

# Art and Perception



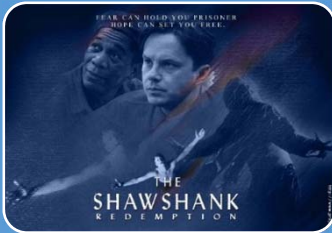
Weizhe Ni

June, 5, 2013

# Outline



Painting, Woodcut, lithograph



Movie Poster



Film Techniques

# Depth and Pictorial Perception

Depth Perceptual Cues come from the information conveyed by optical array projected on our retina.

## Binocular cues

- Require two eyes
- Gained from 3D objects such as sculpture
- Such as convergence and binocular disparity

## Monocular cues

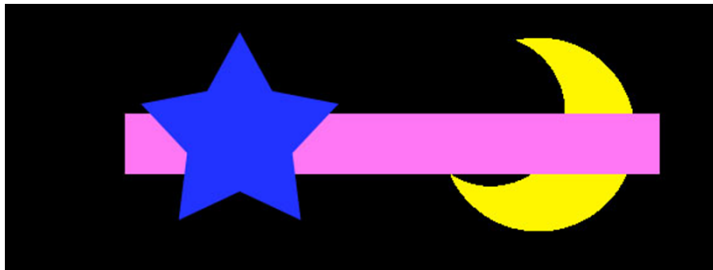
- Require one eye
- Called pictorial cues when the viewer and scene are both stationary
- Often presented simultaneously with each other
- Such as interposition, aerial perspective, shading and lighting, elevation, linear perspective, texture gradient, and relative size



*A seaport at sunset*, Claude Joseph Vernet, 1749

# Interposition

Interposition or partial occlusion happens when objects are overlapping. The object that is partially covered by another one appears to be in the back.



*The First Thanksgiving*, J.L.G. Ferris, early 20th century

# Aerial Perspective

Aerial perspective or clearness refers to the difference in how clearly we can see objects that are far away and those that are near.

- Far objects are less clear because less light rays passing through the atmosphere
- Far objects have lower contrast with the background than near objects do



*Among The Sierra Nevada Mountains, Albert Bierstadt, 1868*

# Elevation and Linear Perspective

The elevation of objects above the horizon in our visual field is an important cue to their depth.



*Pegwell Bay*, William Dyce, 1858

Linear perspective is often refer to perspective, far objects are systematically smaller than nearer objects



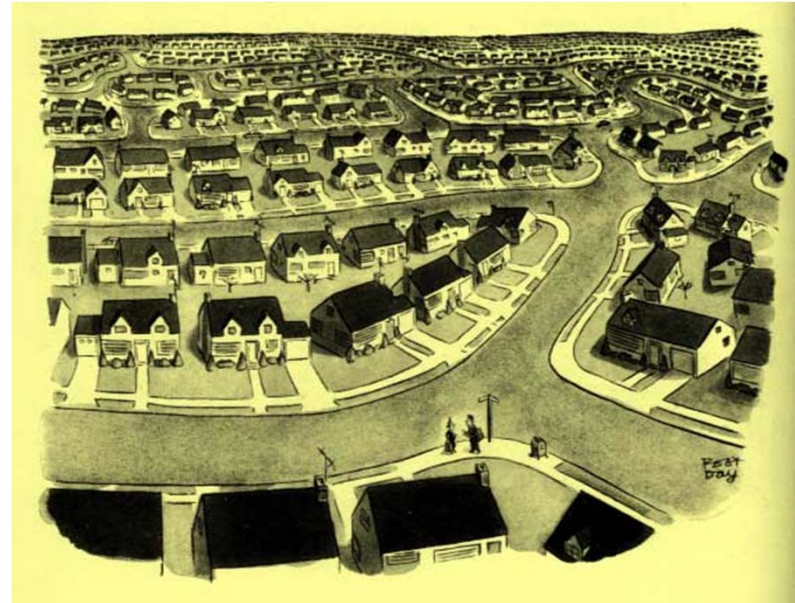
*Bristol, Broad Quay*, unknown artist, 1730

# Texture Gradient and Relative Size

Elements of textured surface appear smaller and denser as the distance increases.



Relative size refers to a cue applied when two identical objects with different sizes are shown



*The New Yorker Album of Drawings, The Viking Press, NY, 1975*

# Summary of Pictorial Perception





# Perception and Impossible Reality

**M. C. Escher** was a Dutch graphic artist

- Known for his mathematically inspired woodcuts and lithographs.
- These feature impossible constructions, created from images in his mind, rather than directly from observations.

**Impossible Reality** painting is a kind of artwork which express quite distinctly recognizable realities bound together in a natural, and yet at the same time a completely impossible, way.

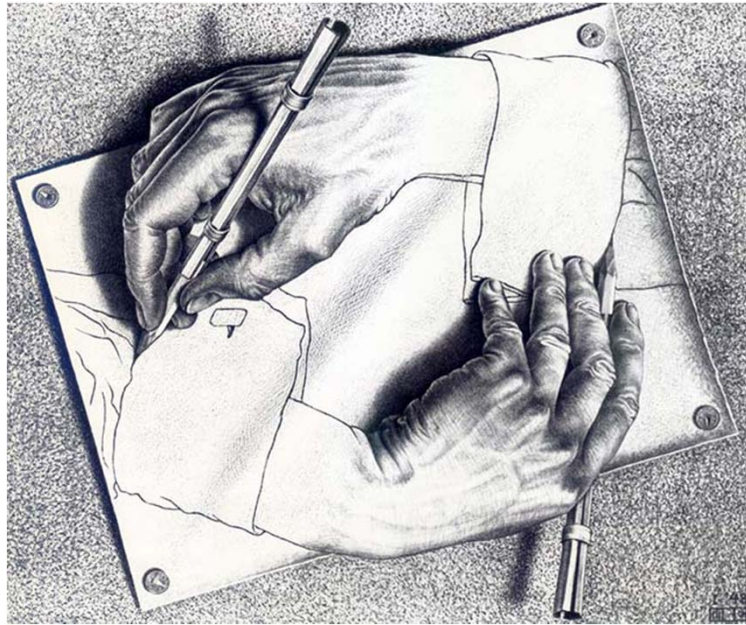


M. C. Escher (1898-1972)

# Perception and Impossible Reality



*Still Life and Street*, M.C. Escher 1937



*Drawing Hands*, M.C. Escher 1948

# Perception and Impossible Reality

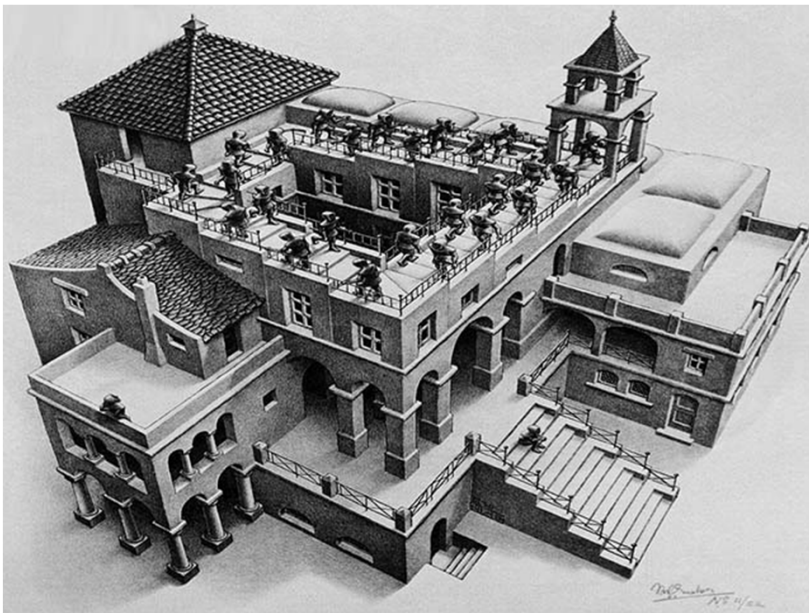


*Waterfall*, M.C. Escher 1961



*Belvedere*, M.C. Escher 1958

# Perception and Impossible Reality



*Ascending and Descending*, M.C. Escher 1960



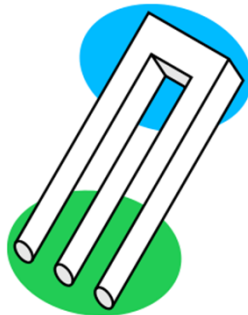
Penrose Stairs in *Inception*, 2010

# Impossible Objects

- Optical illusion consisting of a two-dimensional projection of a three-dimensional object .
- Instantly and subconsciously interpreted by the visual system
- Not geometrically possible for such an object to exist



Penrose triangle



Blivet



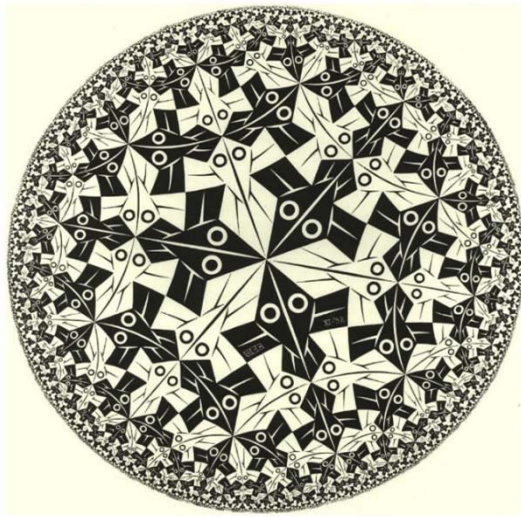
# The Generic View Principle

- The inference of distal structure should remain substantially the same if the "position" of the observer were moderately altered .
- Our visual system assumes we are viewing something from a non-accidental point of view.
- Our visual system is very constrained by how it interprets 2D pictorial images into 3D mental representations.



# Hyperbolic Tessellations

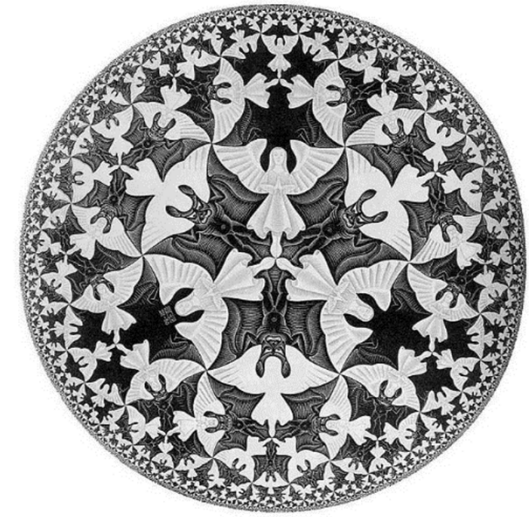
Escher explored the concept of representing infinity on a 2D plane. Discussions with Canadian mathematician H.S.M. Coxeter inspired Escher's interest in hyperbolic tessellations, which are regular tilings of the hyperbolic plane. Escher's wood engravings *Circle Limit I–IV* demonstrate this concept. In 1959.



Circle limit I



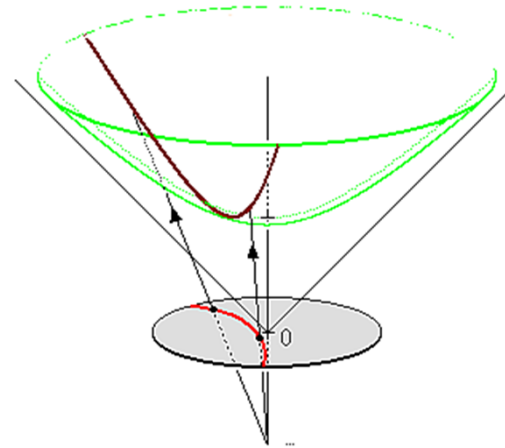
Circle limit III



Circle limit IV

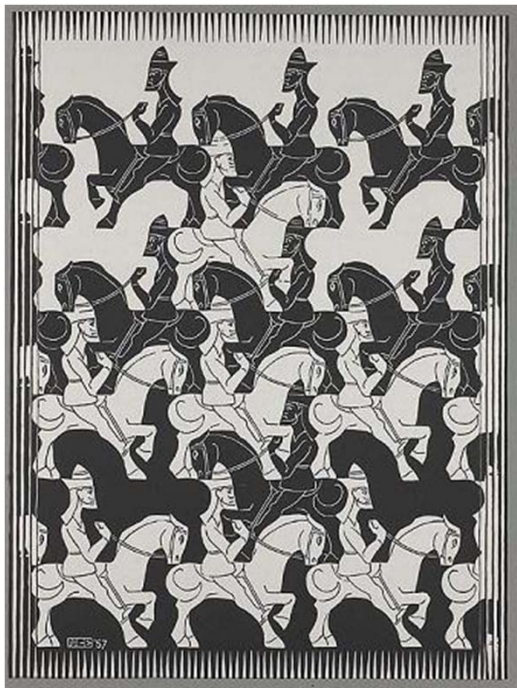
# Conformal Disc Model

- In geometry, it's also called **Poincaré disk model**.
- The Conformal disk model is the projection of hyperbolic model
- Conformal disk model can be constructed through the equation  $x^2+y^2-t^2=1$  viewed from  $t=-1$ , projecting the upper half hyperbolic onto an  $(x,y)$  unit disk at  $t=0$ 
  - Planes passing through the origin represents geodesics on the hyperbolic plane
  - The red circular arc is geodesic in Conformal disk model
  - It projects to the brown geodesic on the green hyperboloid





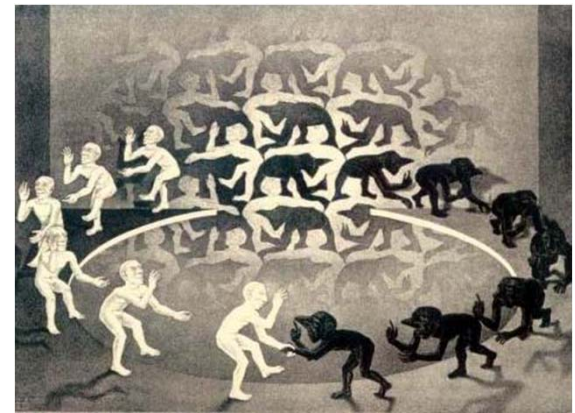
# Infinity Tessellations



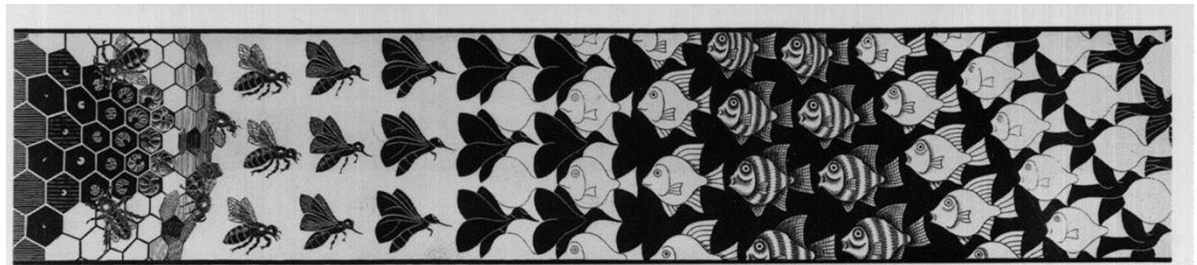
*Regular Division of the Plane III, 1957 (woodcut)*



*Reptiles, 1934 (lithograph)*



*Encounter, 1944 (woodcut)*



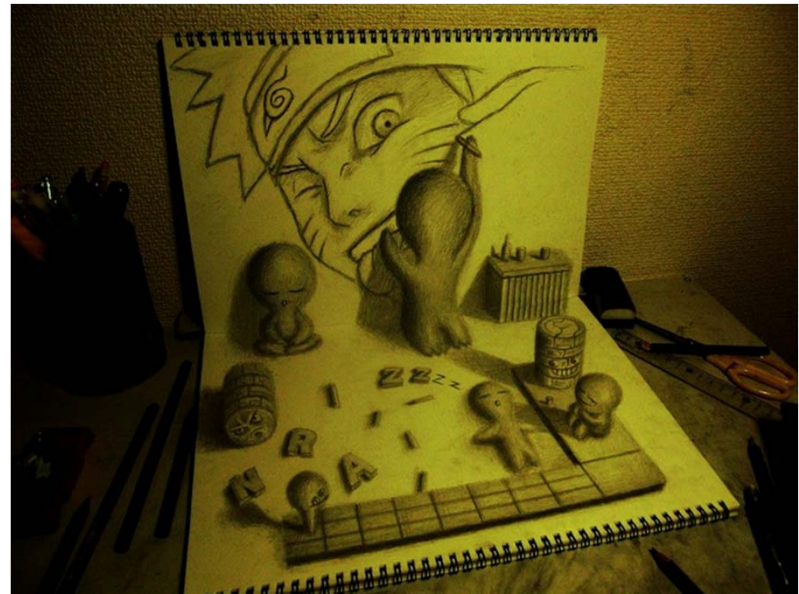
*Metamorphosis III, 1967 (woodcut)*

# Naked Eye 3D Drawings



*Gallery of Nagai Hideyuki, 2013, Japan*

# Naked Eye 3D Drawings



*Gallery of Nagai Hideyuki, 2013, Japan*

# How to..



# More Crazy..



# Even More..



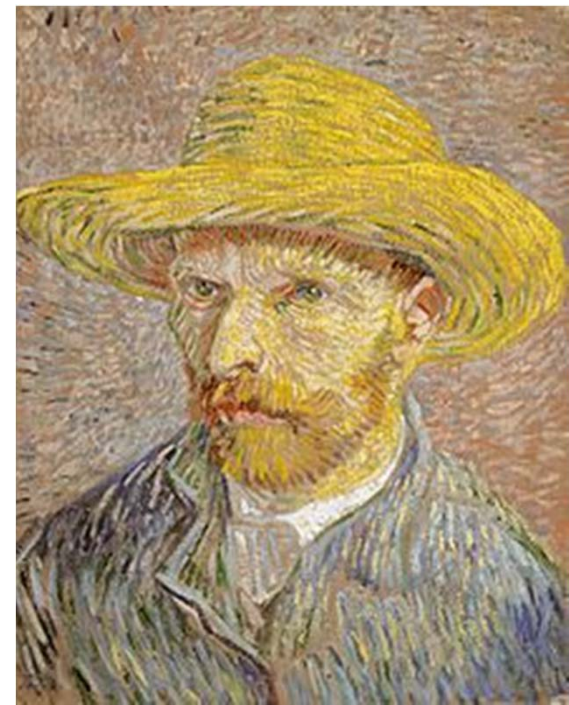
# Vincent van Gogh and Color Blindness

Vincent Willem van Gogh (1853 – 1890) was a Dutch post-Impressionist painter whose work, notable for its rough beauty, emotional honesty and bold color, had a far-reaching influence on 20th-century art.

- Kazunori Asada, who is a Japanese vision expert, breathes fresh life into the seemingly-preposterous theory
- He used a color-blindness lens as filter
- He noticed certain characteristics of van Gogh's work could indicate colorblindness while giving a speech in Hokkaido, Japan, on color deficiencies



Kazunori Asada 浅田一憲



*Self-Portrait with Straw Hat, Paris, Winter 1887/88*

# How life looks to a color-blind person



Revelers perform on the colorful family day at the Notting Hill Carnival this Bank Holiday



The same scene, but through the eyes of the colorblind: Colors are more muted and changed



# How life looks to a color-blind person



A purple-grey sky overshadows Nebraska, as storm-clouds rush over



Lacking the ability to see red hues, a color-blind viewer will see a different landscape, with more watered-down colors

# How life looks to a color-blind person



The fireworks of the closing ceremony of the London Olympics 2012, seen through full vision



And seen again through a color-blind filter, where the fireworks take on a blue tint

# Van Gogh's Masterpieces



What we are used to seeing: *The Starry Night*, 1889, in its original, unaltered state



Improvement? Viewed through a color-blind lens, the textures and mood alters subtly, the outlines become less harsh, and the colors take on a different hue

# Evidences of Color-blindness

## Original Painting Show Strange Way of Using Color

- Lines of different colors run concurrently
- A point of different color suddenly appears
- Color normal people do not understand Van Gogh's paintings well, seemingly

## In Color Vision Experience Room

- Incongruity of color and roughness of line had quietly disappeared
- Each picture had changed into one of brilliance with very delicate lines and shades
- Color deficient people can better understand his pictures



*The Road Menders, 1889*

# Evidences of Color-blindness



Original "*The Road Menders*"



"*The Road Menders*" with 60% Protanomal simulation

# Other Examples

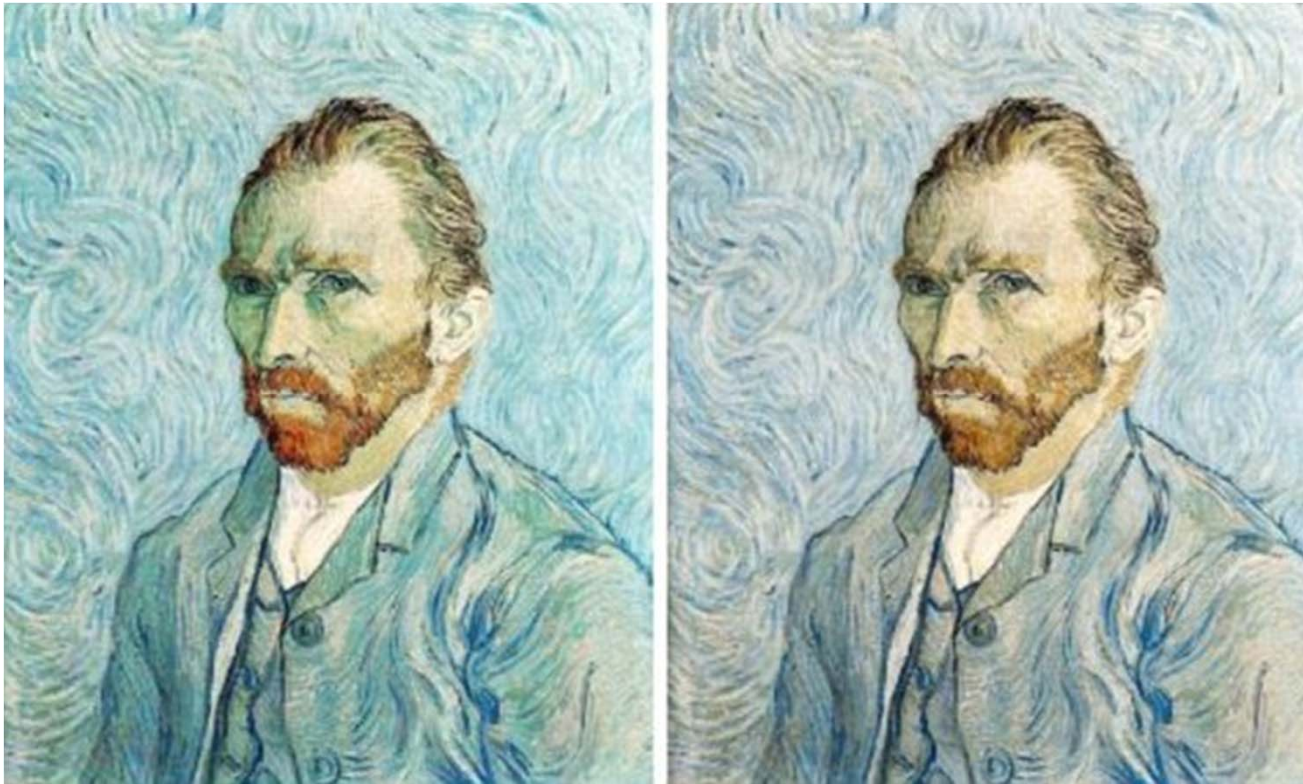


The original version of *Cafe Terrace at Night* appears here



The colorblind version: Using filters washes out some of the green of the images, perhaps showing the picture as Van Gogh intended

# Other Examples

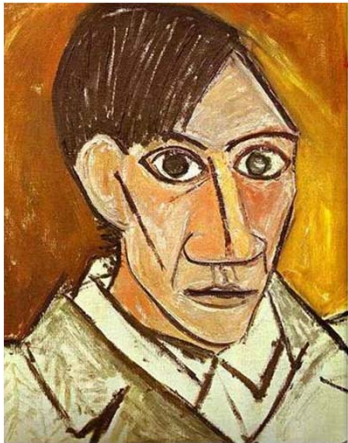


Van Gogh's self-portrait comes in a different hue when seen originally (left) and as a protanomalous simulation (right)

# Picasso and Cubism

Pablo Picasso was a Spanish painter, sculptor, printmaker, ceramicist, and stage designer

One of the greatest and most influential artists of the 20th century



- Co-found the Cubist movement
- Constructed sculpture



Pablo Picasso, 1881 - 1973



# Picasso and Cubism

Cubism is an early-20th-century avant-garde art movement pioneered by Pablo Picasso and Georges Braque

In Cubist artwork, objects are analyzed, broken up and reassembled in an abstracted form

Artists depict the subject from a multitude of viewpoints to represent the subject in a greater context



*Portrait of Ambrose Vollard,*  
Pablo Picasso, 1910

# Picasso and Cubism

Our gaze wanders through the picture, turning this way and that, zooming in, panning out, the image held together by its own internal design.

Short hand-cranked silent film, allowing you to view the black-and-white frames one by one

Pulls off the effect of motion through time in a single image



*Portrait of Ambrose Vollard,*  
Pablo Picasso, 1910

# Another Example



*Still Life with Apples and Oranges, Pablo Picasso, 1895-1900*

Tension between 2-D pattern and 3-D depth.

Quirky shifts of perspective seem to mimic the artist inspecting the objects from different angles.

# Multi Perspective VS No Perspective

There is no perspective

The houses appear to be stacked on one another instead of being one behind the other

Mountain VS. Houses

Where is the sky?



*Houses on the Hill, at Horta de Ebro, Pablo Picasso, 1909*

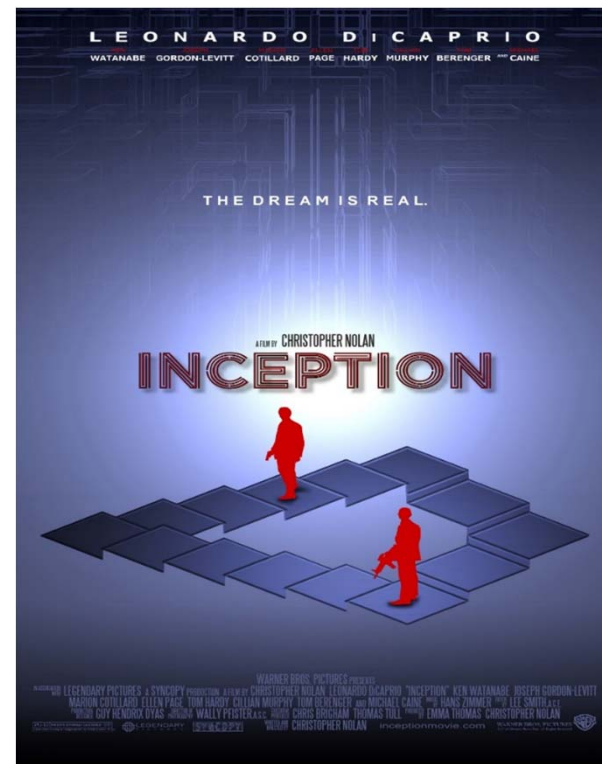
# Perception in Movie Posters

## What makes iconic movie posters

- Burned onto the viewer's consciousness
- Recognizable and representative
- Highly visual attractive to grab attention
- Expressive for the content of the movie

## Visual Techniques

- Symbolic Objects
- Top-Down Visual Process
- Feature Hierarchy
- Contrast
- Space/Scale/Depth/Dimension



*Inception*, 2010

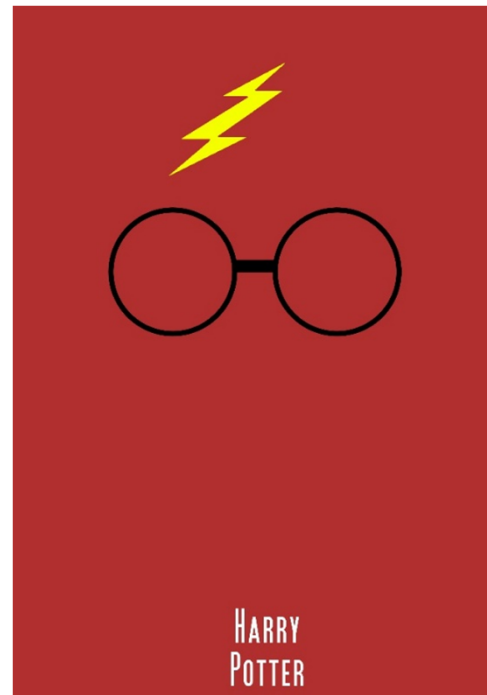
# Symbolic Objects

## What are symbolic objects

- Symbols are a means of complex communication that often times can have multiple levels of meaning
- Symbols basis for human understanding
- Symbols are made up from meaningless simple parts and become expressive together

## Characteristics

- Extracted from important characters, objects, scenes and events in the movie
- Easily recognized, highly representative



*Harry Potter and the Sorcerer's Stone, 2001*



*Inglourious Basterds, 2009*

# Symbolic Objects

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*Wall Street, 1987*

*The Matrix, 1999*

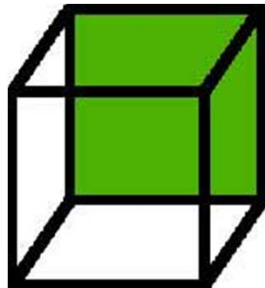
# Top-Down Visual Process

Psychologist **Richard Gregory** in 1970 argued that perception is a constructive process which relies on **Top-Down processing**.

- A lot of information reaches the eye, but much is lost by the time it reaches the brain (90%)
- Brain has to guess what we see based on past experiences
- Perceptions of the world are hypotheses based on past experiences and stored information
- Sensors receive information and combine them with previously stored knowledge/experience
- Incorrect hypotheses will lead to errors of perception



Necker Cube:



**Perceptions can be ambiguous!**

Gregory argued that this object appears to flip between orientations because the brain develops two equally plausible hypotheses and is unable to decide between them.



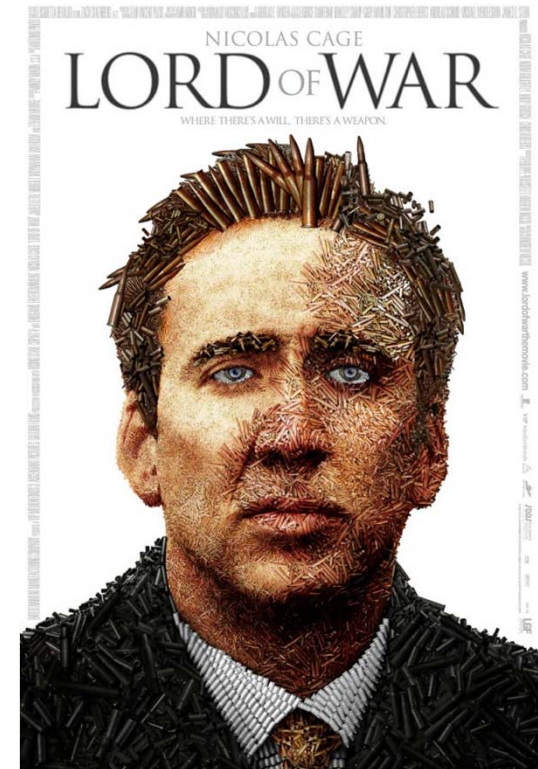
# Top-Down Visual Process



*The Dark Knight Rises, 2012*



*Terminator Salvation, 2009*



*Lord of War, 2005*

# Perceptual Segregation

Perceptual segregation reflects the cognitive ability to separate features belonging to the same real world entity, the grouping of these features into mutually exclusive areas, and their separation from other incompatible features in a manner that promotes a biologically useful representation of the scene.

## Identify Objects

- Symmetry
- Familiarity
- Continuous

## Visual Segregation

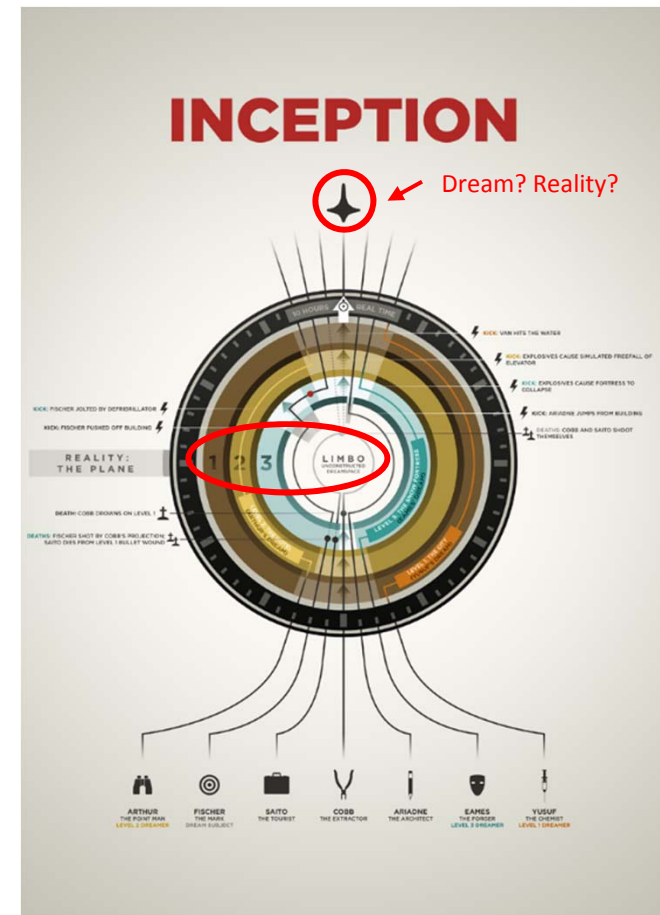
- Dynamic interaction between the visual stimulus and brain structures on a moment-to-moment basis
- Preceding attentional allocation
- Prior to imparting meaning to a scene
- Recognition and Segregation happen in parallel



# Feature Hierarchy

“Features” here means **Visual Features**, they makes it easier to understand what is being displayed. Eyes see color and brightness as the highest feature in the visual hierarchy, then size, then shape.

- A shape of circle with brighter color
- Eye, Nerve, Brain
- Cobb’s Totem - gyro
- 3 level of dreams and Limbo
- Dream VS. Reality



*Inception, 2010*

# Contrast and Saliency

## Contrast

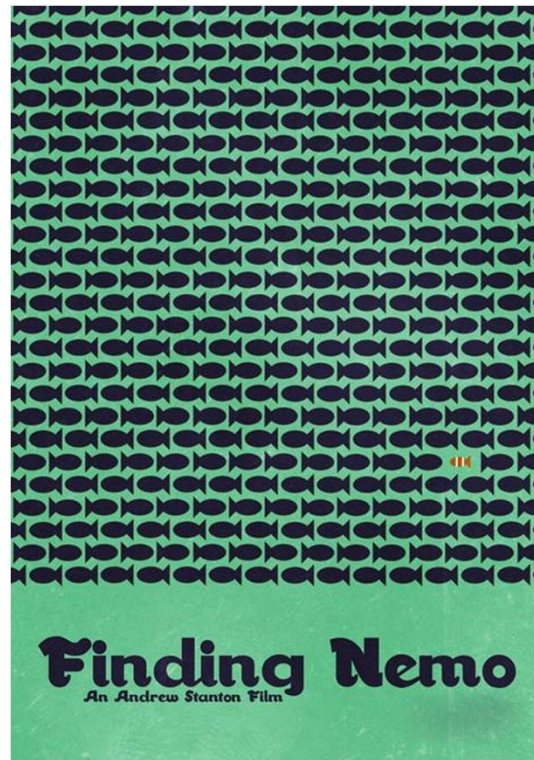
- Contrast is the difference in luminance and/or color that makes an object distinguishable

- In real world, contrast is determined by the difference in color /brightness between objects within the same field of view

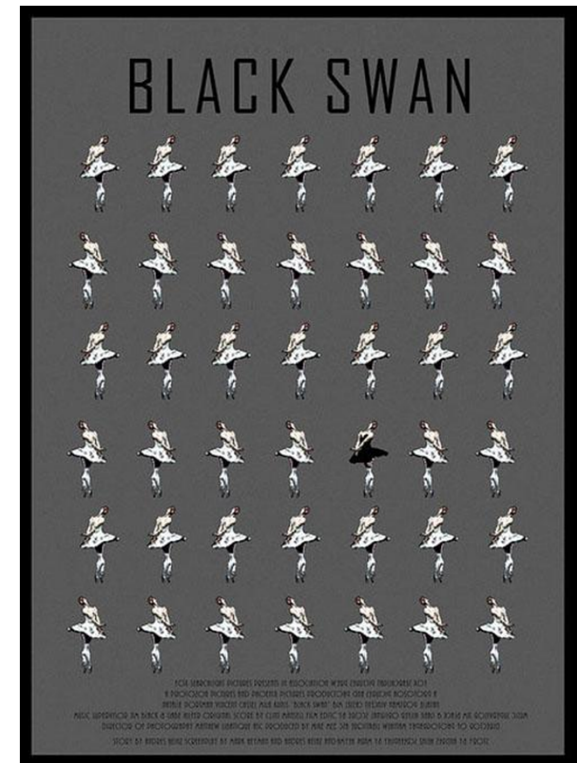
## Saliency

- A few colors used to make each object and color well defined

- Abnormal objects embedded in large number of same normal objects to attract attention



*Finding Nemo, 2003*

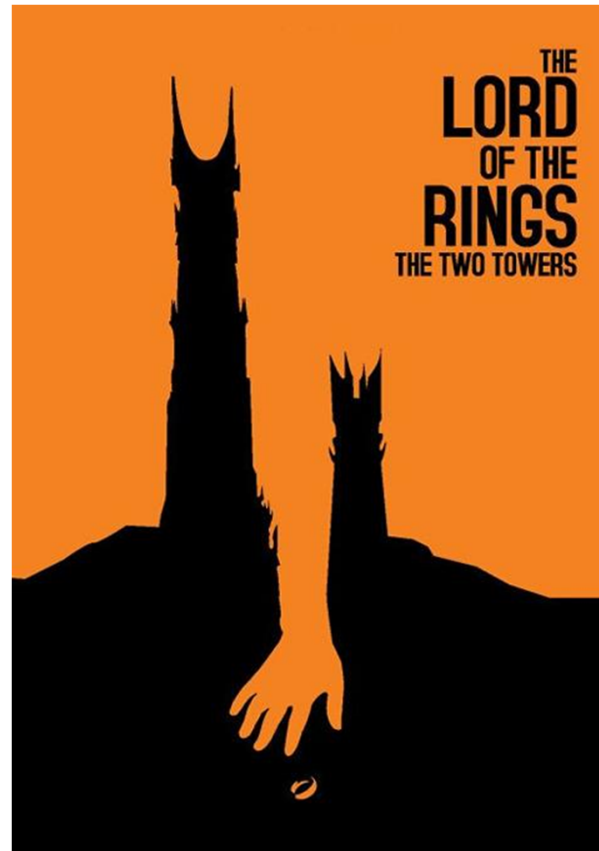


*Black Swan, 2010*

# View it in two ways

## Foreground and Background

- Gestalt Theory
- Reversible figure ground
  - More object like
  - Figure in front of ground
  - Ground is uniform region behind figure
  - Separating contours belong to figure



*The Lord of the Rings. The Two Towers, 2002*

# View it in two ways

Multi-interpretation on the same symbol

- Familiarity
- Focus and Attention
- Different impression on different people

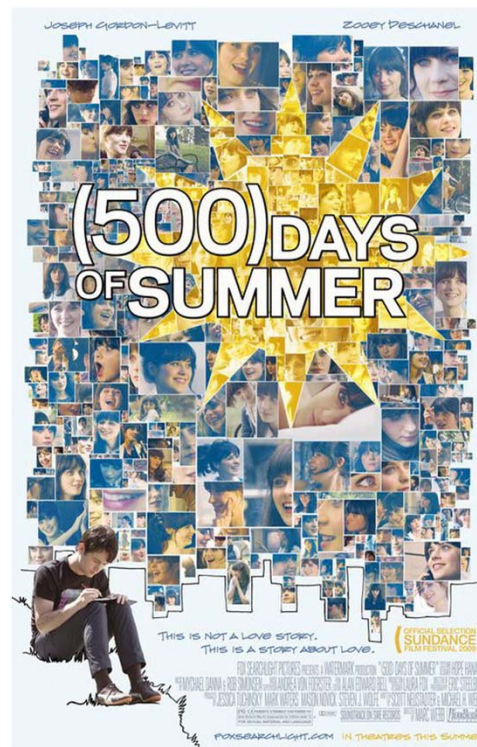


*Batman Begins, 2005*

# Other Interesting Stuff



*Memento, 2000*

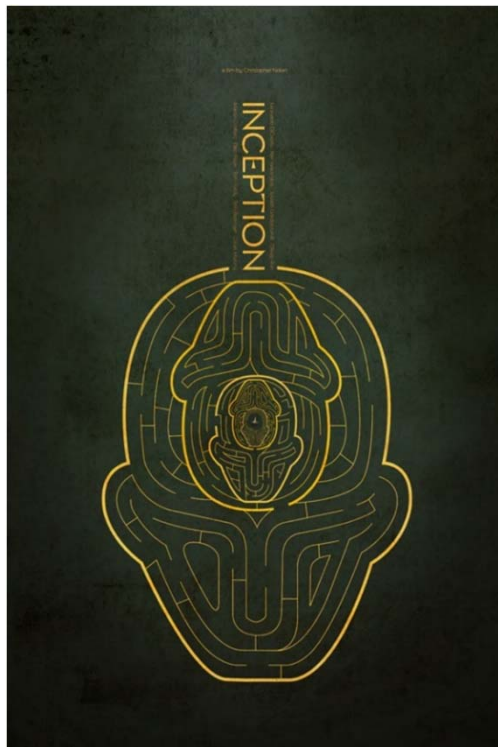


*500 Days of Summer, 2009*

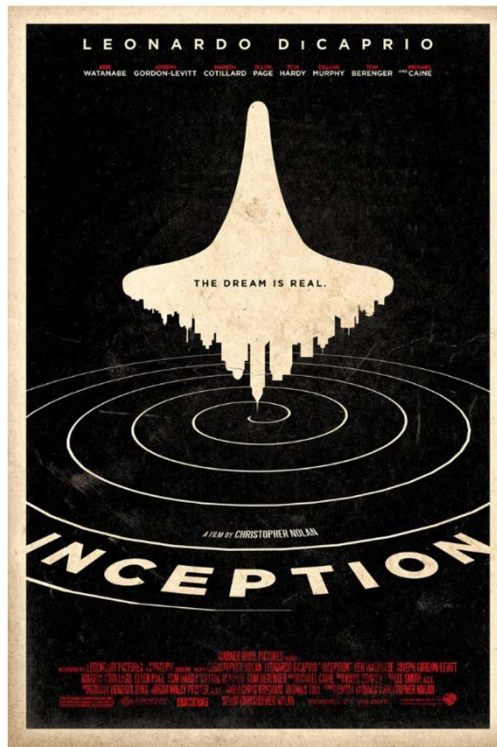


*Memento, 2000*

# Other Interesting Stuff



*Inception, 2010*



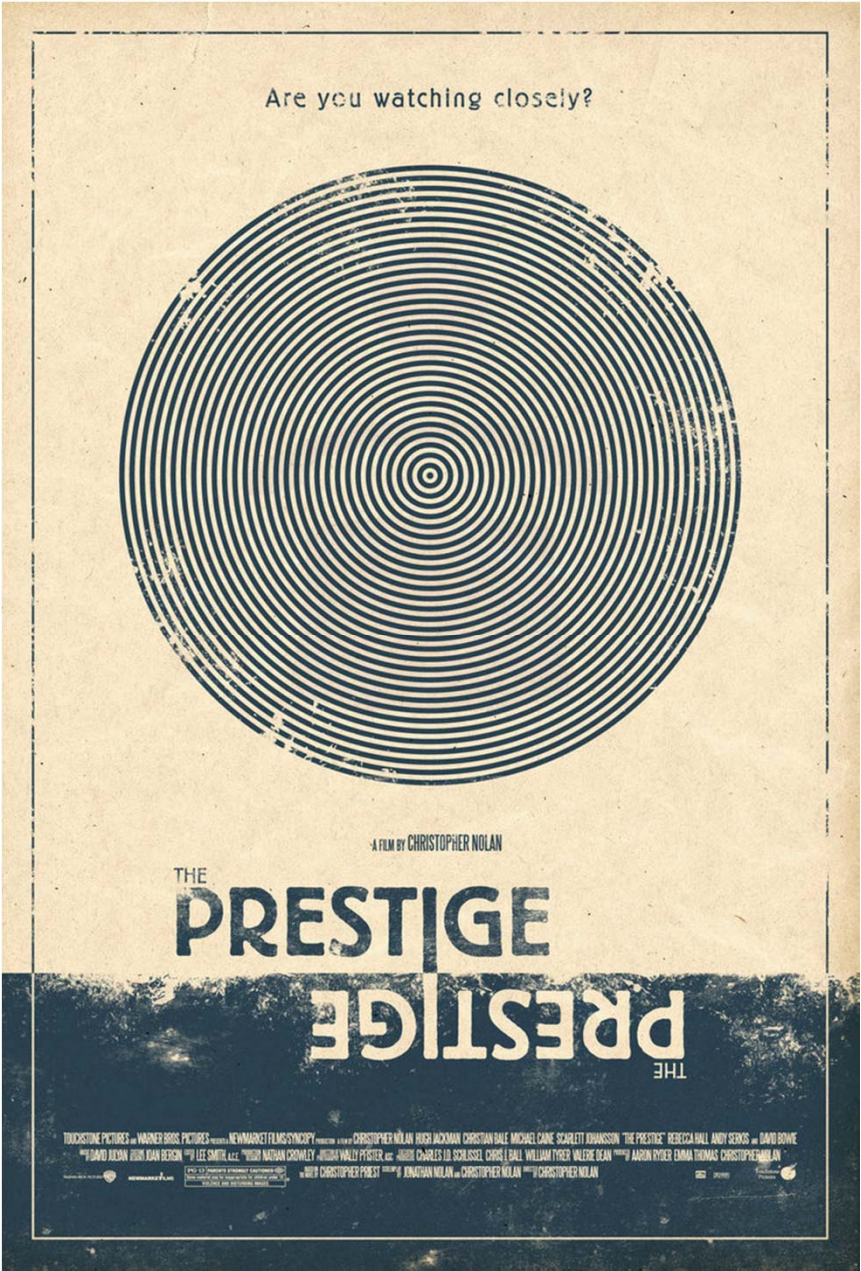
*Inception, 2010*



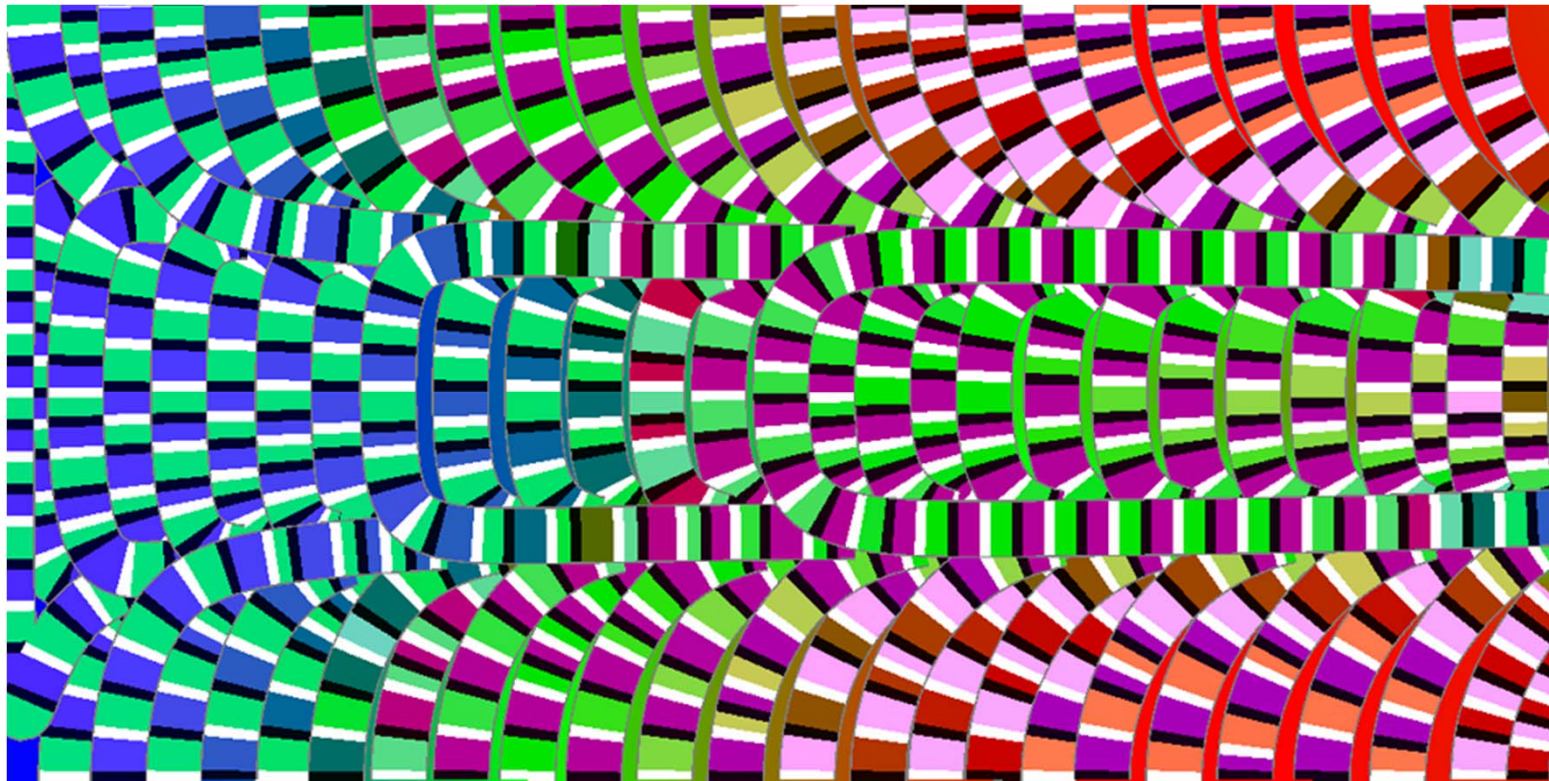
*The Dark Knight, 2008*



Are You Watching Closely?



# Self-Animating Images

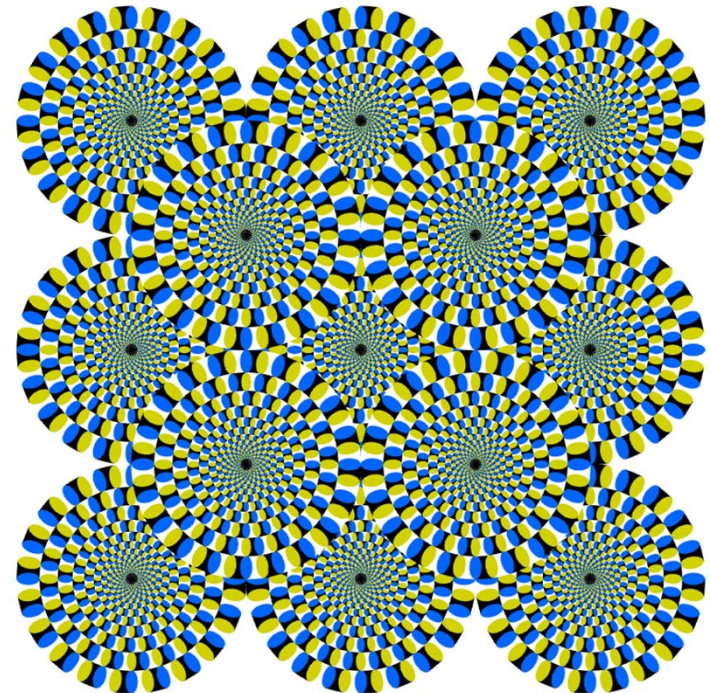


# Self-Animating Images

Illusory Motion is an optical illusion in which a static image appears to be moving due to the cognitive effects of interacting color contrasts and shape position.

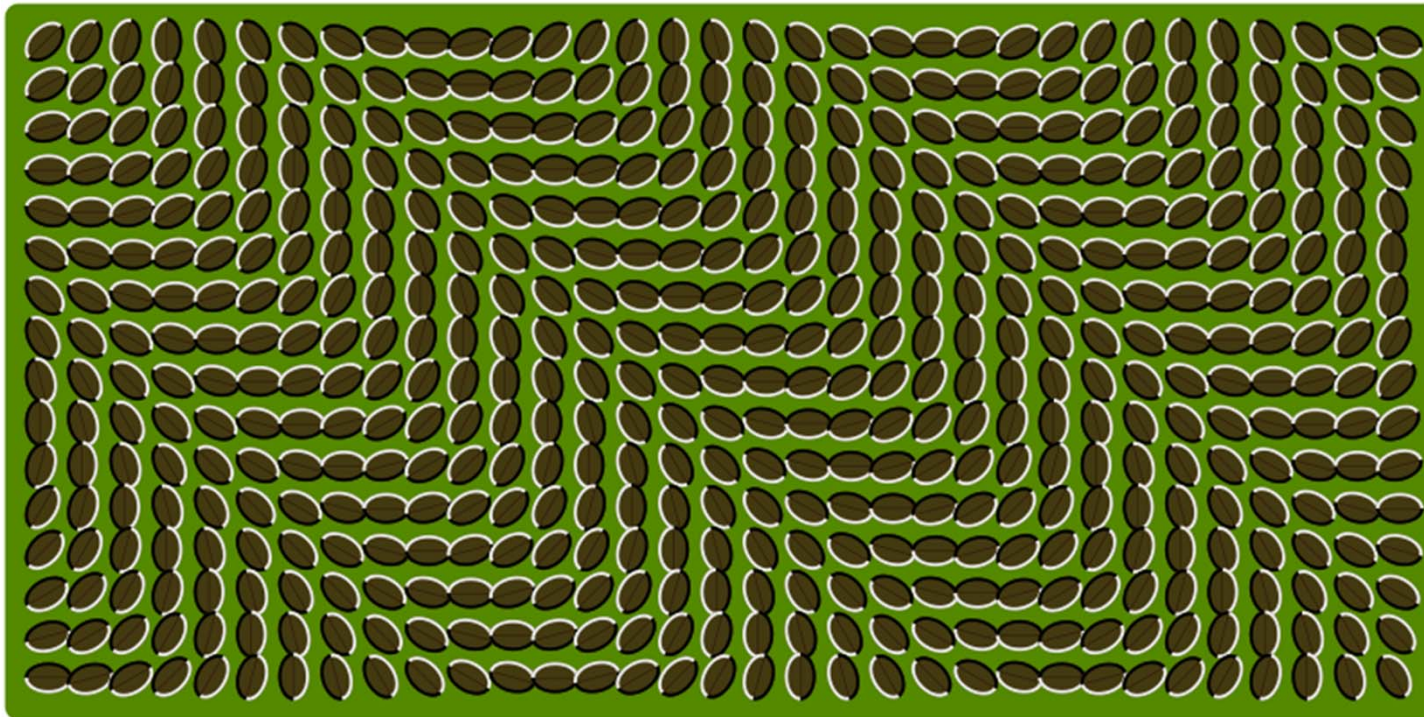
## How it works

- Repeated Asymmetric Pattern (RAP) can cause illusory motion in a still image
- Lots of repeating parts make it hard for visual system to lock on to any part of the pattern to get a frame of reference
- Shading of different parts creates illusory motion that combines with motion from small eye movements
- The effect is greatest in peripheral vision, where your visual resolution is most susceptible to the illusionary motion cue in the shading of the patterns
- Eyes attracted by the illusory motion causes more illusory motion



*Rotating Snake* by Akiyoshi Kitaoka

# Another Examples to Play With

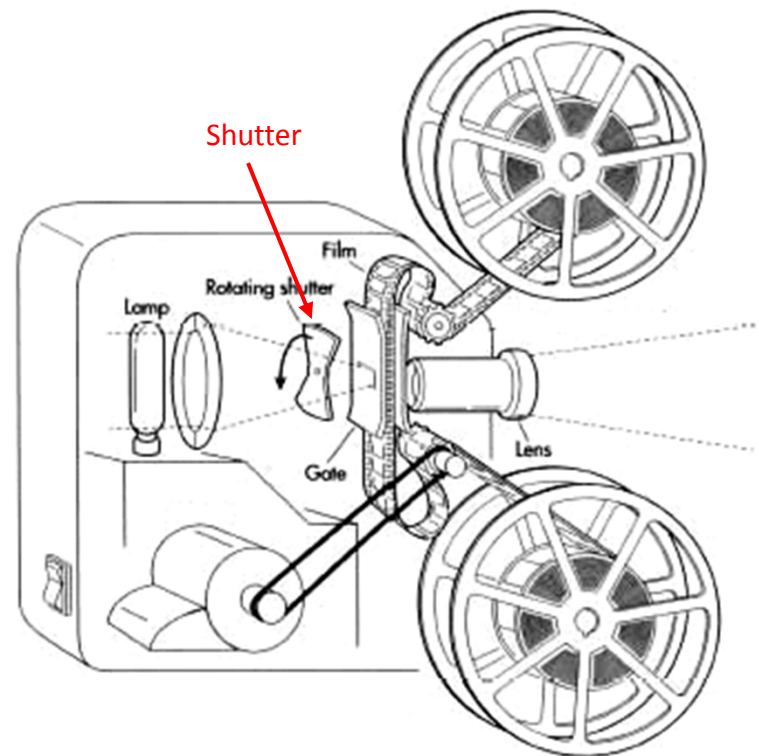


# Apparent Motion

Apparent Motion is the most common type of illusory motion and is perceived when images are displayed in succession at a specific frame rate such as in a movie

## Apparent Motion in film projector

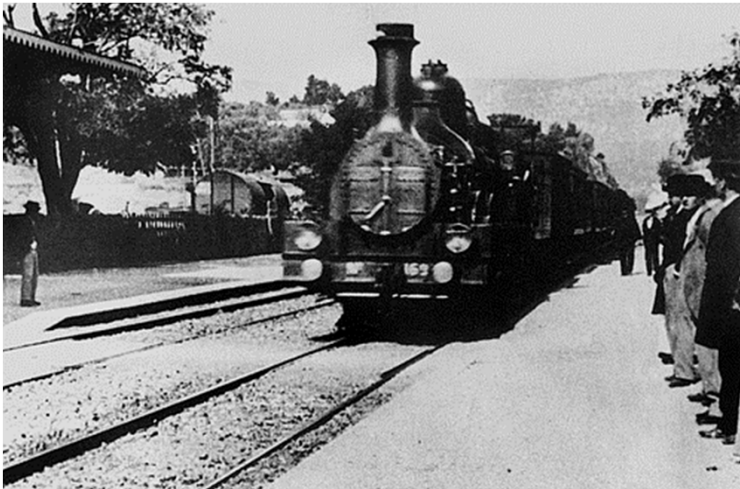
- Film is made up of a series of still pictures called frames
- Just running the film through a projector would not create the illusion of movement, but only blur
- Projector is constructed that each frame is paused momentarily in front of the projector's light source
- Shutter



# Lumière Brothers

The Lumière brothers began to create moving pictures in 1892. They patented a number of significant processes leading up to their film camera.

They held their first private screening of projected motion pictures in 1895.



*Arrival of a Train at La Ciotat, 1895*



Auguste Lumière and Louis Lumière

# Lumière Brothers



Clips from  
*Hugo*, 2011

# Georges Méliès

Georges Méliès was a French illusionist and filmmaker famous for leading many technical and narrative developments in the earliest days of cinema.



*A Trip to the Moon* (French: *Le Voyage dans la Lune*), is a 1902 French black-and-white silent science fiction film.



Marie-Georges-Jean Méliès (1861-1938)



# Cut and Motion Perception



Clips from  
*Hugo*, 2011

**Cutting techniques allow the director to control what information the user sees by breaking the visual continuity of the film.**

**Cuts provide an interesting perceptual mechanism for question and answer patterns**

- Transition the viewer both within a scene and between scenes
- Break the visual continuity of a narrative

# Cut and Motion Perception



Clips from  
*Hugo*, 2011

Induced motion can commonly be seen where a stationary background stimulus appears to be in motion when placed against a moving foreground

Distance between moving objects and primary characteristics, like orientation or color, can change the perception of a particular set of motions between global and local

# Match Cuts

A match cut, also called a graphic match, is a cut in film editing to help establish a strong continuity of action and linking the two shots metaphorically

- Between different objects
- Between different spaces
- Between different compositions

Continuity editing smoothens the inherent discontinuity of shot changes to establish a logical coherence between shots



*Minority Report*, Steven Spielberg, 2002

# Match Cuts



Clips from *Batman Begins*, 2005

# Stories in the Mirror



Clips from *Munich*, 2005

# Stories in the Mirror



Another Clips from *Munich*, 2005

# Film Effects



Clips from  
*Inception*, 2010

- Materials made of foam
- Computed explosive trace
- Slow motion recorded by high frame camera
- Aftereffects

# Film Effects



Clips from  
*Inception*, 2010

How can they make it?



# They are indeed in a “Van”



- A rotating vertical van with corridor scene insight
- Several cameras tracking the actors with the rotation of the van

# Film Effects



Clips from  
*The Matrix*, 1999

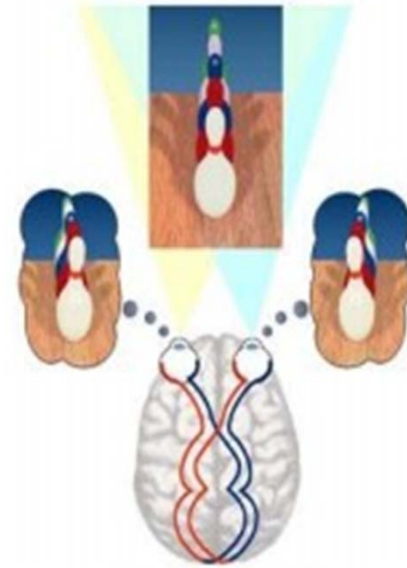
# 3D Films

## 3D

- Humans have two eyes located side-by-side and they see slightly different images of the same object
- Both images simultaneously arrive the brain and depth is unconsciously inferred.
- Vision is a matter of deriving a probable interpretation for incomplete data.
- Perception of the depth makes stereo vision life-like.

## 3D history

- In June 1838, Sir Charles Wheatstone addressed the phenomena of binocular vision. He also invented stereoscope to display images separately
- In the entertainment industry, 3D movies were released as early as 1915. But was not pay enough attention until recently



Old **Zeiss** pocket stereoscope with original test image

# 3D Visualization

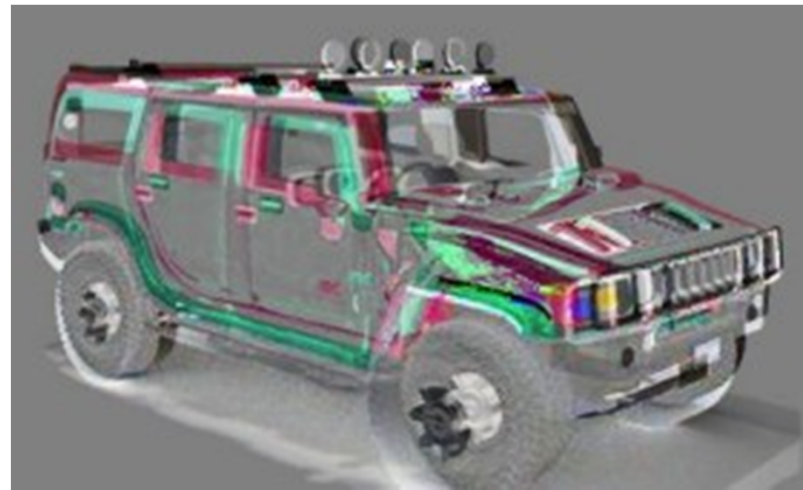


2D Image on Back TFT LCD

# 3D Visualization



Front TFT LCD – Left Eye View



Front TFT LCD – Right Eye View

Front information gives depth cue to human eyes, with left eye polarized to 45 degree and right eye 135 degree.

# 3D Visualization

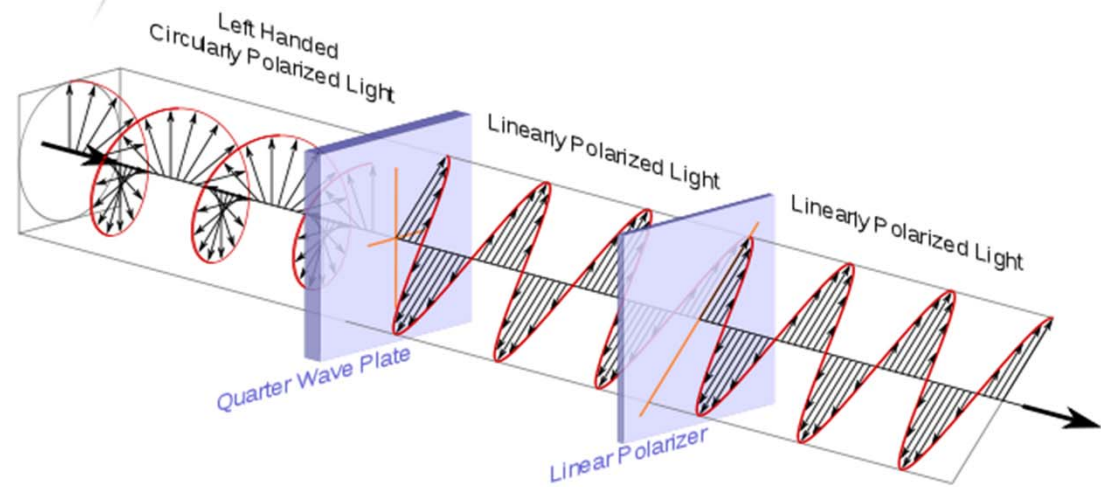
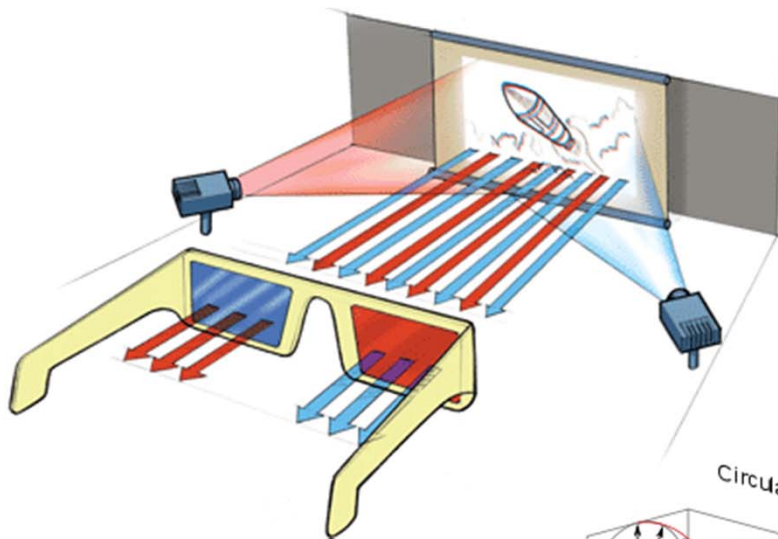


3D image without polarizer glasses shows parallax outlines



3D image viewed with polarizer glasses

# Polarized 3D system



**END**

*Thank You*