Principles of Computer Game Design and Implementation

Lecture 30

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“Am I a Game Developer Now?”

- Who am I to say?
- We looked at
  - Game architecture
  - 3D game engines
    - including maths required
    - Some physics
  - AI

Artwork

More maths and physics

Team work

Game writing as storytelling

Programming techniques

Production and management

Learning Outcomes

At the end of the module, the student will have:

1. An understanding of different design issues related to computer games development: game structure, game engine, physics engine;
2. An appreciation of the fundamental concepts associated with game development: game physics, game artificial intelligence, content generation;
3. The ability to implement a simple game using an existing game engine.

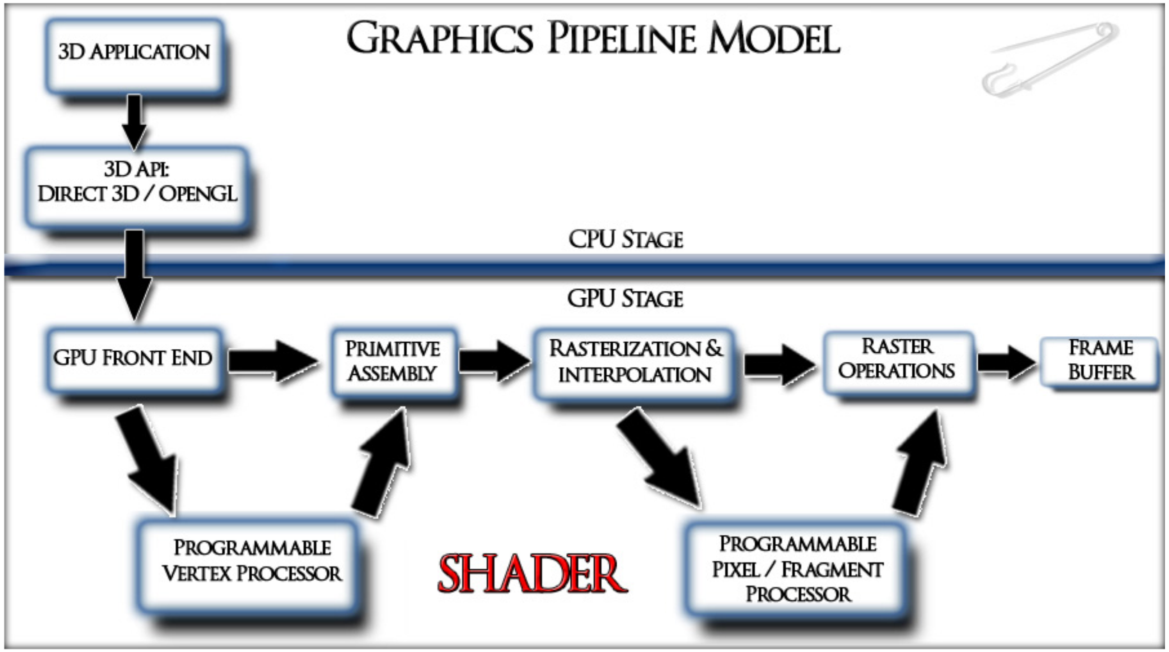
Game Architecture

- Game Design
  - Think movies
    - Idea → Design → lots of work → final product
- More arts than technology
  - One can study approaches to design
  - Vast area
- Nothing beats a clear good idea

3D Game Engines

- Graphics
  - Rendering pipeline

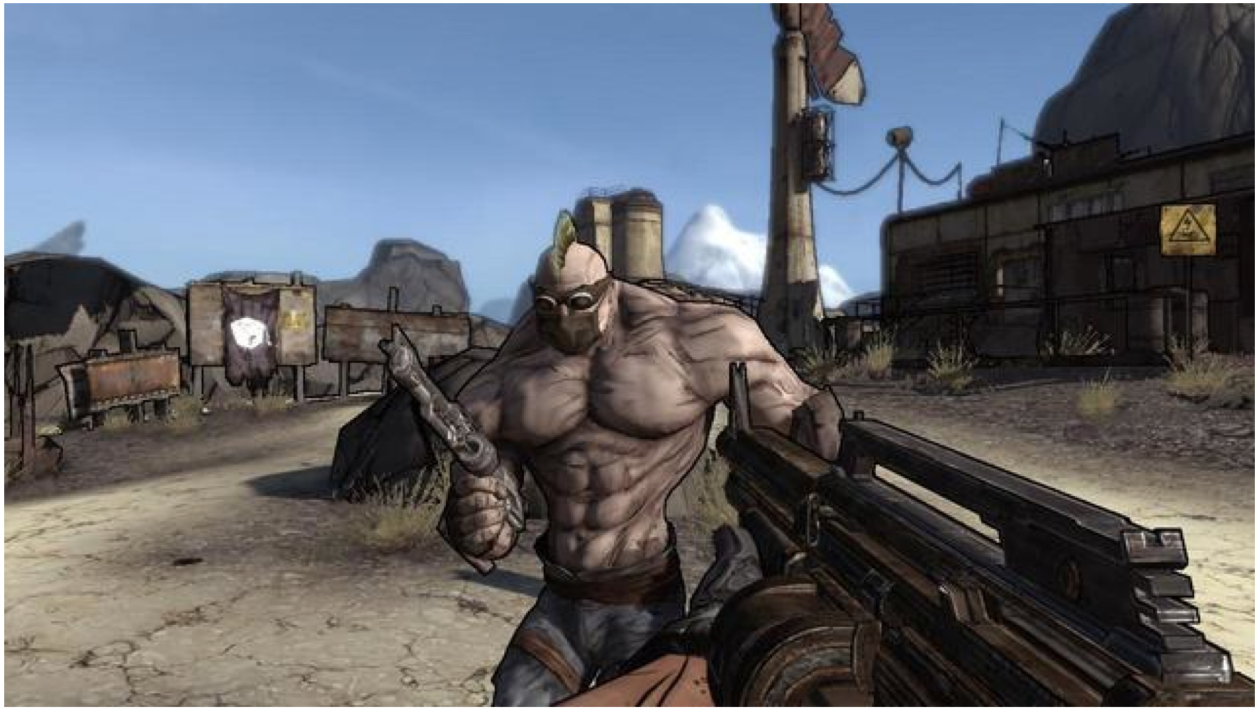
Shadows, water, sky, transparent and translucent objects,…


GRAPHICS PIPELINE MODEL
3D APPLICATION
3D API: DIRECT 3D / OPENGL
CPU STAGE
GPU STAGE
GPU FRONT END
PRIMITIVE ASSEMBLY
RASTERIZATION & INTERPOLATION
RASTER OPERATIONS
FRAME BUFFER
PROGRAMMABLE VERTEX PROCESSOR
SHADER
PROGRAMMABLE PIXEL / FRAGMENT PROCESSOR

http://www.iamthomasvogel.de/?page_id=85

Styled Graphics

- Photo-realistic 3D graphics does not sell
  - ???
- Moody atmospheric graphics



3D Modelling

- We combined geometries within game engine
- 3D Modelling tools
  - Autodesk Maya
  - Autodesk 3ds Max
  - *Blender*
    - Integration with

Physics

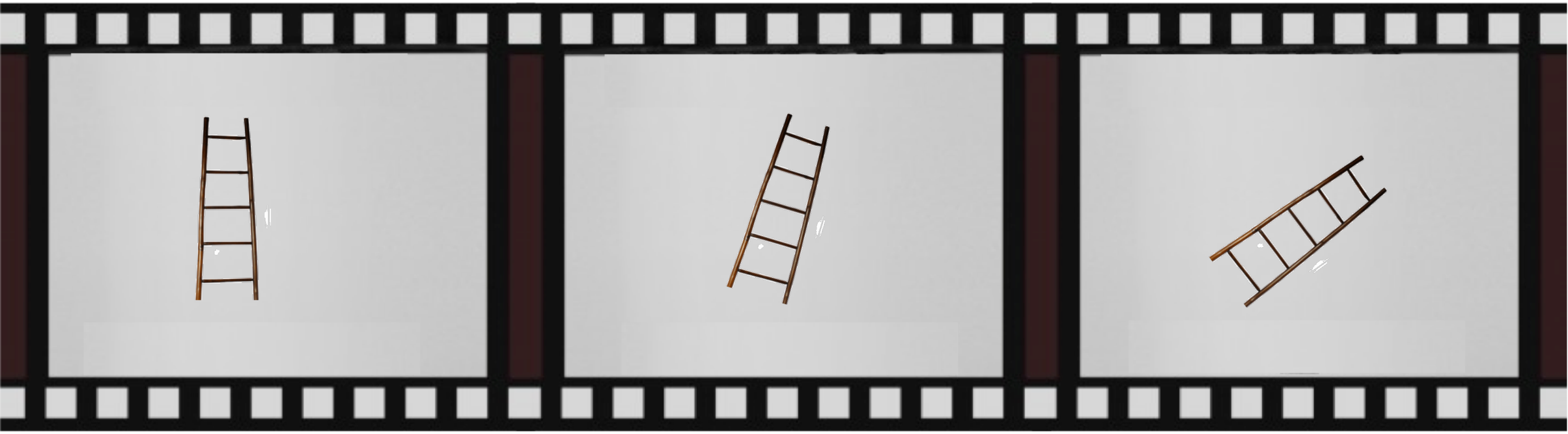
- A tighter integration of physics and game engines
  - Drawing fur, grass, etc
  - Particles
  - Flame
  - …

Animation in Games

- We modelled object motion
  - a kind of animations
- Characters should move realistically
  - Modelled in a 3D modelling tool (blender)
  - Provide “hooks” to play sequence from game
- Motion capture
  - Play the sequence

Keyframe Animation

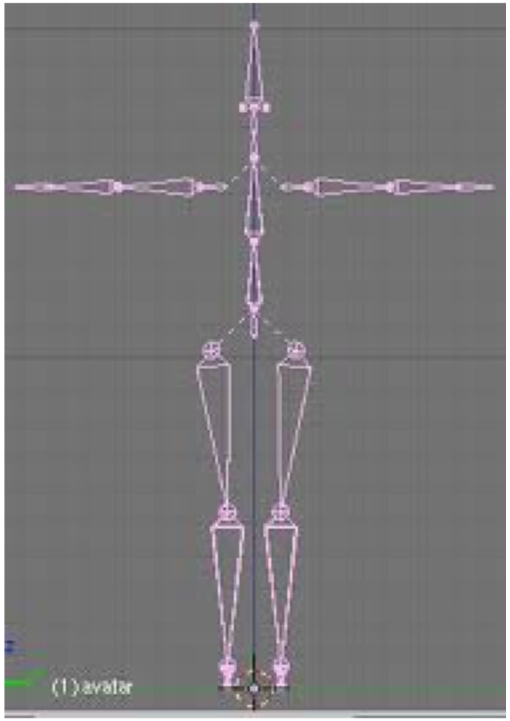
- Storing (and processing) each frame is too expensive
- Keyframe animation: store a (relatively small) number of keyframes and *interpolate*



Animation of Models

- Rigid body animation
  - Body is immutable
  - Sequence of keyframes

- Skeletal animation
  - **Bones**
  - Skin
    - Follows the skeleton



Inverse Kinematics

- Normally, animation is **forward kinematics**
  - Sequence of keyframes specifying bone motion

- Inverse kinematics
  - Specify where you want a bone to move
  - Animate the model
    - Pick up an object
  - Limits have to be set!

Content Generation

- Modern games are (by in large) about *assets*
  - Worlds to explore
  - Enemies to kill
  - Friends to make

- Level designers

Procedural Content Generation (1)

- Assets generated by an algorithm
  - As a tool for game developers

www.speedtree.com

Procedural Content Generation (2)

- Terragen

  http://planetside.co.uk

Procedural Content Generation (3)

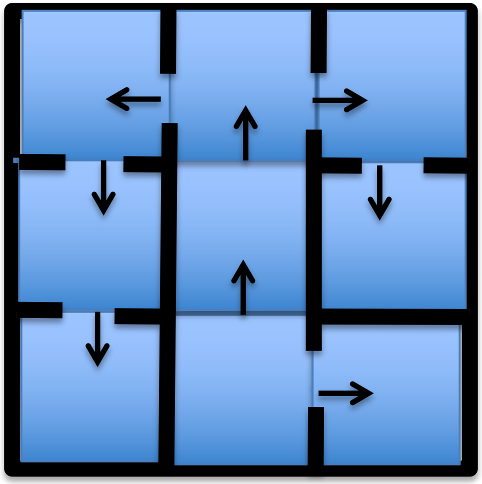
- Assets generated by an algorithm *on the fly*
- Map generation
  - Dungeon generation in 2D
  - Problems with 3d
    - Too slow
    - Too dull
    - Verification required

Tribal trouble

Example: A Growing Tree Algorithm

2D maze generation

- Pick a maze cell
- See if there's space to grow into
  - – Random direction
- Carve into the space
- Repeat until finished



Procedural Content Generation (3)

- Assets *tuned* by an algorithm
- Face Instances

- Borderlands
  - Combinations of guns
- Spore
  - Combinations of features

Procedural Content Generation (4)

Procedural population

- S.T.A.L.K.E.R.: Shadow of Chernobyl
  - Dynamical placement of characters
    - Artificial Life
- Left4Dead
  - In addition to placement, adaptive pacing
  - If intensity is too high, remove major threats for a while

Conclusion

- These are just some of directions
- Lots of further info online
  - www.gamasutra.com
  - aigamedev.com
  - www.gamedev.net
  - …
- Tons of books
- Experiment yourself!