Computer Games 2015
Game Development

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You'll need for grade A ...

- A concept (1-2 pages)
- The actual game (level)
- A postmortem document (2 pages)
- A short video of the game (level)
- A final presentation

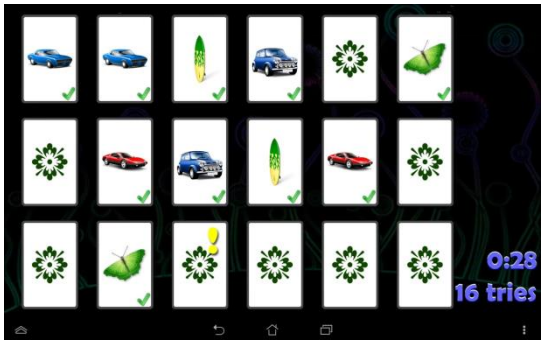
Organizational

- Mo, 22.06.2014, 12-14, E.2.42: Student Presentations
  - 10 Minutes to show your game!
  - Create a video!!

A Demo Game ...

- Based on libGDX
- Is Apache v2 licensed
  - Including most of the assets

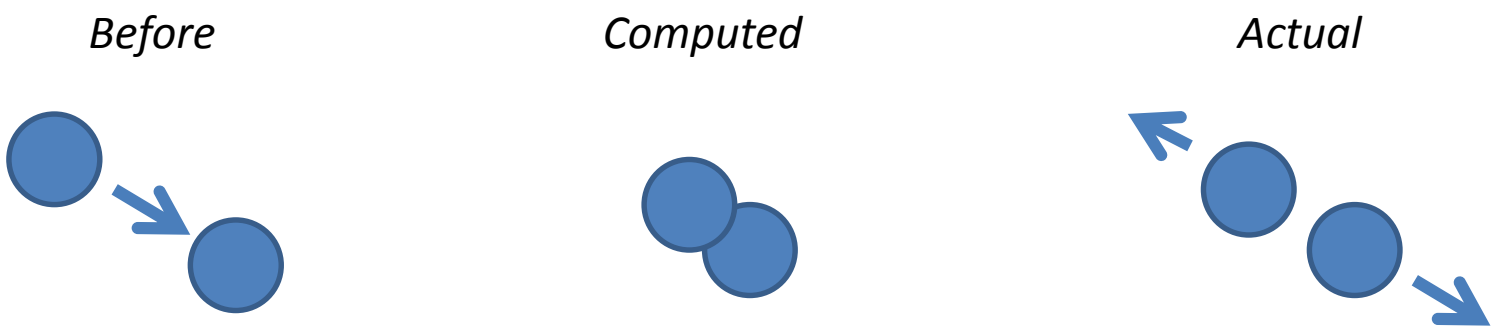
https://github.com/dermotte/memory-game-android
https://play.google.com/store/apps/details?id=at.juggle.games.memory



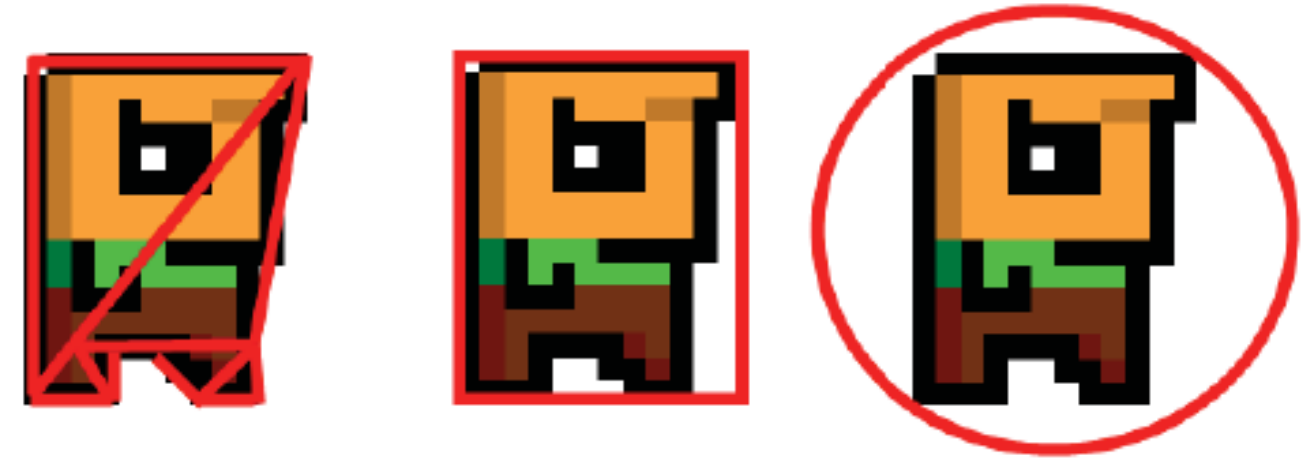
Collision Detection

- Collision occurs before the overlap
- So an overlap indicates a collision

- Example Pool Billard



Bounding Boxes



src. M. Zechner, Beginning Android Games, Apress, 2011

Triangle Mesh

- Convex hull, convex polygon
- Tight approximation of the object
- Requires storage
- Hard to create
- Expensive to test

src. M. Zechner, Beginning Android Games, Apress, 2011

Axis Aligned Bounding Box

- Smallest box containing the object
- Edges are aligned to x-axis and y-axis
- Fast to test
- Less precise than triangle mesh
- Stored as corner + width + height

src. M. Zechner, Beginning Android Games, Apress, 2011

Bounding Circle

- Smalles circle that contains the object
- Very fast test
- Least precise method
- Stored as
  center + radius

src. M. Zechner, Beginning Android Games, Apress, 2011

Bounding shape updates

- Every object in the game has
  - position, scale, oritention &
  - bounding shape
- Position, scale and orientation are influenced by the game play
  - Bounding shape has to be update accordingly

src. M. Zechner, Beginning Android Games, Apress, 2011

Bounding shape updates

- Changes in position
  - Move vertices, box corner or circle center
- Changes in scale
  - Easy if center of change is center of object
  - Scale vectors in relation to center,
  - or change radius of a bounding circle

src. M. Zechner, Beginning Android Games, Apress, 2011

Bounding shape updates

- Change in orientation
  - if center of rotation is center of object …
  - for triangle meshes triangles are rotated
  - bounding circles remain untouched
  - for bounding boxes corner points have to be rotated & a new box has to be found

src. M. Zechner, Beginning Android Games, Apress, 2011

Phases in Collision Detection

- Broad phase
  - Identify potentially colliding objects
  - With less precise bounding shapes
- Medium phase
  - Determine actually colliding objects
- Narrow phase
  - Find when (contact time) and where (contact set)

src. David H. Eberly, Game Physics 2nd Edt., Morgan Kaufmann, 2010

Collision Culling: Circles

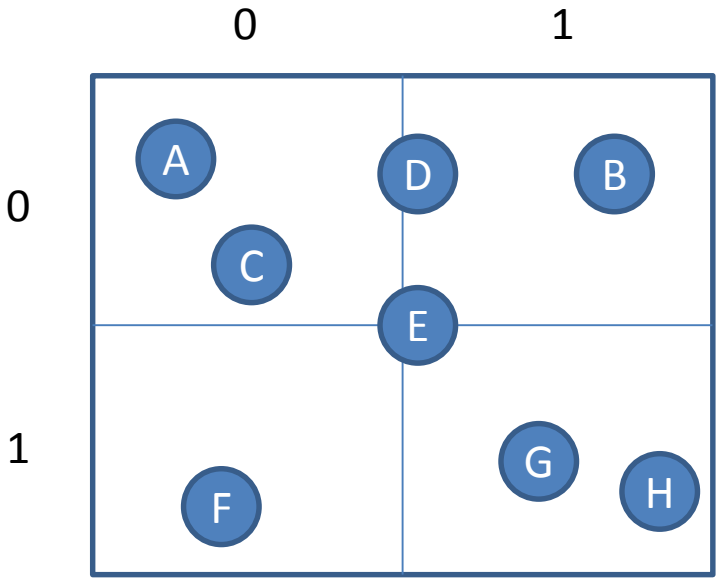
- Bounding Circles
  - with center C_i and radius r_i
  - potential collision when $| C_i - C_j | < r_i + r_i$
  - number of collision tests c with c_p as time for one test

$$c = \frac{n(n-1)}{2} c_p$$

src. David H. Eberly, Game Physics 2nd Edt., Morgan Kaufmann, 2010

Collision Culling: Circles

- Bounding Circles
  - speed up with grid
  - eg. B_{00} = {A, C, D, E}
- Supposing we have b circles in each bin:

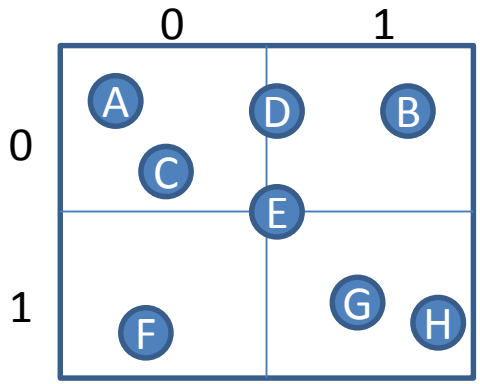


$$\tilde{c} = \frac{n/b(n/b-1)}{2} c_p$$

src. David H. Eberly, Game Physics 2nd Edt., Morgan Kaufmann, 2010

Collision Culling: Circles

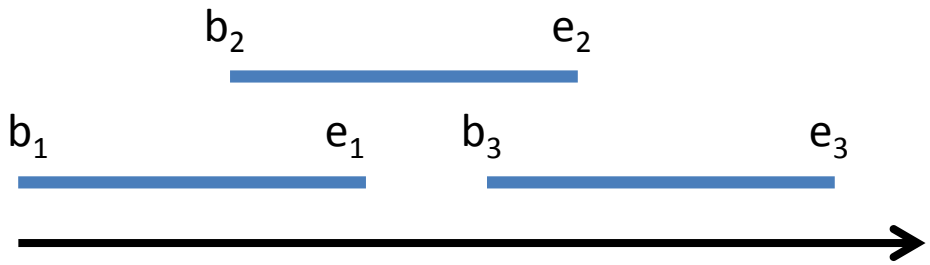
- Still missing the cost for determining the bin …
- Naive approach tests against axis-aligned borders
- Trade-off between
  - grid size (det. bin)
  - culling cost c
- Solution: add time coherence



src. David H. Eberly, Game Physics 2nd Edt., Morgan Kaufmann, 2010

Collision Culling: Axis-Aligned Bounding Boxes

- Intersection of AABBs based on intervals
- Sorting andand update in real time
- Intervals reflect edges parallell to an axis
  - $I_i = [b_i, e_i]$

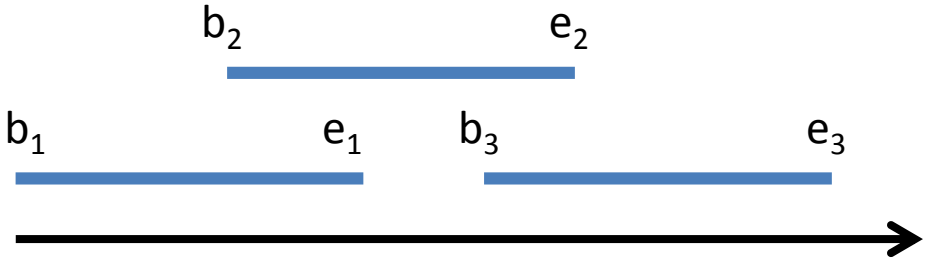


src. David H. Eberly, Game Physics 2nd Edt., Morgan Kaufmann, 2010

Collision Culling: Axis-Aligned Bounding Boxes

Start from left hand side

1. b1 encountered, A={} -> no intersection, update A={I1}
2. b2 encountered, intersection I1+I2, update A={I1, I2}
3. e1 encountered, update A={I2}
4. b3 encountered, intersection I2+I3, update A={I2, I3}
5. … and so on



src. David H. Eberly, Game Physics 2nd Edt., Morgan Kaufmann, 2010

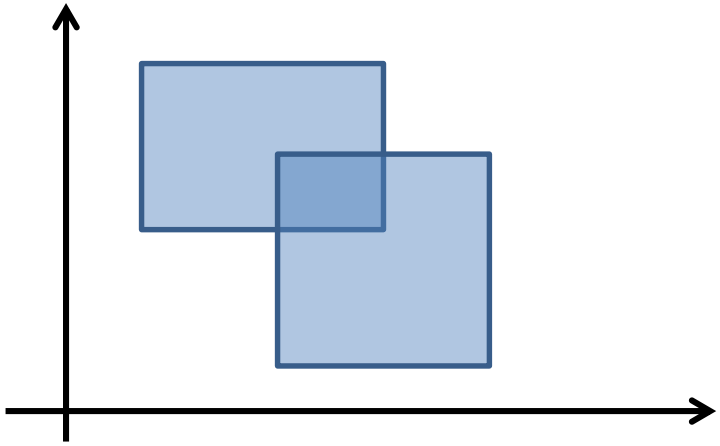
Collision Culling: Axis-Aligned Bounding Boxes

- Apply “dirty” tag for sorting
  - Faster if fewer changes
- Performance depends on the number of intersections m
  - sweep is O(n), sort is O(n log n), intersection report is O(m)
  - worst case: all intervals overlap, m=n^2

src. David H. Eberly, Game Physics 2nd Edt., Morgan Kaufmann, 2010

Rectangle Intersection

- Rectangles intersect when
  - they intersect on x- axis and y-axis
- So just test the candidates on the other axis



src. David H. Eberly, Game Physics 2nd Edt., Morgan Kaufmann, 2010

Toolchain (Professional)

- FMOD
- RAD Game Tools
- Autodesk Scaleform
- Havok
- (Bullet)
- (Box2D)

FMOD

- FMOD Ex / FMOD Designer
  - Low level API (mixer, interfaces, dsp, 3D, …)
  - Tool for Event creation
  - Looping, effects, etc.
- FMOD Studio
  - DAW like approach to 7.1 game sound mastering
  - multiple platforms
  - Plugins for UE, Unity

FMOD

- Sound designer creates project in FMOD Studio

FMOD

- Programmers / Scripters then
  - call events and loops from the API
  - at the target platform
- FMOD takes care of the packaging & performance

FMOD Licenses

- Non Commercial & Indie License
- Commercial License

FMOD Studio	Game/App Budget	Cost for 1 title
First platform	< $100K USD	1 title per year free! Otherwise $500
Subsequent platforms	< $100K USD	1 title per year free! Otherwise $500
First platform	$100K-$500K USD	$3,000 USD
Subsequent platforms	$100K-$500K USD	$1,500 USD
First platform	> $500K USD	$15,000 USD
Subsequent platforms	> $500K USD	$3,000 USD

RAD Game Tools

- Privately held company owned by Jeff Roberts & Mitch Soule
- Based in Kirkland, Washington
- Develops video game software technologies
- Hires one specific person to write, document and support each single product
- refuses to patent any of their technologies

src. Wikipedia (en)

RAD Game Tools

- 1988 Windows dev & consulting
- 1993 Smacker, 8-bit video codec (time of CDs)
- 1994 Fastest growing company in Utah, 63rd in U.S.
- 1995 Aquisition of Miles Sound System
- 1999 Release of Bink
- 2002 Pixomatic (software 3D fallback system)
- 2014 VOGL (open GL debugger, MIT license)

src. Wikipedia (en)

Bink (2)

- Video game codec for games
  - licensed for > 6,200 games
- Full control through Bink SDK
  - no callbacks etc.
- Self-contained, no 3rd party SW

src. http://www.radgametools.com/

Bink (2)

- Ressource efficient
  - less memory
  - multi core, 70% SIMD
- Multiple platforms
  - same API on many different platforms
- Supported by many game engines

src. http://www.radgametools.com/

Miles Sound System

- Licensed for > 5,200 games
- Integrates
  - high-level sound authoring with 2D and 3D digital audio
  - featuring streaming, environmental reverb, DSP filtering, multichannel mixing
  - highly-optimized audio decoders (MP3, Ogg and Bink Audio)
- Designer for Windows
- Deployment to “all” platforms supported

src. http://www.radgametools.com/

Miles Sound System

- MP3 decoder and license
- Bink audio decoder
  - faster & smaller memory footprints
- Ogg Vorb audio decoder
- 3D Audio
- A lot of DSP filters

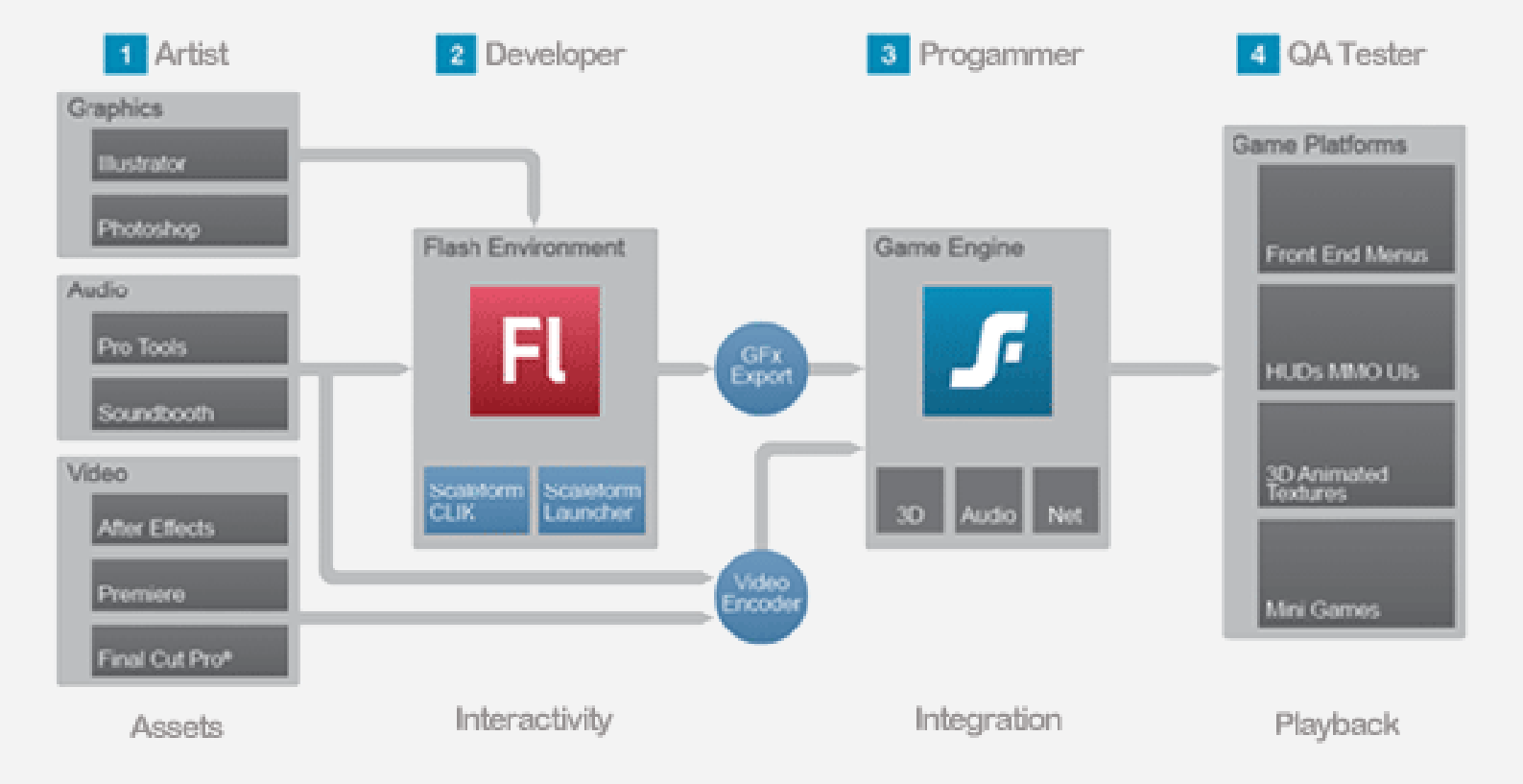
src. http://www.radgametools.com/

Iggy Game UI

- User Interface library for
  - Windows, Xbox 360 and One, Sony PS3/4, iOS Nintendo Wii / U, ...
- Utilizes Flash content (up to v9)
  - includes ActionScript 3 interpreter
- Interactive performance tools
  - for memory and performance debugging

src. http://www.radgametools.com/

Autodesk Scaleform



Src. http://gameware.autodesk.com/scaleform/features/overview

Scaleform

1. Create UI assets, including bitmaps, vectors, audio, and video using the Adobe Creative Suite
2. Import assets into Flash Studio and add interactivity and animation
3. Export Flash content to game & connect UI
4. Test the Flash content navigation, localization and functionality running in game

Autodesk GAMEWARE

Src. http://gameware.autodesk.com/scaleform/features/overview

Havok Physics

- Irish company, since 1998
  - owned by Intel
- Real-time physics simulation
  - collision and dynamics of rigid bodies
  - ragdolls & character animation
  - movement of vehicles

Havok Cloth

- Simulation of cloth, hair, foliage and other deformable objects
- Animate believable behaviors of character garments and environmental cloth

- http://youtu.be/qTOzOgAdYWk?hd=1

Havok Destruction

- Tool set & runtime SDK
- Fracture meshes and use in-game
- Destruction of complex structures
- Simulate destruction in runtime

- http://youtu.be/cIcg5eotZlY?hd=1

Havok

- Havok AI – pathfinding and following
- Havok Animation Studio – character animation
- Havok Vision Engine – C++ game engine
- Havok Script – Lua compatible virtual machine for consoles

Autodesk

- Maya & 3ds Max
- Educational programs
  - Autodesk University
  - Student licenses (http://students.autodesk.com)

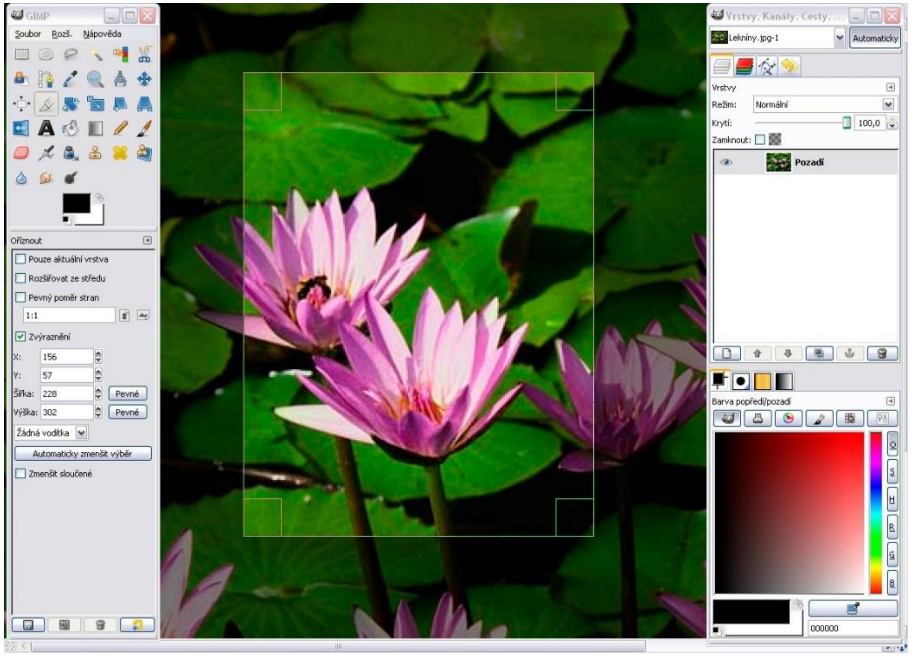
Autodesk
Education Community

Toolchain (Indie)

- Graphics
  - Gimp
  - Blender
- Audio
  - bfxr
  - Audiotool

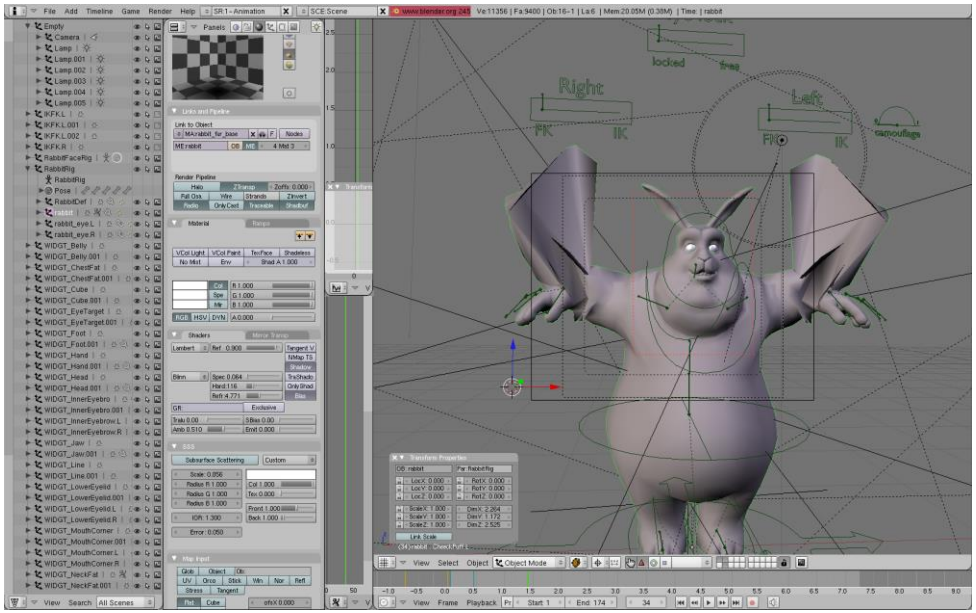
Gimp

- The „open source photoshop“



Blender

- The „open source maya“



bfxr

- Based on the famous sfxr by dr petter
- Creation of sound effects for games

Audiotool

- Audio work station in your browser
  - Analog synth emulators
  - Mixer
  - Patching
  - …

And many more

- Spine - 2D Animation
  - http://esotericsoftware.com/
- Tiled Map Editor – Tile and map editor
  - http://www.mapeditor.org/
- Littera – Bitmap Font Generator
  - http://www.kvazars.com/littera/
- Audacity – sound editor
  - http://web.audacityteam.org/

Thanks …

… any questions?