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DD3336/DH2650




www.csc.kth.se/~chpeters/projects.html

MIDDLEWARE

A Brief Overview

Christopher Peters

HPCViz, KTH Royal Institute of Technology, Sweden

chpeters@kth.se

http://www.csc.kth.se/~chpeters/

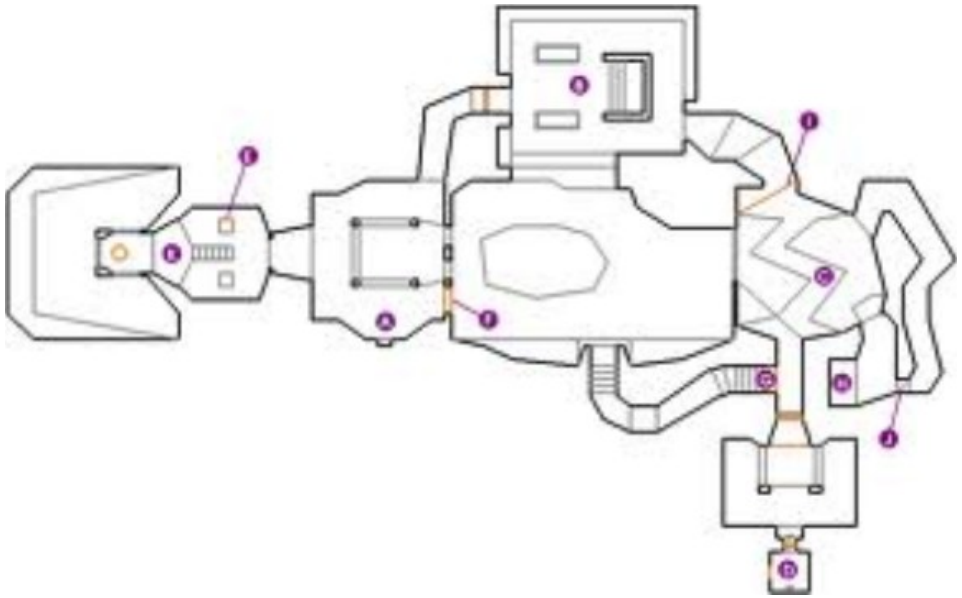
Who am I?

- Christopher Peters
  - email: chpeters@kth.se
  - https://www.kth.se/profile/chpeters/

By John Turesson, DH2320

Who am I?

- Unofficial Irish Doom E1M1 champ, ~1994



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Who am I?

- Telekinesys (Havok), 1999
  - Physics middleware

Who am I?

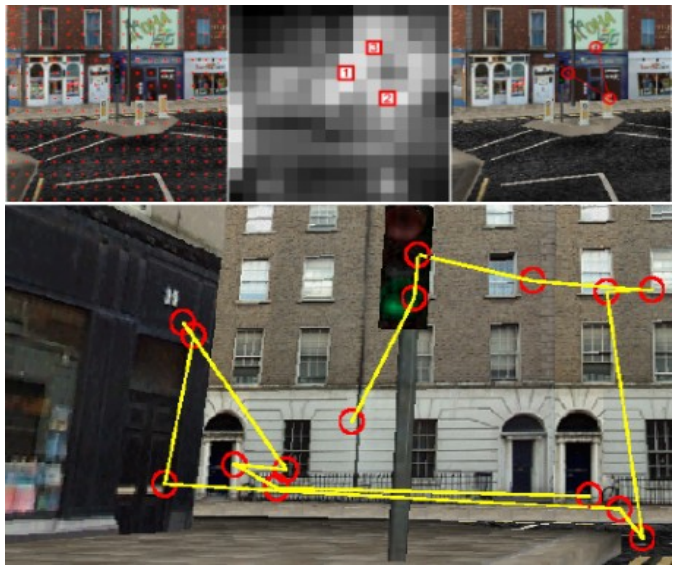
- Christopher Peters
  - email: chpeters@kth.se
  - https://www.kth.se/profile/chpeters/
- Associate Prof. (Docent)
- Research:

Real-time computer graphics & animation

Virtual characters and social robots

Game technologies

Perceptual computing



PhD, Visual Attention for Animating Characters

Metropolis Project, Trinity College Dublin

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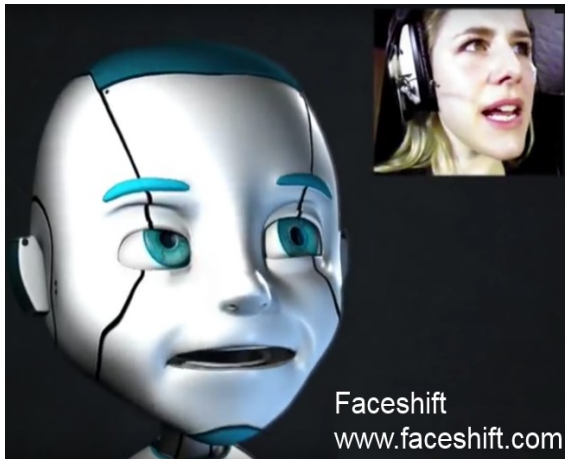
Investigating Uncanny Valley in Virtual Facial Expressions

Keywords: virtual faces, computer game technologies, robots

Uncanny Valley:

"...phenomenon whereby a computer-generated figure or humanoid robot bearing a near-identical resemblance to a human being arouses a sense of unease or revulsion in the person viewing it."



Project goal: Map facial expressions onto different virtual characters and a physical robot; investigate human perception and *uncanniness*

Tools: Unity 3D game engine, Faceshift, Furhat robot

Collaborators: Uppsala University, Maastricht University

Email: ***chpeters@kth.se*** **http://www.csc.kth.se/~chpeters/projects.html**

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Virtual Reality Walk-through for Urban Design and Therapy

Keywords: computer game technologies, city modelling, virtual reality

Project goal: Develop/extend a first-person urban walk-through aiming to recreate the experience of being in real urban environments through graphics, audio and virtual reality technologies.

Users: Allow non-experts to tailor environments (e.g. vegetation, building types, crowds, etc) for the purposes of design and experimentation.

Tools: Unity 3D game engine, Oculus Rift, pre-existing walk-through (alpha)

Collaborators: Sustainable Cities (KTH), Karolinska Institute (KI)

Email: ***chpeters@kth.se*** **http://www.csc.kth.se/~chpeters/projects.html**

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Courses

- **DD3336**, Interactive Entertainment Technologies (PhD level)
- **DH2560**, Computer Game Design
- **DT2350**, Human Perception for Information Technology
- **DH2323**, Computer Graphics and Interaction
- **DD1354**, Models and Simulation (game physics!)

- Visualization (VIC) Studio

  4K screen, Oculus Rift, eye-trackers, etc

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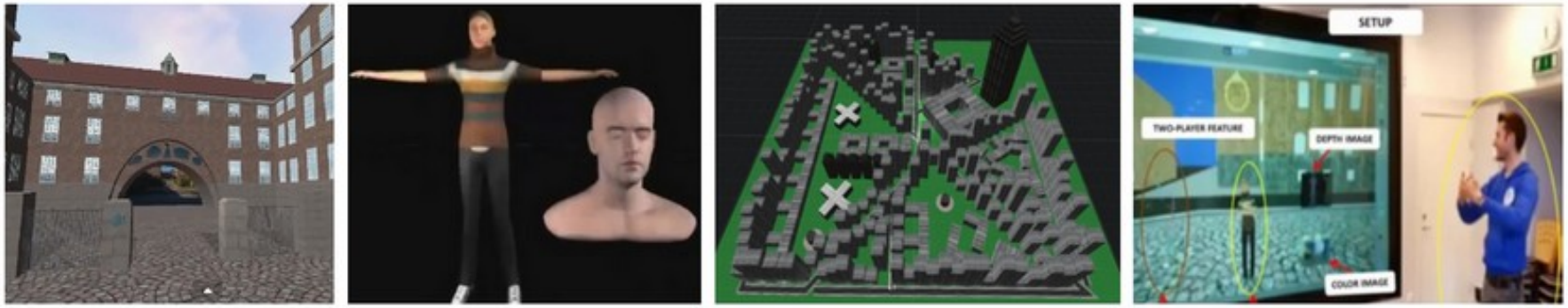
Interactive Entertainment Technologies (DD3336)

Third Cycle (PhD level) Course, 6.0 hp



Samples from KTH students in the domains of 3D modelling and architecture, human skin shading, procedural city generation and digital puppetry

Course description

The video game and interactive entertainment industry is already a multi-billion dollar enterprise, with some estimates forecasting a valuation of $82 billion for the global market by 2017. At the core of these products are sophisticated real-time algorithms and infrastructures (e.g. game engines) that have foundations in domains such as computer graphics, artificial intelligence, HCI, computer science and mathematics. Entertainment technologies will continue to be decisive in pushing back technological barriers to enable new modes of interactive experience and communication and they therefore represent an important cross-over between academic and industry research.

This course builds upon the Computer Game Design course DH2650, using the wider context of infrastructure (i.e. data-driven game engines and tool-chains), design and HCI to focus further on the development and application of advanced interactive entertainment technologies. It is intended for PhD students with an interest in the design and implementation (programming) of real-time interactive technologies where the end user and their experience is of paramount concern.

Note: this course runs in parallel to DH2650 Computer Game Design, which is open to second cycle students.

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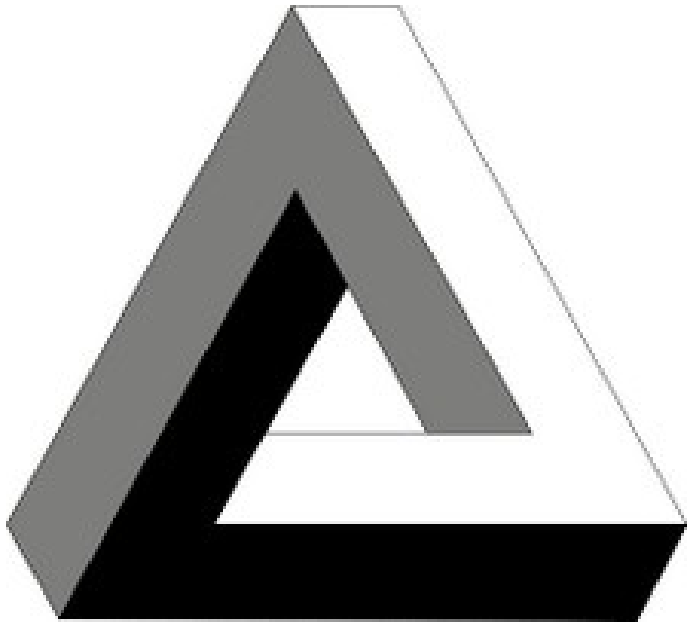
Story



Game Technologies

Game Mechanics

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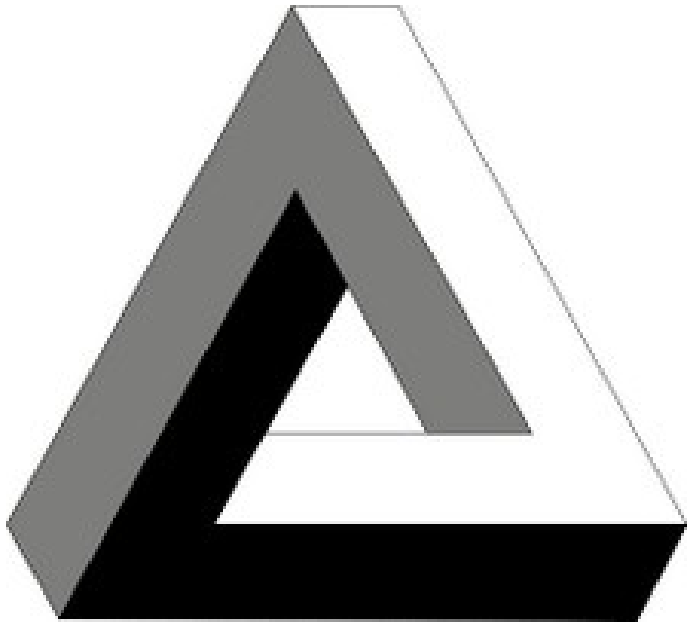
Story



Game Technologies

Game Mechanics

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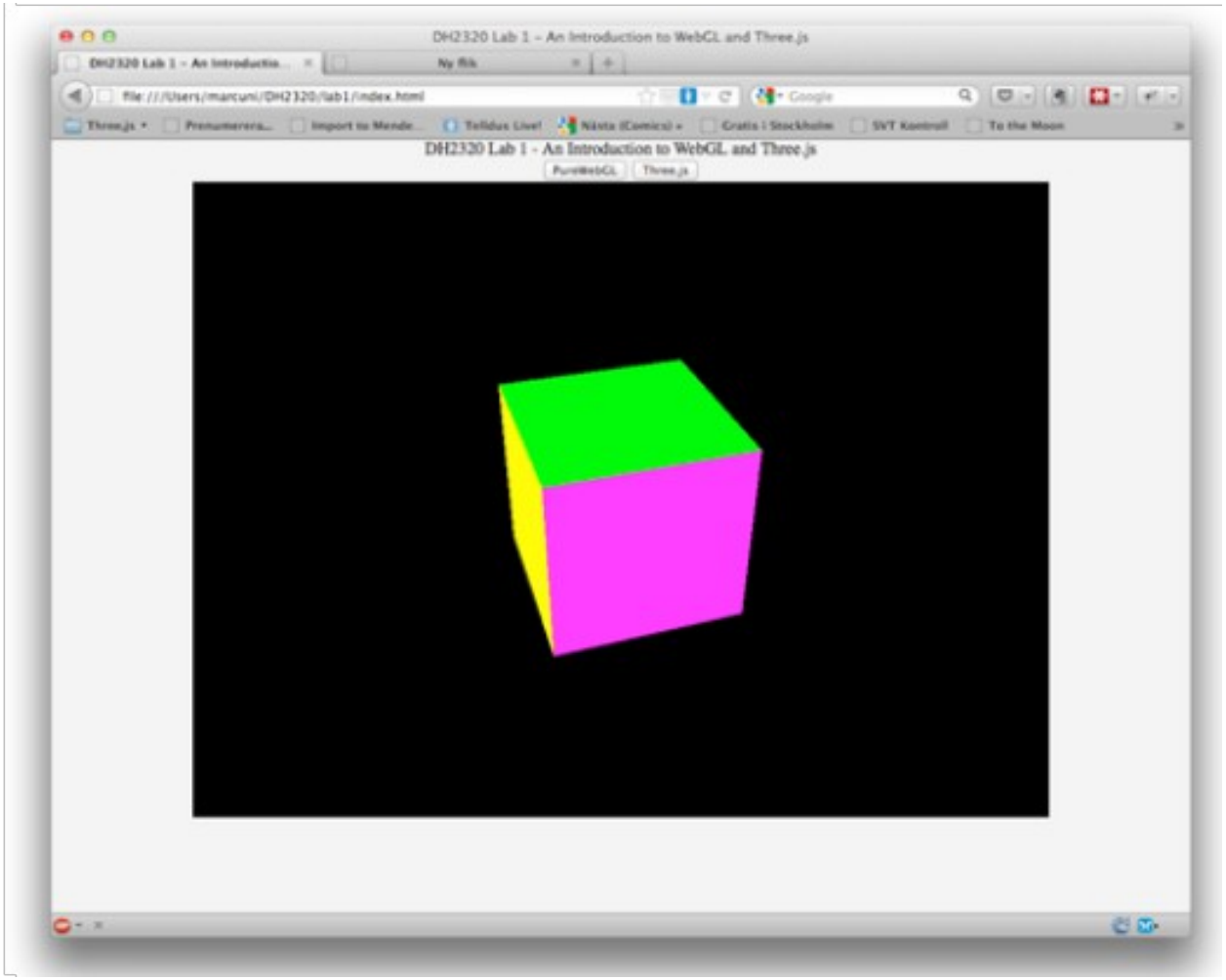
Today's Question

How to go from *this*...



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Today's Question

…To *this*?

Battlefield 4, DICE

Game Complexity

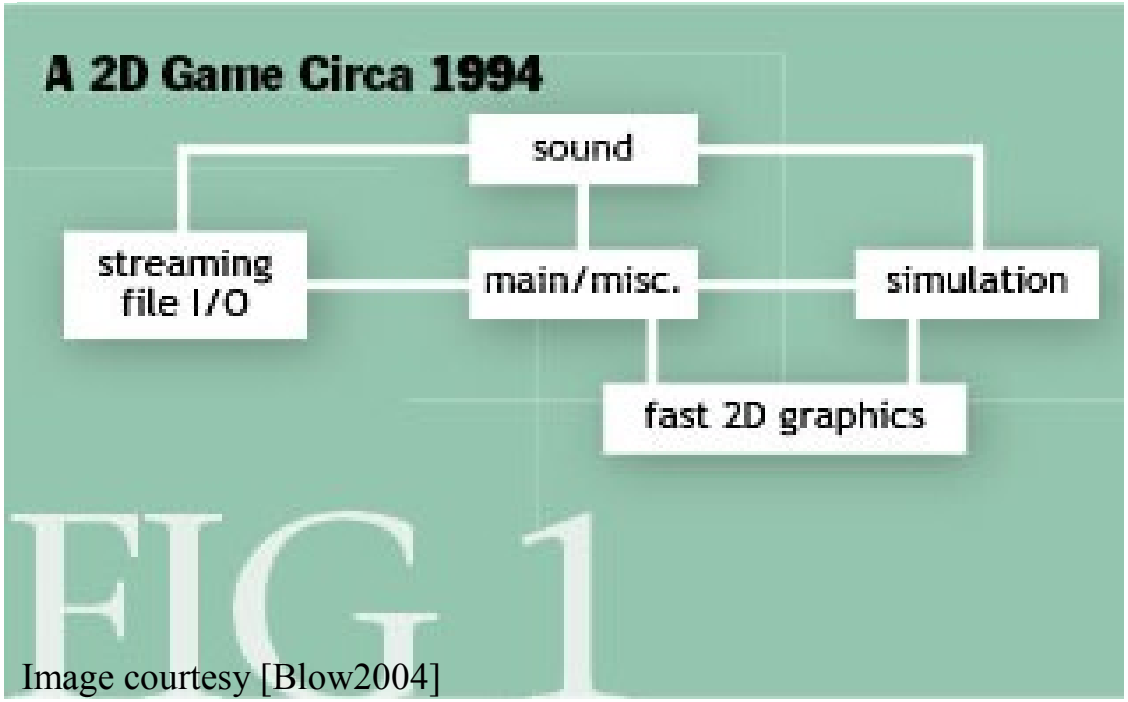


Image courtesy [Blow2004]

Blow, J. (2004).Game Development: Harder than you think, ACM Queue 1(10)

Game Complexity

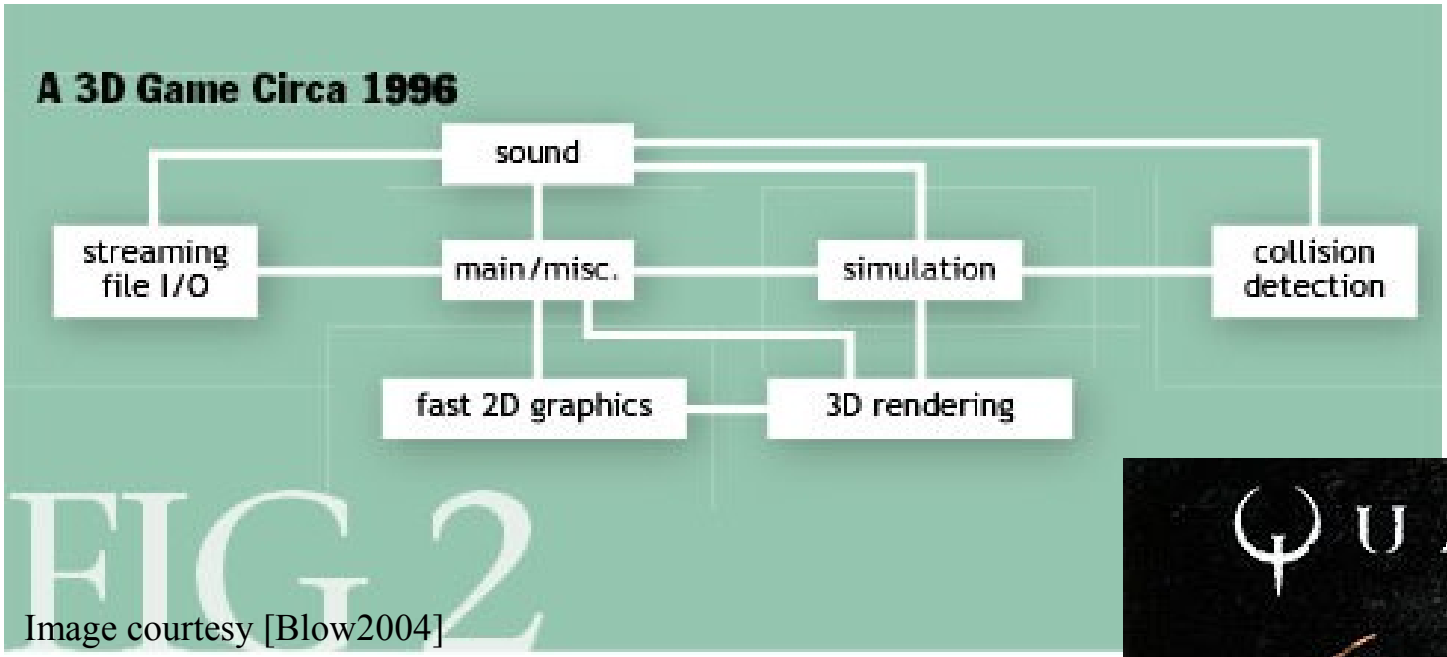
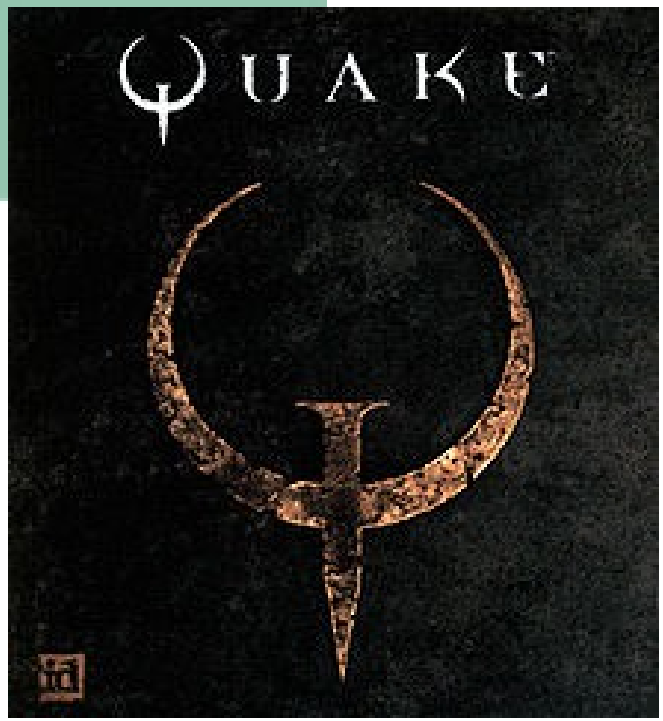


Image courtesy [Blow2004]



Game Complexity

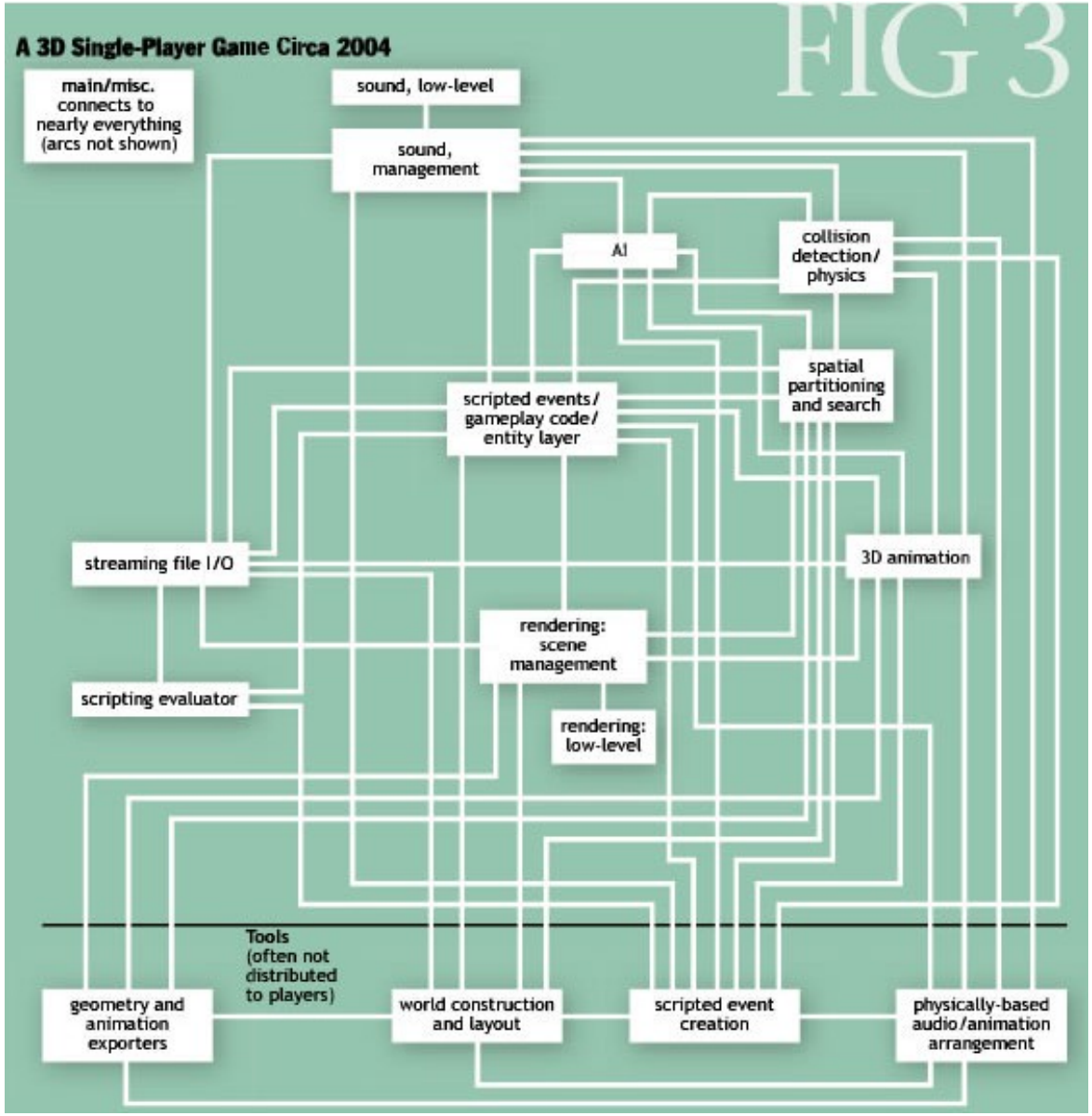


Image courtesy [Blow2004]

Game Complexity: 2004++

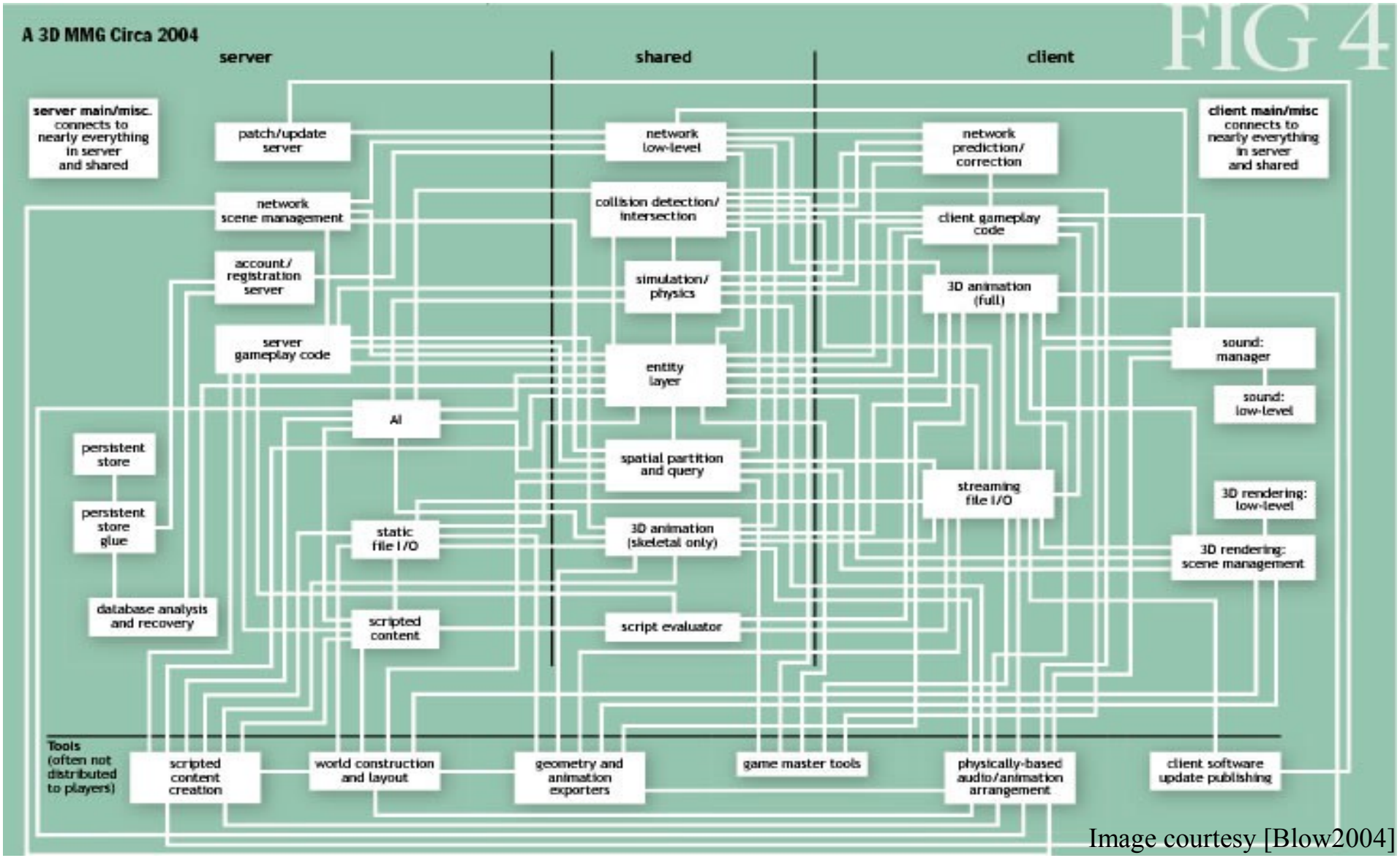
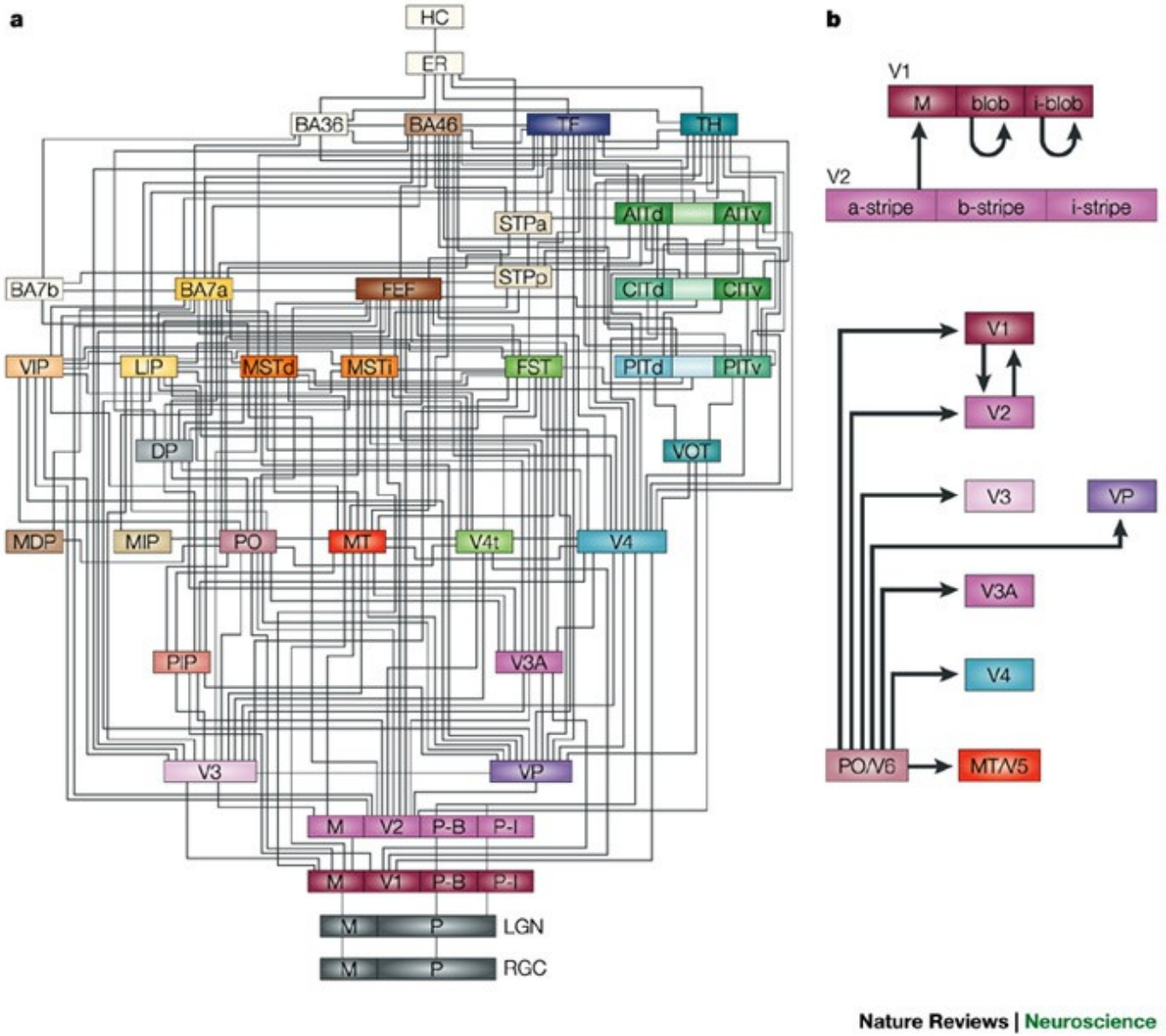


Image courtesy [Blow2004]

Game Complexity >2014?



Rees, Kreiman and Koch, Neural correlates of consciousness in humans, Nature Reviews Neuroscience 3, 261-270, 2002

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Q.

Do you have to *reinvent the wheel*?

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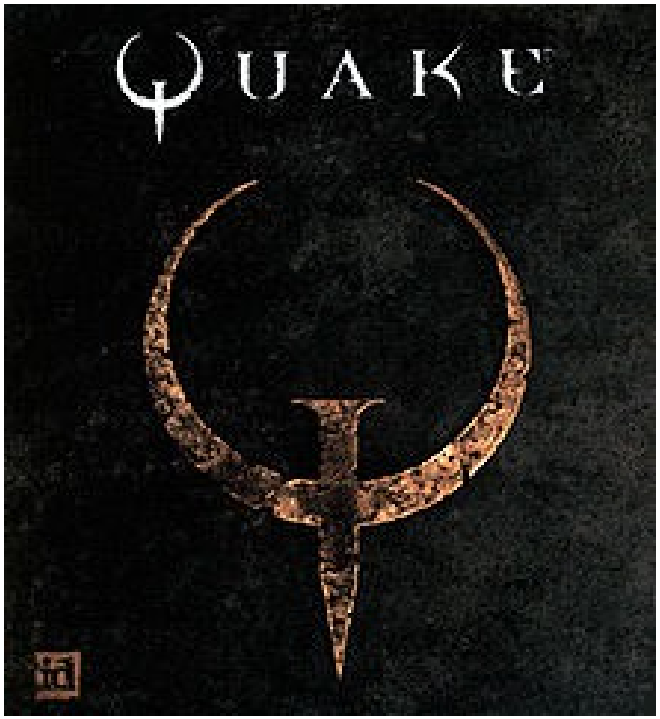
A.

No: Reuse game components

Game Components



Game Components

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Game Components

Core Code – Engines and middleware
(from programmers)
+
Tools
(from programmers)
+
Content
(from artists, designers, sound engineers...)

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Game Components

Core Code – Engines and middleware
(from programmers)

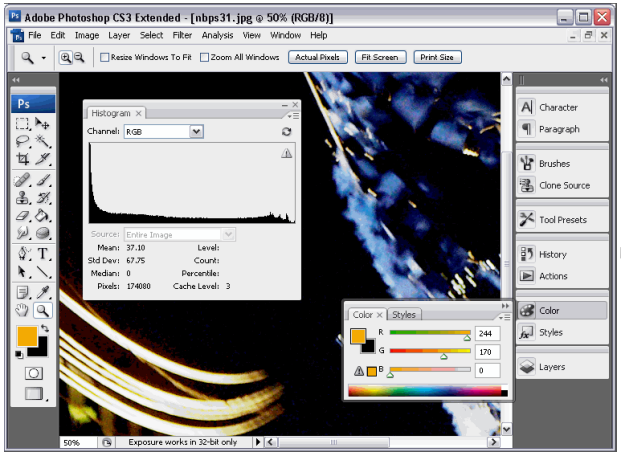
+

Tools
(from programmers)

+

Content
(from artists, designers, sound engineers...)

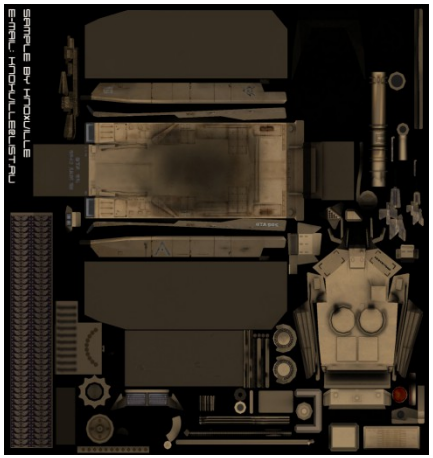
A Typical Chain



2D paint package

3D modelling package

Real-time engine

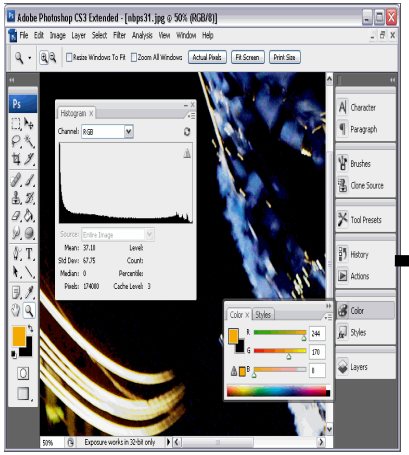


2D textures

3D models and animations

Real-time rendering, animation and interaction

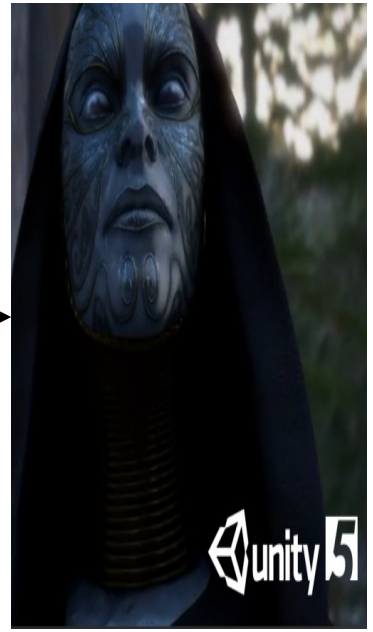
A Typical Chain



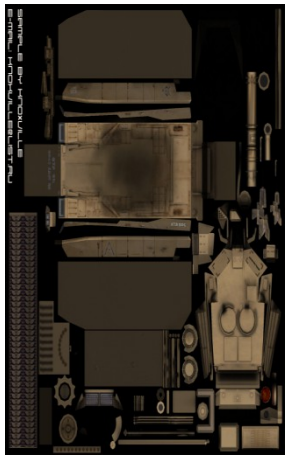
2D paint package

3D modelling package

Middleware



Real-time engine



2D textures

3D models and animations

Plugins
APIs
SDKs
Engines

Real-time rendering, animation and interaction

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No Reinventing the Wheel

- API (Application Programmers Interface)

Software that interfaces with operating systems, libraries and services

- SDK (Software Development Kit)

Collection of libraries, API's and tools made available for programming

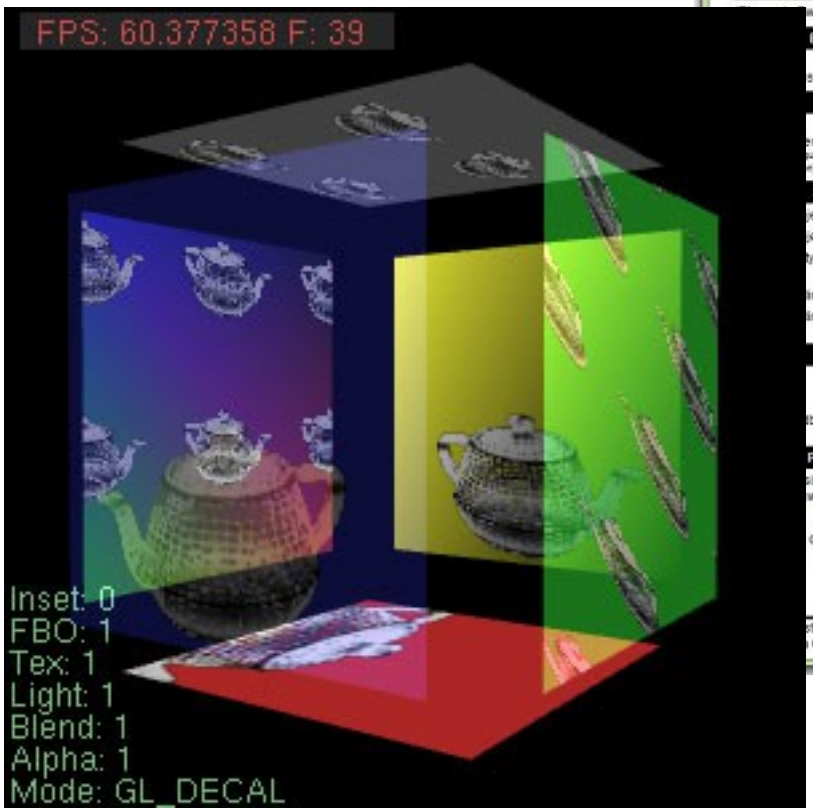
- Graphics/rendering engine

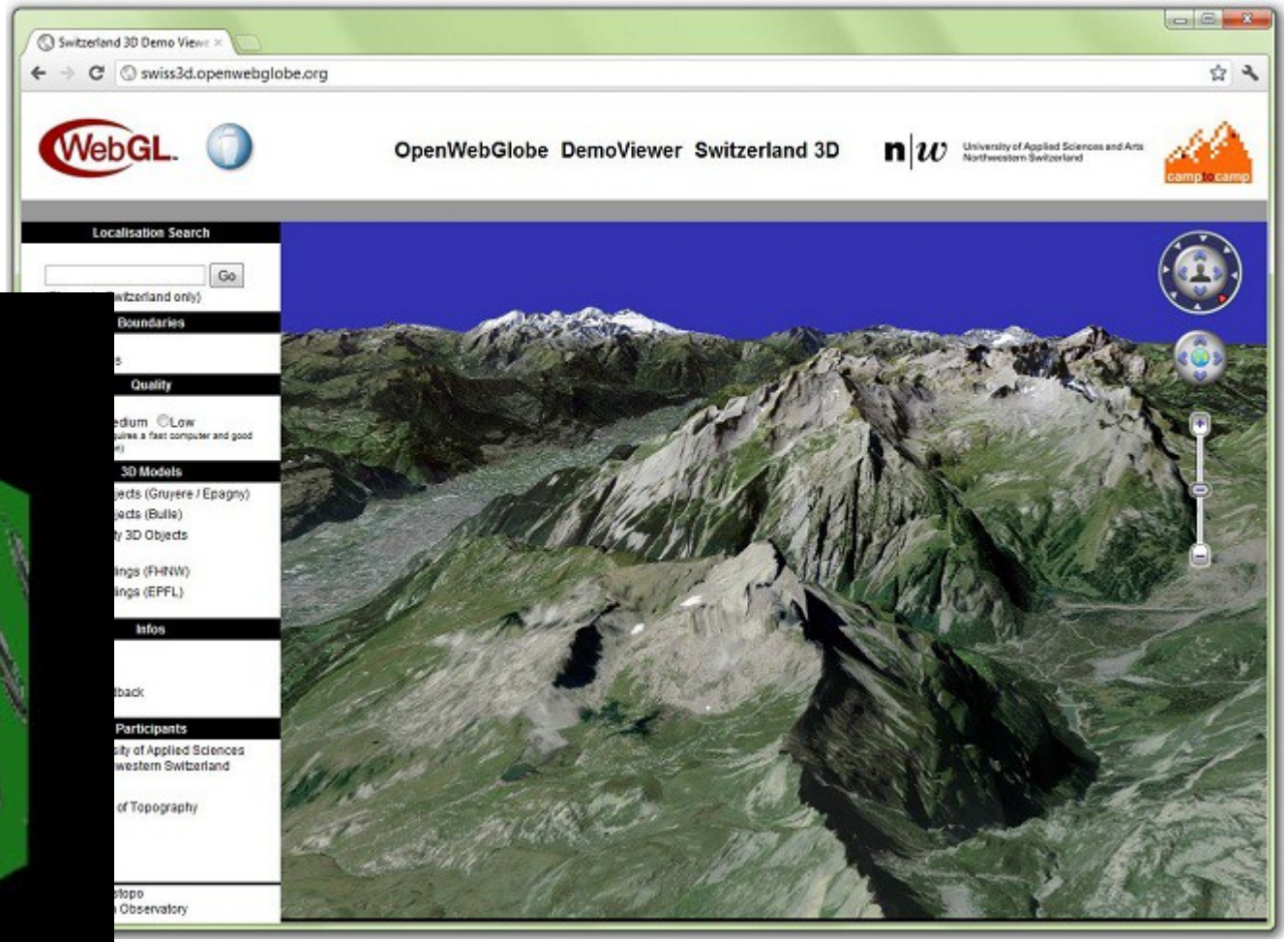
Takes care of rendering activities – visible surface determination, shading etc.

- Game engine

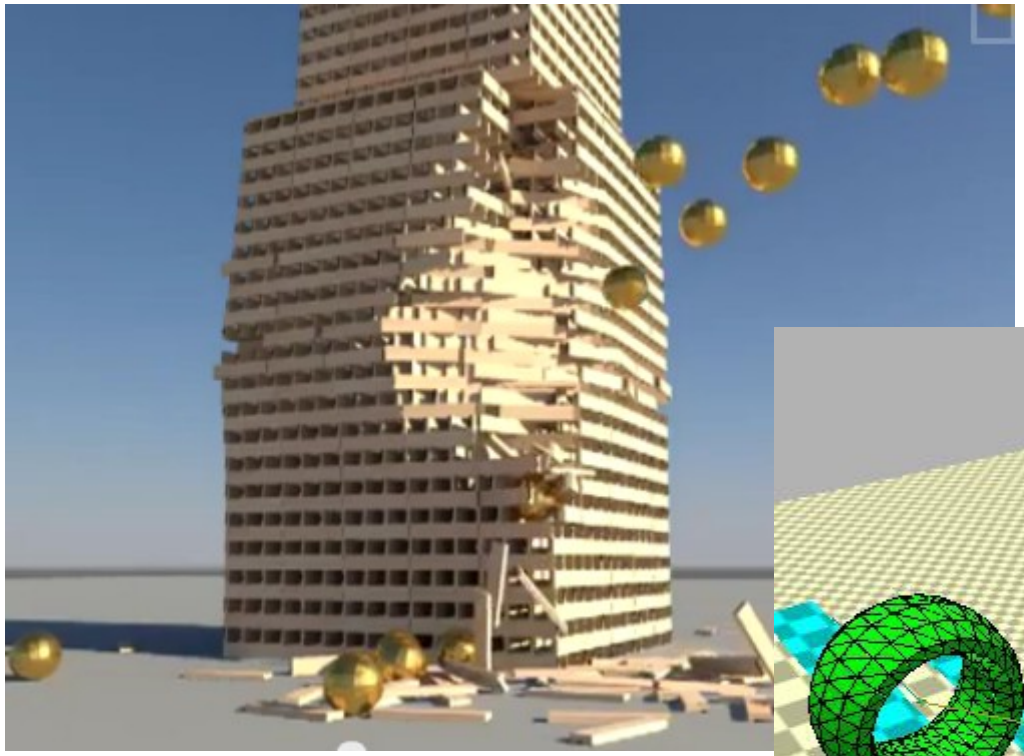
Integrated game development kit encompassing graphics and many other game-related aspects …

Example: OpenGL

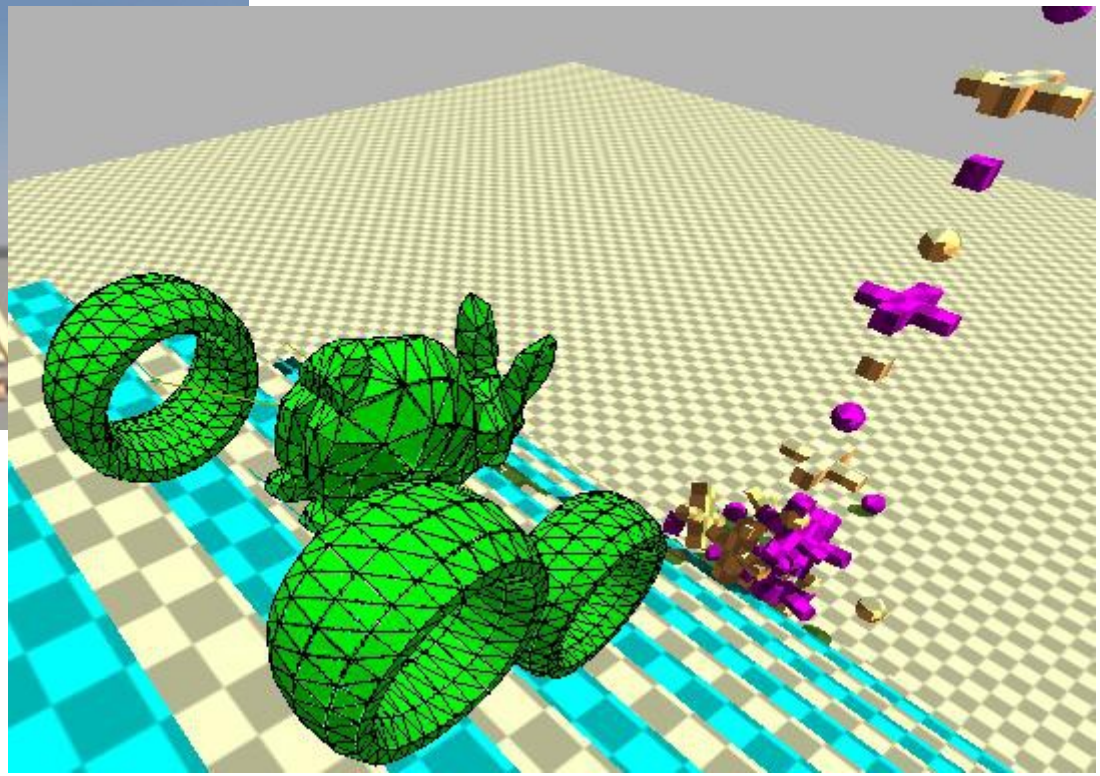




Example: Bullet Physics SDK



http://www.youtube.com/watch?v=J9HaT23b-xc



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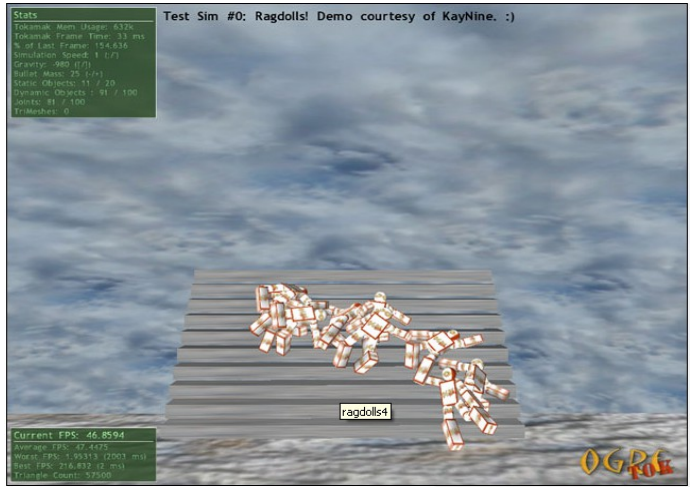
Example: OGRE

Object-oriented Graphics Rendering Engine

OGRE is primarily a **graphics engine** http://www.ogre3d.org/

Does not concentrate on sound, AI, networking, collision, physics (but often available as add-ons...)

Ambient occlusion, parallax mapping, soft shadows, etc



Example: Unity

Unity is a **games engine** http://unity3d.com

Graphics *and...*

Sound, AI, networking, collision, physics, particles, animation, lighting, scripting, mobile support, etc

The Hard Way (1)

Integrate your own components…

Choose a **graphics library**

- OpenGL, DirectX

Add in peripherals

- GUI (Crazy Eddie)
- Model loading (AssImp)
- Physics (Bullet)
- Networking (Raknet)

Code your own shaders, etc (including loading and management…)

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The Hard Way (2)

Integrate your own components

Choose a **graphics engine**

- Ogre

Add in peripherals

- GUI (CrazyEddie)
- Networking (Raknet)
- Add your own specialised algorithms

No need to create a full graphics engine

Component **integration** is still an issue

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The Modern Way

Just use a **game engine** already…

Modern engines deliver great off-the-shelf features

Great for rapid prototyping (GameMaker)

For **specialised features**, you will still need to make your own plugins, libraries, SDKs, etc the old/hard way

E.g. C++ dll, DD3336, ACM Siggraph

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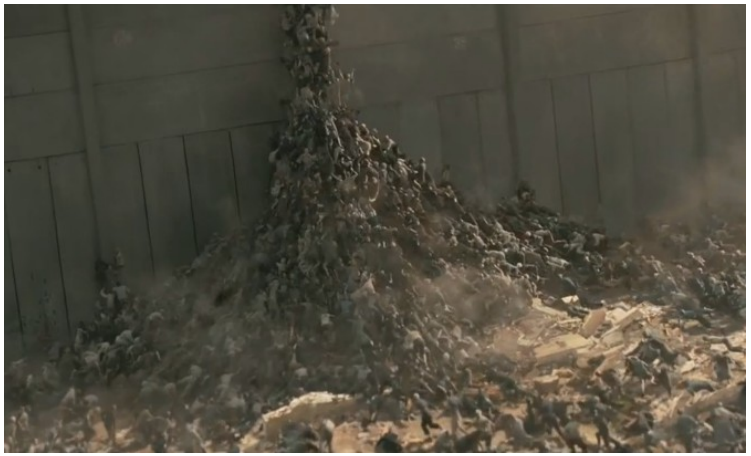
Specialised Features

- Specialist **game technologies**
  - Not 'out of the box' features (yet)
- Enable unique mechanics, atmosphere or story elements
- Important selling points for a game
- Example: Zombie hordes

Zombie Hordes

The Walking Dead



World War Z

Specialist game technology

- Not an 'out of the box' feature (yet)

Technical research areas:

- Crowd generation, rendering, simulation and perception

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Zombie Hordes

Rendering challenges

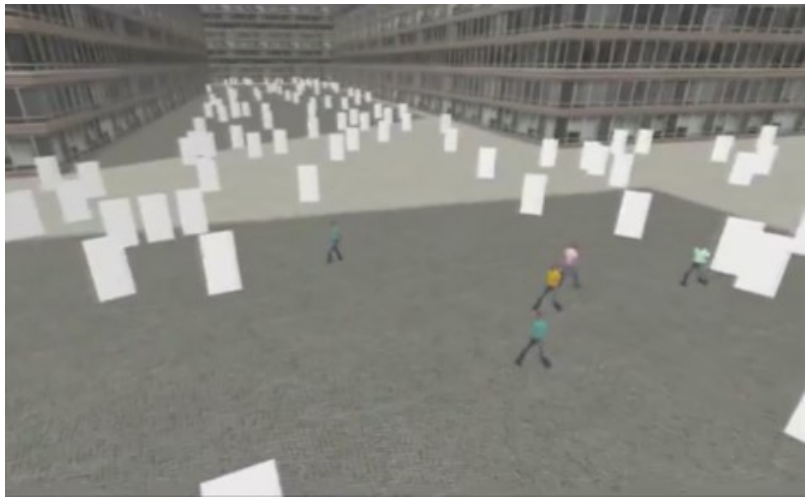
- Real-time operation
- Representation and variety of appearance

Zombie Hordes

Rendering challenges

Real-time operation -> Imposters

Representation and variety of appearance



'Eye-posters' and 'perceptually varied crowd' projects, Ludwig Axelsson, Håkan Eriksson, Tim Lindeberg, Martin Schön; Måns Odstam, Andreas Stjerndal

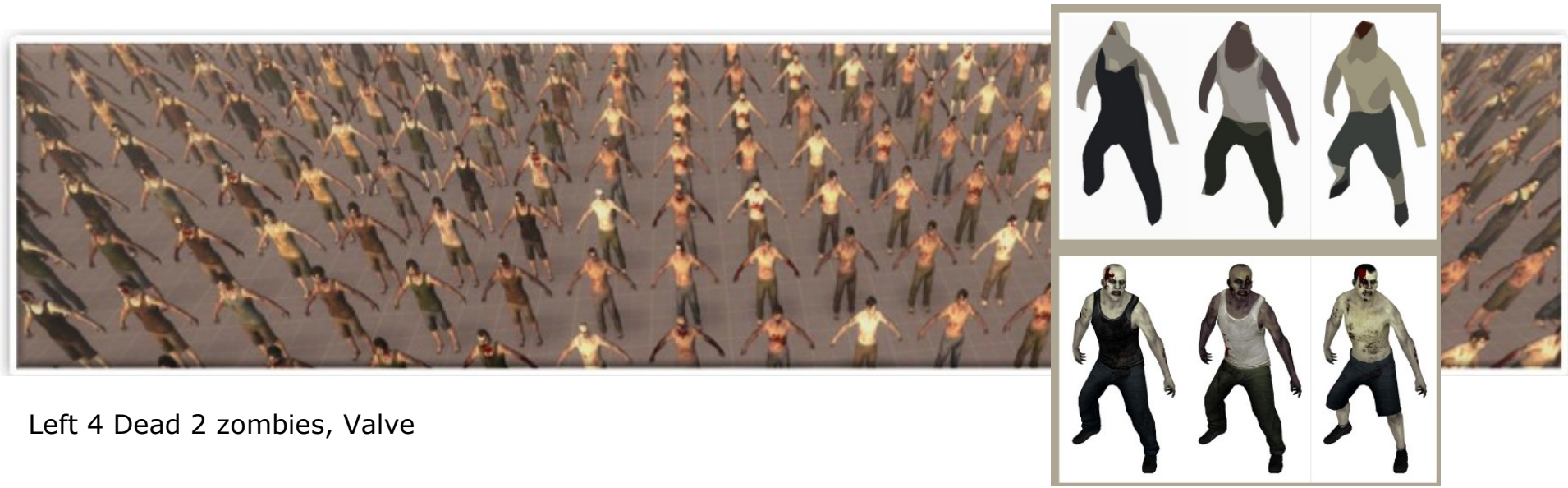
Video: https://kth.box.com/s/1654ydyjwq837gnlnw3bxjbp6g47uu7o

Zombie Hordes

Rendering challenges

Real-time operation -> Imposters

Representation and variety of appearance -> Generation



Left 4 Dead 2 zombies, Valve

Zombie Hordes

Rendering challenges

Real-time operation -> Imposters

Representation and variety of appearance -> Perception

Clone Attack! Perception of Crowd Variety

McDonnell, et al., ACM Transactions on Graphics (SIGGRAPH 2008), 2008

Evaluating the perception of group emotion from full body movements in the context of virtual crowds

Carretero, et al., ACM Symposium on Applied Perception, 2014

Zombie Hordes

Rendering challenges

Real-time operation -> Imposters

Representation and variety of appearance -> Simulation

High density crowds via unilaterally incompressible fluid simulation, Richard Ristic and Johan Berglund

Paper available for download from www.csc.kth.se/~chpeters/projects.html

Video: https://kth.box.com/s/0t3w4nln7h436hctbf7kqkmh6pi59q28

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Middleware Considerations

- Check licenses and costs (first!)
- Developer support
  - There's a reason for it…
  - Forum activity
- Integration issues with your engine
  - Source code access sometimes critical
- Tool and engine support
  - Blender/Maya/Max integration

Middleware Landscape

Ranked:

Physics (big!)

AI Navigation

Virtual characters

Weather rendering

Real-time global illumination

Occlusion culling

Trees and foilage*

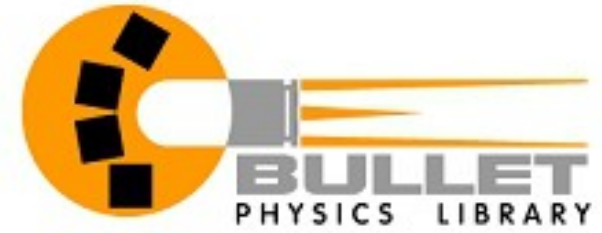
Miscellaneous (networking, UI)

Physics

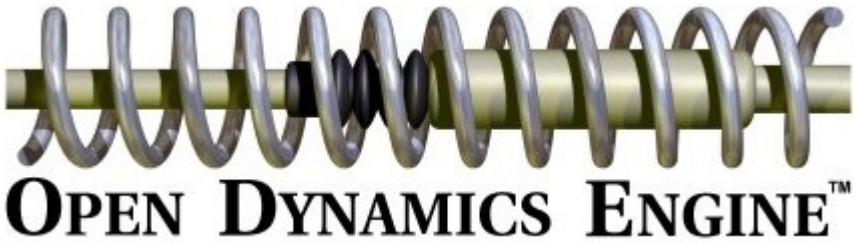
Mainly rigid-body and cloth simulation
Some fluid simulation (getting better)

Havok

Bullet

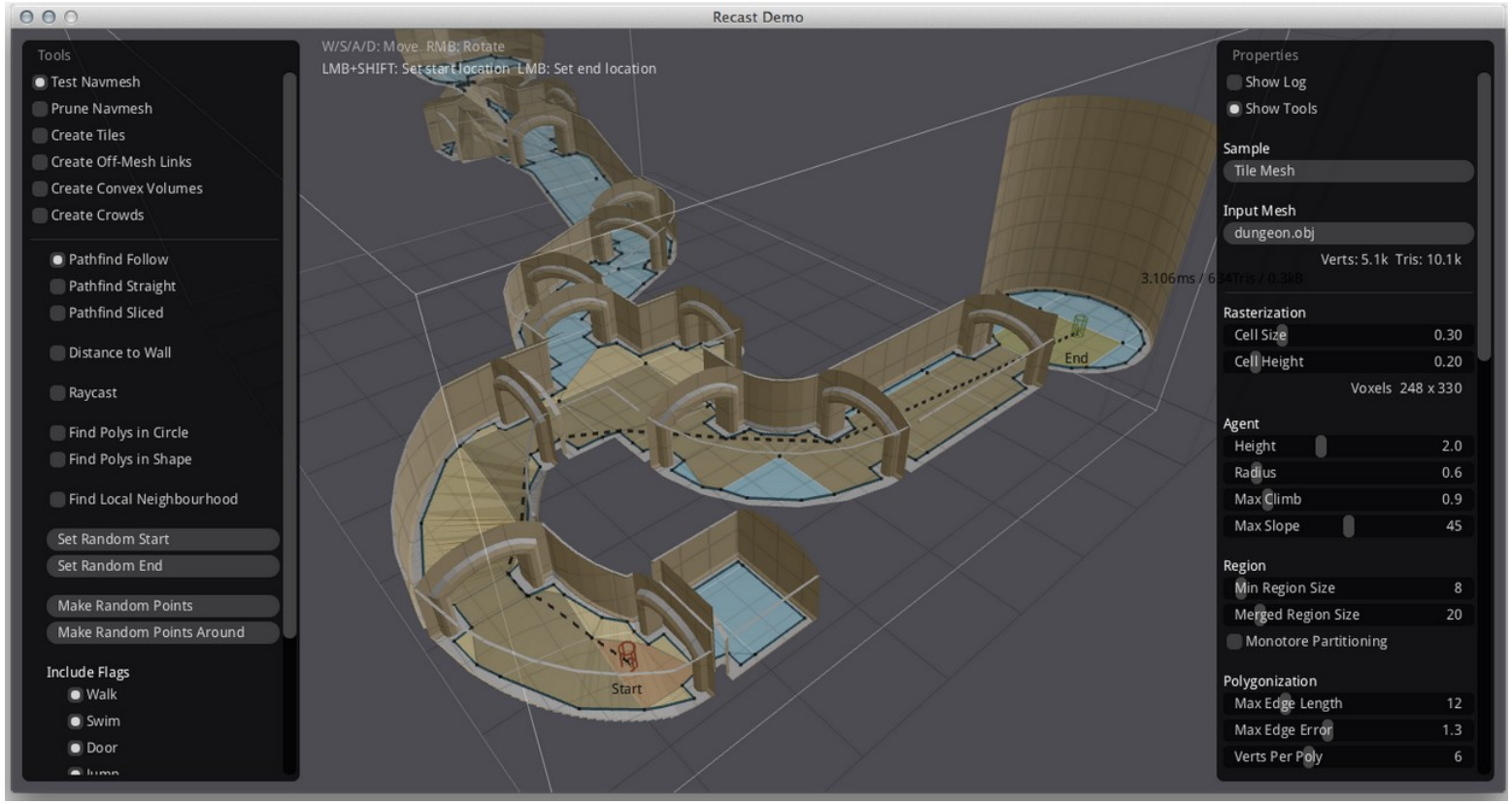


ODE



AI Navigation

Recast (nav meshes), Detour (pathfinding and spatial reasoning), MIT license



https://www.youtube.com/watch?v=XyfLSocd9ec

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Real-time Global Illumination

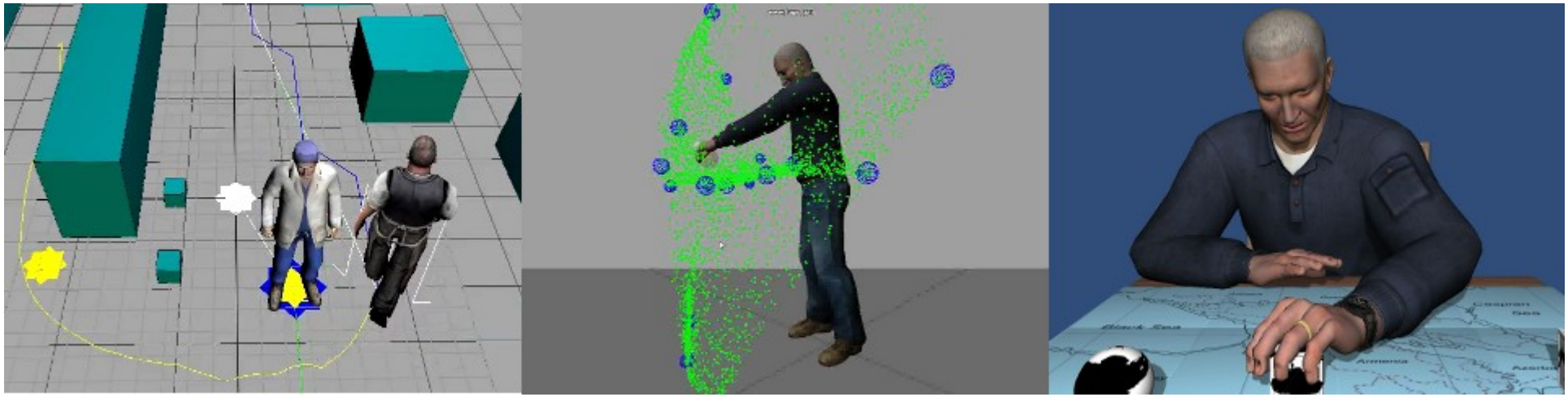
Geomerics Enlighten

http://www.geomerics.com/enlighten/

Face Animation

http://www.facefx.com/content/english-un-declaration-human-rights

Intelligent Virtual Characters



Smartbody

LGPL license

http://smartbody.ict.usc.edu/video

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Sky and Weather

Simul TrueSky

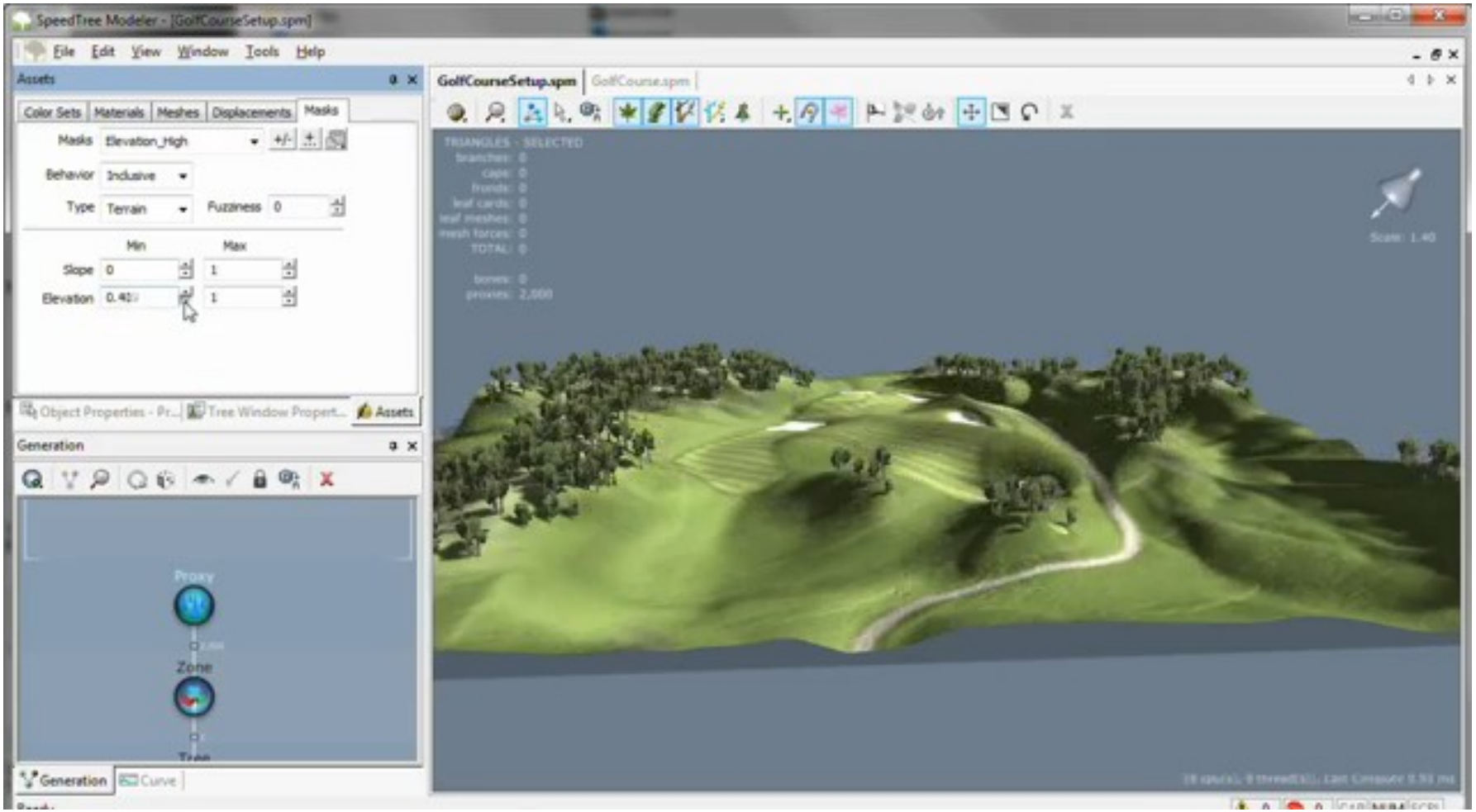
http://simul.co/truesky/truesky-alpha-for-unity/

Sky and Oceans

Silverlining and Triton

http://sundog-soft.com/sds/

Trees and Foilage



http://www.speedtree.com/

http://www.youtube.com/watch?v=r18c7QlWLBQ

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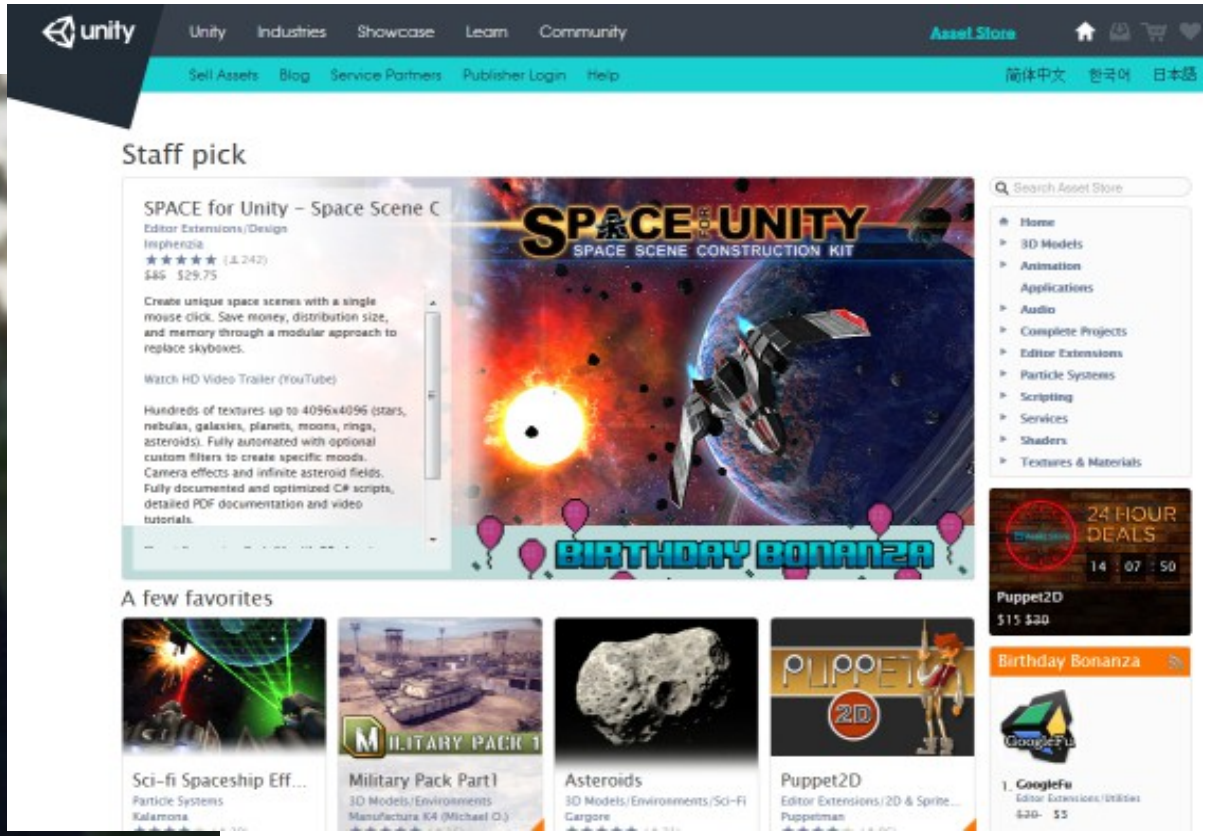
Using Unity?

To the Asset Store Immediately!



https://www.assetstore.unity3d.com/en/