CS7029 Animation Project

Part 1: Concepts and Blender

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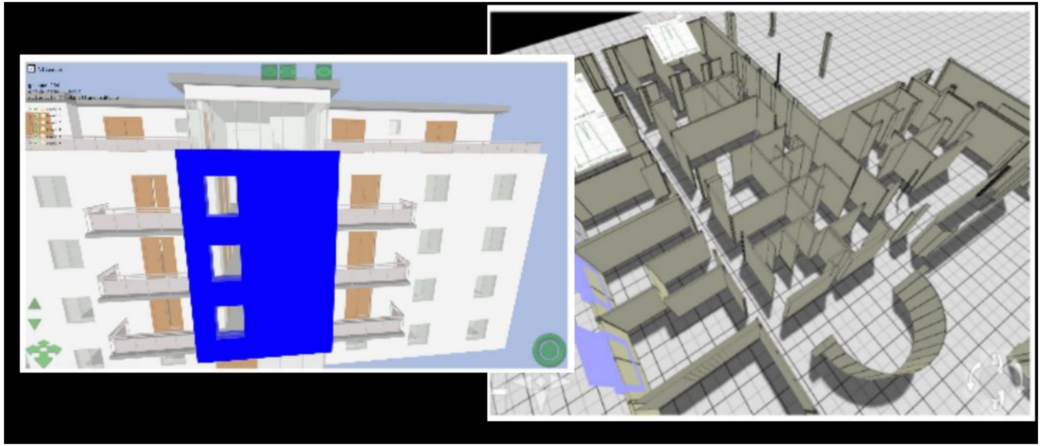
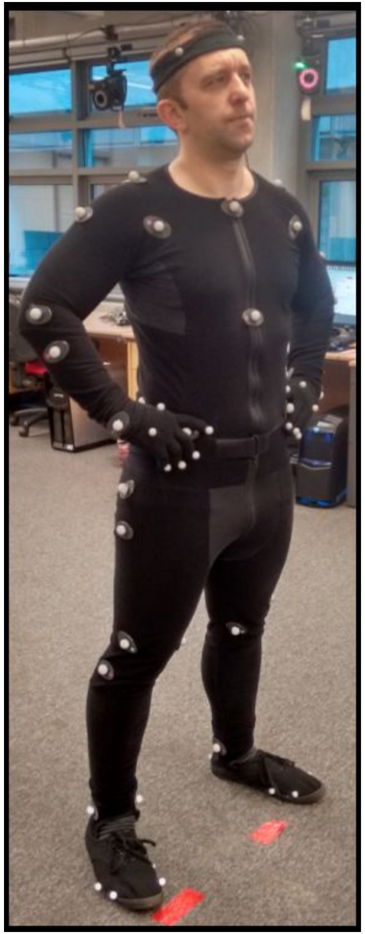
me

- from New Zealand
- programming [games, graphics]
- computer graphics [opengl]
- 3d models, textures, 2d art
- animation
- GV2
- BTH, Sweden
- webgl, mobile

antongerdelan.net





Assignment

End of semester

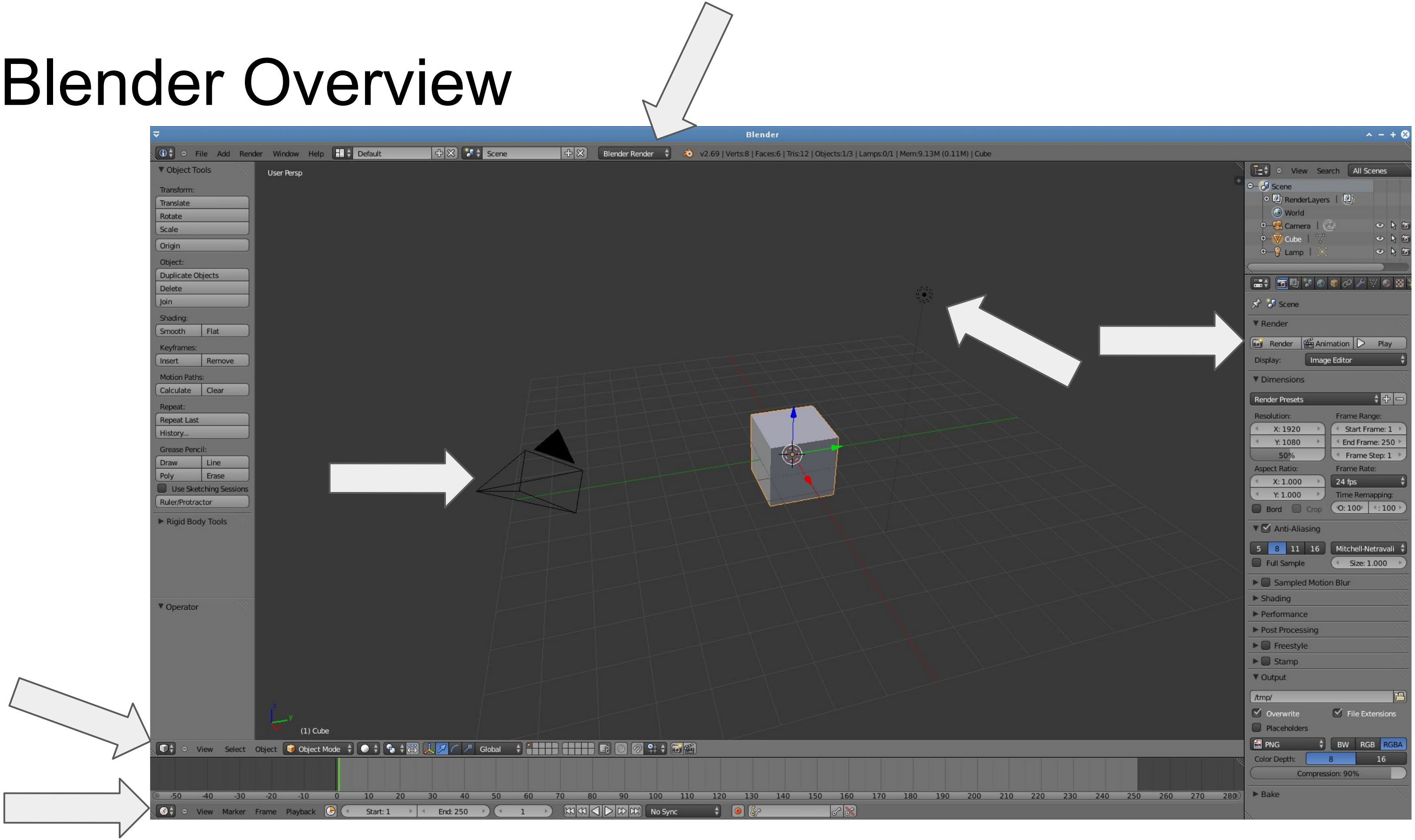
30 second clip

- 3d models & textures
- camera & animations
- consistent composition (most important - requires attention to detail)
- video & summary report

lots of room to put work into what you like

several hours of tutorials / videos / research / practice required

Blender Overview



v2.69 | Verts:8 | Faces:6 | Tris:12 | Objects:1/3 | Lamps:0/1 | Mem:9.13M (0.11M) | Cube

Display: Image Editor

Resolution: X: 1920, Y: 1080, 50%

Frame Range: Start Frame: 1, End Frame: 250, Frame Step: 1

Aspect Ratio: X: 1.000, Y: 1.000

Frame Rate: 24 fps

Time Remapping: O: 100, N: 100

□ Bord □ Crop

☑ Anti-Aliasing: 5 8 11 16, Mitchell-Netravali

□ Full Sample, Size: 1.000

/tmp/

☑ Overwrite ☑ File Extensions

□ Placeholders

PNG, BW RGB RGBA

Color Depth: 8 16

Compression: 90%

Very basic walk-through

- select object with mouse, move camera with **MMB**, **mwheel**, and **+shift**
- use arrows or the **G** button to move around (right click to cancel)
- look through current camera with **NUM0**
- set keyframe with **I**
- drag the green needle to a new time-line position
- move object again, and set a new keyframe
- play sequence with **alt+a**
- choose output file format/folder on render options pane (default is numbered PNGs)
- press ‘animate’ (save first - may crash)
- try with a different renderer

Next … you have a lot of design choices

- texturing, 2d or 3d painting, photographs
- 3d modelling, sculpting
- different animation techniques
- lighting, particles, advanced materials (glass, water etc.)
- storyboarding, grease pencil templates

lots of different (shorter) tutorials to learn concepts and Blender-specific techniques

a good plan, and be prepared to abandon time-consuming ideas

helpful Blender tips

don’t be overwhelmed by all the panels and buttons!

learn all the shortcut-keys

a selects/deselects all

b box selects (works in lots of 2d views too)

g moves, **r** rotates, **s** scales

modifier keys (**shift**, **alt**, **mmb**) modify operations e.g. scale in increments

the “dope sheet” view can space/move keyframes on the timeline

inspiration

Conor Snyed - http://youtu.be/ofgfaO91_R4

Neil O’Carroll - http://youtu.be/fqsgS4H6DH0

Tim’s TV - https://youtu.be/VkUy_4NlY7s

Tim’s fracture test - https://youtu.be/GGS0JAVvMus

Cosmos Laundromat - https://youtu.be/Y-rmzh0PI3c

Llamigos - https://cloud.blender.org/p/caminandes-3/

(see **Reels->Quad Split**, concept art, making of)

general good plan

I have been doing 3d modelling since…~1994 and Blender since ~2007

I’m still not an expert at Blender modelling and animation - you will do things I haven’t done before.

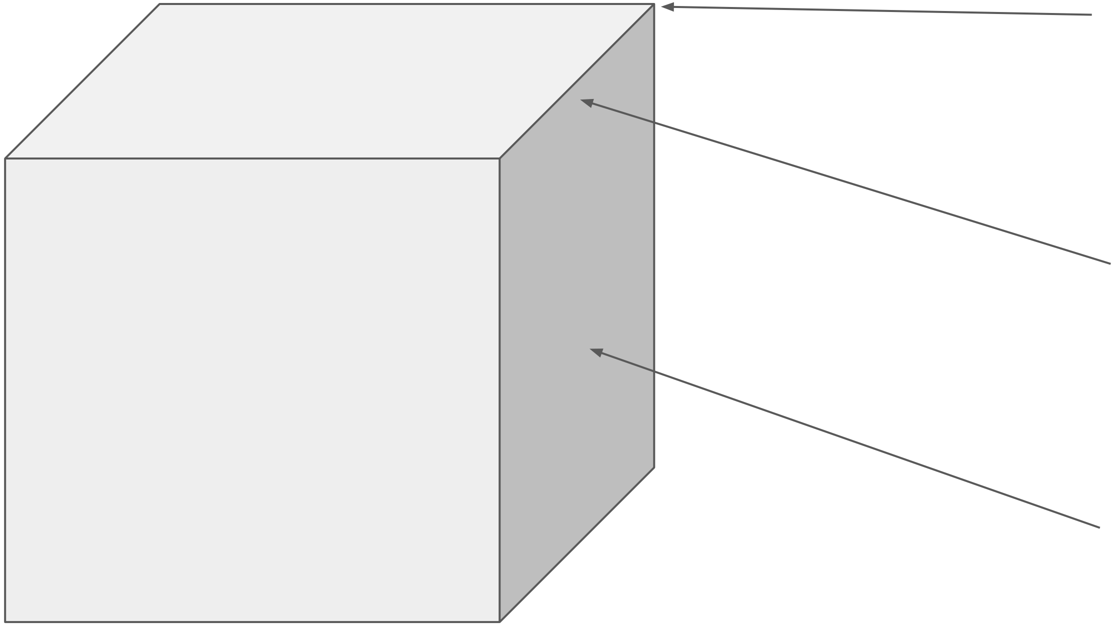
I may not have specific answers but happy to help find them.

Grading is inevitably too subjective and too quick.

Make your contributions very clear.

i.e. Make a summary **table** of techniques used for the report.

creating 3d models
and basic 3d graphics concepts

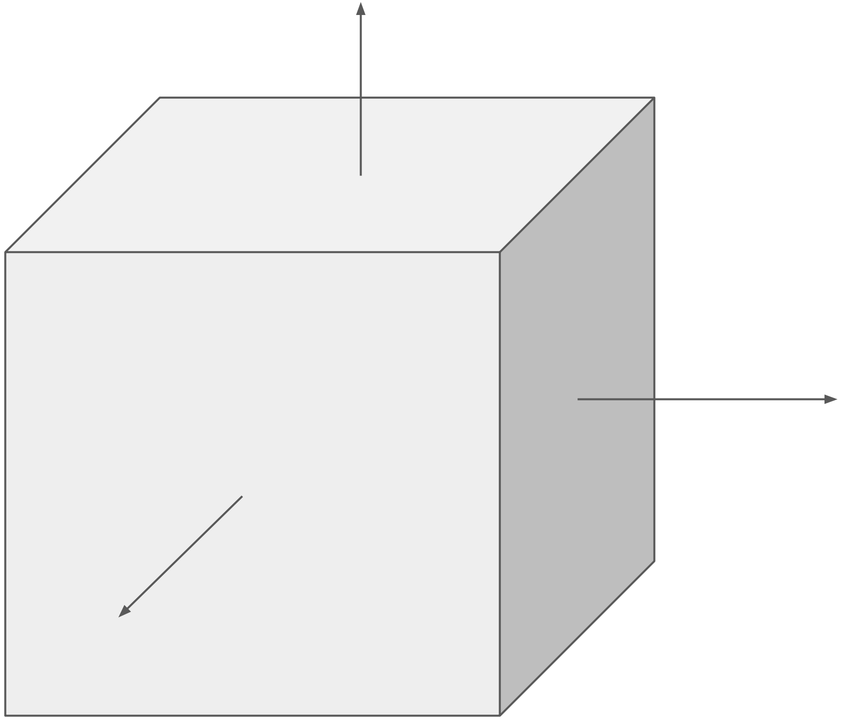


vertex. pl. “vertices”
XYZ 3d position

edge
connects 2 vertices

face or facet
polygon
quads, triangles
one or two-sided
has a definite front side
winding order

Face Normals



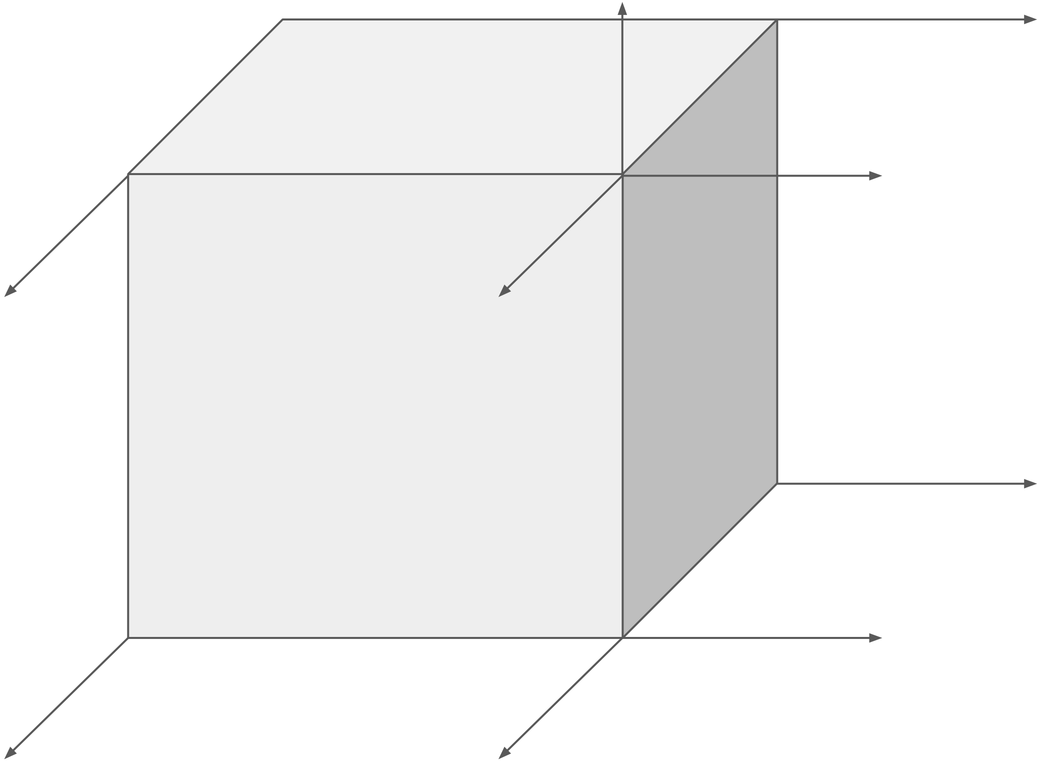
each face has a **normal** vector

points in direction of face

affects lighting calculations

each vertex also has a normal...

Vertex Normals: Flat Shaded



vertex normals same as face normals

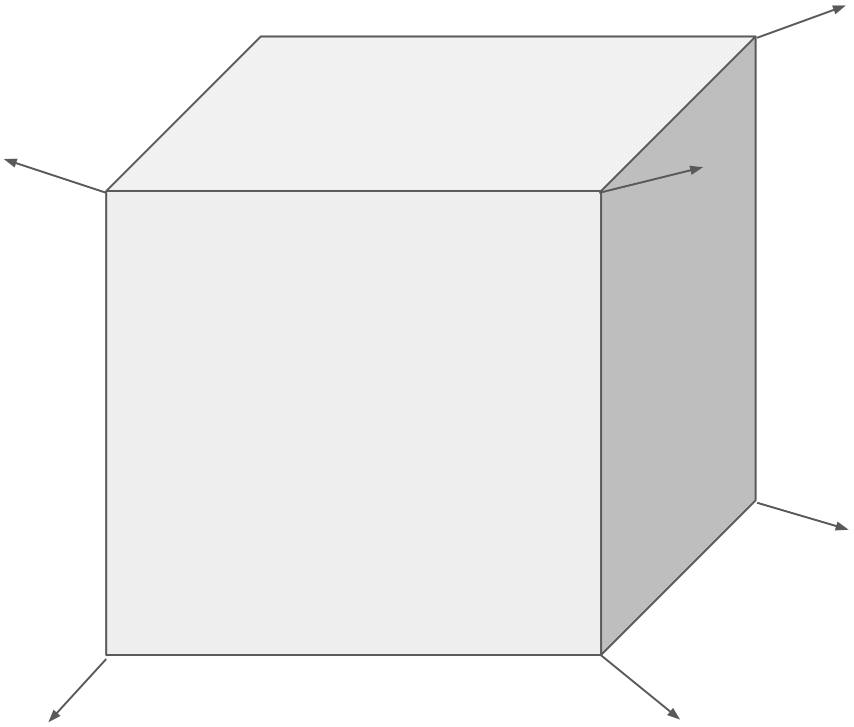
~default

things look blocky and polygonal under lighting

suitable for:

walls, buildings...

Vertex Normals: Smooth Shaded



vertex normals are **average** of surrounding faces' normals

makes **lighting** act like we have a **curved surface**, even though we have blocky polygons

suitable for:

organic things (people), spheres, wheels….

(reminder to self - show them how to switch this in Blender)

Blender’s Scene / Node Hierarchy Concept

Object Mode

what is an object

Edit mode

Object -> Mesh

can move stuff around in both levels. confusing.

Object (top level animation stuff) - “world space”, world origin. “the scene”.

Edit / mesh (changing the _shape_ of a mesh) - “local space”, local origin

Important Note About Scene Hierarchies

This is not an universal system used everywhere

Every 3d editor / game engine / thing has its own concept of what a scene is

Roots in linear algebra

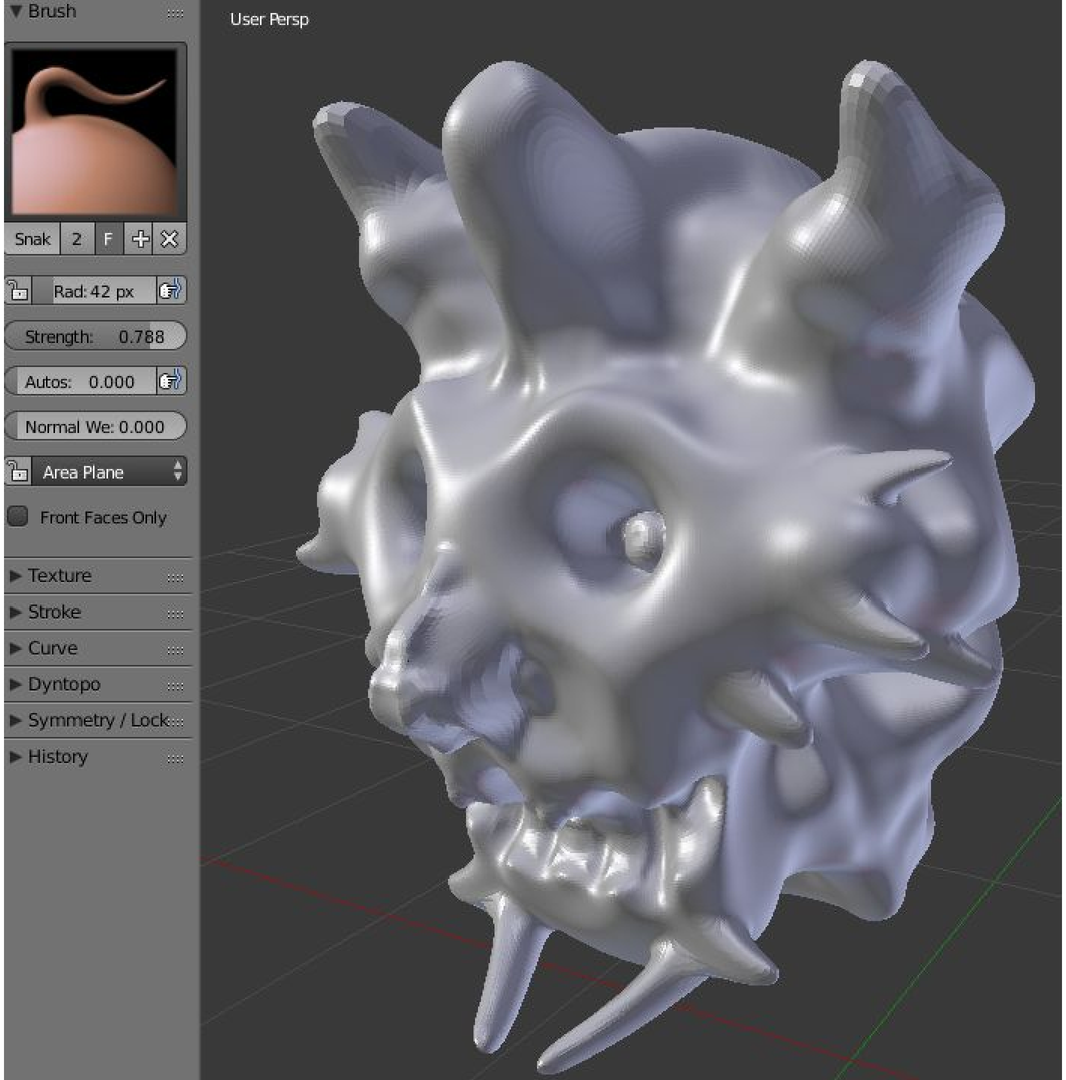
Usually individual meshes are in a “local” space with a local origin

And there is some sort of scene or world space with a world origin

But, depends on how the engine works - usually performance reasons dictate what the node structure looks like (type of game / animation system etc)

Modelling Techniques

- Box modelling, mirroring
- Blueprints and background images
- Sketches and concept art
- Sculpting



Snak 2 F

Rad: 42 px

Strength: 0.788

Autos: 0.000

Normal We: 0.000

Area Plane

Front Faces Only

Rendering Modes

default Blender

- software renderer?

OpenGL

- **rasterised rendering** [this probably deserves a whiteboard diagram]
- hardware (GPU)
- faster (faked lighting/shadows etc.)
- more like games

Rendering Modes

Cycles

- **path tracer** (ray tracing) based on Optics - more like POVRay
  [also deserves a diagram on the WB]
- slower, higher quality (realistic) images
- “noise” (grainy) issues at lower resolutions
- more like films

by request - steam/vapour

hard problem in graphics - approximate complex real-world particle interactions

(1) green screen and record real images
  - only works for limited range of camera angles
  - lots of set-up work

(2) hand drawn 2d animation
  - has to conform to style
  - work

(3) simulation and particles / custom blender effects stuff
  - not too many particles -- we only have width*height pixels in final image
  - fewer, larger, [textured] particles
  - avoid calculating lighting/shadows, refraction etc. for each particle

particle systems

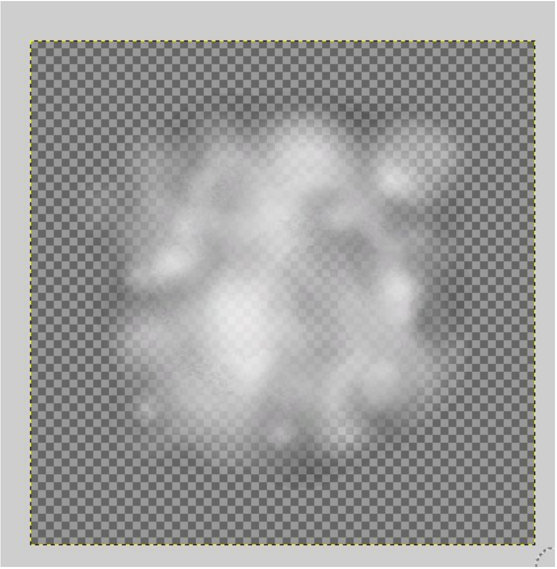
William Reeves, “Particle Systems—a Technique for Modeling a Class of Fuzzy Objects” 1983. http://graphics.cs.cmu.edu/courses/15-869-F07/Papers/Reeves-1983-PSA.pdf

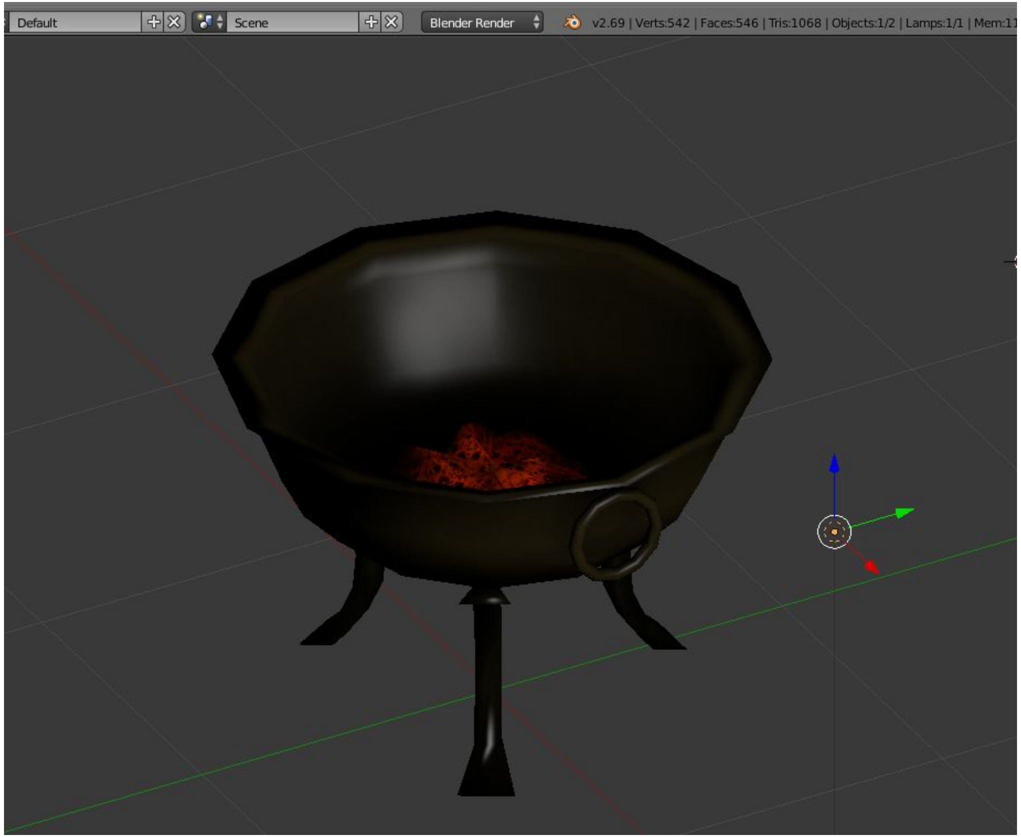
“Modeling phenomena such as ***clouds****,* ***smoke****,* ***water****, and* ***fire*** *has proved difficult with the existing techniques of computer image synthesis. These "fuzzy" objects do not have smooth, well-defined, and shiny surfaces; instead their surfaces are* ***irregular****,* ***complex****, and ill defined. We are interested in their* ***dynamic and fluid changes in shape and appearance****. They are not rigid objects nor can their motions be described by the simple affine transformations that are common in computer graphics.”*

my steam particles

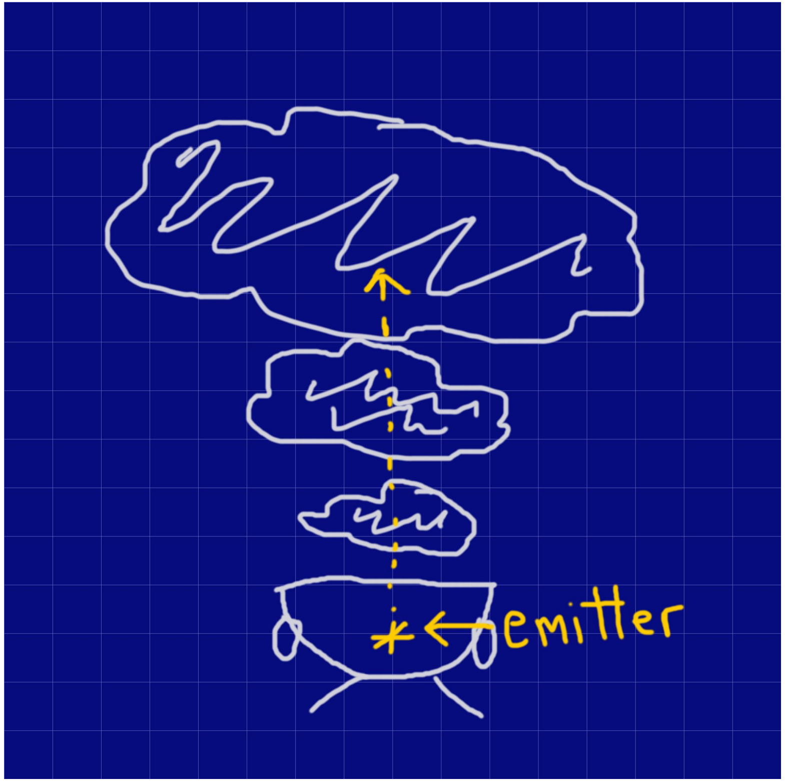
in a game so constraints on

#particles etc. are different




Default
Scene
Blender Render
v2.69 | Verts:542 | Faces:546 | Tris:1068 | Objects:1/2 | Lamps:1/1 | Mem:1

my steam particles



particle system has an **array of particles** in memory
each instance in the array has a set of starting properties
for each particle

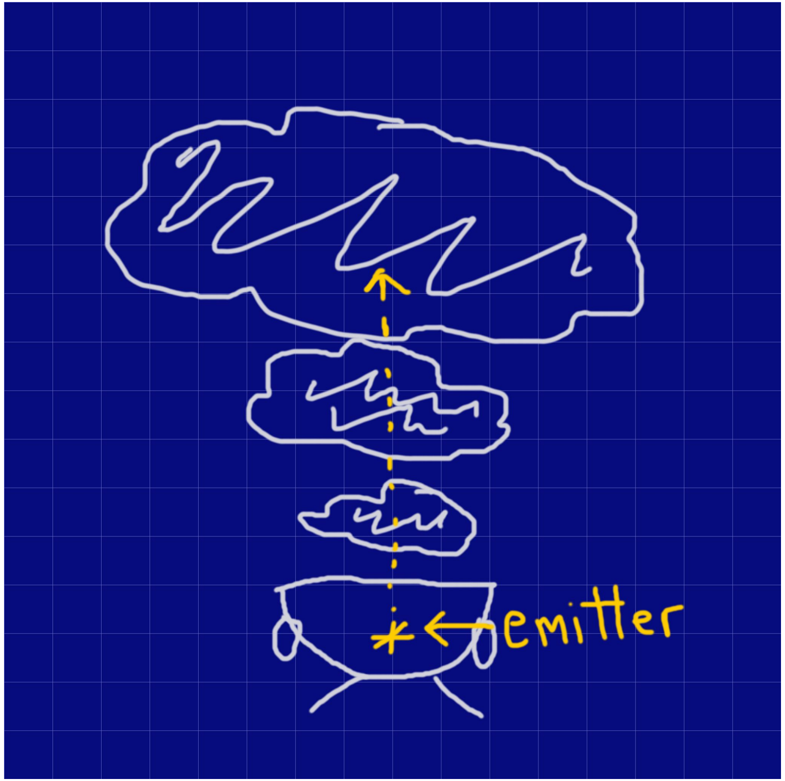
particle system has a **timer**

on system start, you check each particle’s start time
and do a little equation that says

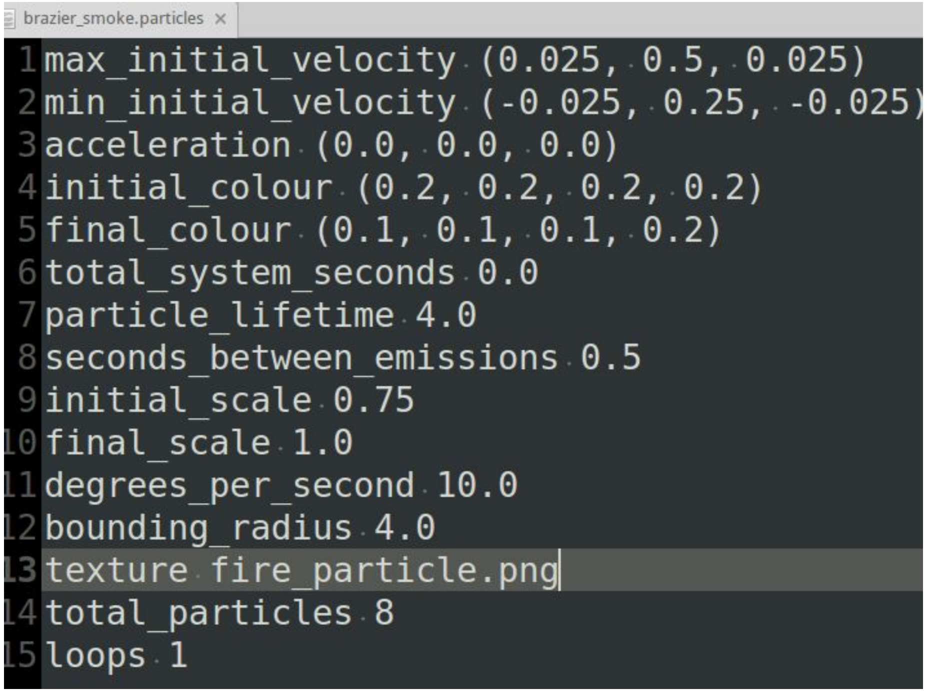
```
if (start_time >= current_time) {
  t = current_time - start_time;
  movement = velocity * t - 0.5 * accel * t * t;
  new_position = old_position + movement;
}
```

$$\Delta x = vt - \frac{1}{2}at^2$$

my steam particles - define particle system



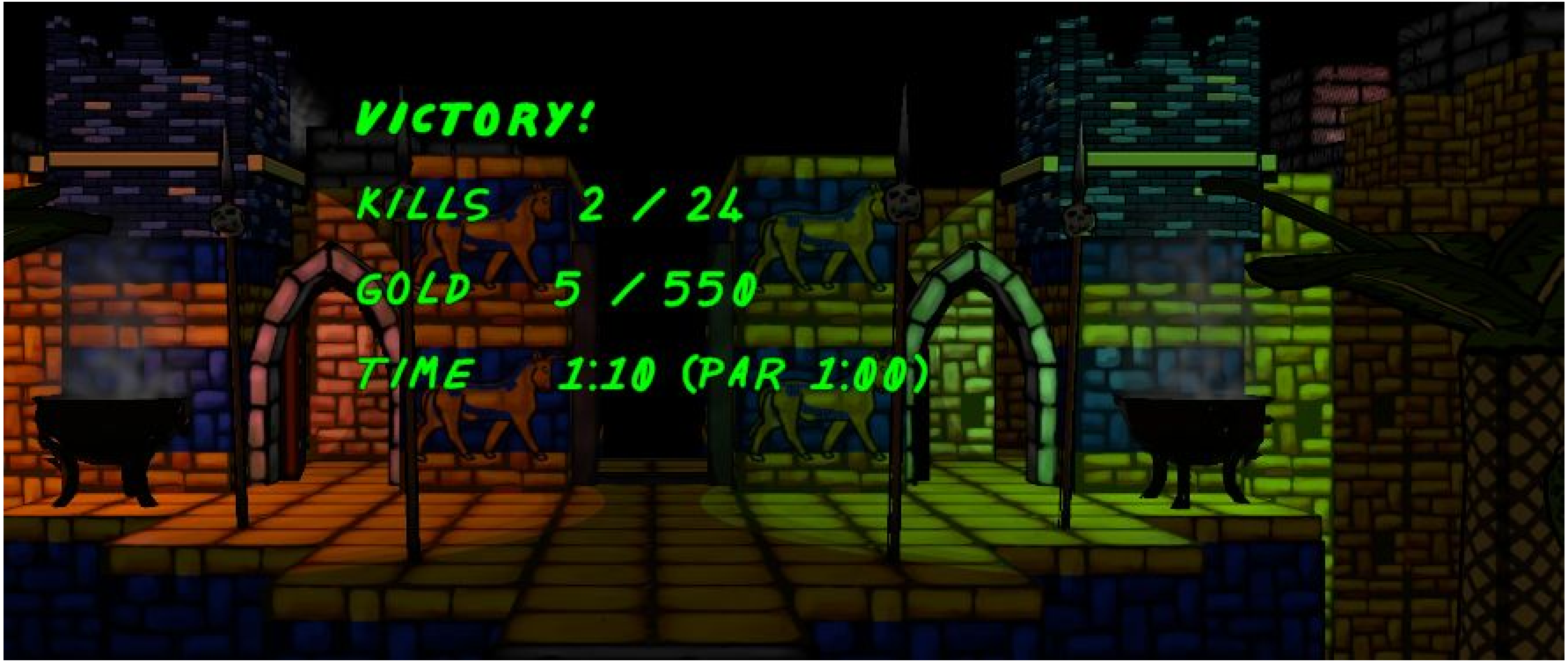
knowing how that works…create properties



```
max_initial_velocity (0.025, 0.5, 0.025)
min_initial_velocity (-0.025, 0.25, -0.025)
acceleration (0.0, 0.0, 0.0)
initial_colour (0.2, 0.2, 0.2, 0.2)
final_colour (0.1, 0.1, 0.1, 0.2)
total_system_seconds 0.0
particle_lifetime 4.0
seconds_between_emissions 0.5
initial_scale 0.75
final_scale 1.0
degrees_per_second 10.0
bounding_radius 4.0
texture fire_particle.png
total_particles 8
loops 1
```

- i couldn’t figure out how to apply a texture to particles in blender
  - maybe it can’t be done?

side view -- particles are point sprite “billboards”



VICTORY!

KILLS 2 / 24

GOLD 5 / 550

TIME 1:10 (PAR 1:00)

blender smoke/fire physics

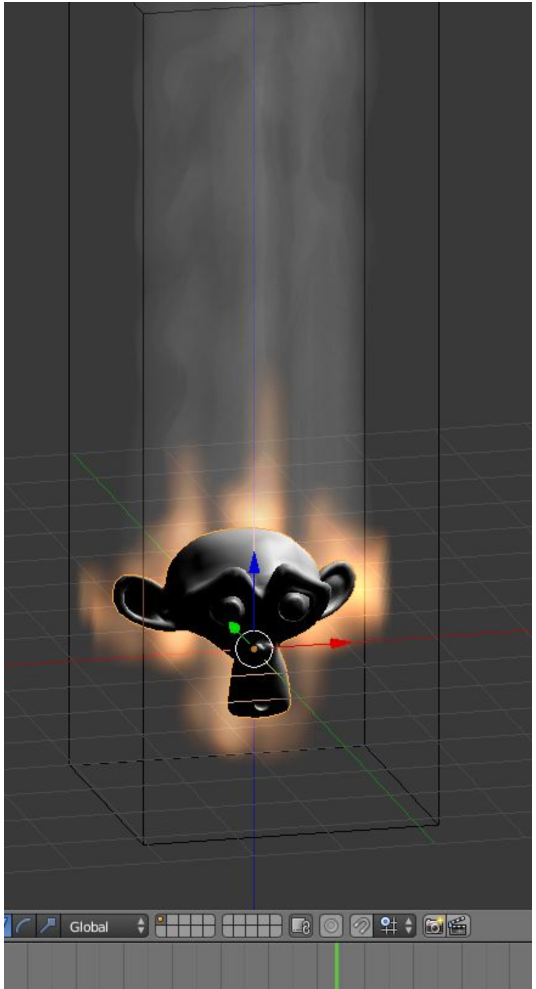
some sort of extra particle system custom thing

under the “physics” button in the object properties panel

looks better than basic particles

volume rendering techniques

lots of sliders to fiddle with



useful links

very basic particles

https://www.youtube.com/watch?v=lmrg0jdSVSc

using the “smoke effects” interface

http://www.3dartistonline.com/news/2013/01/tutorial-blender-2-65-smoke-effects/

can be hooked up to a particle system instead of a mesh