

UGED 1533 - Mathematics in Visual Art

Week 1

Historical Overview

1.1 Historical Background

This course is titled *Mathematics in Visual Art*. It must be clarified from the start that due to time constraint and the academic limitations of the instructor, we are concerned only with visual art, which is itself an ambiguous label.

By any reasonable standard, it is simply impossible to give broad but accurate definitions of words like "Western" and "visual art". We will stay close to the conventional narrative of Western art history, namely the one which is typically adopted by a first-year undergraduate Western art history curriculum. That said, this course has no capacity nor intention of giving a thorough account of Western art. To help familiarize ourselves with the artistic context of this course, we give in the following pages a skeletal body of specific examples of artwork, along with brief comments on their historical contexts.

Roughly, the timeline/geography which we cover stretches (in leaps and bounds) from the Greek Classical Era to Western Europe in the beginning of the twentieth century. It is admittedly a brief and incomplete summary. We strongly encourage students to explore the art historical aspects of this course in more depth for personal enrichment. We assure you that as an endeavour of self-cultivation it is well worth the time and effort.



1.2 Stone Age

20,000-30,000 years ago

When we speak of Western art history, the word "Western" suggests to us certain countries in Western Europe with which we are familiar today: Germany, Austria, Britain, France, Spain, Italy.... Then, the oldest extant examples of Western art might said to be prehistoric figurines such as the Venus of Willendorf and the Lascaux cave paintings, made in the Late Stone Age.



Venus von Willendorf



Lascaux Cave Painting

However, in most conventional narratives such prehistoric artworks do not play particularly significant roles in the subsequent development of Western art.

Instead, in most tellings of Western art history, what are more familiar to the layman as elements of Western art (The Renaissance, Mona Lisa, Van Gogh, "The Scream"...) trace their lineage to a relatively much more recent time, namely Ancient Greece.

1.3 Ancient Greece

8th century BCE - 6th century CE

By Ancient Greece we mean a certain geographical region which has a large overlap with the modern nation state called Greece, during a time span which stretched from the 8th century BCE ("Before Common Era") to the 6th century CE ("Common Era").

The period 8th - 5th century BCE is known as Archaic Greece. The earliest surviving Greek sculptures date to this period. In them we see the influence of Egyptian art from across the Mediterranean. The Doric and Ionic orders of Greek architecture date to this period. Their influence would be felt throughout western art history, up to the modern age.



The Parthenon, 438 BCE

Then came the Classical Greece period, 5th - 4th century BCE. This is the period of Greek history which has the most prominent influence on subsequent developments in Western philosophy, science, art and mathematics (in other words, pretty much the entire Western culture). The Pythagorean Theorem which we learned in school is named after the Greek Pythagoras of Samos, who lived around 570 - 495 BCE. Another Greek mathematician who was active during the Classical Greece period was one Euclid of Alexandria. Besides basic arithmetic and the Pythagorean theorem, arguably all of the mathematics we learn in primary school and the early years of secondary school may be credited to writings by Euclid, who was a Greek mathematician



Copy of Polykleitos's
Doryphoros
Statue original c. 440
BCE

was active during 323 - 283 BCE.

After the classical period we have [Hellenistic Greece](#) (4th - 2nd century BCE). By this time the Greeks have produced some of the greatest sculptures the world has ever seen. However, a significant portion of Greek sculptures were cast in bronze, which unfortunately was a material also useful in a number of non-artistic endeavours. War, for example. Consequently, there are few surviving original Greek sculptures. Hellenistic Greece came to an end when the Greek peninsula came under Roman rule in 146 BCE, ushering in the [Roman Greece](#) period.

1.4 Roman Empire

A detailed discussion of [The Roman Empire](#) deserves its own course, or even more appropriately an entire undergraduate curriculum. For us, we will mainly observe one key fact pertinent to us: Namely, that the Roman elite admired Greek art and the associated aesthetic principles. They made many copies (often in marble) of Greek sculptures, often employing Greek artisans to do so. (Most of what we know today about Greek sculptures are passed down via these Roman marble copies.) Consequently, ancient Greek art in a broad sense merged with the development of Roman art, and the whole general aesthetic is often placed under one label: "Greco-Roman".



Copy of The Dying Gaul
original c. 230 - 220 BCE



Winged Victory of Samothrace
2nd century BCE

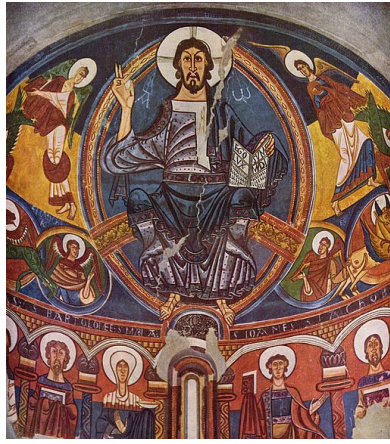
Besides the famous Roman numeral system, your instructor is unaware of any major mathematical innovation in the ancient Roman Empire.

In territorial terms, the Roman Empire reached its peak in 117 CE, after which came its centuries long decline, which we will not discuss in detail. Along the way the empire splits into Eastern and Western Empires. In 5th century CE, the Western Empire split into separate kingdoms ruled by the various "barbaric" tribes (the Gothic tribes, the Franks, the Saxons...) which had earlier invaded or been assimilated by the Roman Empire.

1.5 The Middle Ages

[5th - 14th century CE](#)

After the fall of the Western Roman empire, Western Europe entered the Middle Ages or [Medieval Period](#) (5th - 14th century CE). Two main artistic developments in this region at this time were the Romanesque and then the Gothic styles.



Apse of Saint Clément de Taul



Fresco, Chapelle Sainte-Claire

1.6 The Renaissance

14th - 17th century

The cultural phenomenon known as the **Renaissance** occurred during the time period 14th - 17th century CE. Its complex origin is of great ongoing academic interest. Within the context of this course, it suffices to say that towards the end of the 14th century, a confluence of economic, cultural, political and even environmental factors resulted in an explosion of cultural and intellectual activities in several urban centers (Florence, Venice, Naples,...) in the Italian peninsula. The Italian Renaissance then spread northward to regions which later became present day France, Belgium, the Netherlands and Germany. It was during the Renaissance that linear perspective took a prominent role in painting.

The Renaissance also saw a revival in the development of mathematics. The mathematical theory of linear perspective in painting were developed by a number of individuals, such as Filippo Brunelleschi (who designed the famous Duomo in Florence) and Leon Battista Alberti.



Ascension of St John (14th century CE)

Giotto



The Arnolfini Portrait (1434)
Jan van Eyck



The Birth of Venus (c. 1480)
Sandro Botticelli



Mona Lisa (1503 - 1506) Leonardo Da Vinci



David (1501 - 1504)
Michelangelo Buonarroti

1.7 The Baroque Period, Dutch Golden Age

Approx. 17th century

The 17th century saw several major developments in European history. In art this period coincided with the peak of the [Baroque style](#), prevalent in Southern Europe, and the Dutch Golden Age in the North.

Some notable Baroque painters: Caravaggio (Italian), Jusepe de Ribera (Spanish), Nicolas Poussin (French), Peter Paul Rubens (Flemish), Anthony van Dyck (Flemish).



St John the Baptist (c. 1603-1604)
Caravaggio



Massacre of The Innocents (1611-1612)
Peter Paul Rubens

Some notable Dutch Golden Age artists: Rembrandt Harmenszoon van Rijn, Jan Vermeer, Jacob van Ruisdael, Pieter Claesz.



Self-Portrait at the Age of Sixty-Three
Rembrandt Harmenszoon van Rijn
(1606 - 1669)



The Geographer (c. 1668-1669)
Jan Vermeer

It was also during the 17th Century that Europe saw a great number of scientific/mathematical advances, due to the work of individuals such as Galileo, Newton, Leibniz and Descartes. Descartes introduced what we now call the Cartesian coordinate system, which provides a means to link geometry and algebra (a revolutionary idea at the time), while Calculus (differentiation, integration) was developed by Newton and Leibniz independently. Newton was also the first to demonstrate the spectrum of colours in natural light, which is a milestone for subsequent developments in colour theory.

From this period on, mathematics was to take on an ever more prominent role in the scientific investigations of the natural world. This trend would continue to the present day.

1.8 The Age of Enlightenment

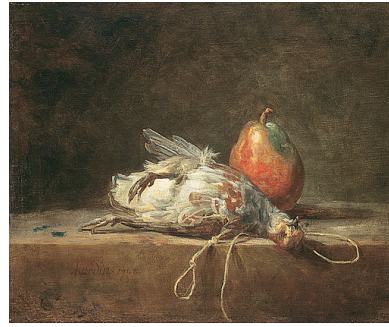
18th century

Eighteenth century Europe saw the emergence of the [Age of Enlightenment](#). Many new ideas in philosophy and mathematics were introduced in this period. For music lovers, a number of the most important composers (Bach, Handel, Haydn, Mozart) in Western music were active in this period.

Some 18th-century painters of note are Thomas Gainsborough, Joshua Reynolds, Fragonard, Jean-Baptiste-Siméon Chardin, Guardi and Jacques-Louis David.



Woman in Blue (c. 1770-1780)
Thomas Gainsborough



Still Life with Partridge and Pear (1748)
Jean-Baptiste-Siméon Chardin

A number of important mathematicians were active in 18th century Europe. They include Leonhard Euler, Évariste Galois and Pierre-Simon Laplace.

Euler is arguably one of the most important mathematicians who have ever lived. He made many important discoveries in Mathematical Analysis, Number Theory and Topology.

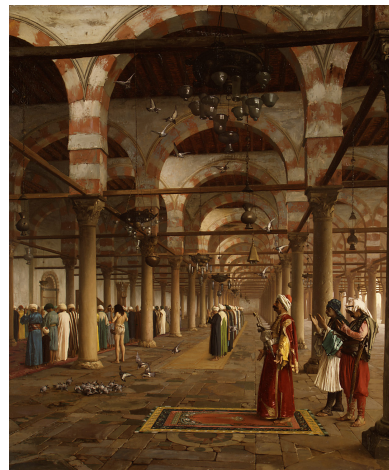
1.9 The 19th Century

1.9.1 Academic Art

By and large the first half of the 19th century was dominated by French **Academic Art**. Of all the art academies which operated in Europe in this time period, the most prominent one was the School of Fine Arts (École des Beaux-Arts) in Paris. Before the advent of the academic system, painters in Europe were typically trained in the studios of individual master painters. Some noteworthy academy-trained painters: Jean-Auguste-Dominique Ingres, Jean-Léon Gérôme, Jean-Louis André Théodore Géricault, Eugène Delacroix, Paul Delaroche, William-Adolphe Bouguereau.



Jupiter and Thetis (1811)
Jean-Auguste-Dominique Ingres



Prayer in the Mosque (1871)
Jean-Léon Gérôme

Concurrently, there were French painters who were not academically-trained, and did not adopt the neoclassical or orientalist subject matter favoured by many academic painters at the time. Some notable painters in this "Realist" movement are:

Gustave Courbet, Edouard Manet, Francois Millet (who did attend the École des Beaux-Arts, but had his scholarship terminated) and Jean-Baptiste-Camille Corot.



The Gleaners (1857)
Jean-François Millet



Luncheon on the Grass (1863)
Edouard Manet

1.9.2 Impressionism, Post-Impressionism

2nd half of 19th century.



Dance at Bougival (c. 1882 - 1883)
Pierre-Auguste Renoir

The second half of the 19th century saw the **Impressionism** movement. Artists (Claude Monet, Pierre-Auguste Renoir, Camille Pissarro, Alfred Sisley) who are often labeled as impressionists tended to favour outdoor painting (made possible by the introduction of oil paints packaged in metal tubes), with great emphasis placed on capturing the effect of light, using novel ideas in colour theory, new styles of paint application, and oil paints which had been unavailable before the Industrial Revolution.



Pont d'Argenteuil (c. 1874)
Claude Monet

Following Impressionism came **Post-Impressionism**. A chief component of this movement is Pointilism, which further developed the optical mixing technique first seen in some Impressionist works. Some noted Post-Impressionists are: Georges Seurat, Paul Signac and Vincent van Gogh.



A Sunday on La Grande Jatte (1884-1886)
Georges Seurat



Starry Night (1889)
Vincent van Gogh

The 19th century saw further major advances in mathematics, made by people such as Joseph Fourier, Bernhard Riemann, Peter Dirichlet and Carl Friedrich Gauss.

1.10 "Modernity"

20th century.



Madame Cézanne (1888 - 1890)
Paul Cézanne

One key figure in Post-Impressionism is a certain Frenchman named Paul Cézanne (1839-1906), and with him it might very well be argued that the age of Modern Art began. From then on the

world saw the works of Matisse, Picasso, Delaunay, Chirico, Morandi, Marc, Ernst, Beckmann, Kandinsky, Klee.... There was also a distinct shift of momentum to the USA, led by such painters as Gorky, Rothko, DeKooning, Pollock, Motherwell, Newman (many of whom were immigrants from Europe). By this point, it is evident from just the long lists of names that the art world would grow at an ever greater rate, and in ever more diverse directions. So, we will stop here, lest these notes never end.