



The rig used for "Bullet Time" in The Matrix

# CNM 190

## Advanced Digital Animation

### Lec 08 : Cinematography & Editing Techniques

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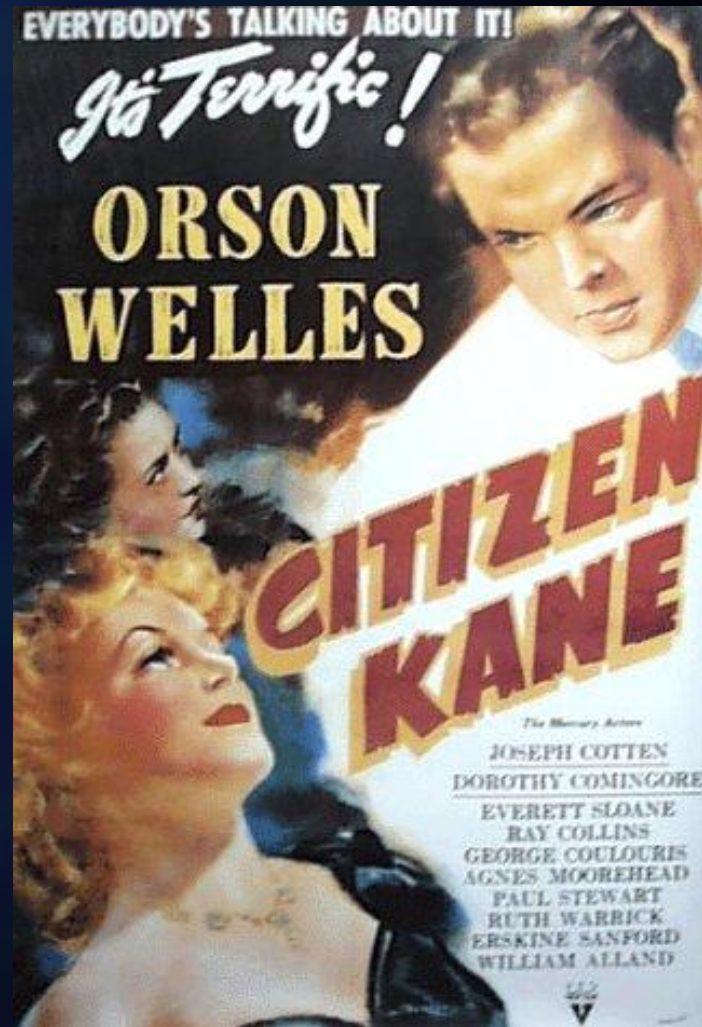
# Overview

- **What you know already**
- **Basic cinematography**
- **Distance of shot**
  - Extreme close up
  - close up (CU)
  - Medium close up (MCU)
  - Medium shot (MS)
  - Long shot
  - Point of view (POV) shot
  - Birds eye view shot
- **Camera Angles**
  - Low angle (fear)
  - High angle (weakness)
  - Straight Angle
- **What you'll learn today**
- **Classic techniques of cinematography & editing**
  - Why study classical techniques?
  - Film & Editing Resources
  - Review
  - Continuity Editing
  - Duration
  - Camera Direction
- **Procedural techniques of cinematography & editing**
  - Motion Interpolation
  - Quaternions & Slerping
  - Splines

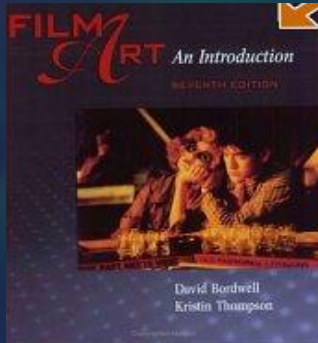
# Why Study Classic Techniques?

Those who cannot remember the past are condemned to repeat it. - Santayana

- You don't want your camera and editing to **obstruct** your storytelling
- Instead, use them as tools to **advance narrative!**
- If you want to break the rules, you need to know what they are first!
  - Do it for a good, artistic reason, not ignorance!

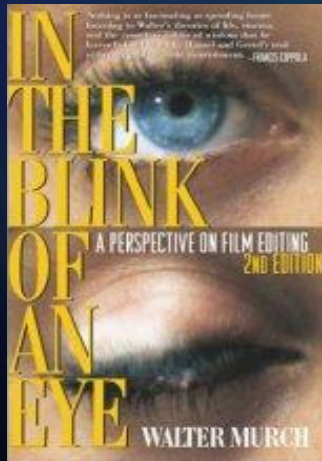


# Film & Editing Resources



## Film Art : An Introduction

- by David Bordwell & Kristin Thompson
- McGraw-Hill, 2003
- \$38 on Amazon



## In the Blink of an Eye (2nd Edition)

- Walter Murch
- Silman-James Press, 2001
- \$11 on Amazon

# Six Main Criteria of Film Editing

[en.wikipedia.org/wiki/{Film\\_editing,Walter\\_Murch}](https://en.wikipedia.org/wiki/Film_editing,Walter_Murch)

- **Walter Murch**
  - Four Academy nominations for films edited on different systems
  - Film editing Pioneer!
- **He ranks 6 editing criteria**
  1. Emotion
  2. Story
  3. Rhythm
  4. Eye trace
  5. 2D place of the screen
  6. 3D space of action



# Continuity Editing (CE)

[en.wikipedia.org/wiki/Continuity\\_editing](http://en.wikipedia.org/wiki/Continuity_editing)

- **Goal**
  - **Make the editor as invisible as possible**
  - The viewer should not notice the cuts
  - Shots should flow together naturally (direction, position, time)
  - Sequence of shots should appear to be **continuous in time and space to advance narrative**
- **If you notice (editor, temperature in a room), something is wrong.**



Steenbeck film editing machine rollers

Neighbors, 1920



# CE : (Re)Establishing Shot

[en.wikipedia.org/wiki/Establishing\\_shot](http://en.wikipedia.org/wiki/Establishing_shot)

- As the name implies, it “establishes” the scene and/or its participants
- E.g., Seinfeld’s restaurant exterior shot before an interior scene
- What is **your** establishing shot?

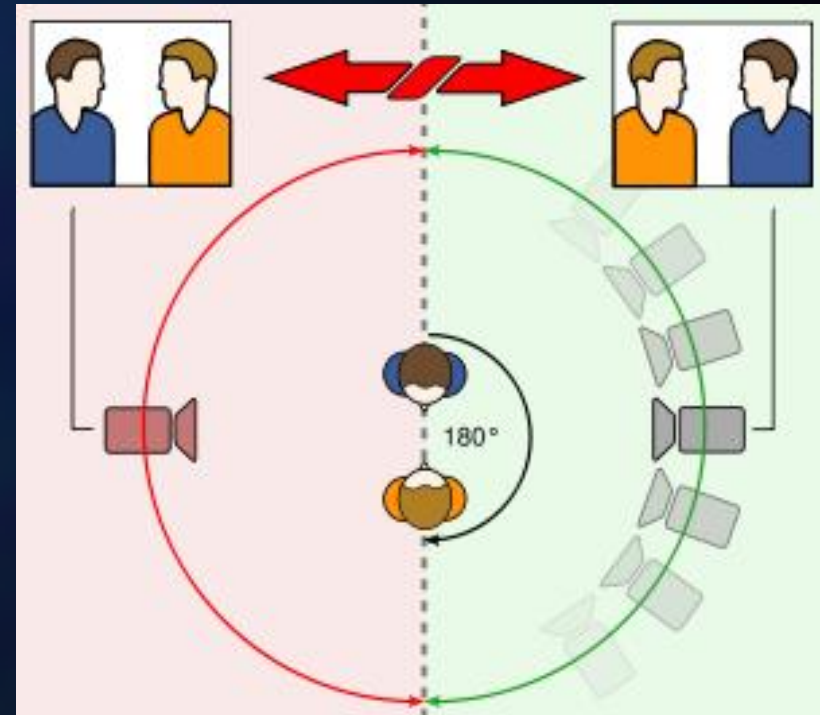


Exterior of “Monk’s” restaurant from Seinfeld

# CE : 180 degree rule

[en.wikipedia.org/wiki/180\\_degree\\_rule](http://en.wikipedia.org/wiki/180_degree_rule)

- Often called **The Line** or **Line of Action**, it allows the camera to stay in the **green** area
- If the camera violates this (**crossing the line** into the **red**), the characters will swap places on screen!
- Subjects should be spatially consistent, with consistent **axis of action**
- You can cross the line with intermediate head-on shot, POV or reestablishing shot, but try to avoid this if possible



The green camera preserves Left/Right positions

Saturday Night Fever





# CE : Shot/Reverse Shot & Eyeline Matches

[classes.yale.edu/film-analysis/htmlfiles/editing.htm](http://classes.yale.edu/film-analysis/htmlfiles/editing.htm)

- A shot from the opposite side of the green 180° area
  - Often used as establishing
  - 30° rule : Camera moves at least that much between shots
- An **eyeline match** is one that associates what a character is looking at
  - You see what they saw
  - It often associates matching close-ups
- In film, characters don't even have to be in same room!



Scenes from Peking Opera Blues, 1986



Scenes from The Stendhal Syndrome, 1996

# CE : Graphic Match

[classes.yale.edu/film-analysis/htmlfiles/editing.htm](http://classes.yale.edu/film-analysis/htmlfiles/editing.htm)

- Two successive shots joined so as to suggest a similarity
  - Color
  - Shape
  - Location
- Some feel they are “heavy-handed”, not subtle
- Kubrick’s classic 2001 A Space Odyssey: bone → spaceship



Scenes from Women on the Verge of a Nervous Breakdown, 1988

Finding Nemo Main Titles

# CE : Match/Cut on Action (MOA)

[classes.yale.edu/film-analysis/htmlfiles/editing.htm](http://classes.yale.edu/film-analysis/htmlfiles/editing.htm)

- Cuts between shots are more seamless if they occur on action
- **Definition: A cut which splices two different views of the same action together at the same moment in the movement**
- E.g., if A is getting up and walks to the window, cut AS he's getting up, not before.
  - Cutting after could be eyeline match
- MOA can help with a jumpy cut
- MOA can be a subtle motion too



Scenes from Traffic, 2000

# CE : Cut-in, Cut away

[classes.yale.edu/film-analysis/htmlfiles/editing.htm](http://classes.yale.edu/film-analysis/htmlfiles/editing.htm)

[www.filmclass.com/flm222/continuity.pdf](http://www.filmclass.com/flm222/continuity.pdf)

## ■ Cut-in

- Instantaneous cut to a close-up of something already in **frame**

## ■ Cut away

- Close-up to something in **scene** but not in the frame (usually)
- E.g., if you had a character getting up to answer the door, you might cut away to a knock.



Scenes from Dancer in the Dark, 2000

Dancer in the Dark

# CE : Cross-cutting

[classes.yale.edu/film-analysis/htmlfiles/editing.htm](http://classes.yale.edu/film-analysis/htmlfiles/editing.htm)

- A series of cutaways & cutbacks
- Also known as **Parallel Editing** or **Parallel Montage**
  - Alternating shots of “two or more lines of action occurring in different places, usually simultaneously”
  - E.g., a chase scene. First the cops, then the robbers, then the cops...
  - Can also be used symbolically
    - Show a 1930s man in line for bread, then a rich man getting into a Rolls
  - In film, this can be used to cheat
    - A man running from a train doesn't have to be anywhere near it!
- The Simpsons used to do this a lot until Family Guy started too, then they quit!



Scenes from Yi Yi, 2000  
The father and daughter are both on first dates (different countries)

# CE Rule #1 : Avoid Jump/Elliptical Cuts!

[classes.yale.edu/film-analysis/htmlfiles/editing.htm](http://classes.yale.edu/film-analysis/htmlfiles/editing.htm)

- A shot transition that omits parts of an event, as if had ellipses (...) in plot
  - Also a cut with too-similar framing
  - Or with straight angle but different people (they look like they morph!)
- It's what you would do if you had no training in editing and just cut pieces of a story together
  - It usually looks like a mistake!
  - This is what iTunes does when it summarizes a game into 10 min!
  - In the sixties, there was a wave of it
- To avoid
  - Zoom instead of cut
  - Make the framing more different
  - Use the match techniques



A jump cut from wide shot to semi-wide



A better cut (wide / mid / medium close-up)

Dancer in the Dark

# CE Suggestions

[www.filmclass.com/flm222/continuity.pdf](http://www.filmclass.com/flm222/continuity.pdf)

- **Avoid home video style**
  - Move subjects away from center of the frame; don't shoot frontally
    - Thus avoiding "character morph" jump cuts
    - This is a good idea in general, even from a photographer's standpoint
  - Have a smooth camera!!
  - Use a variety of shots and CE!
- **"The single most common mistake in beginning student productions is that they have no, or not enough close-ups"**



Headshots from The Apprentice, 2004

# Alternatives to CE

[classes.yale.edu/film-analysis/htmlfiles/editing.htm](http://classes.yale.edu/film-analysis/htmlfiles/editing.htm)

[en.wikipedia.org/wiki/Montage\\_%28film%29](http://en.wikipedia.org/wiki/Montage_%28film%29)

- Elliptical editing (jump-cuts)
- Montage
  - Montage: French for “editing”
  - In this context, we mean disparate images/shots that tell a story
  - Developed by 1920s Soviet theorists, e.g., Sergei Eisenstein
  - Five varieties of montage:
    - **Metric** (# of frames)
    - **rhythmic** (rhythm)
    - **tonal** (light-dark contrasts), **overtonal** (emotions)
    - **intellectual** (all 4 but for meaning)



Traffic (2000) Elliptical Editing



Godfather (1973) Montage, Michael showing his duty to his two “families”

Traffic, Godfather





# Duration

[classes.yale.edu/film-analysis/htmlfiles/editing.htm](http://classes.yale.edu/film-analysis/htmlfiles/editing.htm)

- Thanks to editing, time is completely in your control. You can...
  - have a very long take
  - cut boring events out (compress time)
  - Extend one event to the whole film! (24)
  - revisit it over and over
  - change the rhythm
  - explore the space-time continuum!



# Long Take (Plan-sequence)

[classes.yale.edu/film-analysis/htmlfiles/editing.htm](http://classes.yale.edu/film-analysis/htmlfiles/editing.htm)

- A shot of unusual length
  - Draws attention to itself, very different from norm
  - Shots above 1 minute are now considered a long take
  - Extremely hard to shoot in real life, but trivial in CG
  - Depending on movement, can make film intense, carefree, or stagnant!

## ■ Examples

- Orson Welles' Touch of Evil
- Robert Altman's The Player
- David Fincher's Panic Room
  - Lots of CG tricks!



The Player (1992) 8-minute shot!

Touch of Evil, The Player, Forrest Gump, Goodfellas



# Overlapping Editing

[classes.yale.edu/film-analysis/htmlfiles/editing.htm](http://classes.yale.edu/film-analysis/htmlfiles/editing.htm)

- Cuts that recall part of the action, as if instant replay
  - Draws attention to itself, again very distinctive
  - Usually associated with experimental filmmaking
  - Usually found in films where action >> plot
  - Common in Hong Kong action films of the 80s / 90s



MI:2 (2000) John Woo comes to Hollywood

# Rhythm

[classes.yale.edu/film-analysis/htmlfiles/editing.htm](http://classes.yale.edu/film-analysis/htmlfiles/editing.htm)

[www.boston.com/news/globe/ideas/articles/2006/08/13/the\\_lost\\_art\\_of\\_film\\_editing?mode=PF](http://www.boston.com/news/globe/ideas/articles/2006/08/13/the_lost_art_of_film_editing?mode=PF)

- Rhythm is the “perceived” rate of sounds, movements & series of shots
  - Usually it’s the cuts that determines the rhythm
  - Just as the story has rhythm, so does the editing
  - #3 of Murch’s six main criteria when it comes to film editing
  - There’s a feeling that this fine art has been lost as we cater to the ADD MTV generation



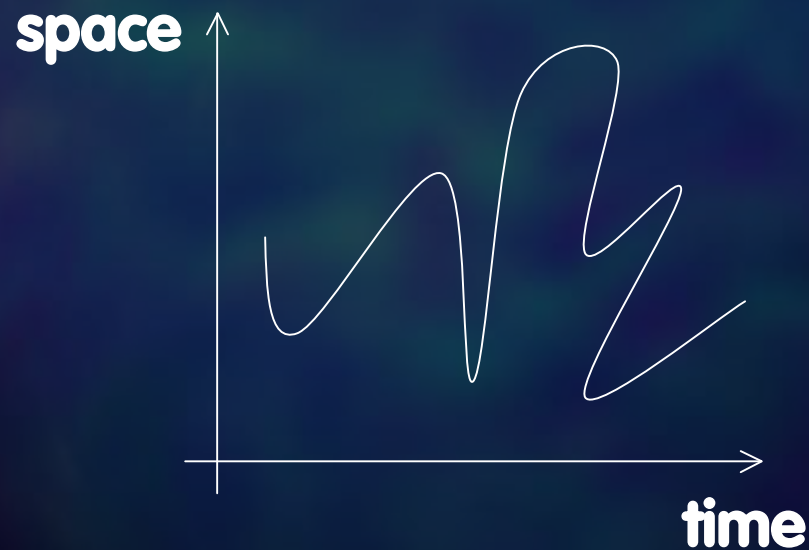
The Good, the Bad and the Ugly (1966)

The Good, the Bad and the Ugly

# Bullet Time

[en.wikipedia.org/wiki/Bullet\\_time](http://en.wikipedia.org/wiki/Bullet_time)

- Imagine time and space as a two-dimensional graph:



The rig used for Bullet time in The Matrix

- We can traverse anywhere in this space! (easy in CG)

Making of The Matrix



# Camera Direction

Inspired 3D Short Film Production

- Lock-off camera
  - Simplest form of setup
  - Position, angle, zoom, focus fixed throughout the shot
  - A film consisting only of lock-off shots will feel dull
- Camera move
  - Rotating, moving, zooming, shifting focus or field of view
  - A film where the camera never stops moving can be unsettling.
    - When does this ride end?
- “Try not to get too carried away with camera moves”
- Mantra : smooth cameras



# Rack Focus

- Changing the focus of a lens so that one element goes out and another comes into focus
- By default, CG images are through a pinhole camera
  - Infinite depth of field!
- Done in Maya via a choice of **Depth of Field** in Camera and adjusting the **Focus Distance**
  - Render times explode!
  - Can be cheated in post by blurring composite layers



Peking Opera Blues (1986) Racking Focus

Peking Opera Blues

# Maya Turntable Demo

- Creating a turntable, or “how to rotate a camera around the center of the world”
  - Select camera group
  - Set keyframes to the start and end with 0 degrees and 360 degrees Y rotation

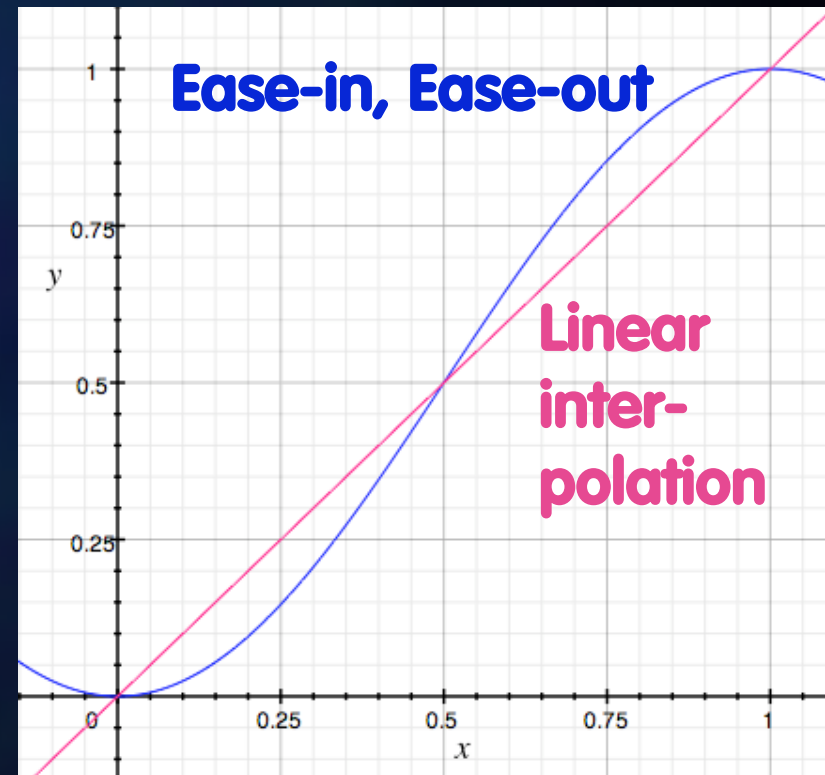




# Linear vs Ease-in, Ease-out

[www.siggraph.org/education/materials/HyperGraph/animation/rick\\_parent/Full.html](http://www.siggraph.org/education/materials/HyperGraph/animation/rick_parent/Full.html)

- Linear interpolation of motion produces very unreal motion (Lerping)
  - $P(t) = (1-t) P_0 + t P_1$
  - Nothing has infinite acceleration!
- Ease-in, Ease-out
  - $P(t) = (1-f(t)) P_0 + f(t) P_1$
  - With  $f(t)$  being something smooth like the blue curve on the right
- $f(t) = (\sin(\pi t - \pi/2) + 1)/2$ 
  - Just one example of  $f(t)$



# Orientation Representation & Interpolation

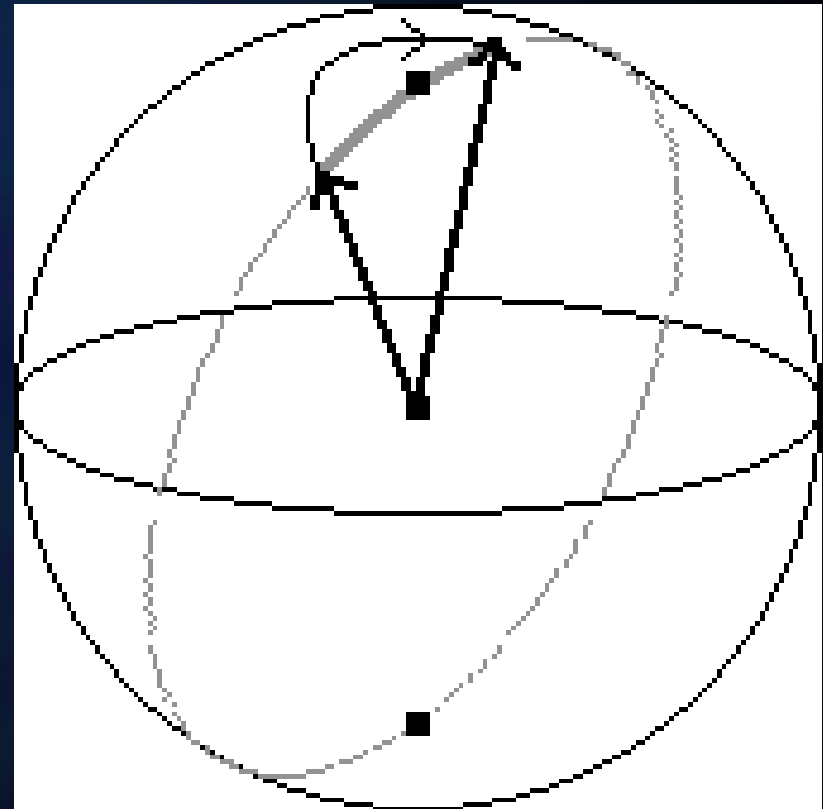
- Fixed Angle Representation
  - Angles about fixed, global axes (e.g., xyz)
  - Gimbal lock when axes align...singularity!
    - Imagine plane straight up; where's yaw?
  - Bad interpolation property
- Euler angles
  - Angles of rotation fixed to object, not global
  - Same problems!



# Quaternions

[en.wikipedia.org/wiki/{Quaternion\\_and\\_spatial\\_rotation,Slerp}](http://en.wikipedia.org/wiki/Quaternion_and_spatial_rotation,Slerp)

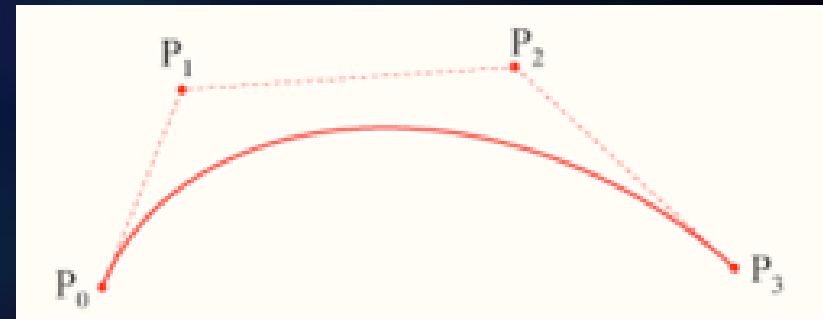
- Technique for encoding 3D orientation
  - Lots of math involved using complex notation
  - Great interpolation properties
  - It finds the great circle arc between two positions
- Interpolating between quaternion poses linearly is called **Slerping**



# Smooth motion : Splines (1)

[en.wikipedia.org/wiki/Spline\\_\(mathematics\)](http://en.wikipedia.org/wiki/Spline_(mathematics))

- Piecewise polynomial curves with great properties
- Imagine interpolating lots of points with  $y=f(x)$ 
  - You'd have to have a very high-dimensional function
  - But if you allowed it to be broken up into pieces, you could solve with many lower-dim functions!
  - Continuity of pieces?
- Prof Barsky is local expert!

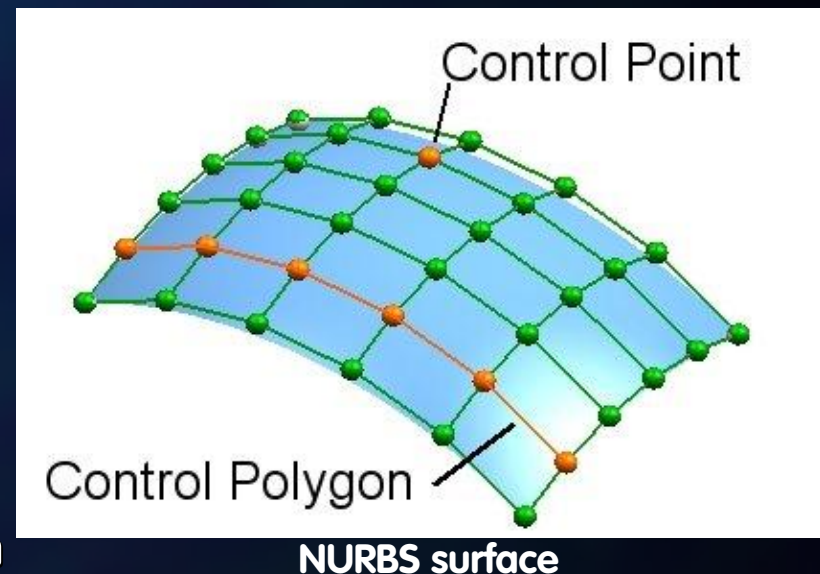


Bezier interpolating spline

# Smooth motion : Splines (2)

[en.wikipedia.org/wiki/Nurbs](http://en.wikipedia.org/wiki/Nurbs)

- Two classes
  - **Interpolating** (goes through control points)
  - **Approximating** (gets near the control points)
- Polynomial order?
  - Standard is cubic (order = 3)
- Local control
  - Adjusting control point only affects local part of curve
- Continuity (C0, C1, C2) across joints critically important
- NURBS are generalizations with expressive power
  - Curves AND surfaces



Spline demo gif

# Conclusion

- If time, look at Pixar Shorts
- It's important to understand the classical techniques of editing & cinematography
  - Use them to facilitate your narrative!
  - Smooth camera motions!!!
- Tremendous power if you code motion yourself...
  - Most SW does heavy lifting!
- Next week:
  - Animation 1 : Basics, motion, sound, data

