, such as hydrogen and helium. These gases are said to have reached the moon by solar wind From studying the moon astronauts have found two different types of rocks basalt and breccias. Basalt is formed from hardened lava. Breccias are formed from soil and rock that have been squeezed together when hit by falling objects. The moon's composition has always been interesting to scientists because it is so different than Earth's is. With information that has been discovers and found it makes it easier to know what and how the moon works.

The moon is the satellite of earth it moves around the earth, following the Kepler's law. The moon is not self-luminous body it shines in the light which it receives from the sun.

The two points of intersection of lunar orbit and ecliptic are called the nodes of the lunar orbit. The point when the moon crosses the ecliptic in going north is called ascending node and the other point where the moon crosses the ecliptic in going south is called descending node. The line joining the nodes of the lunar orbit is called a nodal line.

Sidereal Month

The sidereal month is the period of one complete revolution of the moon around the earth relative to any fixed star it is about 27.1/3 (days)

27 Days, 7 Hours, 43 Minutes

Synodic Month

The period of one complete revolution of the moon around the earth relative to the sun is called synodic month, it is about 29.1/2 (days)

29 Days, 12 Hours, 44 minutes

Conjunction

The moon is said to be in conjunction with the sun if it is seen from the earth in the same direction as the sun

At conjunction the elongation of the moon is "Zero"

The conjunction takes place on "New Moon Day"

Opposition

The moon is said to be in opposition with the sun when it is seen from the earth in opposite direction to that of the sun. at opposition the elongation of the moon is 180^0

Opposition takes place on Full Moon Day

Age of the moon

The age of moon on any day is the number of days that has elapsed. Since the previous new moon day it is measured at mid night.

The age of moon multiplicated by 12.2^0 gives its distance east of the sun.

Phase of moon

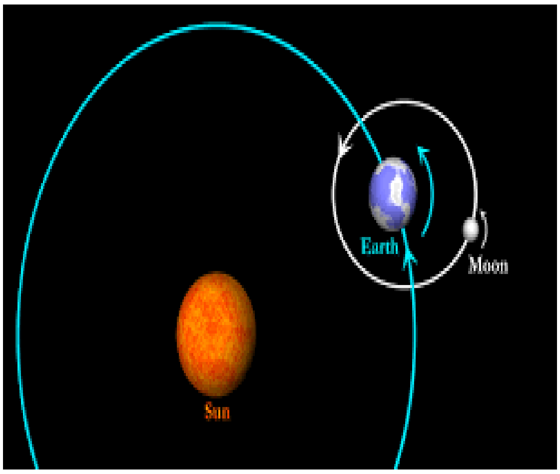
The phase of moon are the different forms in which the moon is seen by the Terrestrial observer.

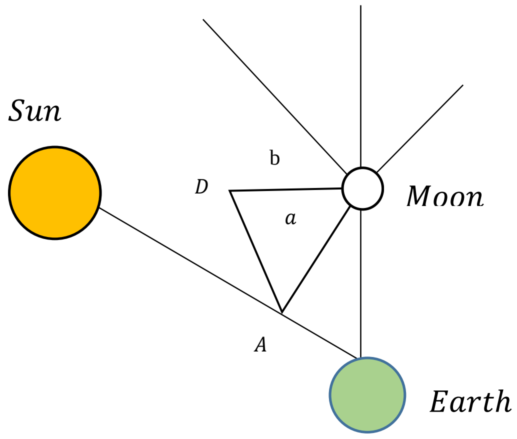
The phase of moon is mathematically defined as the ratio of visible portion of moon's disc to the whole illuminated disc.

Formula for Phase of Moon

Let 'S' be the Sun 'E' be the Earth and 'M' be the Moon.

The moon receives the light from the sun in the direction 'SM'





The moon is observed from the earth in the direction 'EM'

The visible portion is the area "XLYDX" which is equal to semicircle XLYX – semi eclipse

$$= XLYX - XDYX$$

$$= \frac{\pi a^2}{2} - \frac{\pi ab}{2} \qquad -1$$

Where a is the radius of the moon and $b =' MD'$ (eclipse) (semi)

Let θ be the elongation of the moon

From Δ "AMD"

$$MD = a\cos\theta$$

$$b = a\cos\theta \qquad -2$$

Substitute in equation '1'

The visible portion is

$$= \frac{\pi a^2}{2} - \frac{\pi a(a\cos\theta)}{2}$$

$$= \frac{\pi a^2}{2} - \frac{\pi a^2\cos\theta)}{2}$$

$$= \frac{\pi a^2}{2}(1-\cos\theta)$$

$$The\ phase\ of\ the\ moon$$

$$= \frac{visible\ portion}{whole\ illuminated\ disc}$$

$$= \frac{\frac{\pi a^2}{2}(1-\cos\theta)}{\pi a^2}$$

$$= \frac{1-\cos\theta}{2}$$

The phase of the moon $= \frac{1-\cos\theta}{2}$

Different phase of the Moon using formula

Phase $= \frac{1-\cos\theta}{2}$ where θ is the elongation of the moon.

When $\theta = 0$

Phase $= \frac{1-cos\,0}{2} \quad = \frac{1-1}{2}$

Phase $= 0$

The moon is **New**

Phase of the moon $= \frac{1-\cos\theta}{2}$

When $\theta < 90$

Phase is $< \frac{1}{2}$

The moon is **Crescent**

Phase of the moon $= \frac{1-\cos\theta}{2}$

When $\theta = 90$

Phase is $= \frac{1}{2}$

The moon is **Dichotomized**

Phase of the moon $= \frac{1-\cos\theta}{2}$

When $\theta > 90$

Phase is $> \frac{1}{2}$

The moon is **Gibbous**

Phase of the moon $= \frac{1-\cos\theta}{2}$

When $\theta = 180$

Phase is $= \frac{1-\cos(180)}{2}$

Phase is $= \frac{2}{2} = 1$

The moon is **Full**

The Time Dilation Equation

Of all the major advances in physics from about 1900 onwards special relativity is the only one that can be reasonably well understood in its entirety without recourse to mathematics beyond that of high school level. However, just as with all physics, special relativity has at its base a precise set of mathematical formulas from which predictions can be made and tested against experimental results. It will come as no surprise then that time dilation also has a precise mathematical formula. This is it:

$$t' = t\sqrt{1 - V^2/c^2}$$

Where $t' = dilated\ time$

$t = stationary\ time$

$V = velocity$

$c = speed\ of\ light$

Example 1: Solving the equation as a factor of 1

The effects of time dilation don't become really noticeable until very high speeds are reached so for this worked example I will use a speed of 90% of that of light, that is 270,000 km per second (the speed of light is very close to 300,000 km per second, or 186,000 miles per second). The first thing we must do is to write down the equation

$$t' = t\sqrt{1 - V^2/c^2}$$

We now need to "plug in the numbers". Because V^2/c^2 is a ratio we can either use the exact values or just the percentages of each value. It's easier, in this case, to do the latter. Because we're only interested in the dilated time factor we can set the stationary time to be 1. Note that we can drop the percentage symbols and that c is equal to 100% of the speed of light. Plugging in the numbers we get

$$t' = 1 \times \sqrt{1 - 90^2/100^2}$$

We can now begin to solve the equation. The first thing we can do is remove the leading number 1 (anything multiplied by 1 is itself), then square the last two terms

$$t' = 1 \times \sqrt{1 - 8100/10000}$$

We can now reduce the equation by carrying out the division

$$t' = \sqrt{1 - 0.81}$$

We then carry out the subtraction:

$$t' = \sqrt{0.19}$$

And finally we take the square root (and round the answer to a workable value)

$$t' = 0.436$$

This result means that at 90% of the speed of light local time has slowed down to 43.6% of that relative to an external observer. Put another way, if a rocket is sent out into space on a 10 (Earth) year mission at 90% of the speed of light the rocket and its occupants will have only aged by about four and a half years when they return, while everyone and everything on Earth will have aged 10 years.

Example 2: Solving the equation as a measure of time

The first example solved the equation as a factor of 1. This example puts a real time scale into the equation. In this example we will look at how time changes over 10 years travelling at a speed of 50% of that of light.

Instead of the commentary approach of the last example I will just carry out the equation but show each of the steps involved.

$$t' = t\sqrt{1 - V^2/c^2}$$

$$= 10\,years\,\sqrt{1 - 50^2/100^2}$$

$$= 10\,years\,\sqrt{1 - 2500/10000}$$

$$= 10\,years\,\sqrt{1 - 0.25}$$

$$= 10\,years\,\sqrt{0.75}$$

$$= 10\,years\ \times 0.866$$

$$= 8.66\,years$$

So for a rocket travelling at 50% of the speed of light 8.66 years will pass in the same time as 10 years pass for a stationary observer. Note that while the unit of time used was years it could have been any other unit of time, such as seconds or millennia, as long as the result is in the same units as the units used in the equation

As a side note, something that is only rarely, if ever, mentioned in science fiction is the effects of time dilation. Instead, we see spaceships travelling for months or even years on end and then returning to Earth with no differences in time. If we ever do manage to send people into space at very high percentages of the speed of light there will be the added dimension of different rates of ageing. For example, it would be possible for astronauts to return only to find tahat their children are older than they are. There’s also the question of whether or not they are to be paid in ship time or Earth time.

A final point is that the equation holds for all speeds, even the speeds we move about at from day to day, such as when walking, driving or flying.

Real Life Application of Linear equation

A linear equation is an algebraic equation in which each term is either a constant or the product of a constant and (the first power of) a single variable (however, different variables may occur in different terms). A simple example of a linear equation with only one variable, *x*, may be written in the form: $ax + b = 0$, where *a* and *b* are constants and $a \neq 0$. The constants may be numbers, parameters, or even non-linear functions of parameters, and the distinction between variables and parameters may depend on the problem

Linear equations can have one or more variables. An example of a linear equation with three variables, *x*, *y*, and *z*, is given by: $ax + by + cz + d = 0$, where *a*, *b*, *c*, and *d* are constants and *a*, *b*, and *c* are non-zero. Linear equations occur frequently in most subareas of mathematics and especially in applied mathematics. While they arise quite naturally when modeling many phenomena, they are particularly useful since many non-linear equations may be reduced to linear equations by assuming that quantities of interest vary to only a small extent from some "background" state. An equation is linear if the sum of the exponents of the variables of each term is one.

Equations with exponents greater than one are non-linear. An example of a non-linear equation of two variables is axy + b = 0, where a and b are constants and a ≠ 0. It has two variables, x and y, and is non-linear because the sum of the exponents of the variables in the first term, axy, is two

If you only have linear formulas in your equation, you have a linear equation. When you have the variable on only one side of the sign $= -$ sign, you can use the reversed arrow chain, card method or the balance method. When you have the variable on both sides of the sign $= -$, then you have to use the balance methods.

Examples

$$3a + 5 = 26$$
$$5w + 7 = 4 - 8w$$
$$3x = 5x + 2x + 5$$

Balance Method

Balance method you can solve equations by doing the same operation on both sides of the sign $= -$. The name comes from the thought behind it: a balance is an old weighing instrument with a scale/ dish/ weighing pan on both sides. On both sides of the balance you put a part of the equation. What is to the left of the = - sign in the equation goes on the left – hand scale and what is to the right of the = - sign in the equation goes on the right hand scale. Now start removing or adding things from the scale until left with the answer.

Example

Given is the equation $4a + 11 = 6a + 3$

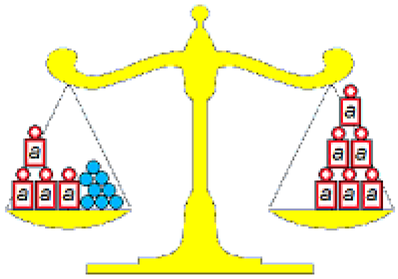
You can make the following balance

Take bags of marbles for a and separate marbles for the numbers

On both sides you have separate marbles.

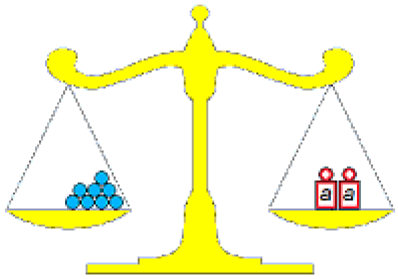
This means that on both sides you can remove three marbles without losing the equilibrium of the balance

You will get: $4a + 8 = 6a$



You can also remove 4 bags of marbles without losing the equilibrium of the balance

You will get: $8 = 2a$



When two bags are equal to 8 marbles, there must be 8: 2 = 4 marbles in each bag.

Solution: a = 4

The example and explanation above you have to keep in mind when solving any equation.

Not only linear equations. You have to use the balance method with other equations too.

Mathematics where is it used in Engineering?

Vector and Trigonometry

Mechanical Engineering:

Resolving forces in a plane, design of gears (e.g. in cars), design of airplane landing gear

Civil Engineering:

Structural engineering, surveying, traffic engineering, geotechnical engineering

Electrical and Electronic Engineering:

Oscillating waves (circuits, signal processing), electric and magnetic fields, design of power generating equipment, radio frequency (RF) systems and antenna design

Energy Systems Engineering:

Design of sun-tracking mirrors (heliostats) for concentrating solar power plants.

Differentiation / differential equations (e.g. ordinary differential and partial differential equations, separation of variables, rates of change, Fourier Series)

Energy Systems Engineering (Mechanical & Civil):

Computational fluid dynamics, modelling of airflow in buildings (for design and temperature control), design of HVAC systems, wave equation for water and seismic waves

Electrical and Electronic Engineering:

Calculation of currents in a circuit, wave propagation, design of semiconductors, Image Analyses (e.g. edge detection)

Civil Engineering:

Hydraulics, conservation of mass equations (e.g. wastewater and water treatment), air pollution models , design of reactor vessels, predicting quantities of materials necessary for construction, design of foundations (soil consolidation), computational solid mechanics

Mechanical Engineering:

Fluid flow, dynamics (motion of projectiles, simple harmonic motion), heat transfer, temperature distribution, combustion (internal combustion engines), computational solid mechanics

General Engineering:

Calculate volumes, areas and lengths of objects, shapes, lines & curves

Integration (e.g. integration by substitution, integration by parts, partial fractions, root mean squares etc.)

Sports and Exercise Engineering:

Gait analysis, power meters, design of portable and wearable sensors

Civil Engineering:

Modelling of pollution dispersal, modelling and forecasting of ocean currents, waves and the effect of climate on these, fire engineering

Mechanical Engineering:

Fluid mechanics (e.g. de-icing planes), dynamics (motion of projectiles, simple harmonic motion), mechanics, determination of centre of mass of objects, design of combustion vessels, fuel cells

Biomedical Engineering:

Modelling of internal organs (e.g. model and test medical hypothesis of kidney functions to aid treatment)

Energy Systems Engineering:

Forecasting the effect of renewable energy on reducing greenhouse gas emissions into the future.

Electrical and Electronic Engineering:

Design of thyristor firing circuits (used in power supplies, photographic flashlights, dimming lights, alarm systems, robotics).

General Engineering:

Food processing (design of milk processing systems, production of cheese strings (cooling requirements to ensure bacteria are killed)!

Functions, polynomial, linear equations (Gaussian elimination), inequalities, logarithms, Euclidean geometry (incl. plane intersection)

Almost all engineering problems will use some if not all of these topics.

General Engineering:

Empirical relationships for engineering design, curve fitting, kinetics (biological and chemical reactions), fuel cell design, traffic modelling, power analysis, optimisation of industrial processes (e.g. injection moulding systems), stress analysis, determining the size and shape of almost all engineered parts (e.g. where beams are welded together at an angle they have to be first cut appropriately), software design, computer graphics etc.

Names of Numbers

One of the first mathematical challenges we find ourselves facing in astronomy is dealing with very large numbers. Unless you are an accountant for the federal government, these are numbers you just don't encounter in everyday life. Before we can begin to even talk about them we need words to name these very large numbers.

Numbers are named following a very straightforward pattern. Starting with the familiar, one thousand, and progressing to larger numbers it goes as follows:

1,000	one thousand
1,000,000	one million
1,000,000,000	one billion
1,000,000,000,000	one trillion

Notice how each set of three zeros (separated by a comma) has a new name. Note the order of the names, thousand, million, billion, trillion, each greater than the previous.

1,000,000,000,000,000 one quadrillion
1,000,000,000,000,000,000 one quintillion
1,000,000,000,000,000,000,000 one sextillion
1,000,000,000,000,000,000,000,000 one septillion
1,000,000,000,000,000,000,000,000,000 one octillion
1,000,000,000,000,000,000,000,000,000,000 one nonillion
1,000,000,000,000,000,000,000,000,000,000,000 one decillion
... etc.

Each name represents a number one thousand times larger than the previous, and since we can always multiply any number by 1,000 there is no largest number, and the naming convention continues. But concentrate on the first table, thousand, million, billion, and trillion. If you can keep these straight, which is larger than which, and how many digits each has.

Now of course there are numbers in between one million and one billion, one billion and one trillion and we need names for these as well. Fortunately we don't have to memorize billions of names since all of these numbers follow a very straight forward naming convention, and if you can count to one thousand, you already know it. Lets start with million.

1,000,000 one million
2,000,000 two million
3,000,000 three million
5,000,000 five million
10,000,000 ten million
20,000,000 twenty million
50,000,000 fifty million
100,000,000 one hundred million
250,000,000 two hundred fifty million
585,000,000 five hundred eighty-five million

Notice that the six zeros to the right are just there to tell us “million” and the digits left of these zeros are telling us how many million. This pattern repeats for billion, trillion, and all numbers larger. For example:

2,000,000,000 two billion
10,000,000,000 ten billion
13,000,000,000 thirteen billion
151,000,000,000 one hundred fifty-one billion
2,000,000,000,000 two trillion
8,000,000,000,000 eight trillion
214,000,000,000,000 two hundred fourteen trillion

Finally, we can mix these all together. For example:

1,854,000 one million, eight hundred fifty-four thousand
12,130,000 twelve million, one hundred thirty thousand
2,064,600,000 two billion, sixty-four million, six hundred thousand
8,284,347,418,671 eight trillion, two-hundred eight-four billion, three hundred forty-seven million, four hundred eighteen thousand, six hundred seventy one

With the numbers in this last set, especially the very last one, you can already seen one of the advantages mathematics has as a tool. It is much easier to write the number with numerical digits than it is to write it out in English

Applications of Mathematics

Algebra

- Computer Science
- Cryptology (and the Protection of financial accounts with encrypted codes)
- Scheduling tasks on processors in a heterogeneous multiprocessor computing network
- Alteration of pattern pieces for precise seam alignment
- Study of crystal symmetry in Chemistry (Group Theory)

Differential Equations (Ordinary and Partial) and Fourier Analysis

- Most of Physics and Engineering (esp. Electrical and Mechanical)
- Sound waves in air; linearized supersonic airflow
- Crystal growth
- Cryocooler modeling
- Casting of materials
- Materials science
- Electromagnetics analysis for detection by radar
- Material constitutive modeling and equation of state
- Underwater acoustic signal processing
- Predict the evolution of crystals growing in an industrial crystallizer
- Reentry simulations for the Space Shuttle
- Rocket launch trajectory analysis
- Trajectory prescribed path control and optimal control problems
- Motion of a space vehicle
- Aircraft landing field length
- Design and analysis of control systems for aircraft
- Underwater acoustic signal processing
- Nonlinear dynamics
- Large scale shock wave physics code development
- Material constitutive modeling and equation of state
- Molecular and cellular mechanisms of toxicity
- Transport and disposition of chemicals through the body
- Modeling of airflow over airplane bodies
- Photographic development (Eastman Kodak)
- Waves in composite media
- Immuno-assay chemistry for developing new blood tests
- Radio interferometry
- Free mesons in nuclear physics
- Seismic wave propagation in the earth (earthquakes)
- Heat transfer

- Airflow over airplane bodies (aerodynamics)

Differential and Computational Geometry

- Computer aided design of mechanical parts and assemblies
- Terrain modeling
- Molecular beam epotaxy modeling (computational geometry)
- Color balance in a photographic system
- Optics for design of a reflector
- Cryptology
- Airflow patterns in the respiratory tract

Probability and Statistics

- Calculation of insurance risks and price of insurance
- Analysis of statistical data taken by a census
- Reliability and uncertainty of large scale physical simulations
- Speech recognition
- Signal processing
- Computer network design
- Tracking and searching for submarines
- Estimation of ocean currents (geostatistics)
- Paint stripping using lasers
- Onset and progression of cancer and pre-malignant cells
- Determining launch schedules to establish and maintain prescribed satellite constellations (also uses Monte Carlo methods)
- Radar track initiation
- Aircraft survivability and effectiveness
- Color sample acceptance tolerance correlation and prediction
- Determination of sample sizes for color acceptability evaluation (uses advanced statistical methods)
- Underwater acoustic signal processing
- Reliability analysis of complex systems
- Radio interferometry

Numerical Analysis

- Estimation of ocean currents
- Modeling combustion flow in a coal power plant
- Airflow patterns in the respiratory tract (and diff. eqs.)
- Regional uptake of inhaled materials by respiratory tract
- Transport and disposition of chemicals through the body (and ODEs + PDEs)
- Molecular and cellular mechanisms of toxicity (and ODEs + PDEs)
- Reentry simulations for the Space Shuttle
- Trajectory prescribed path control and optimal control problems
- Shuttle/tank separation
- Scientific programming
- Modeling of airflow over airplane bodies
- Electromagnetics analysis for detection by radar

- Design and analysis of control systems for aircraft
- Electromagnetics
- Large scale shock wave physics code development
- Curve fitting of tabular data

Operations Research and Optimization

- Network formulation of cut order planning problem
- Shade sorting of colored samples to an acceptable tolerance by hierarchical clustering
- Inventory control for factory parts
- Search for and tracking of submarines
- Motion of a space vehicle
- Aircraft survivability and effectiveness
- Interplanetary mission analysis
- Radio interferometry
- Scheduling tasks on processors in a heterogeneous multiprocessor computing network
- Microwave measurements analysis
- Coordinate measuring machine (optimization error modeling)
- Optics for design of a reflector
- Materials science
- Reliability and uncertainty of large scale physical simulations

Mathematics Quotes by Mathematicians, Philosophers, and Enthusiasts

- Mathematics is the door and key to the sciences. — Roger Bacon
- Mathematics is the supreme judge; from its decisions there is no appeal.–Tobias Dantzig
- Mathematics is like love; a simple idea, but it can get complicated.
- Mathematics is a great motivator for all humans.. Because its career starts with zero and it never end (infinity).
- Mathematics Is an Edifice, Not a Toolbox
- Mathematics is an independent world created out of pure intelligence. — William Woods Worth
- The pure mathematician, like the musician, is a free creator of his world of ordered beauty – Bertrand Russell
- Do not worry about your difficulties in Mathematics. I can assure you mine are still greater.- Albert Einstein

National Centre for Mathematics

www.ncmath.org

(A joint centre of TIFR and IIT Bombay)

www.atmschools.org

Advanced Training in Mathematics Schools 2017

(Supported by National Board for Higher Mathematics)

Annual Foundation Schools			
Program	**Period**	**Venue**	**Organizers**
AFS - II	8th May to 3rd Jun	31st Jan	S.A. Katre V.V. Acharya
AFS - II	8th May to 3rd Jun	KSOM, Kozhikode	M. Manickam T.E. Venkata Balaji A.K. Vijayarajan
AFS - III	12th Jun to 8th Jul	North Eastern Hill University Shillong	Himadri Mukherjee A.T. Singh
Instructional Schools for Lecturers			
Gröbner Bases and their Applications	11th to 23rd Dec	Indraprastha Institute of Information Technology (IIIT), Delhi	Anuradha Sharma J.K. Verma
Groups and Rings	5th to 17th Jun	Himachal Pradesh University, Shimla	R.P. Sharma Dinesh Khurana
Commutative Algebra	24th Apr to 6th May	St. Joseph's College, Irinjalakuda, Kerala	Clare D'Cruz Manoj Kummini Mangalambal N.R.
Topology	01st to 13th May	IIT Patna	Ashish K. Upadhyay Om Prakash
Advanced Linear Algebra	10th to 22nd Jul	IIT Gandhinagar	Indranath Sengupta Sanjay Amrutiya
Advanced Instructional Schools			
Representation Theory of Finite Groups	12th Jun to 1st Jul	CMI, Chennai	Amritanshu Prasad K.N. Raghavan K.V. Subrahmanyam
Several Complex Variables	This programme has been postponed to 2018	IISc, Bangalore	Kaushal Verma Gautam Bharali
Class Field Theory	8th to 27th May	CMI, Chennai	M. Ram Murty P. Rath Sanoli Gun
Gröbner Bases and their Applications	11th to 23rd Dec	Indraprastha Institute of Information Technology (IIIT), Delhi	Anuradha Sharma J.K. Verma
Linear Partial Differential Equations	19th Jun to 8th Jul	TIFR - CAM	Veerappa Gowda Ujjwal Koley
h -Principle	22nd May to 10th Jun	ISI Kolkata	Mahuya Datta Adimurthi Goutam Mukherjee

Workshops			
Positive Characteristic Methods in Commutative Algebra	19th to 30th Jun	IIT Bombay	J. K. Verma Manoj Kummini
Differential Geometry	24th to 29th Jul	IISER, Pune	Indranil Biswas Mahan Mj Tejas Kalelkar
Langlands Programme	2nd to 7th Oct	TIFR, Mumbai	Dipendra Prasad C.S. Rajan
Analytic Number Theory	26th to 30th Dec	ISI Kolkata	Ritabrata Munshi Satadal Ganguly
Harmonic Analysis	11th to 16th Dec	(IISc), Bangalore	E.K. Narayanan P.K. Ratnakumar
Operator Algebra	11th to 16th Sep	The Institute of Mathematical Sciences, Chennai	Vijay Kodiyalam Partha Sarathi Chakraborty
Schubert Varieties	4th to 16th Sep	IIMSc, Chennai	K.N. Raghavan Sudhir R. Ghorpade
Teacher's Enrichment Workshop			
Group Theory, Analysis and Topology	09th - 14th Oct	Doon University, Uttarakhand	Sarita Singh Rajendra Prasad Mahender Singh