The Animation Presentation

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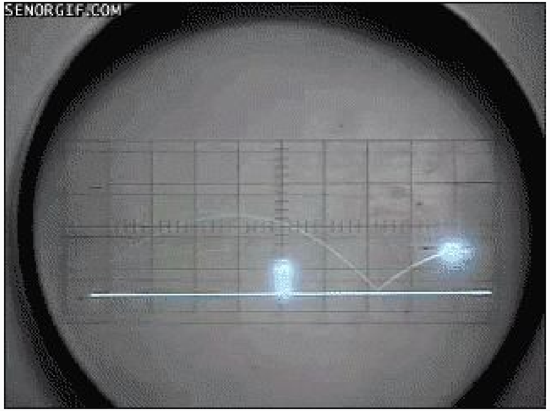
History - Oscilloscope

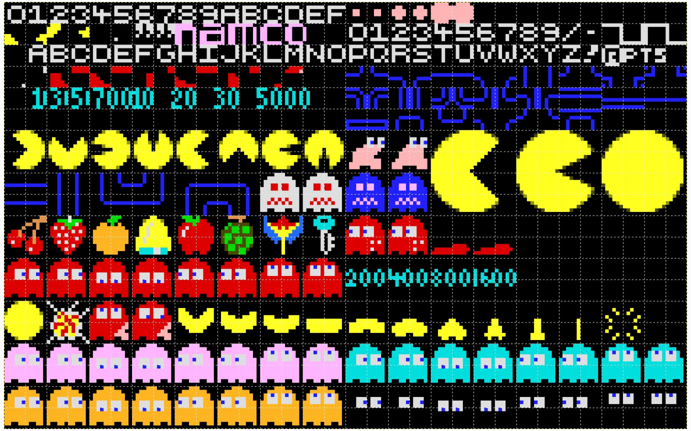
- Tennis for Two
- Pong
- Space War



History - 2D Sprites

- Sprite sheets were used to switch out different sprites to create the illusion of movement
- This method was commonly used in old arcade machines, Atari (1975), the Nintendo Entertainment system (NES) (1983), Super NES (SNES)(1990), and the Sega Genesis (1989)

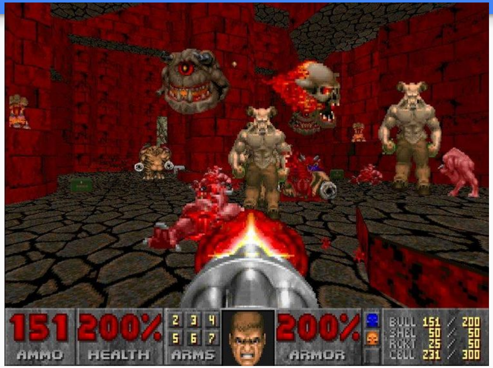
History - 2D Sprites

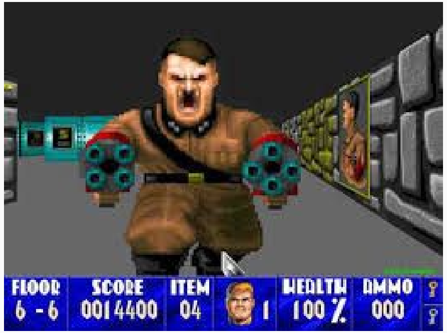


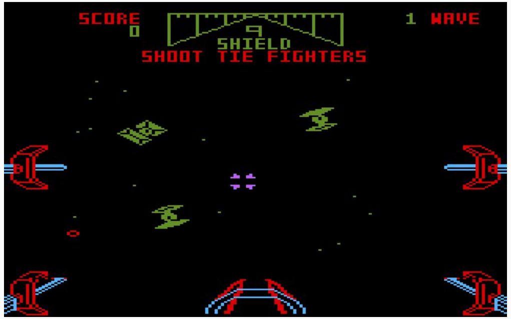
History - 2D Sprites

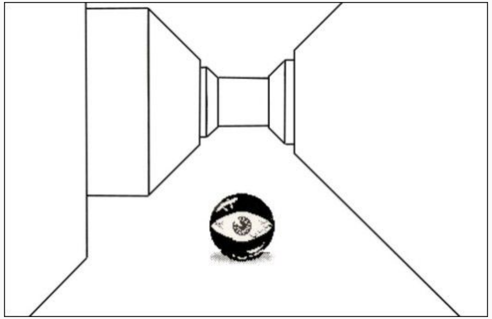
History - Early 3D Graphics

- Maze War (1974)
- Star Wars (1983)
- Wolfenstein 3d (1992)
- Doom (1993)



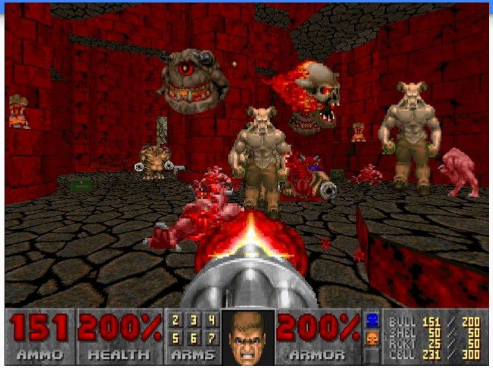


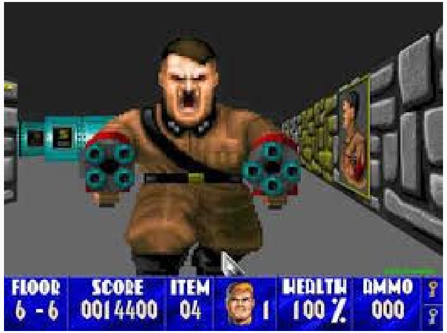


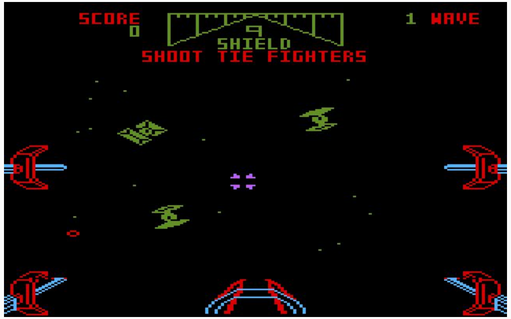


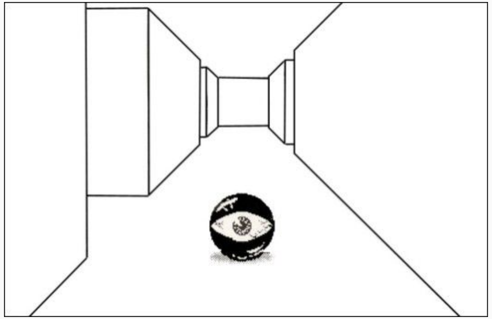
History - Early 3D Graphics

- Added depth perception to a lot of games, but the animation was still done using sprites









History - 3D Graphics

- 3D graphics and animation were greatly popularized throughout the 90s
- Sony Playstation released in 1994
- Nintendo 64 released in 1996

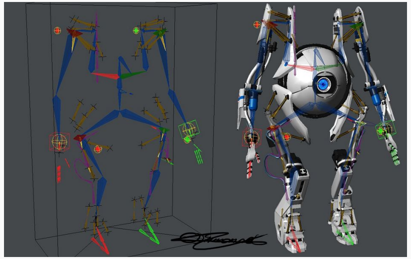
History - 3D Graphics

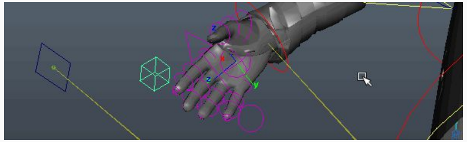
History - 3D Graphics

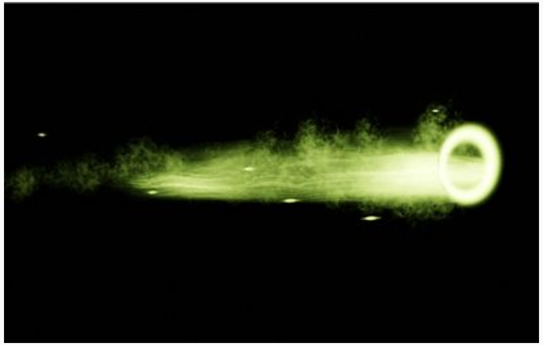
- Several 3D modeling and animation software were released
  - Autodesk 3DS Max (1990) and Autodesk Maya (1998) which both became industry standard for many games
- Geforce 256 released 1999
  - Introduction of Graphical Processing Unit (GPU)

History - 3D Graphics

- Rather than switching out sprites, computers now generated the position of vertices in virtual 3d space and would move them to create the illusion of animation
- 3D software introduced several new techniques including:
  - Keyframing
  - Particle Systems
  - Rigging
  - Realistic Physics Engines







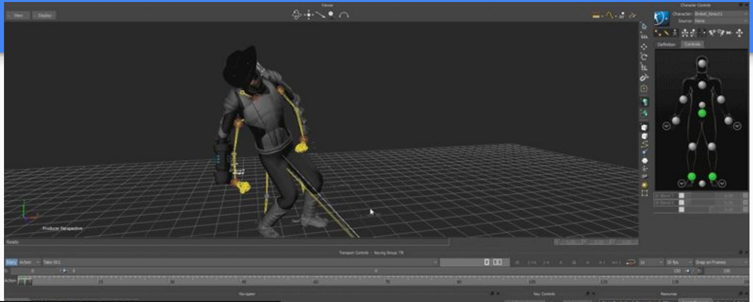
History - Motion Capture (MOCAP)

- Star Wars - The Phantom Menace (1999)
- Sinbad - Beyond the Veil of Mists (2000)
- Final Fantasy - The Spirits Within (2001)
- The Fellowship of the Ring (2001)

History - Motion Capture (MOCAP)

- Locates points in a controlled real world space and maps them to equivalent locations in a virtual 3d space

History - Motion Capture (MOCAP)

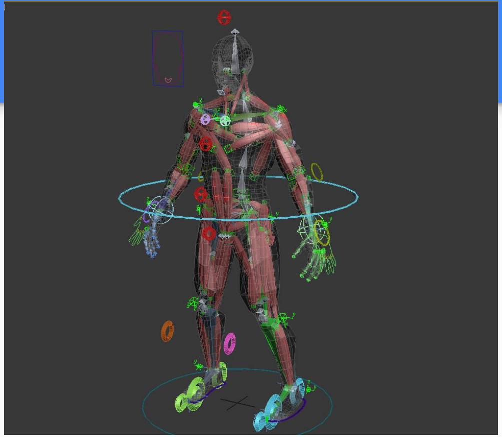


Modern Industry Standards for games

- Create Animations in 3D modeling/Animation software
    - Autodesk 3DS Max (released 1990)
    - Cinema4d (released 1993)
    - Autodesk Maya (released 1998)
    - Blender (released 1995)
        - Mostly used for personal projects
- Import animations into game engine
- Add game logic to transition between animations

BAD ANIMATION

We Take For Granted What Makes a Good Animation



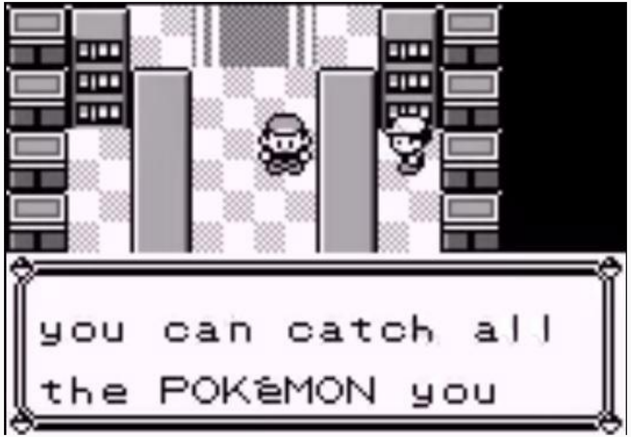
- Animation requires precision
  - from all angles!
  - differs from movies
- Animation requires detail
  - models often have well over 100,000 vertices and polygons
  - animations must be able to successfully manipulate each of these to avoid looking amateurish
  - Animations don’t just have to be good - they need to make the character come to life; “pop”

What Can Go Wrong?

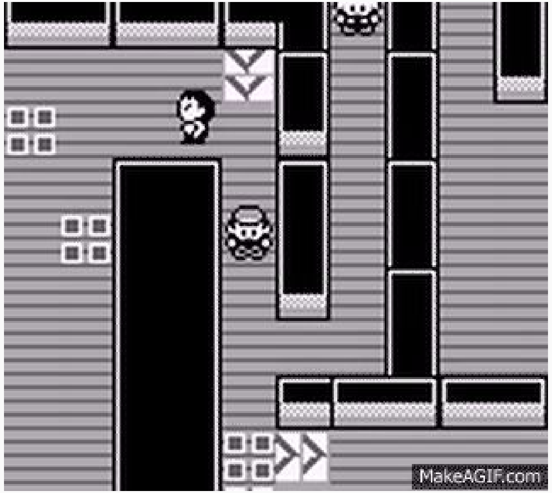
- Bad rigging
  - Rig - hierarchical set of bones; the “skeleton” of character
  - If the skeleton isn’t correct, how does your animation have hope?
- Poor modeling
  - A poor model will lead to deformations when animating
  - As aforementioned, good models have a massive number of vertices
- Good animation isn’t easy!

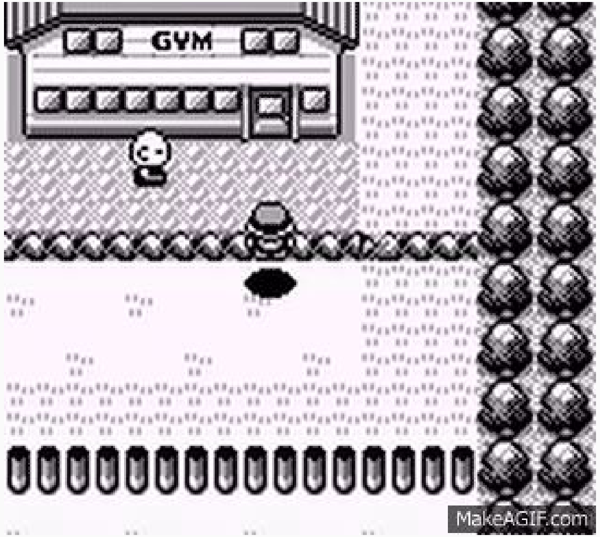
Sometimes, the Animation Isn't Even the Real Problem

- Original Pokemon - Safari zone spinning steps glitch



you can catch all
the POKéMON you



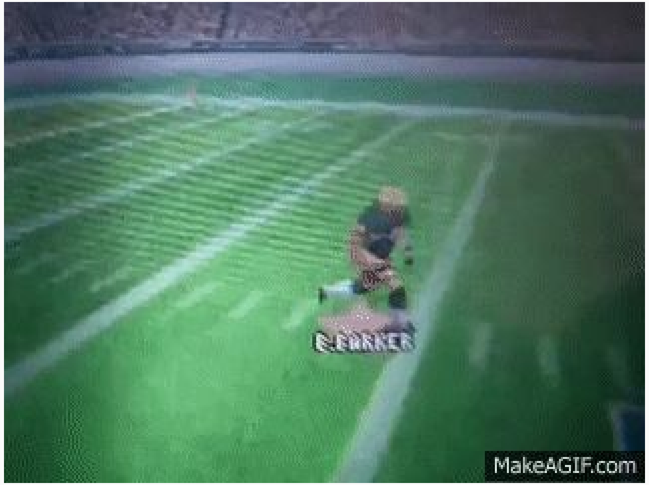


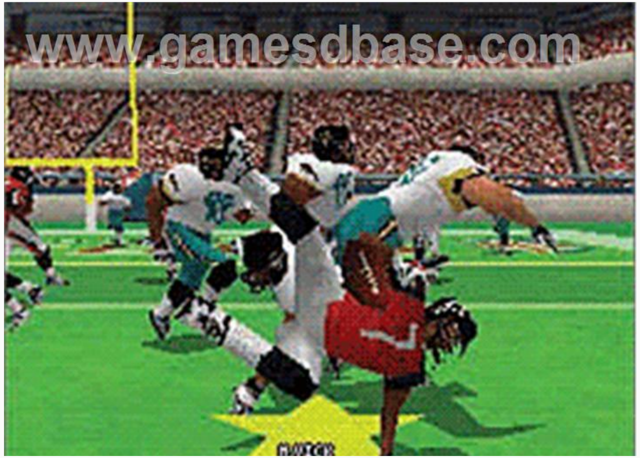
The Definition of “Bad Animation” has grown

- Depending on available technology, “bad animation” is subjective
    - Early games: bad spritesheets?
    - Modern games: Poor models, rigging, etc.
- In some cases, developers have their “hands tied” when animating

Technology Was at One Time an Excuse

- In the past, games were affected by platform constraints
  - Madden 2005 (DS) - Graphics Engine
  - “the athletes are extremely basic geometry and move with a robotic stiffness “ -IGN
  - 4th best DS game of 2004! At least they tried



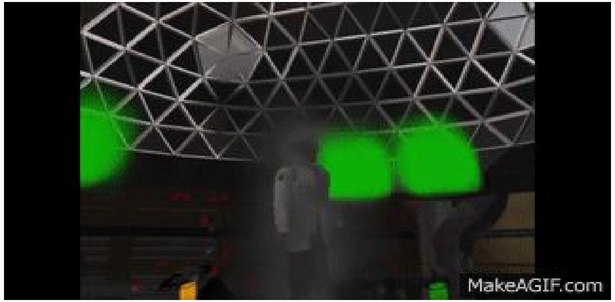


Modern Games Have Created Lofty Standards

- Great animation in popular games
  - Batman: Arkham City, The Last of Us
- In Batman: Arkham Asylum, Batman’s cape took over 700 animations and 2 years to make!
- These games thus used as the measuring stick
  - Even when perhaps they shouldn’t be!
  - Everything else held under a microscope
  - Thus, the “modern” definition of bad animation is much different than in the past

What are byproducts of bad animation?

- People don’t take your game seriously
  - Country Justice: Revenge of the Rednecks
- The game loses its immersive aspect
  - “Survival horror”
- It can affect gameplay
  - GTA 5 “stuck in position” glitch



Lastly, What Went Wrong?

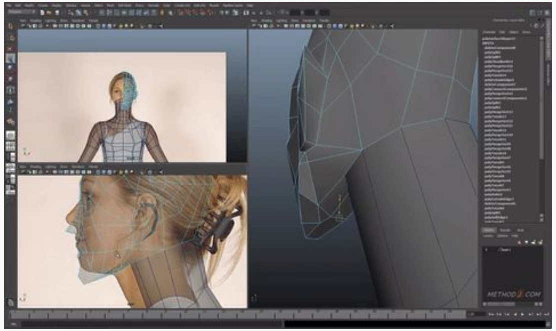
- Resident Evil:
    - Run button tapped as fast as possible
    - Animation of walking up / down stairs skipped
- GTA5:
    - Before character can leave animation, they freeze when they enter car
    - they remain in that state when they exit
- Country Justice: Revenge of the Rednecks:
    - They followed through on their idea to make a game

Standard Toolkits

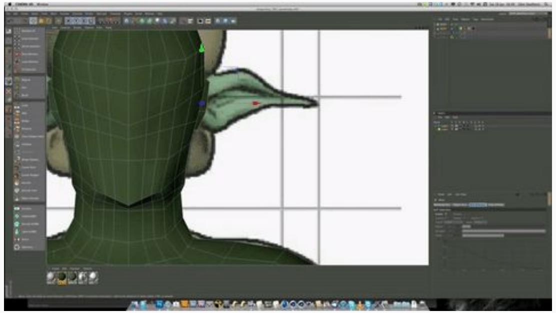
- Maya, 3ds Max, Cinema 4D, Blender
- Similarities:
- Modeling, rigging, animating, and rendering tools
- Simulation tools
- Texturing tools

Modeling

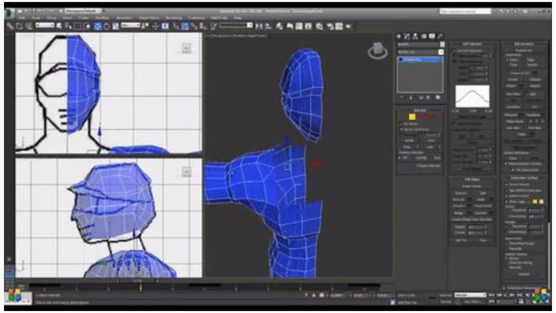
Maya



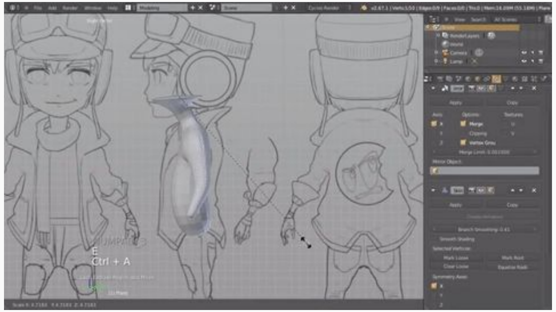
C4D



3ds Max

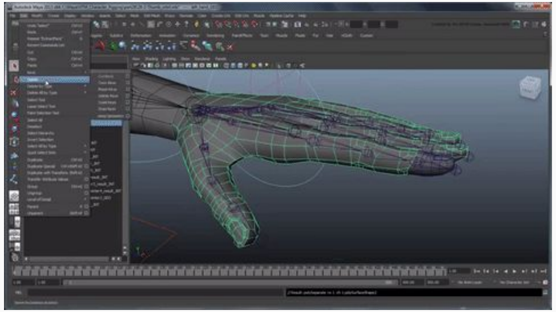


Blender

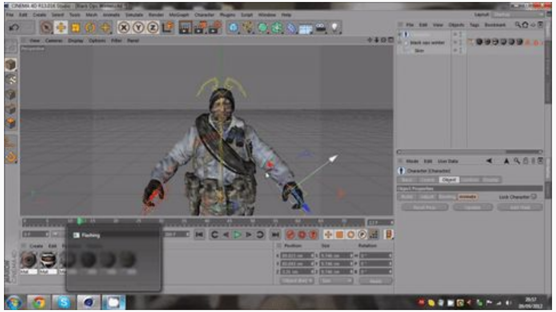


Rigging

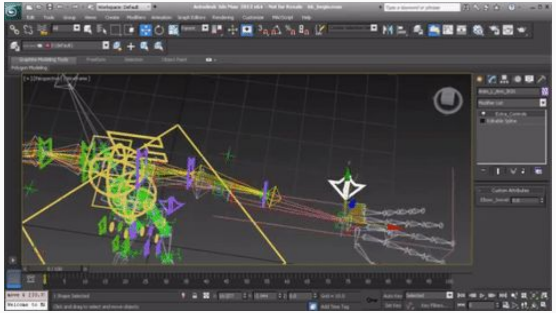
Maya



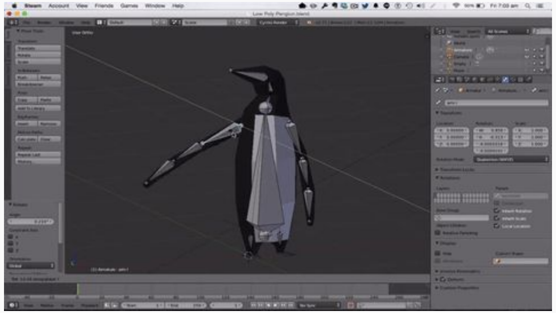
C4D



3ds Max

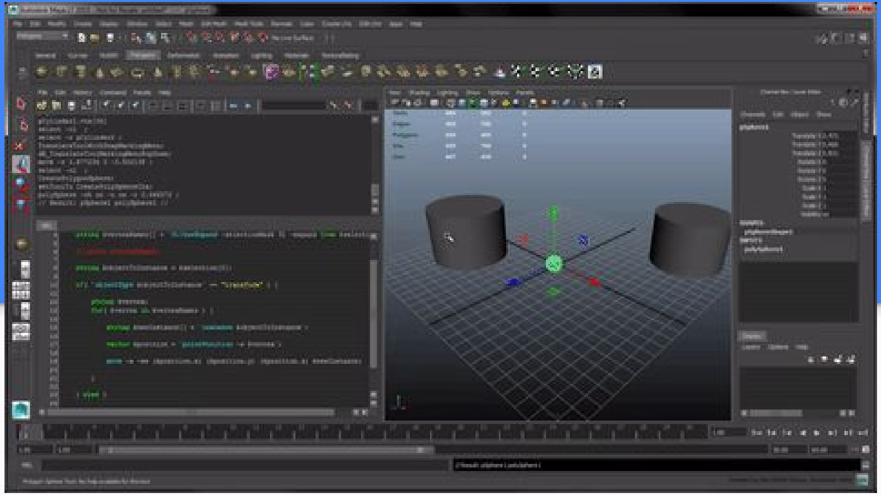


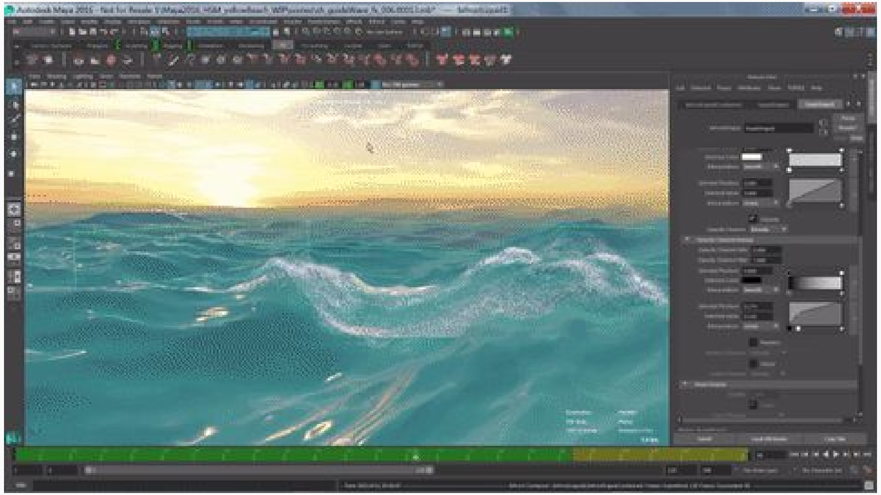
Blender



Maya

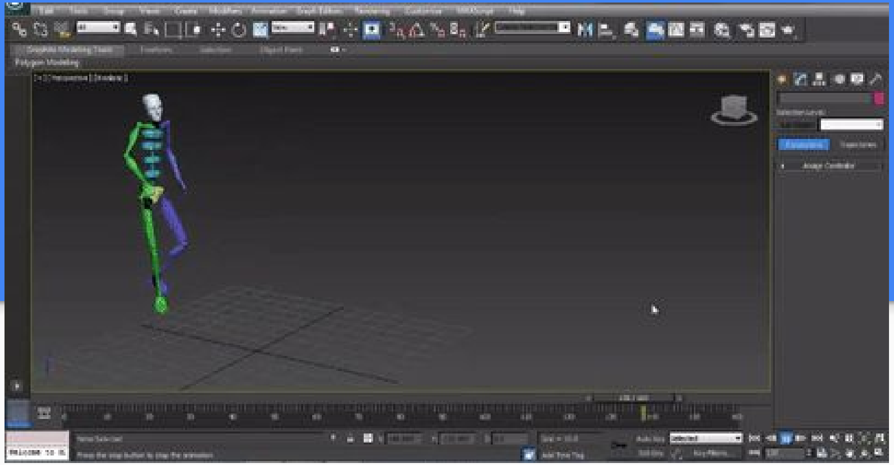
- Developer: Autodesk, Inc.
- Originally released in 1998
- Compatible OS: Windows, Mac, Linux
- Proprietary ($185 monthly)
- Key features: Fluid Effects, Bifrost, Classic Cloth, Fur, nHair, Maya Live, nCloth, nParticle, MatchMover, Composite, Camera Sequencer, Maya Embedded Language

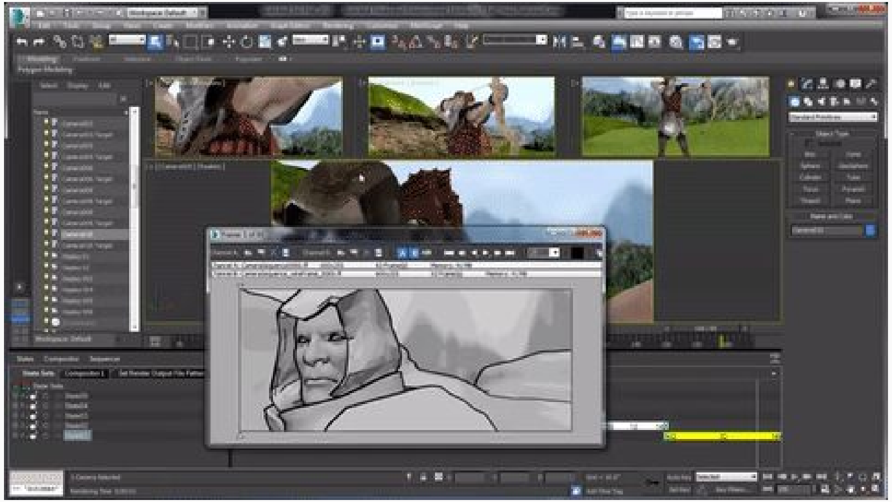




3ds Max

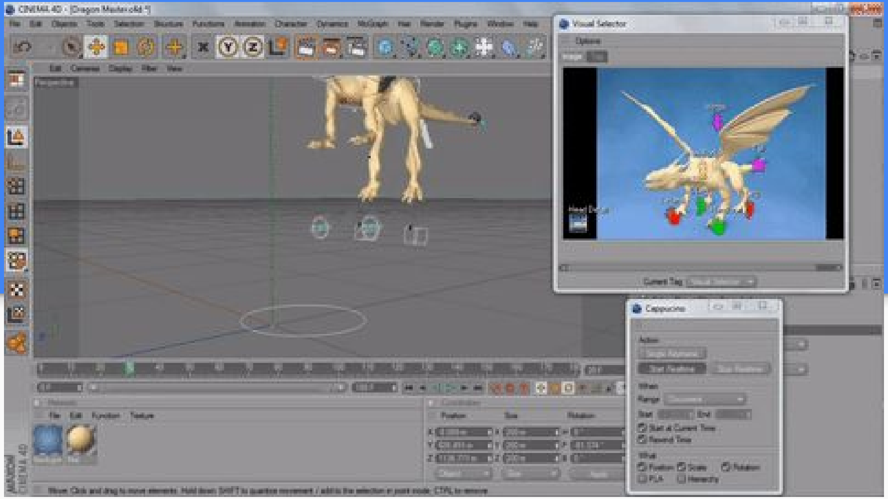
- Developer: Autodesk, Inc.
- Originally released in 1990
- Compatible OS: Windows
- Proprietary ($185 monthly)
- Key features: MAXScript, Character Studio, Scene Explorer, Texture assignment/editing, Constrained animation, Skinning, Integrated Cloth solver, Integration with Autodesk Vault

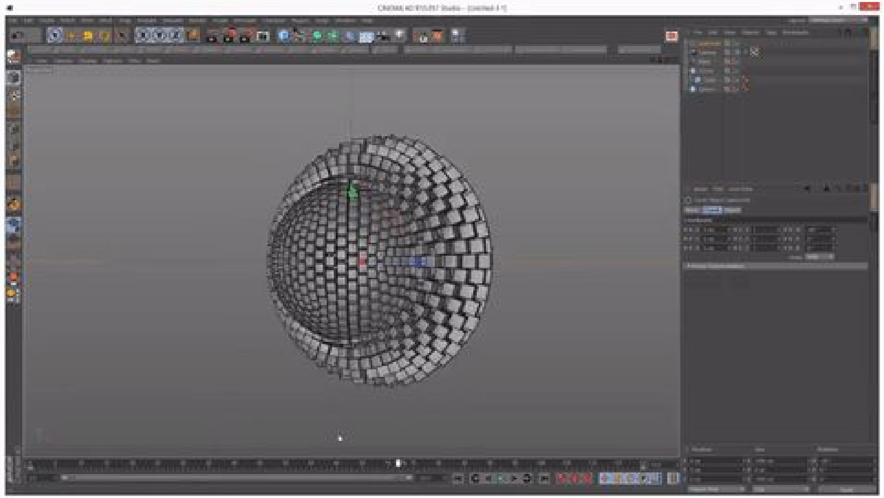




Cinema 4D

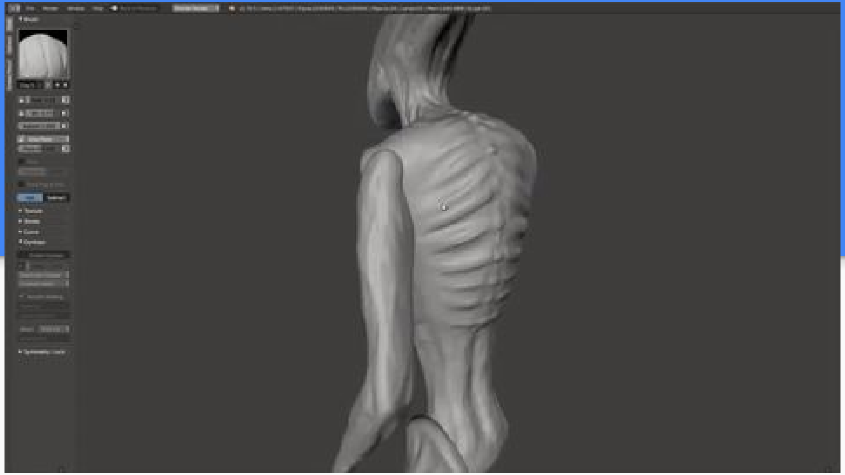
- Developer: Maxon
- Originally released in 1993
- Compatible OS: Windows, Mac, Linux
- Proprietary ($3,695)
- Key features: Advanced Render, BodyPaint 3D, Dynamics, Hair, MOCCA, MoGraph, NET Render, PyroCluster, Sketch & Toon, Thinking Particles, Xpresso

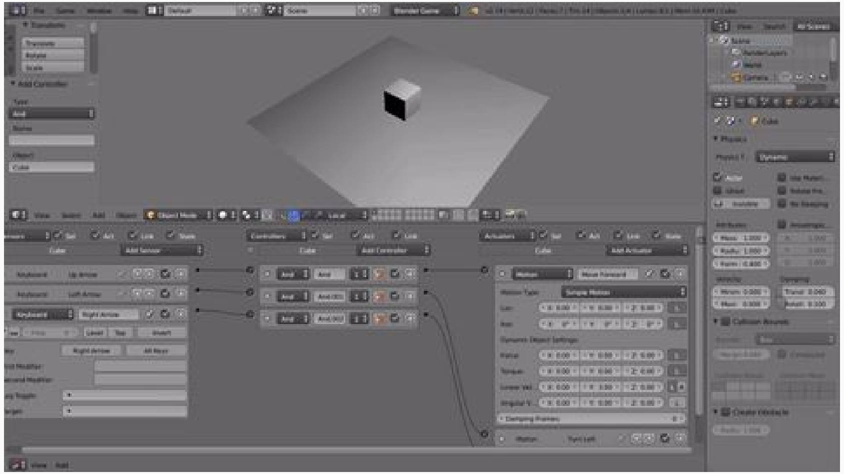




Blender

- Developer: Blender Foundation
- Originally released in 1995
- Compatible OS: Windows, Mac, Linux
- Free and open-source
- Key Features: B-mesh, internal render engine, Cycles, Keyframed animation tools, Simulation tools, particle system, Python scripting, Blender Game Engine, node-based compositor, Procedural and node-based textures





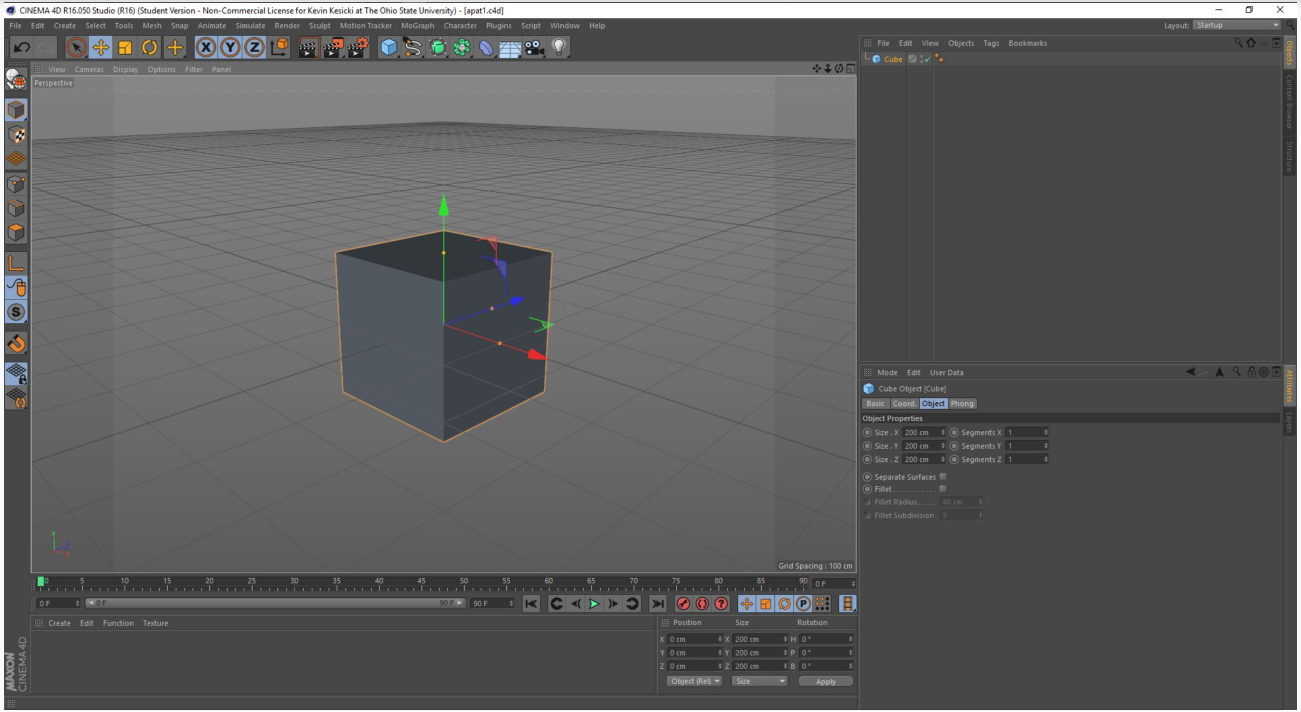
Examples

Autodesk Maya and 3ds Max reel 2014: https://www.youtube.com/watch?v=HmGU4cLAxBo

Conclusion

- Maya tends to be considered the most complicated, but is one of the most used in industry
- Maya and 3ds Max are both widely used, both developed by Autodesk, Maya more complicated but better for animation
- Cinema 4D is considered easier to learn than the Autodesk packages but is still pretty widely used
- Blender is free and open source so it is one of the most popular for personal, hobbyist, and indie developer use
- Pretty much any modeling and animation can be done in any of these, it mostly comes down to personal preference

C4D Demo



CINEMA 4D R16.050 Studio (R16) (Student Version - Non-Commercial License for Kevin Kesicki at The Ohio State University) - [apat1.c4d]

Cube Object [Cube]

Object Properties

Size . X	200 cm	Segments X	1
Size . Y	200 cm	Segments Y	1
Size . Z	200 cm	Segments Z	1

Separate Surfaces □

Fillet . . . . □

Fillet Radius. . . . . 40 cm

Fillet Subdivision 5

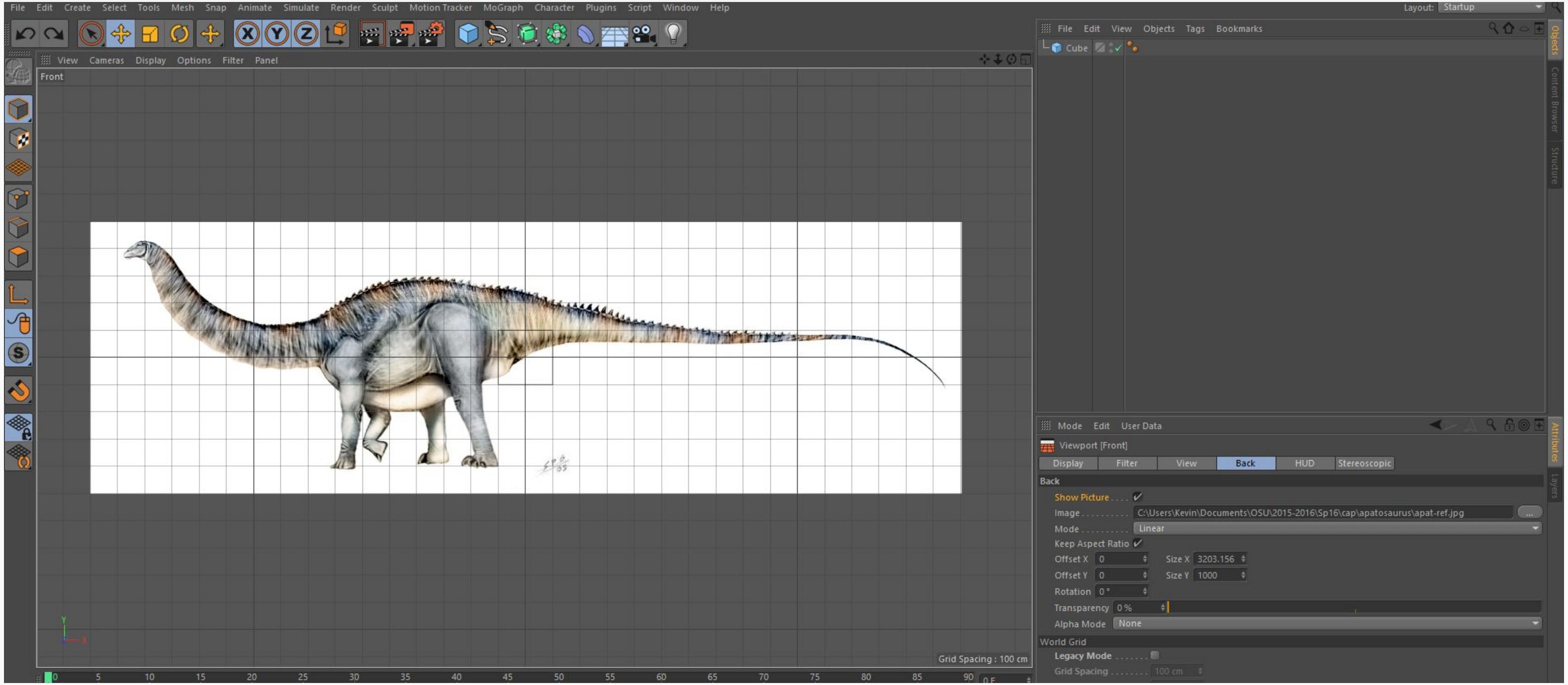
Position		Size		Rotation	
X	0 cm	X	200 cm	H	0 °
Y	0 cm	Y	200 cm	P	0 °
Z	0 cm	Z	200 cm	B	0 °

Object (Rel) · Size · Apply

Grid Spacing : 100 cm

File Edit Create Select Tools Mesh Snap Animate Simulate Render Sculpt Motion Tracker MoGraph Character Plugins Script Window Help
Layout: Startup
View Cameras Display Options Filter Panel
Perspective
File Edit View Objects Tags Bookmarks
Cube
Mode Edit User Data
Basic Coord. Object Phong
0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90
0 F
90 F
Create Edit Function Texture
MAXON CINEMA 4D

C4D Demo - Reference Image



File Edit Create Select Tools Mesh Snap Animate Simulate Render Sculpt Motion Tracker MoGraph Character Plugins Script Window Help
Layout: Startup
View Cameras Display Options Filter Panel
Front
Grid Spacing : 100 cm
0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90
File Edit View Objects Tags Bookmarks
Cube
Mode Edit User Data
Display Filter View Back HUD Stereoscopic
Attributes
Layers

Viewport [Front]

Back

Show Picture . . . . ✓

Image . . . . C:\Users\Kevin\Documents\OSU\2015-2016\Sp16\cap\apatosaurus\apat-ref.jpg

Mode . . . . Linear

Keep Aspect Ratio ✓

Offset X 0 Size X 3203.156

Offset Y 0 Size Y 1000

Rotation 0 °

Transparency 0 %

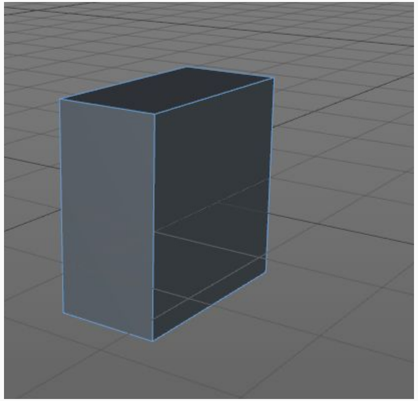
Alpha Mode None

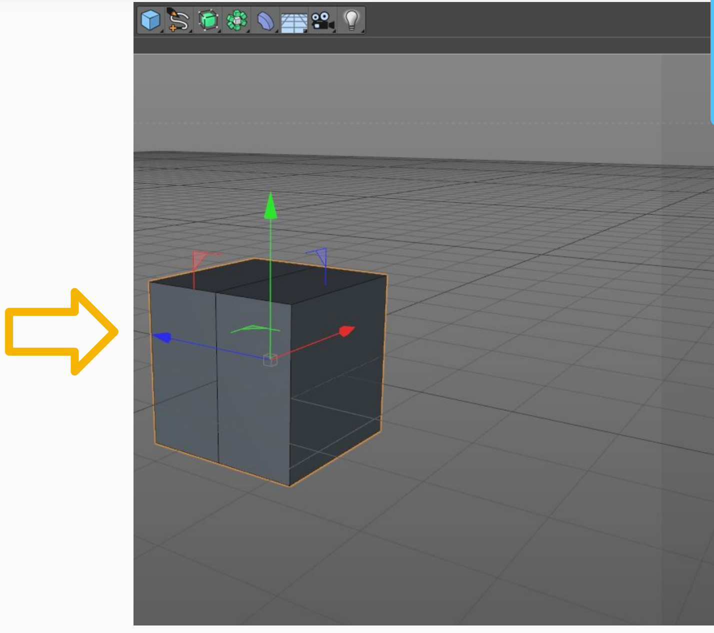
World Grid

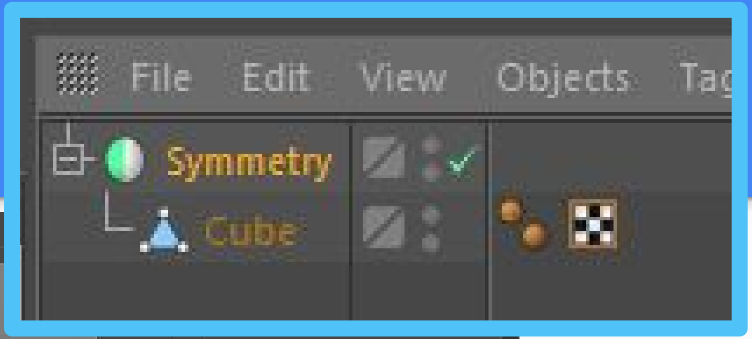
Legacy Mode . . . . □

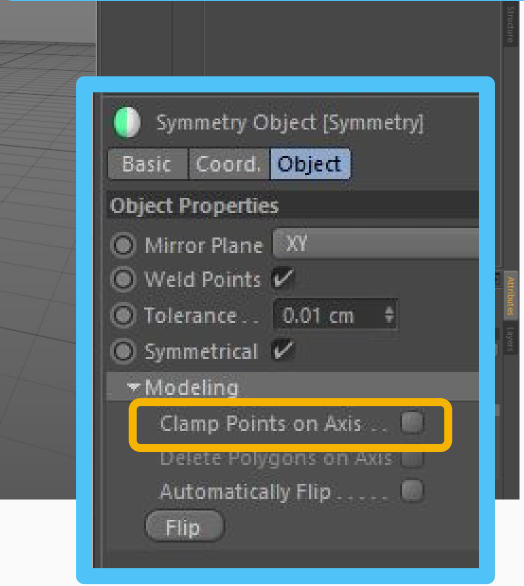
Grid Spacing . . . . 100 cm

C4D Demo - Symmetry









Symmetry Object [Symmetry]

Basic | Coord. | Object

Object Properties

- Mirror Plane: XY
- Weld Points: ✓
- Tolerance . . 0.01 cm
- Symmetrical: ✓

Modeling

- Clamp Points on Axis . . □
- Delete Polygons on Axis □
- Automatically Flip . . . . . □

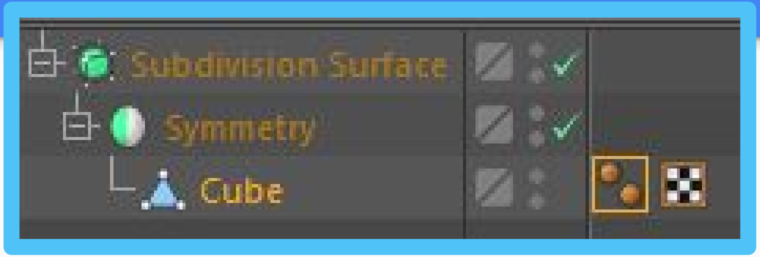
Flip

C4D Demo - Subdivision Surface

- Catmull - Clark for C4D
  - **face point** created for each original polygon
    - avg of every point in the polygon
  - **edge point** created for each old edge
    - avg of original edge midpoint + two adjacent face points
  - **vertex points** created
    - each original vertex has *n* points sharing it
    - ***(n-3)/n * (old vertex)***

      + (1/n) * (avg of face points for adjoining polys)

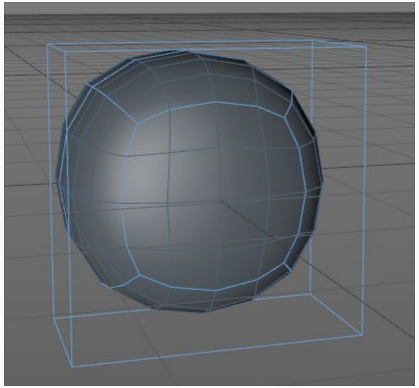
      + (2/n) * (avg of midpoint edges adjoining the old vertex)



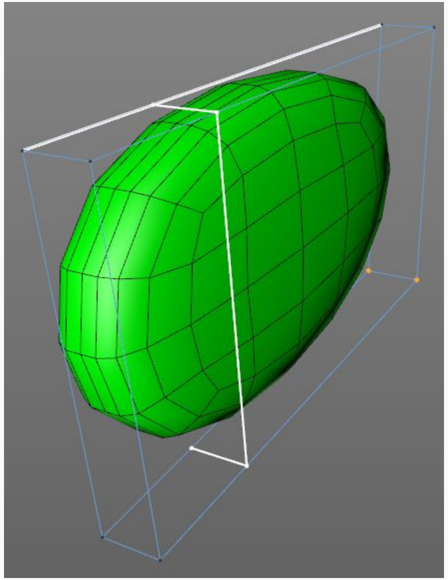
Subdivision Surface

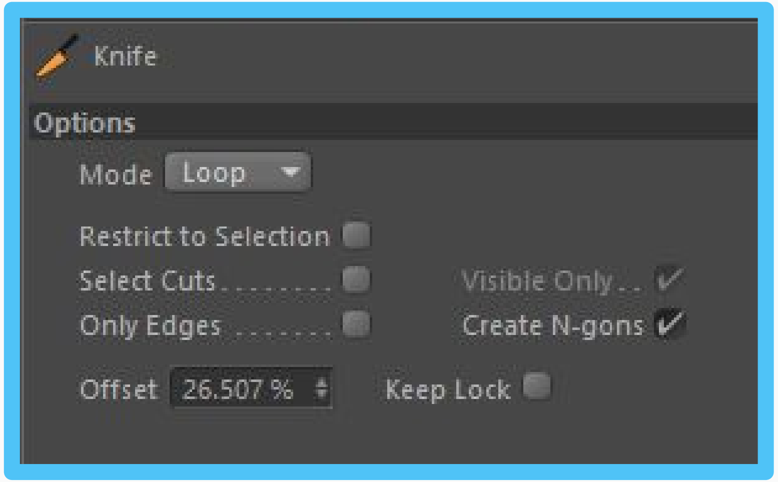
Symmetry

Cube



C4D Demo - Knife Tool





Knife

Options

Mode: Loop

Restrict to Selection □

Select Cuts □

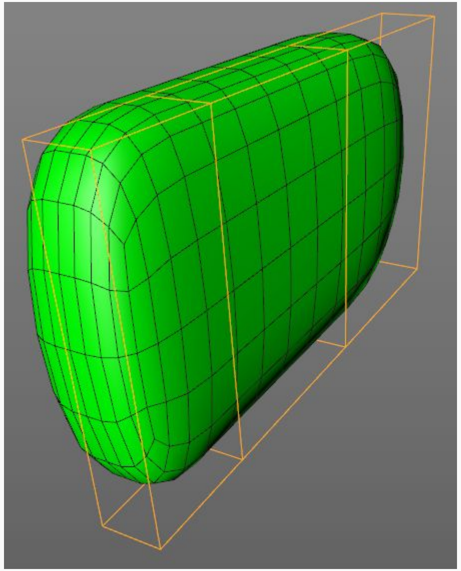
Visible Only ☑

Only Edges □

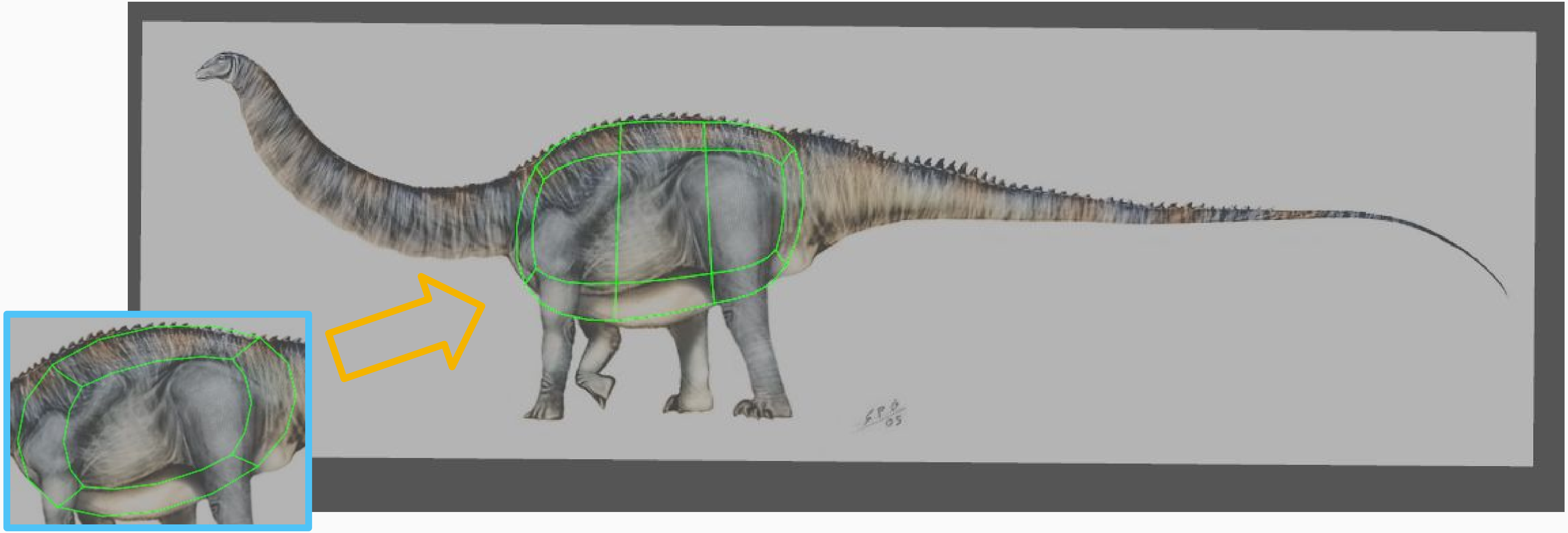
Create N-gons ☑

Offset 26.507 %

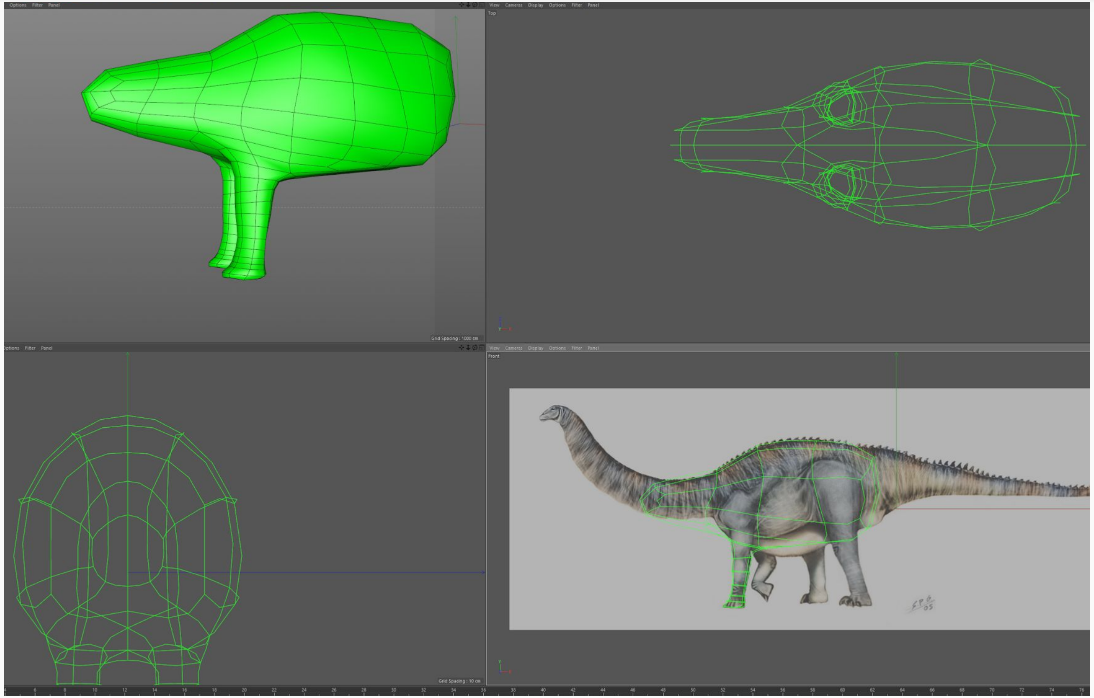
Keep Lock □



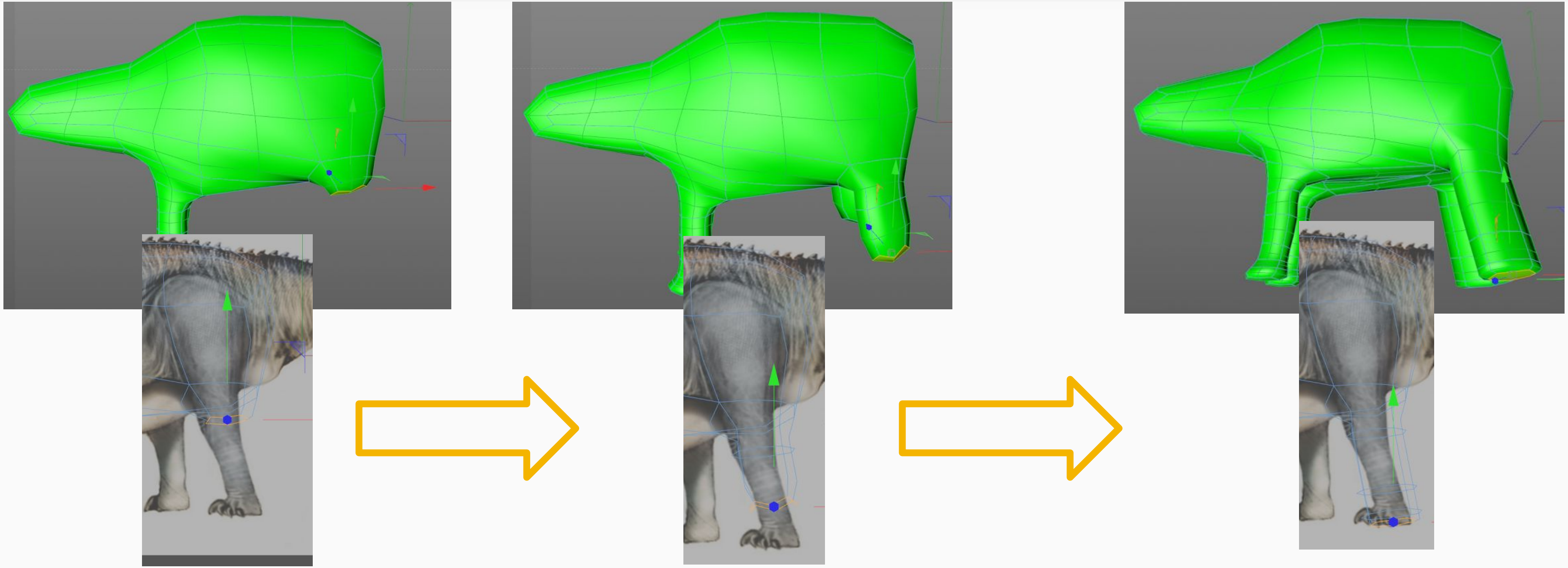
C4D Demo - More Polys, More Detail



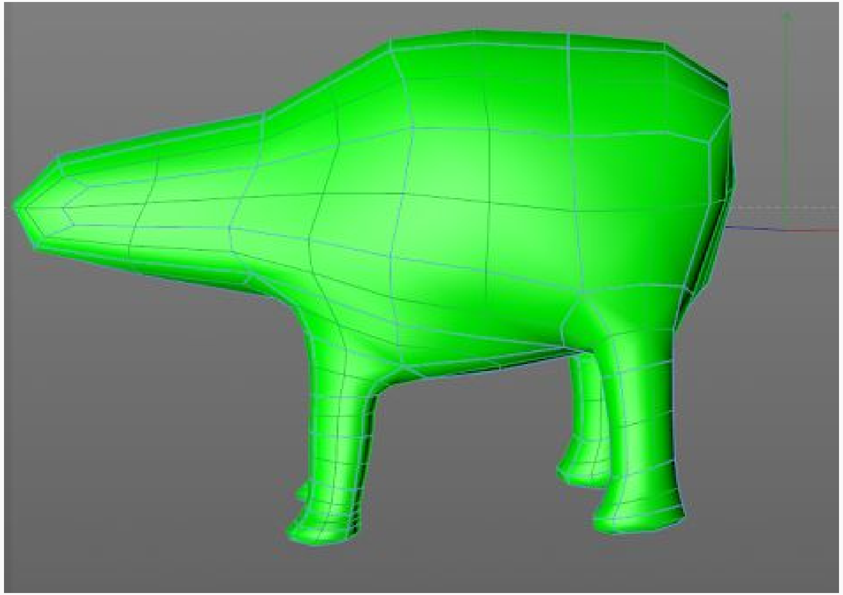
C4D Demo - Extrusion



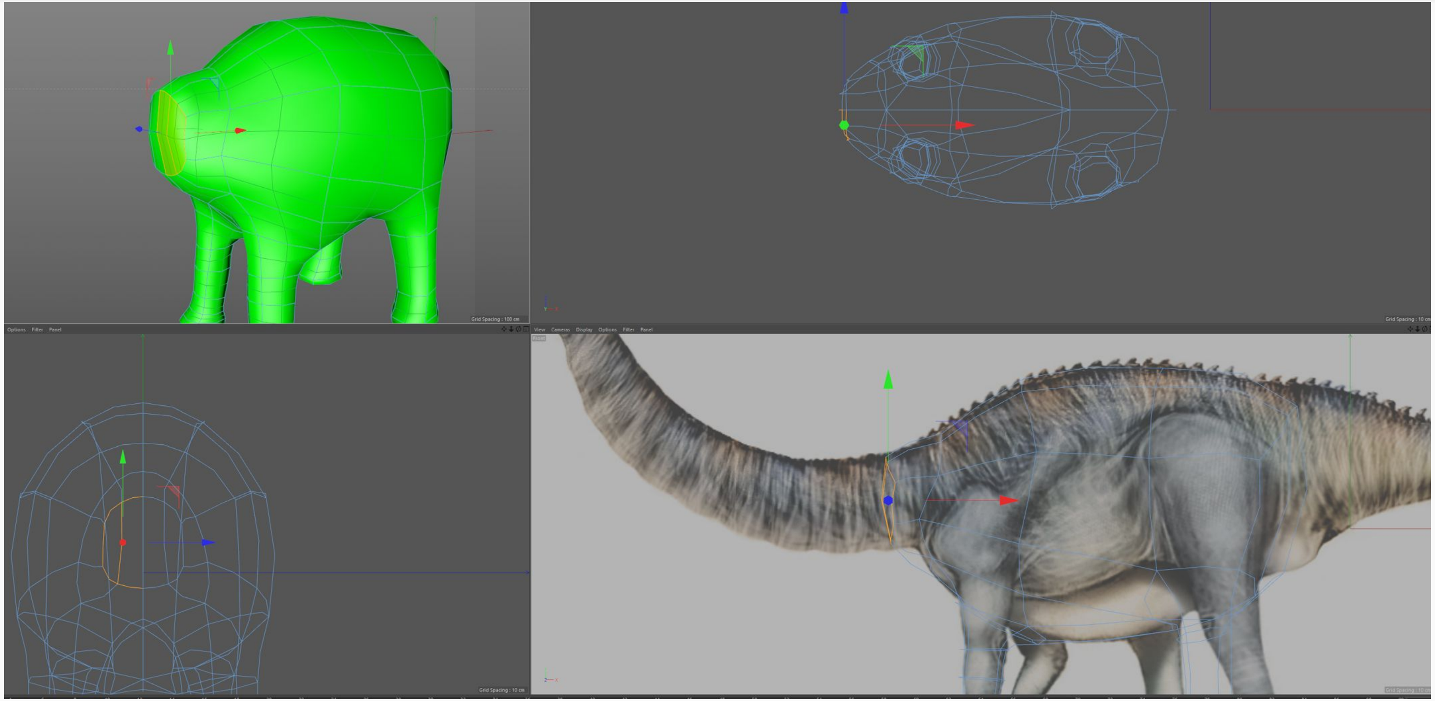
C4D Demo - Extrusion



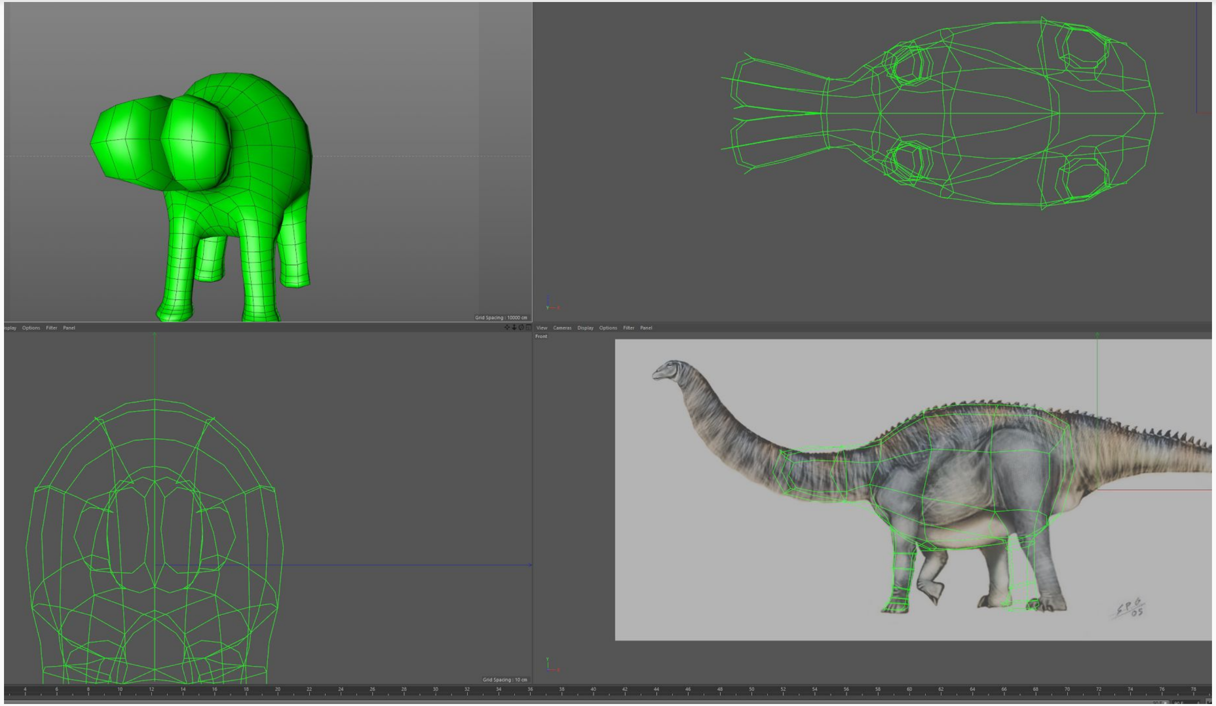
C4D Demo - Extrusion



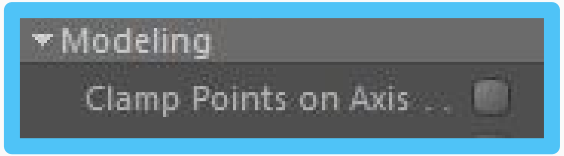
C4D Demo - Extrusion



C4D Demo - Extrusion OOPS!

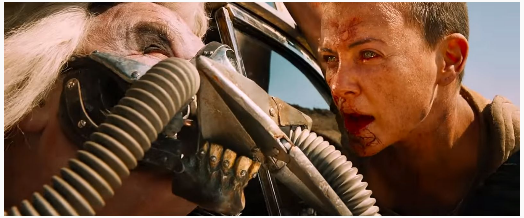


REMEMBER ME???



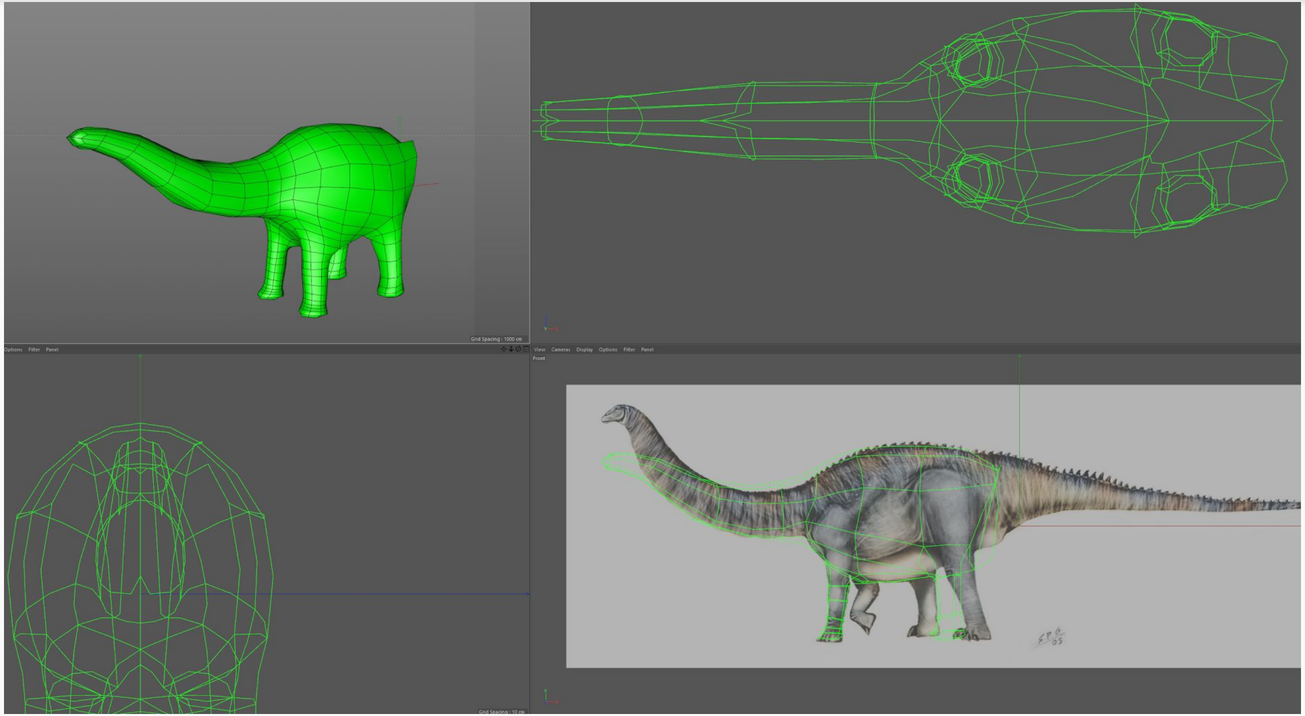
Modeling

Clamp Points on Axis ... □

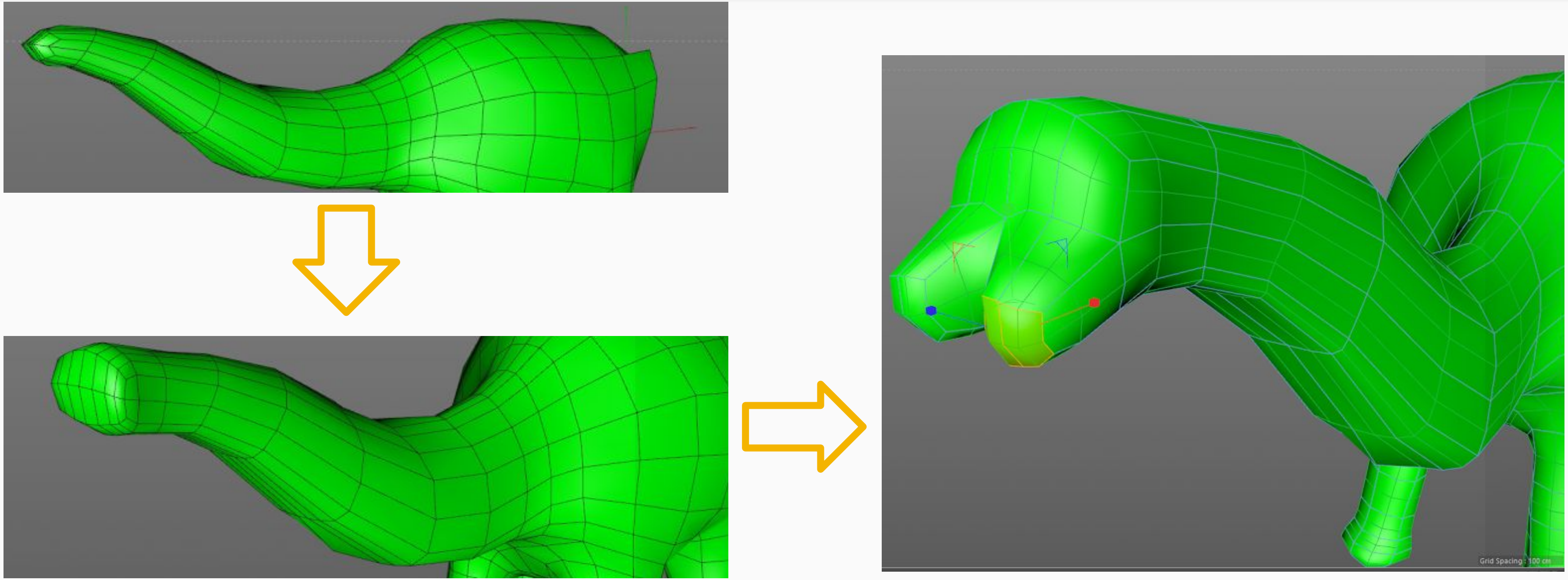


REMEMBER ME???

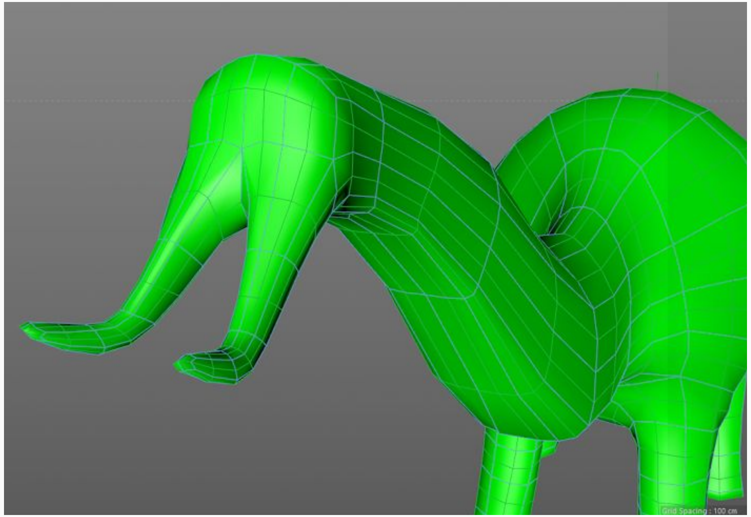
C4D Demo - Neck Extrusion

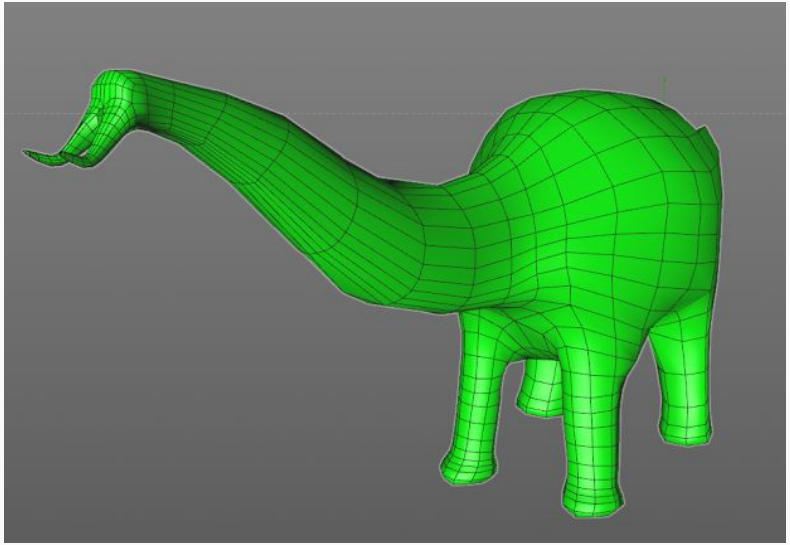


C4D Demo - Head

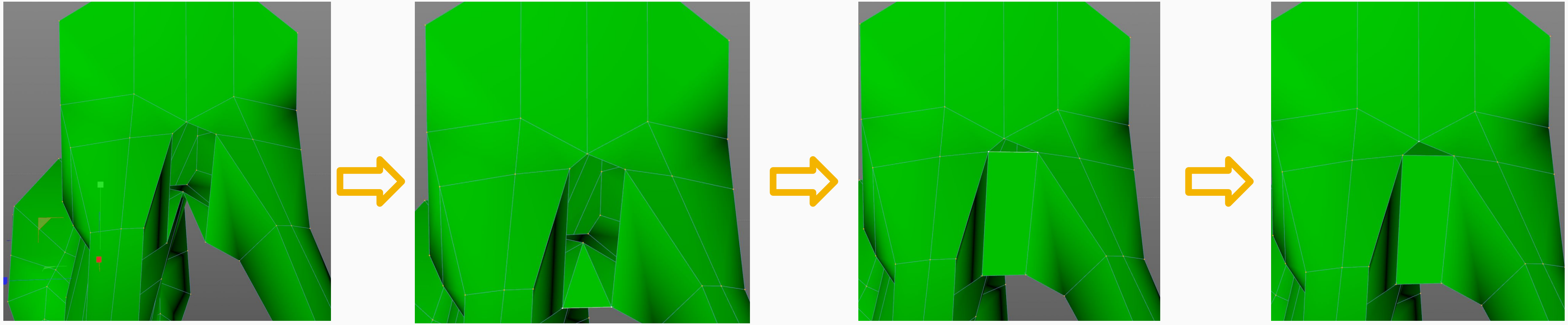


C4D Demo - Mammoth Monster

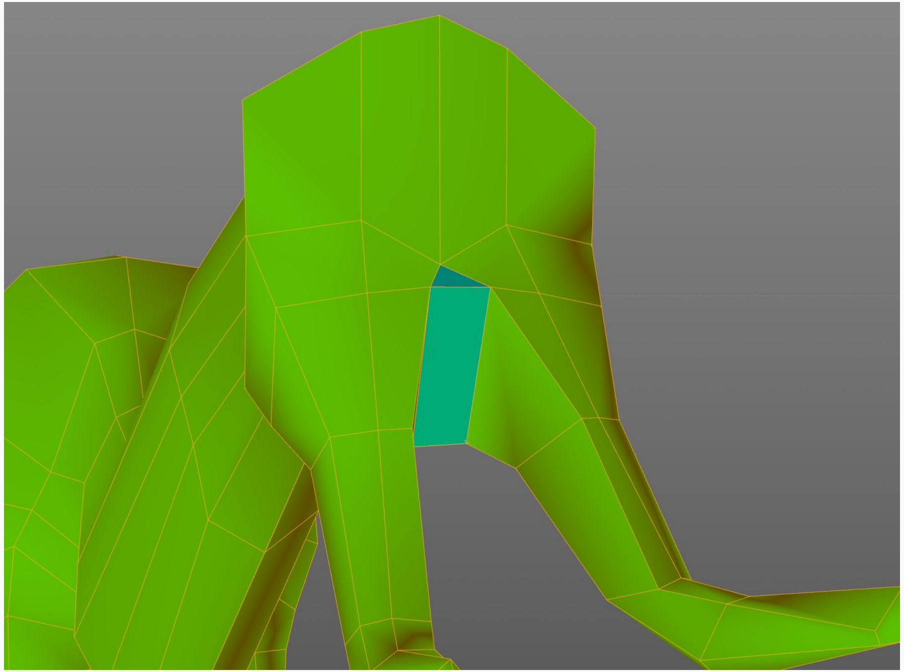




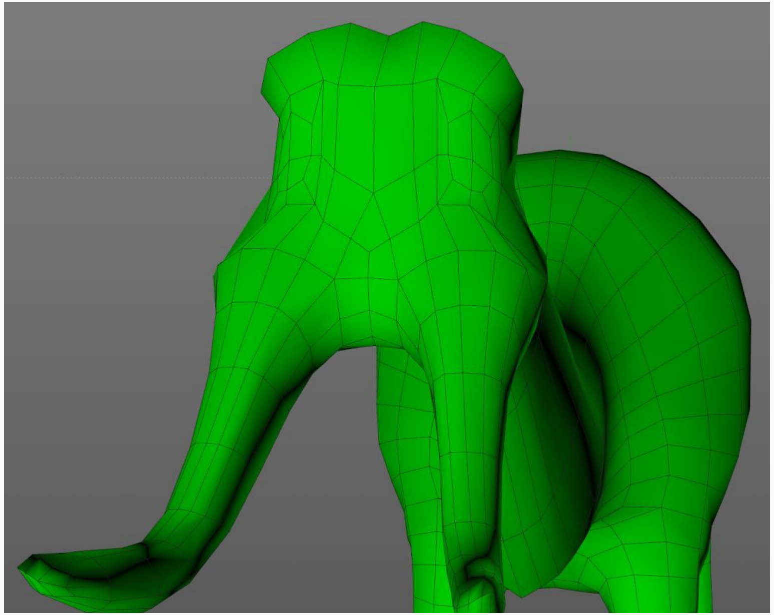
C4D Demo - Bridge Tool

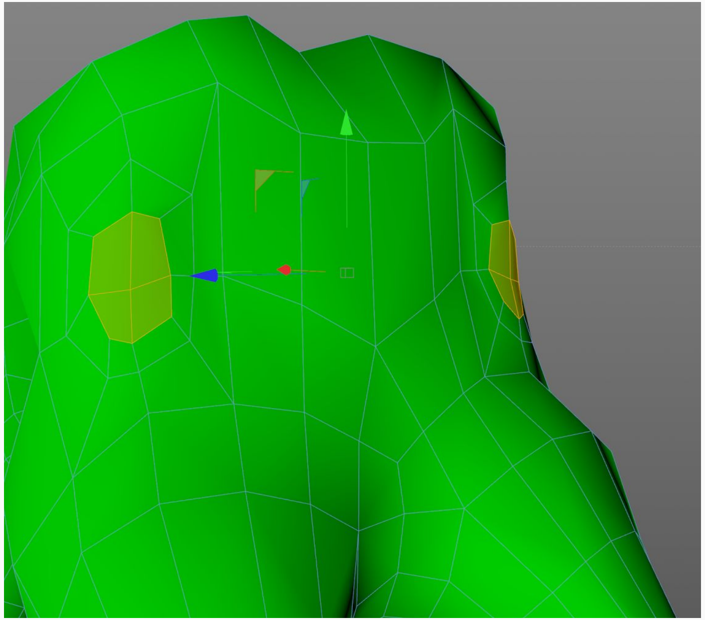


C4D Demo - Normals

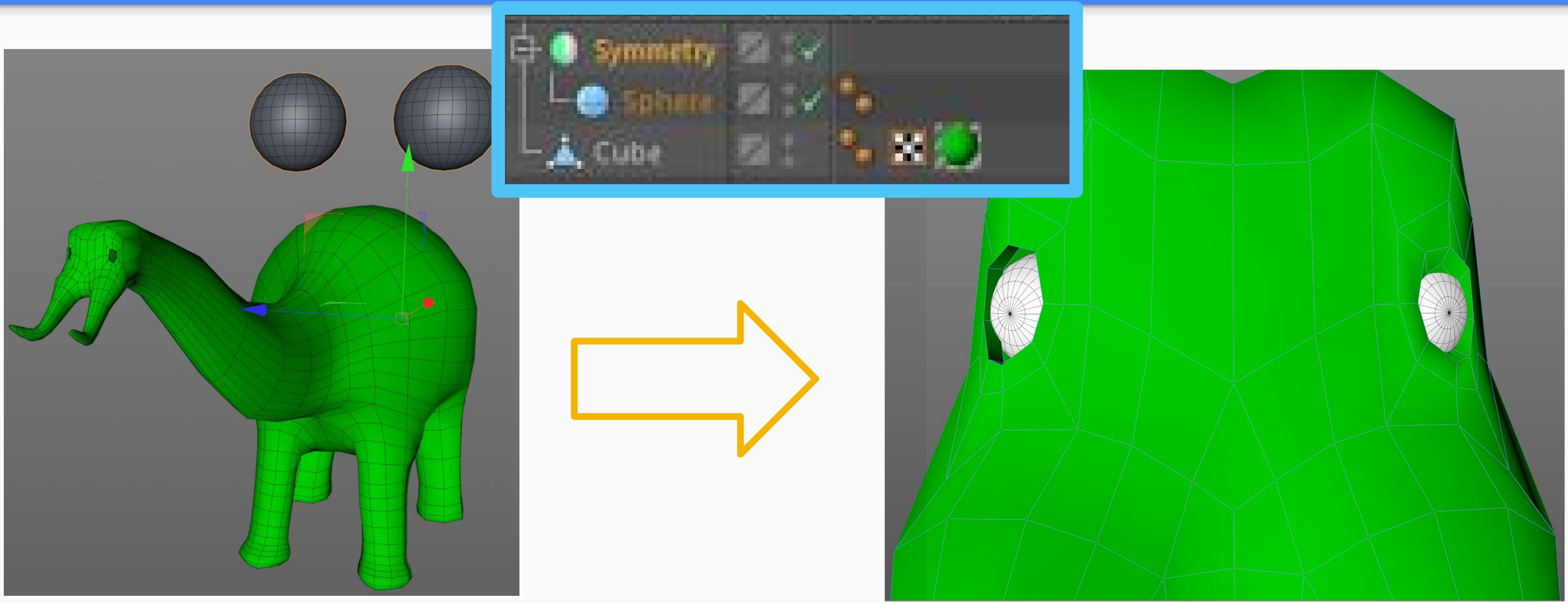


C4D Demo -Extrude Inner



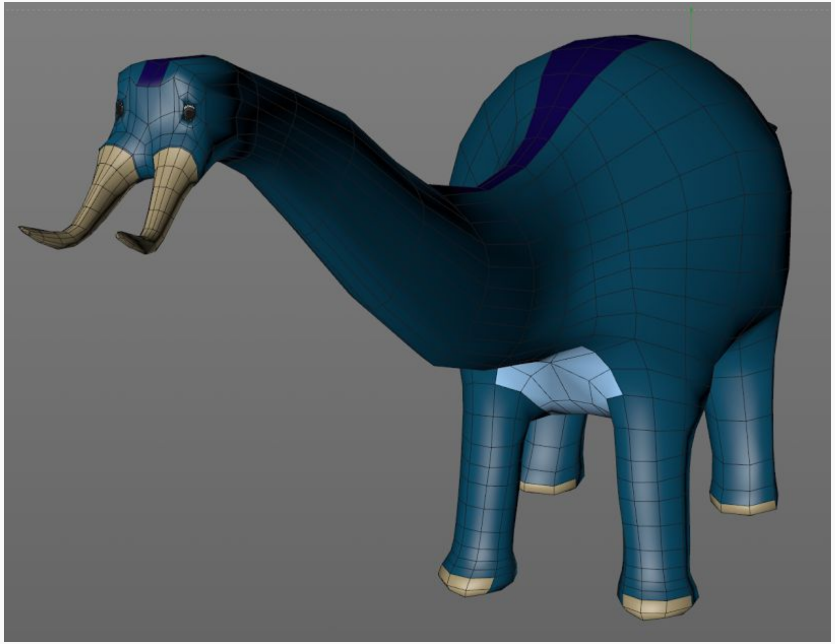


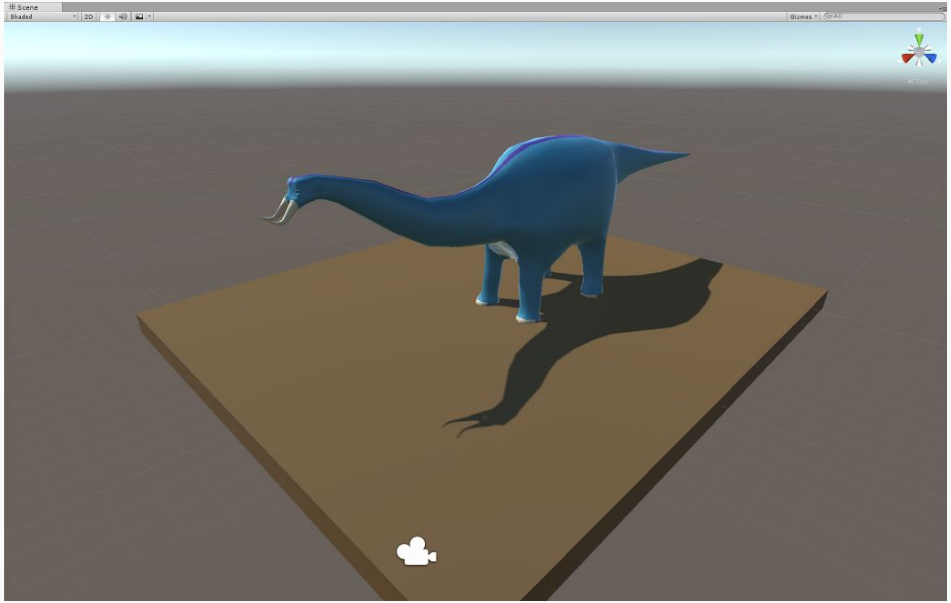
C4D Demo - Eyes



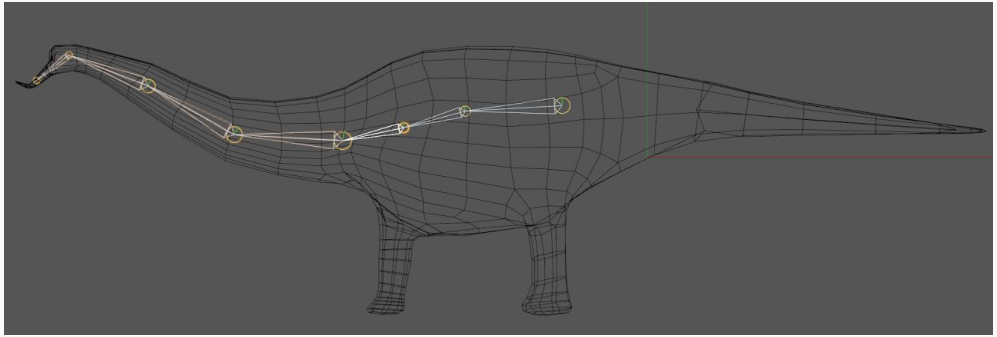
- Symmetry
  - Sphere
  - Cube

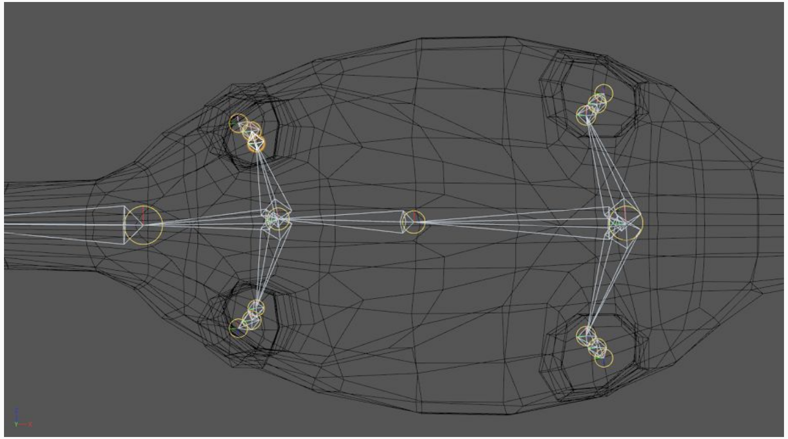
C4D Demo - Color



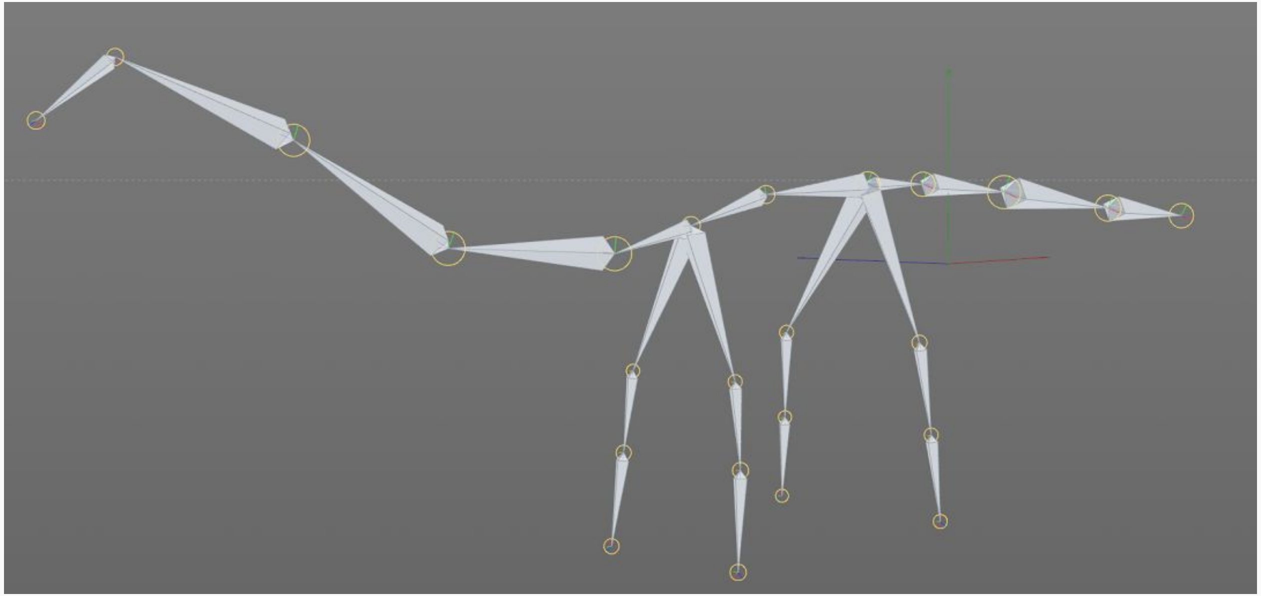


C4D Demo - Rigging

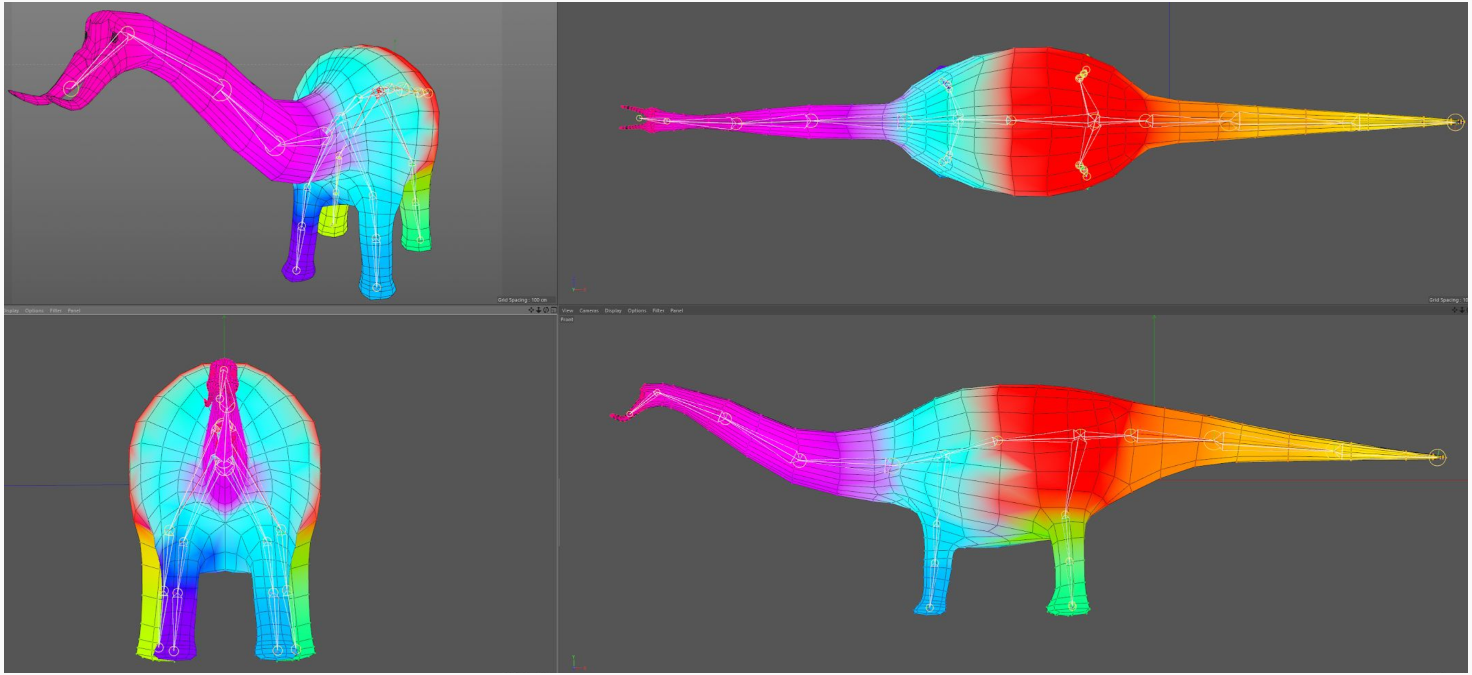




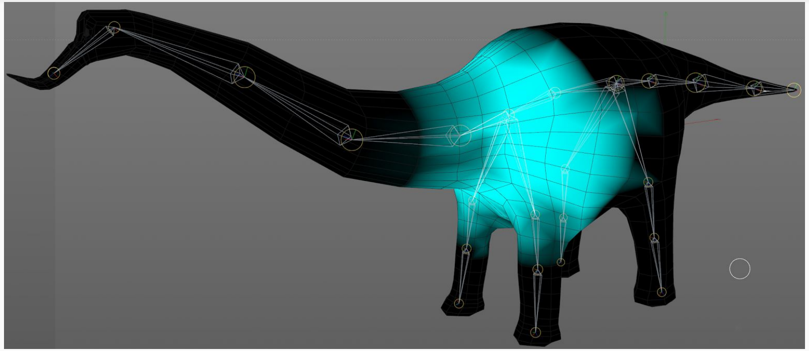
C4D Demo - “Skeleton”

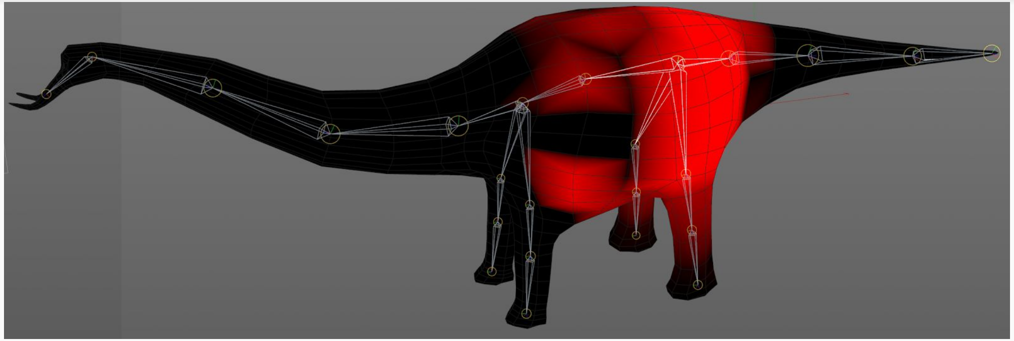


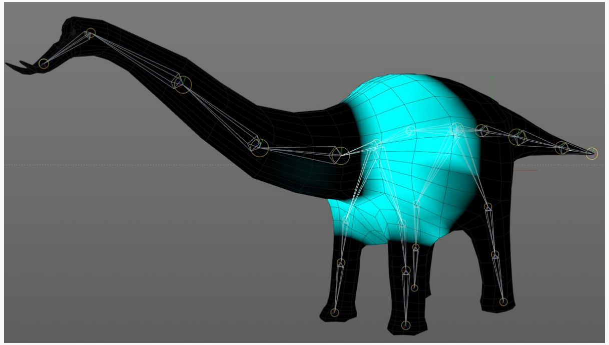
C4D Demo - Weight Painting

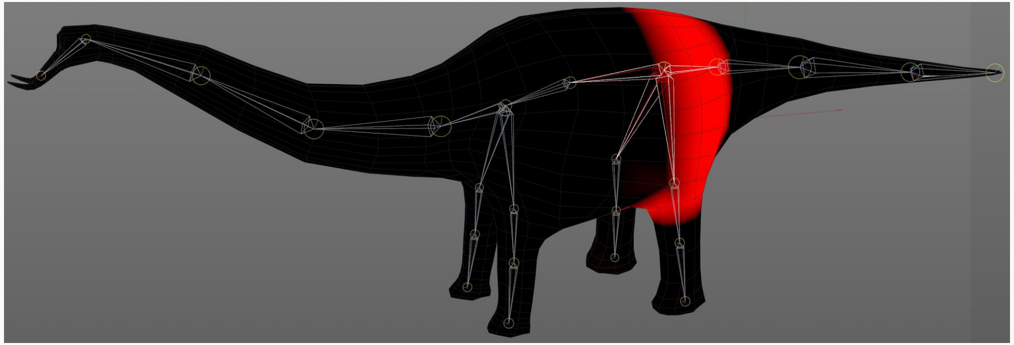

Grid Spacing : 100 cm
isplay Options Filter Panel
View Cameras Display Options Filter Panel
Front
Grid Spacing : 10

C4D Demo - Weight Painting

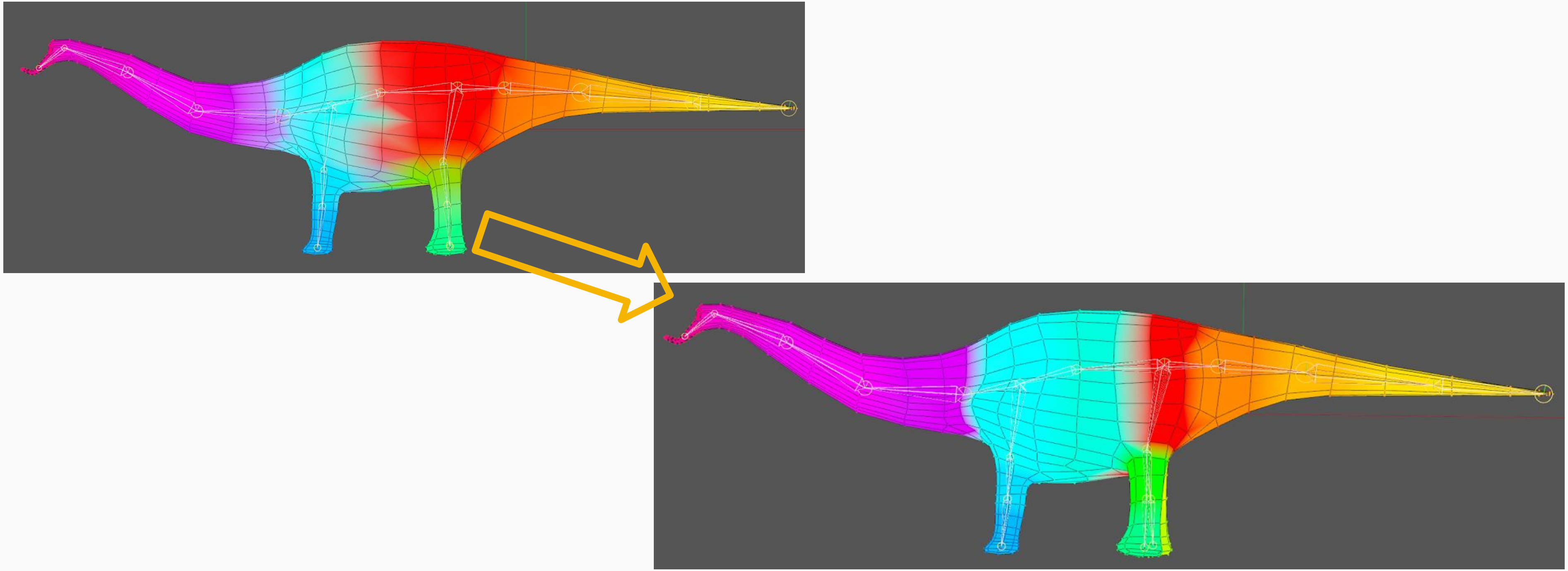






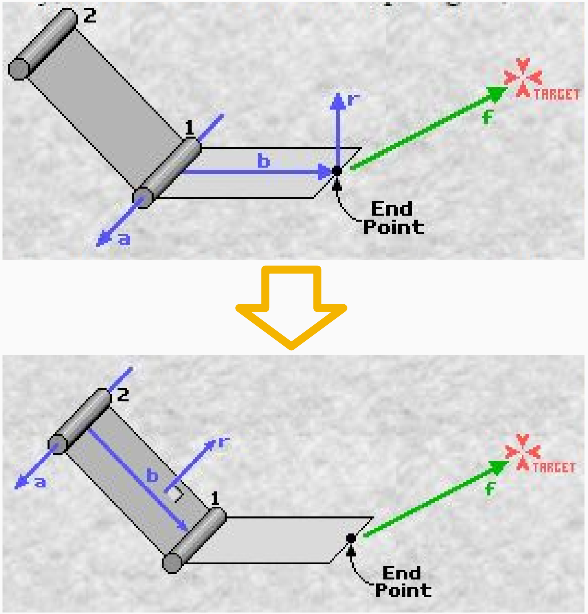


C4D Demo - Weight Painting

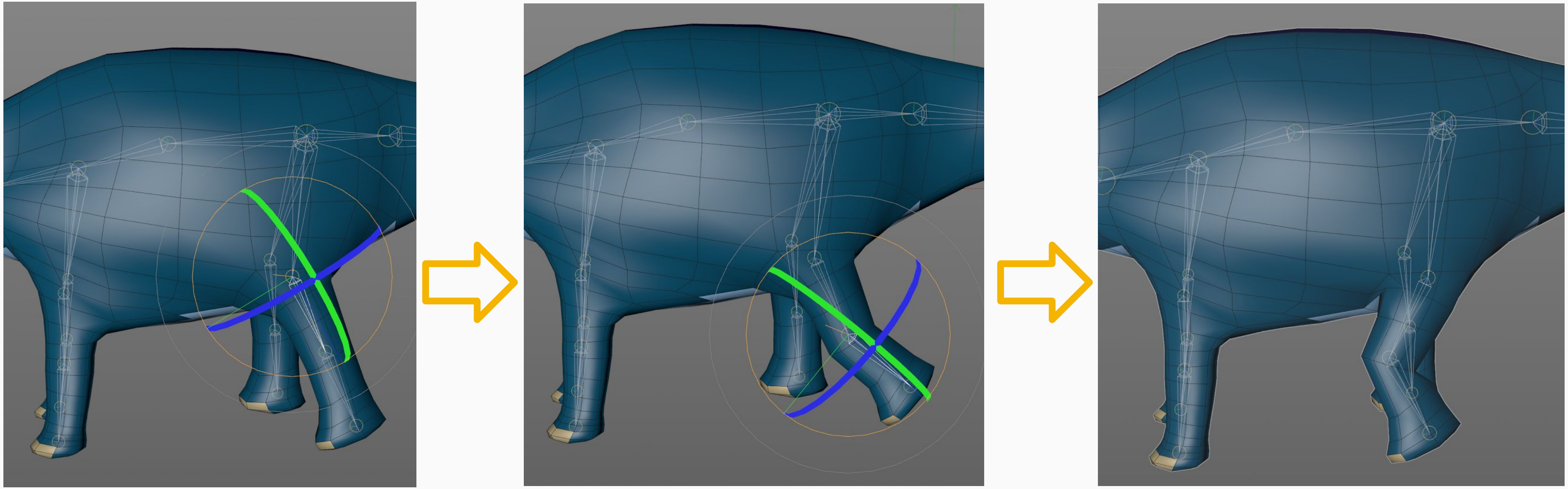


Inverse Kinematics (IK Spline)

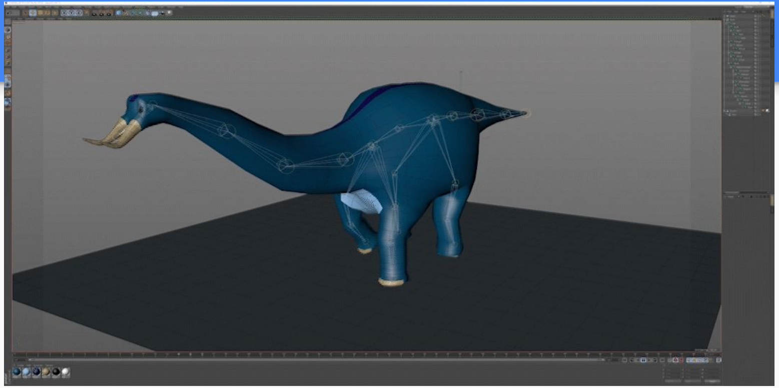
- “The process of calculating the position in space of the end of a linked structure, given the angles of all the joints.
- ***mag(f) * SinVect(a,f) * SinVect(b,f) * sign(CosVect(r,f)) * c***
    - ***a*** = Axis of Joint
    - ***b*** = Vector representing the Bone
    - ***r*** = Orthogonal vector to Plane **ab**
    - ***f*** = Vector from Endpoint to Target (“force vector”)
    - ***c*** = Scalar Constant
    - ***SinVect(x,y)*** = sine of the angle between vectors **x** & **y**
    - ***CosVect(x,y)*** = cosine of the angle between vectors **x** & **y**
    - ***sign(x)*** = sign of x (positive, negative, or zero)

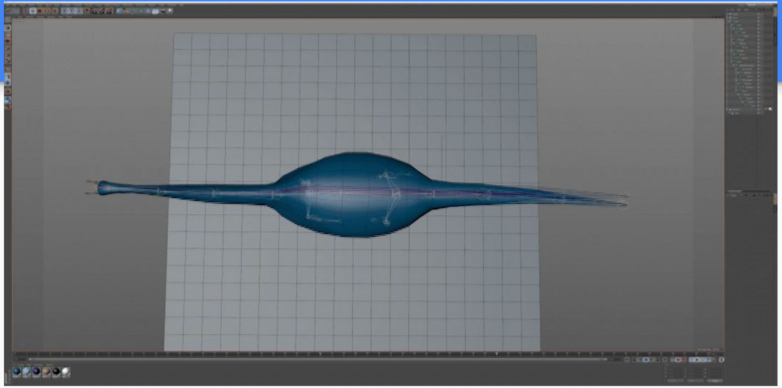


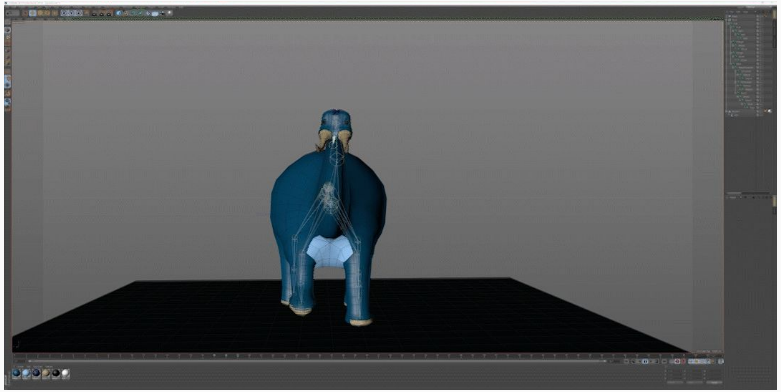
C4D Demo - FK Spline (Forward Kinematics)

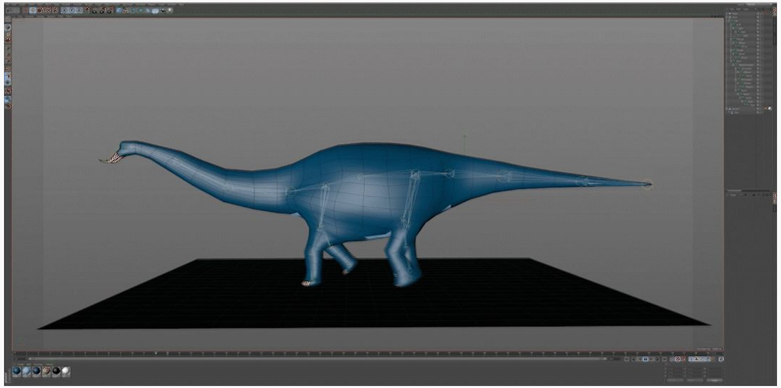


C4D Demo - Walk Cycle

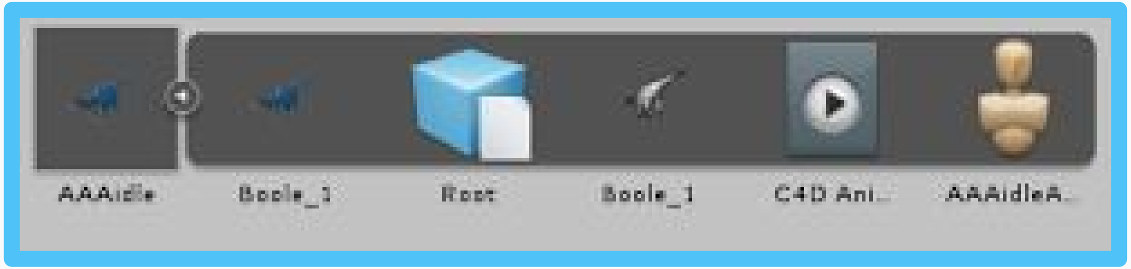


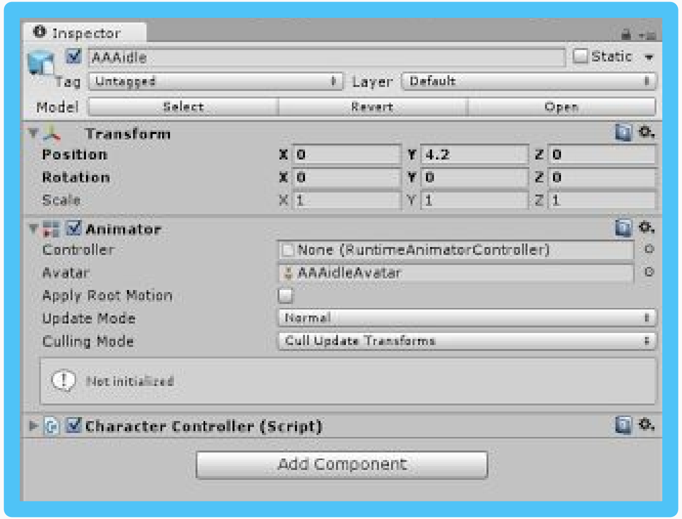






~~C4D~~ Unity Demo - Importing Assets




Inspector

☑ AAAidle □ Static

Tag Untagged Layer Default

Model Select Revert Open

Transform

Position	X 0	Y 4.2	Z 0
Rotation	X 0	Y 0	Z 0
Scale	X 1	Y 1	Z 1

☑ Animator

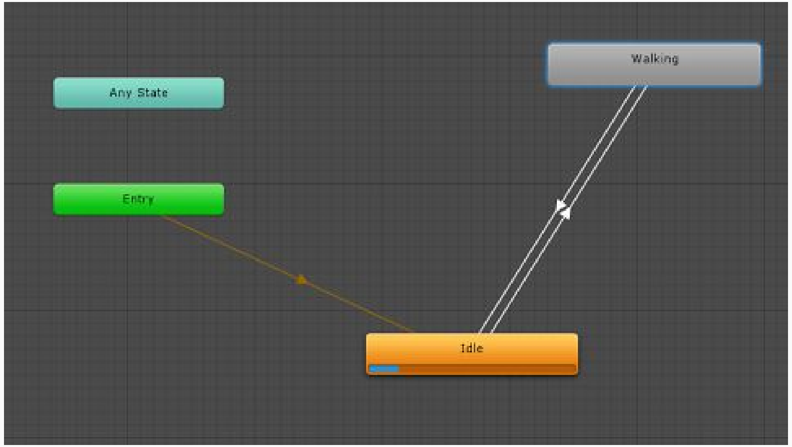
Controller	None (RuntimeAnimatorController)
Avatar	AAAidleAvatar
Apply Root Motion	□
Update Mode	Normal
Culling Mode	Cull Update Transforms

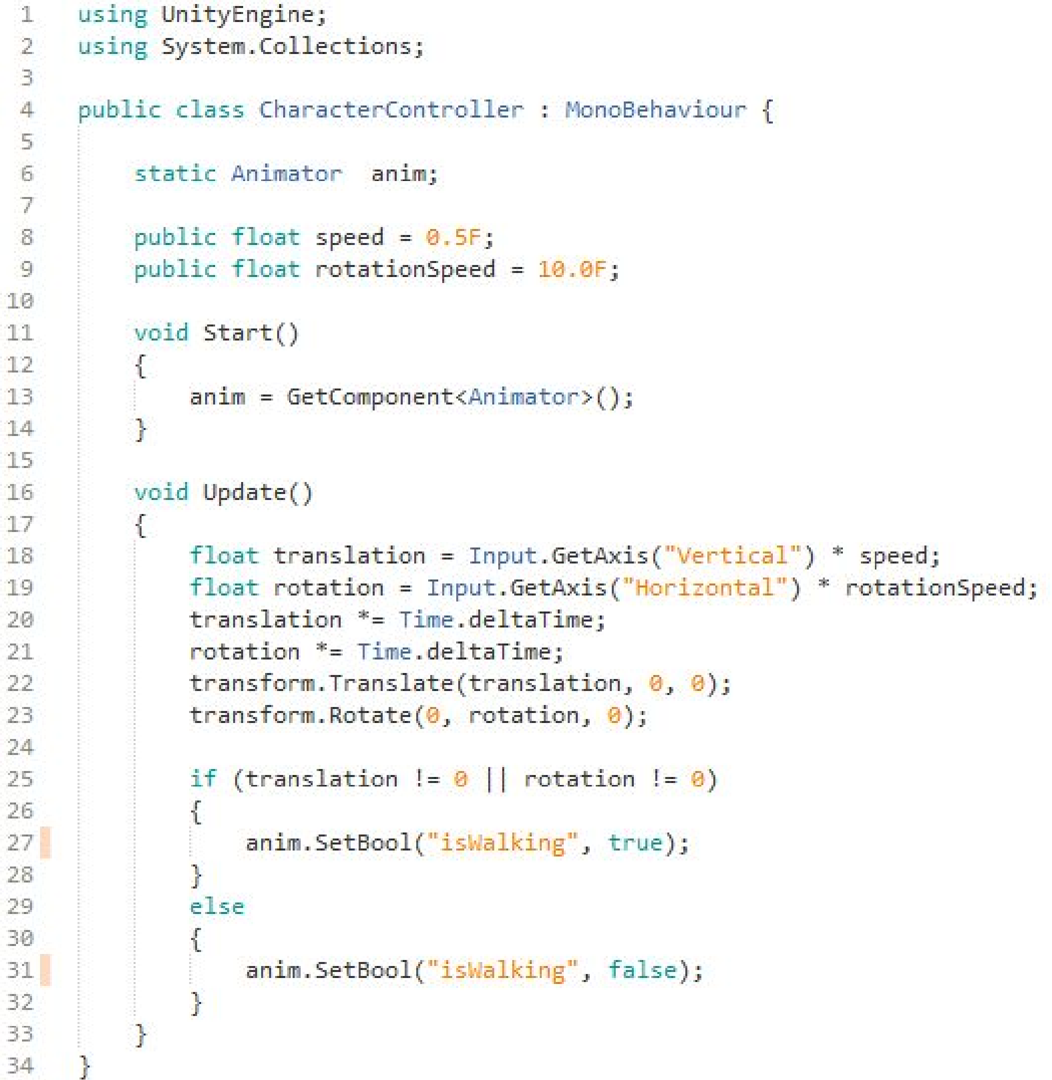
Not initialized

☑ Character Controller (Script)

Add Component

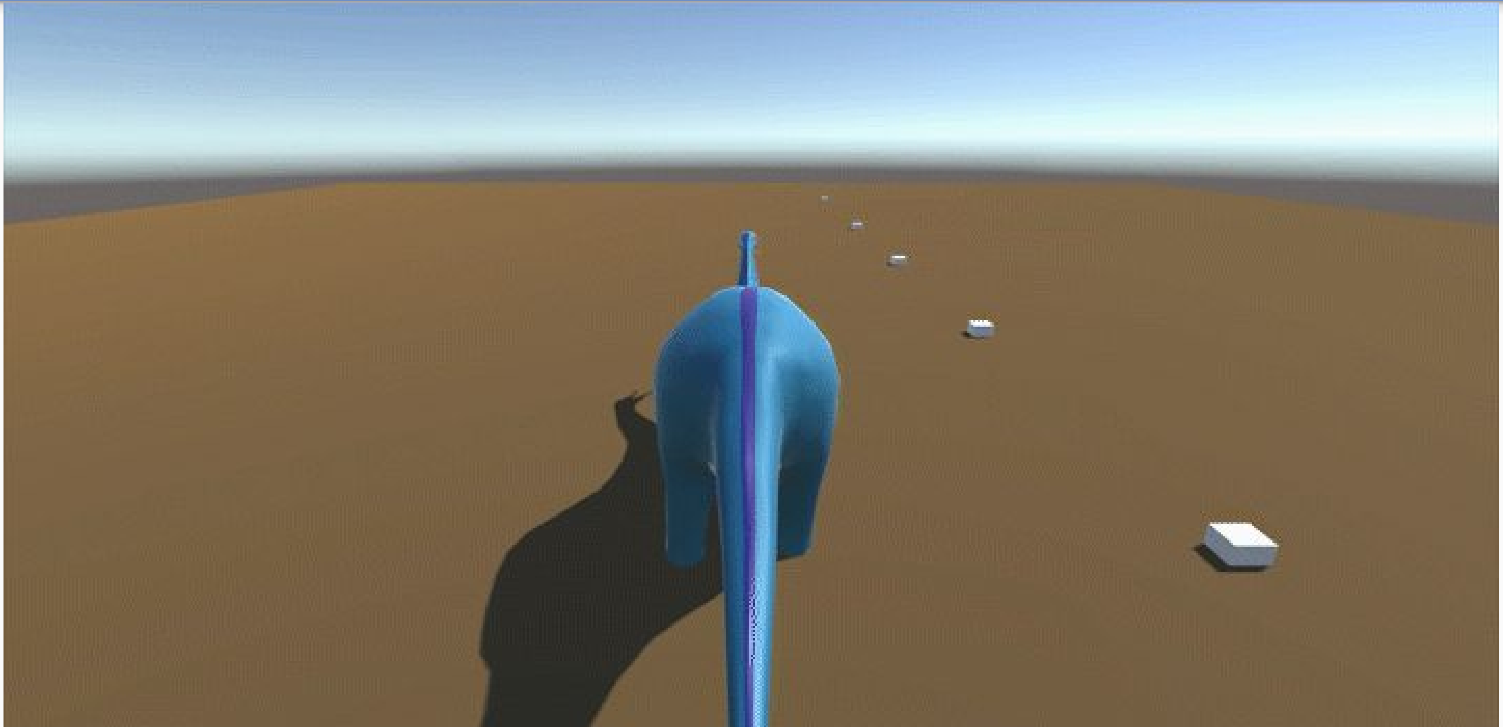
~~C4D~~ Unity Demo - Animation Controller





```
using UnityEngine;
using System.Collections;

public class CharacterController : MonoBehaviour {

    static Animator  anim;

    public float speed = 0.5F;
    public float rotationSpeed = 10.0F;

    void Start()
    {
        anim = GetComponent<Animator>();
    }

    void Update()
    {
        float translation = Input.GetAxis("Vertical") * speed;
        float rotation = Input.GetAxis("Horizontal") * rotationSpeed;
        translation *= Time.deltaTime;
        rotation *= Time.deltaTime;
        transform.Translate(translation, 0, 0);
        transform.Rotate(0, rotation, 0);

        if (translation != 0 || rotation != 0)
        {
            anim.SetBool("isWalking", true);
        }
        else
        {
            anim.SetBool("isWalking", false);
        }
    }
}
```

~~C4D~~ Unity Demo - Animated Character



Resources

- http://www.computerhistory.org/timeline/graphics-games/
- History of Computer Animation
  - https://www.youtube.com/watch?v=LzZwiLUVaKg
- History of 3D in video games
  - https://www.youtube.com/watch?v=hTehcvSgyWI
- https://en.wikipedia.org/wiki/Computer_animation
- Subdivision Surfaces
  - http://www.holmes3d.net/graphics/subdivision/
- Inverse Kinematics
  - http://freespace.virgin.net/hugo.elias/models/m_ik.htm

Resources (Cont.)

- Madden 2005 review http://www.ign.com/games/madden-nfl-2005/nds-692538
- Complex model taken from TurboSquid
- Videos taken from YouTube
- Batman: Arkham Asylum http://uproxx.com/gammasquad/15-fascinating-facts-may-know-batman-arkham-asylum/

Resources (Cont.)

- Maya
- https://en.wikipedia.org/wiki/Autodesk_Maya
- http://www.autodesk.com/products/maya/overview-dts?s_tnt=69290:1:0
- 3ds Max
- https://en.wikipedia.org/wiki/Autodesk_3ds_Max
- http://www.autodesk.com/products/3ds-max/overview-dts?s_tnt=69291:1:0
- C4D
- https://en.wikipedia.org/wiki/Cinema_4D
- http://www.maxon.net/products/cinema-4d-studio/who-should-use-it.html
- Blender
- https://en.wikipedia.org/wiki/Blender_%28software%29
- https://www.blender.org/
- Some Comparisons (of many)
- http://blog.digitaltutors.com/3ds-max-vs-maya-is-one-better-than-the-other/
- http://blog.digitaltutors.com/3ds-max-maya-lt-blender-3d-software-choose-asset-creation/
- http://blog.digitaltutors.com/cinema-4d-3ds-max-motion-graphics/

Questions?