

SCENE DYNAMICS

ANIMATION, SKELETON, TIMELINE

TOMÁŠ POLÁŠEK IPOLASEK@FIT.VUTBR.CZ

BRNO UNIVERSITY OF TECHNOLOGY

FACULTY OF INFORMATION TECHNOLOGY

DCGM, CPhoto@FIT

FACULTY OF FINE ARTS

GAME MEDIA STUDIO



MAKING THINGS MOVE

EVOLUTION OF ANIMATION

- Illusion of Movement
- Historical Development
- World in 2D & 3D
- Animation in Games
- → Animation System



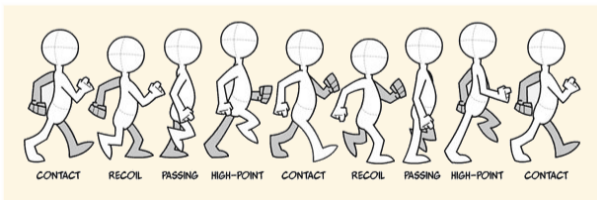
HUMBLE BEGINNINGS

- [1604] Camera Obscura
- [1659] Laterna Magica
- [1866] Zoetrope
- [1906] Humorous Faces
- [1928] Steamboat Willie
- [1937] Snow White



TRADITIONAL ANIMATION

- Sequence of Frames
- Cel Animation
- Depth & Parallax
- Frame Rate: Full × Limited
- On “Ones” and “Twos”
- Animation Loops
- → CGI



Source: Angry Animator



Source: Walt Disney's MultiPlane Camera (1) (2)



Source: Brandon Kouri: Snow White Cel Animation

ANIMATION IN GAMES

SPRITE GRAPHICS

- Sprite \approx Bitmap
- Limited Resources
- Retro & Pixel Art
- Simple Authoring
- Sprite Sheet



Source: Intellivision Running Man



Source: Nintendo's Super Mario World

SPRITE ANIMATION

- Cels \rightsquigarrow Sprites
- Composition & Playback
- Palette Cycling
- Rotoscoping
- Digitized Animation



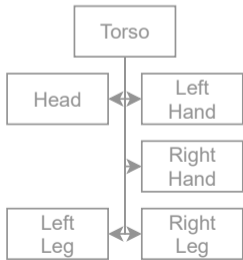
Source: Cuphead – The animation process



Source: Doom

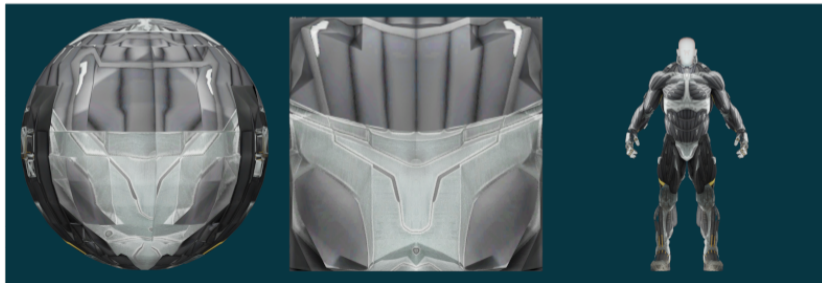
RIGID ANIMATION

- Time Consuming → Automation
- Decompose the Model
- Part Hierarchy
- Animate Parts
- Rigid & Cracking
- Both 2D & 3D



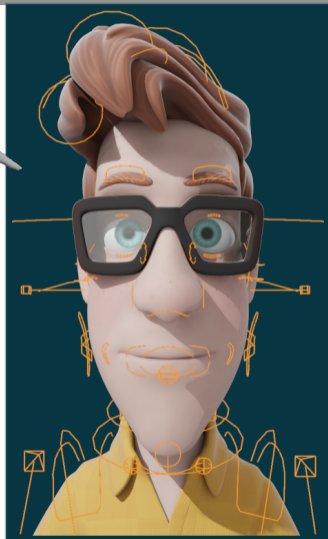
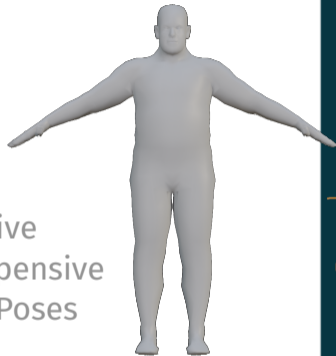
MOVING VERTICES

- Granularity → Fluidity
- Per-Vertex Animation
 - ▶ Complete Control
 - ▶ Model per Frame
 - ▶ Memory Intensive
- Morph Target Animation
 - ▶ Blending Poses
 - ▶ Model Semantics
 - ▶ Limited Memory



ANIMATION AS COMPRESSION

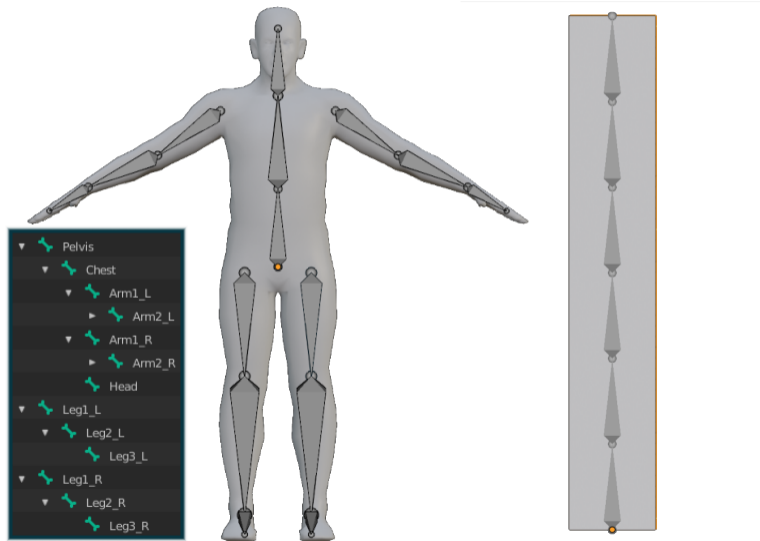
- Limited Resources
 - Time is Money
 - Ease of Use
 - Semantic Manipulation
-
- Full \rightsquigarrow Difficult & Time Intensive
 - Vertex \rightsquigarrow Computationally Expensive
 - Morph \rightsquigarrow Fitting Task, Needs Poses
-
- \Rightarrow Skinned Skeletal Animation



Source: Andy Goralczyk: Vincent

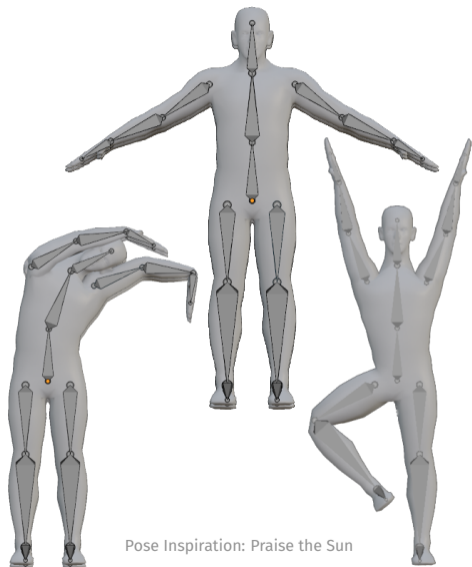
THE SKELETON

- Bones & Joints
- Skeletal Hierarchy
- Joint Properties
 - ▶ Identifier
 - ▶ Transformation
 - ▶ Parent
- Bone Properties
 - ▶ Position
 - ▶ Length & Scale
 - ▶ Rotation
- Root Bone
- Rigging



POSING THE MODELS

- Skeleton Poses
- Bind Pose
 - ▶ Neutral Position
 - ▶ Easier Rigging
- Composition
- Posing Joints
 - ▶ Local
 - ▶ Global



Pose Inspiration: Praise the Sun

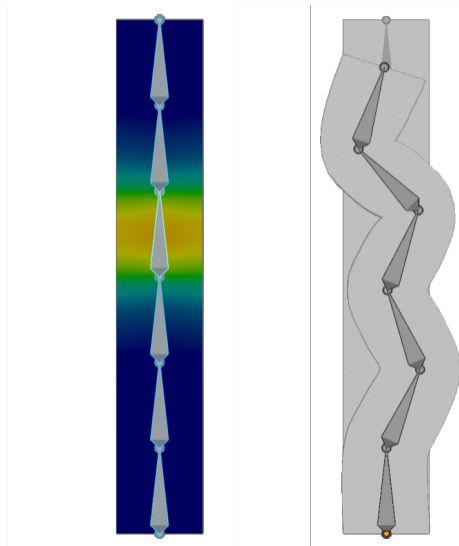
ANIMATION CLIPS

- Granularity → Clips
- Timeline
 - Local – Looping
 - Global – Continuous
- Synchronization
- Pose Interpolation
- Animation Blending
- Animation Parameters
- Retargeting Clips



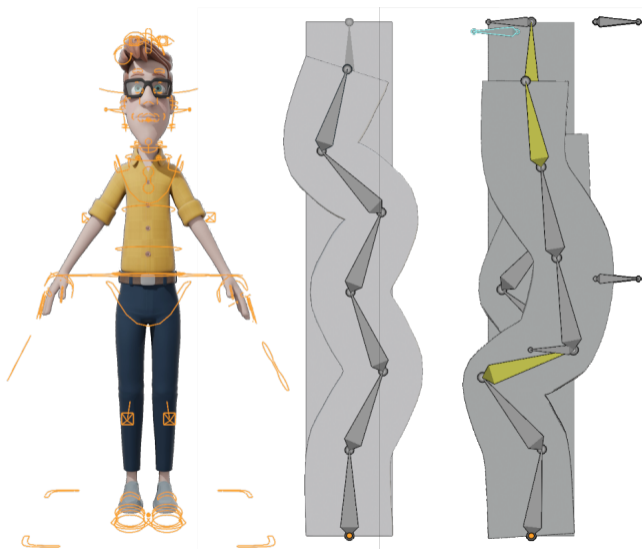
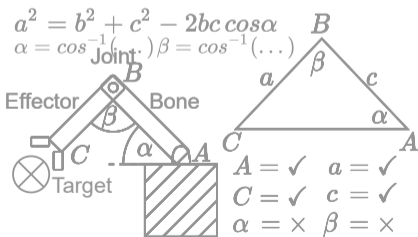
SKINNED ANIMATION

- Bones → Mesh
- Skinning Data
 - Bone Identifier/s
 - Weight/s
- Delta Transformation
- “Painting” Vertices
 - Manual
 - Automated



FORWARD AND INVERSE KINEMATICS

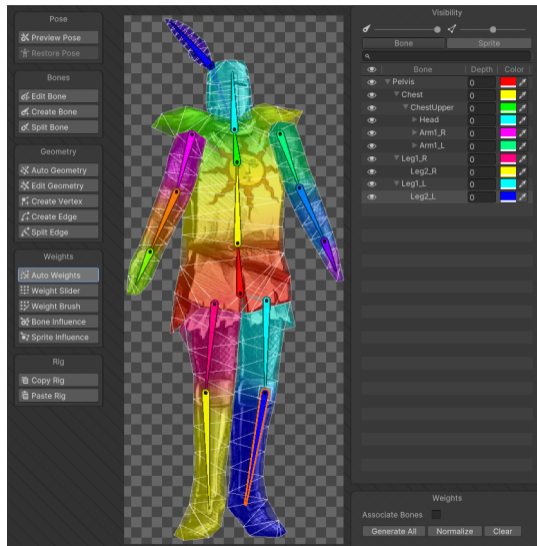
- Explicit → Forward
- Implicit → Inverse [1]
- Effector & Target
- Minimize Error
- → Solver



ANIMATION IN UNITY

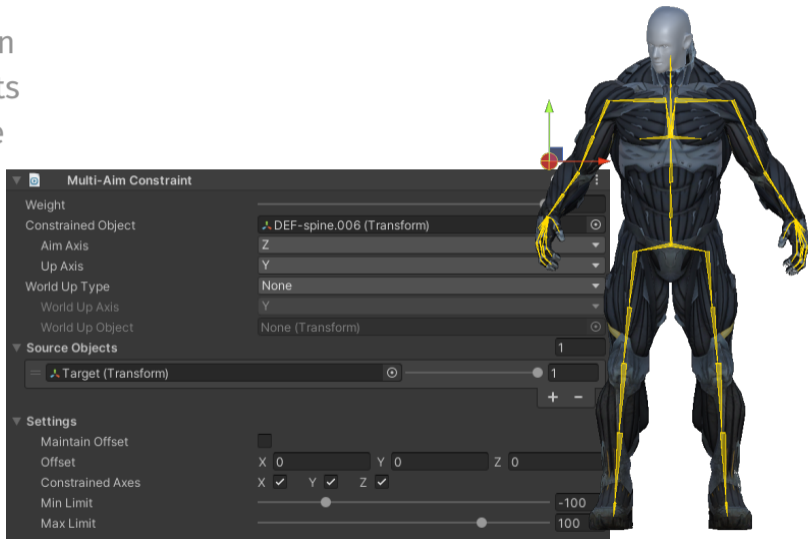
2D ANIMATION

- Sprite & Skeleton
- Asset Import
- Sprite Sheets
- Sprite Editor
- Rigging & IK



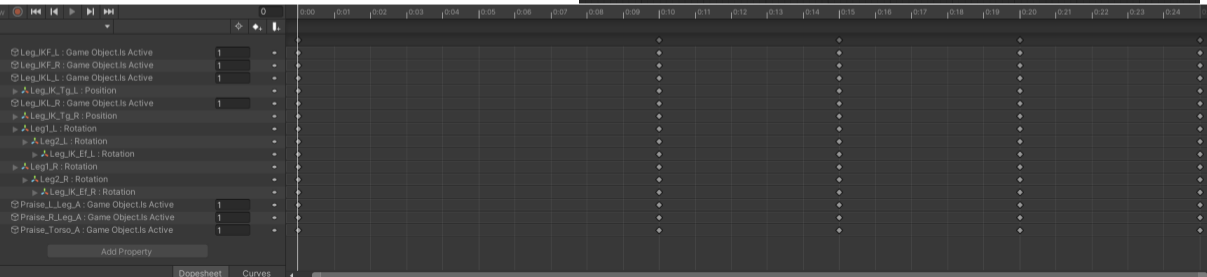
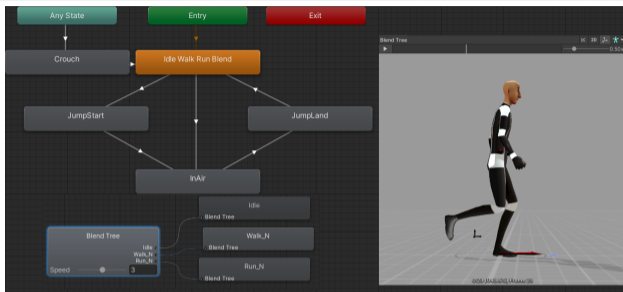
3D ANIMATION

- Skeletal Animation
- Supported Formats
- Forward & Inverse
- Bone Constrains
- IK Rigging



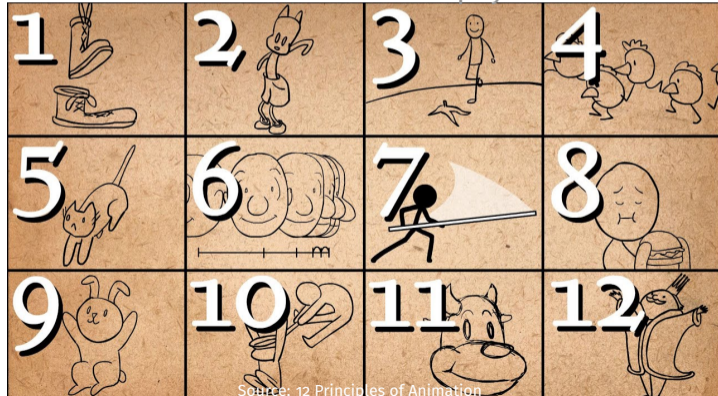
TIMELINE AND ANIMATOR

- Animation Workflow
- Clips, Interpolation & Blending
- Timeline Automation
- Animator Logic



ADDITIONAL RESOURCES

- [YouTube] Aladdin: Cel animation in video games
- [Book] Disney Animation: The Illusion of Life (12 Principles)
- [YouTube] Alan Becker: 12 Principles of Animation
- [YouTube] Jake Clark: Cuphead's Animation Process and Philosophy



Source: 12 Principles of Animation



Thanks For
Your Attention!

The Neverhood

REFERENCES I

- [1] JASON GREGORY. ***GAME ENGINE ARCHITECTURE, SECOND EDITION***. 3rd. USA: A. K. Peters, Ltd., CRC Press, 2018. ISBN: 1351974288.