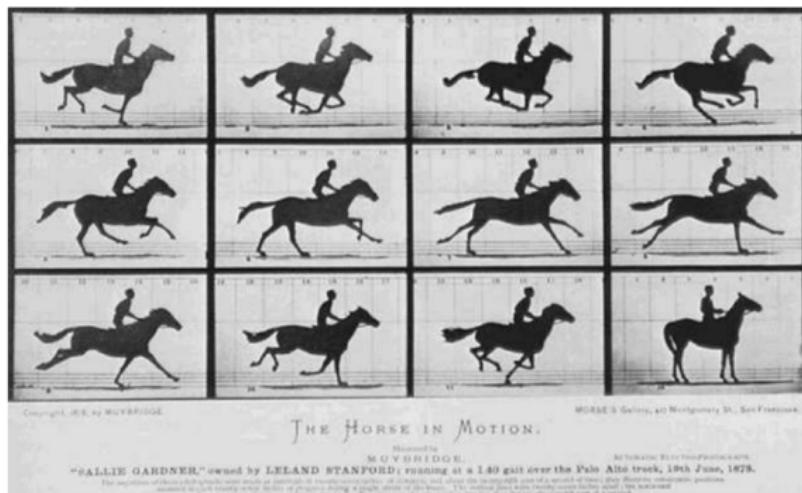


CS 461 - Computer Graphics

Introduction to Animation

Animation

- ▶ Motion can bring the simplest of characters to life
- ▶ Computer animation is the art of creating moving images via the use of computers
- ▶ The basic idea behind animation is to play back the recorded images at the rates fast enough to fool the human eye into interpreting them as continuous motion



History

- ▶ Shahr-e Sukhteh, Iran 3200 BCE
- ▶ tomb of Khnumhotep, Egypt 2400 BCE
- ▶ Phenakistoscope, 1831
- ▶ Eadweard Muybridge, "Sallie Gardner" (1878)
- ▶ Emile Cohl, "Fantasmagorie" (1908)
- ▶ Lotte Reiniger, "Die Abenteuer des Prinzen Achmed" (1926)
- ▶ Disney, "Snow White and the Seven Dwarves" (1937)
- ▶ ...
- ▶ Pixar, "Toy Story" (1995)
- ▶ Toy story 4 :-)

Perception of motion

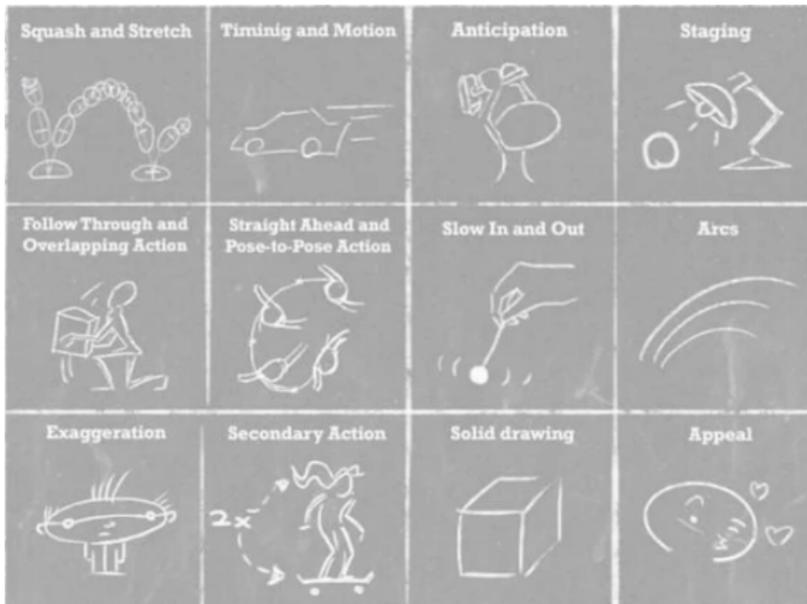
- ▶ The eye is not a camera! More modern explanation:
 - ▶ beta phenomenon: visual memory in brain—not eyeball
 - ▶ phi phenomenon: brain anticipates, giving sense of motion

12 Basic principles of animation

- ▶ 1981 - Frank Thomas & Ollie Johnston

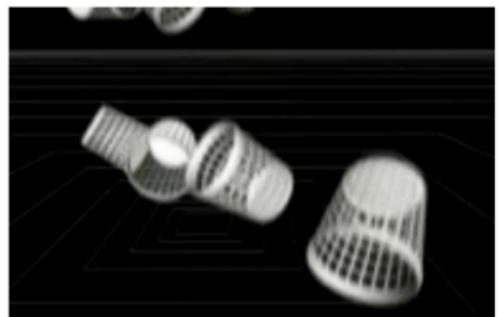
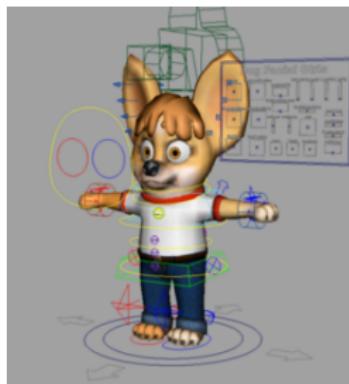
- ▶ Complete video:

<https://www.youtube.com/watch?v=uDqjIdI4bF4>

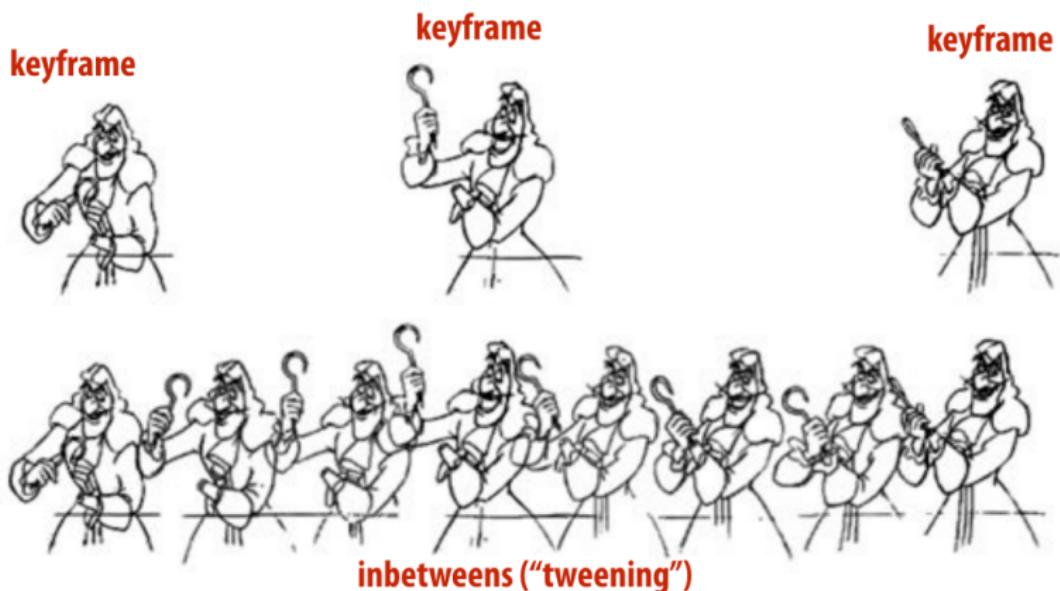


Basic techniques

- ▶ Artist-directed (e.g., keyframing)
- ▶ Data-driven (e.g., motion capture)
- ▶ Procedural (e.g., simulation)



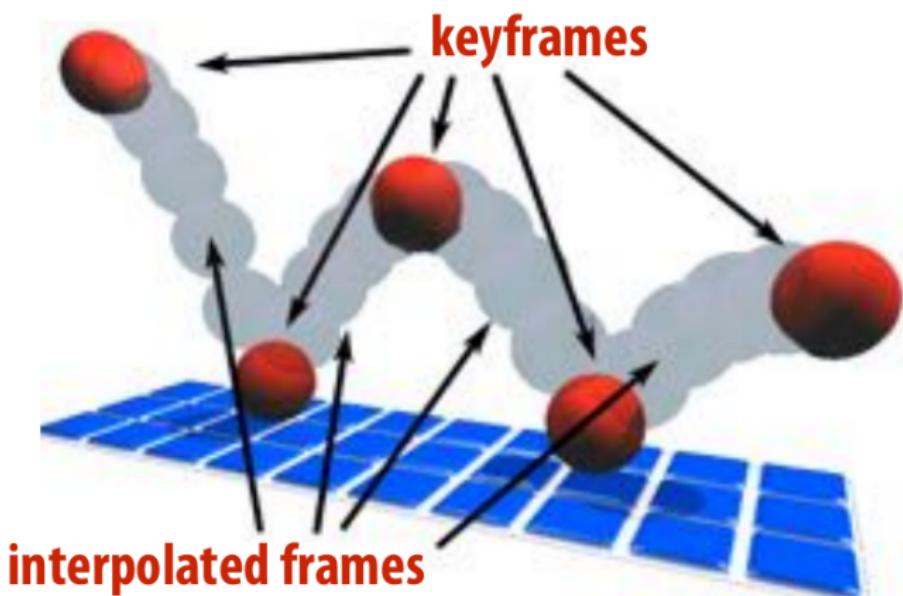
Keyframing



How and what to interpolate?

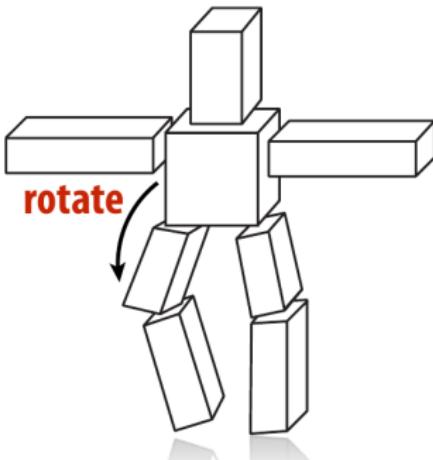
- ▶ BetweenIT :

<https://www.youtube.com/watch?v=DuZNR-6iRo&t=2s>

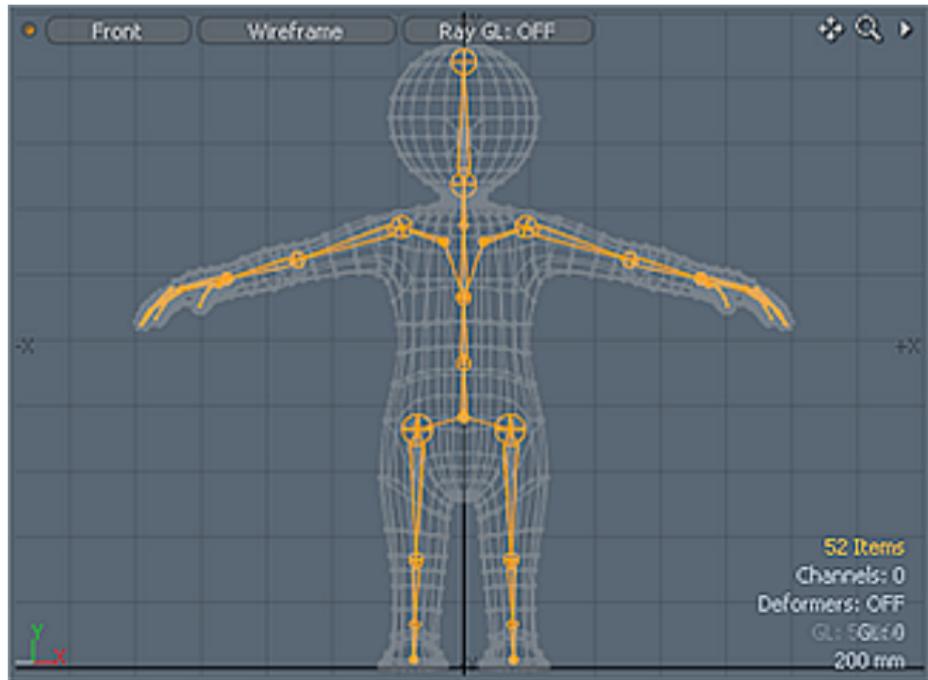


Character animation

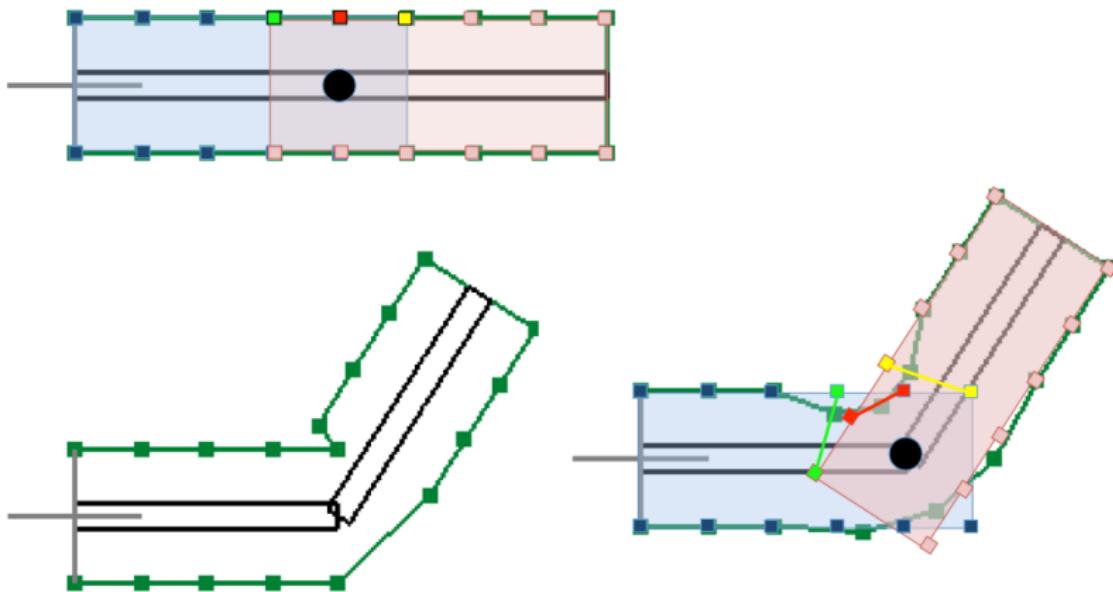
- ▶ Scene graph/kinematic chain: scene as tree of transformations
- ▶ E.g. in our “cube man,” configuration of a leg might be expressed as rotation relative to body
- ▶ Animate by interpolating transformations
- ▶ Often have sophisticated “rig”
- ▶ Forward and Inverse Kinematics



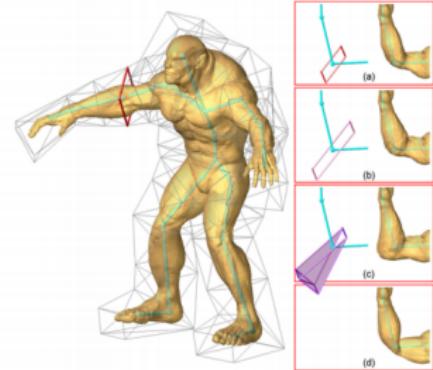
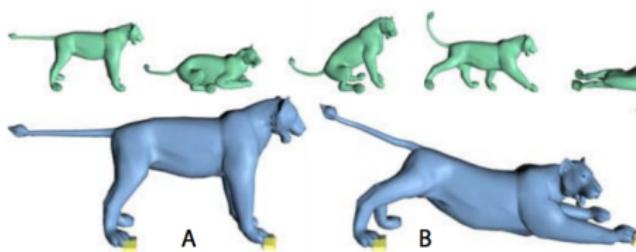
Skeletal animation



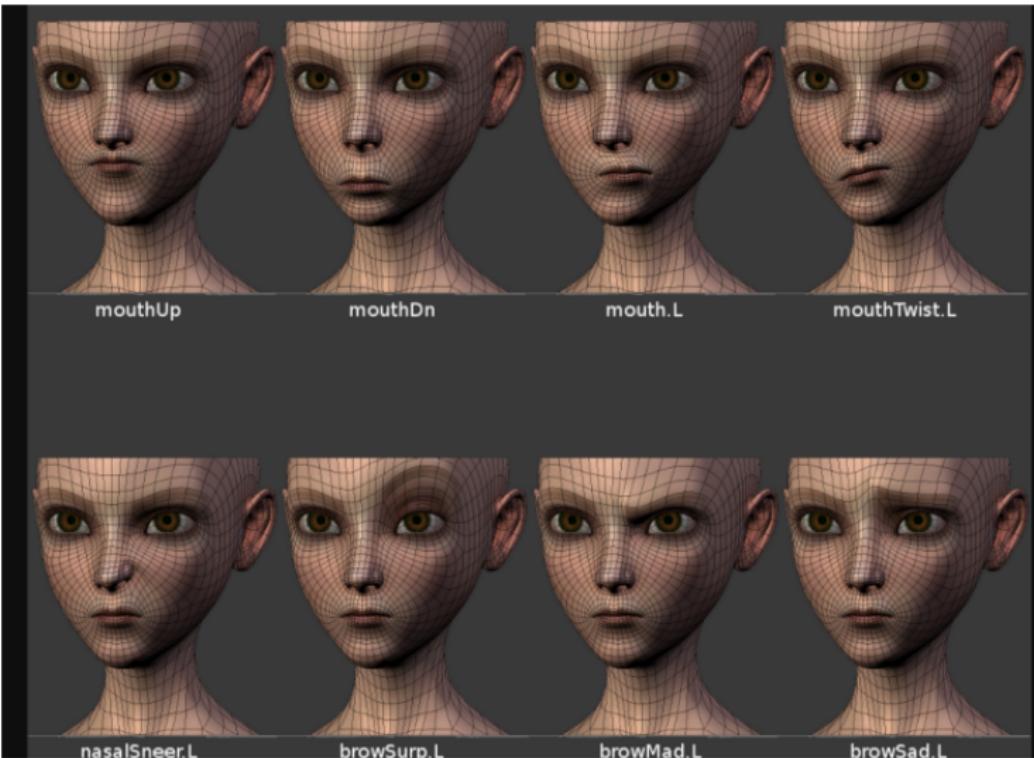
Rigid body skinning & Linear blending



Mesh-based and cage-based animation



Blend animation



Motion capture

- ▶ Usually uses optical markers and multiple high-speed cameras
- ▶ Triangulate to get marker 3D position
- ▶ Captures style, subtle nuances and realism
- ▶ But need ability to record someone



Optical motion capture

- ▶ Active and Passive markers



Facial motion capture



Procedural animation

- ▶ Describes the motion algorithmically
- ▶ Express animation as a function of small number of parameters
- ▶ Example
 - ▶ a clock/watch with second, minute and hour hands
 - ▶ express the clock motions in terms of a "seconds" variable
- ▶ the clock is animated by changing this variable

Physically-based animation

- ▶ Assign physical properties to objects (Masses, forces, etc.)
- ▶ Also procedural forces (like wind)
- ▶ Simulate physics by solving equations of motion (Rigid bodies, fluids, plastic deformation, etc.)
- ▶ Realistic but difficult to control

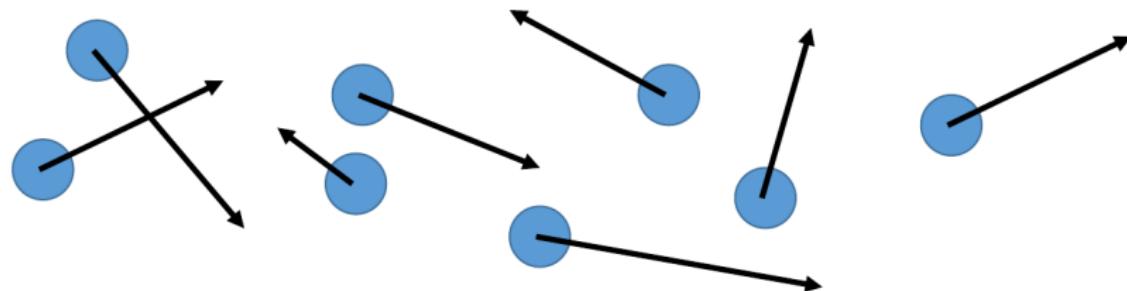
Mass-spring model

- ▶ A very simple way to model complex structures (e.g., hair, cloth, jello) is connecting particles with spring forces
- ▶ Pixar in a Box: <https://youtu.be/BXRIQHvU9Fs>,
<https://youtu.be/-3X6zDaJ8r4>,
<https://youtu.be/tYrst6lFOGU>

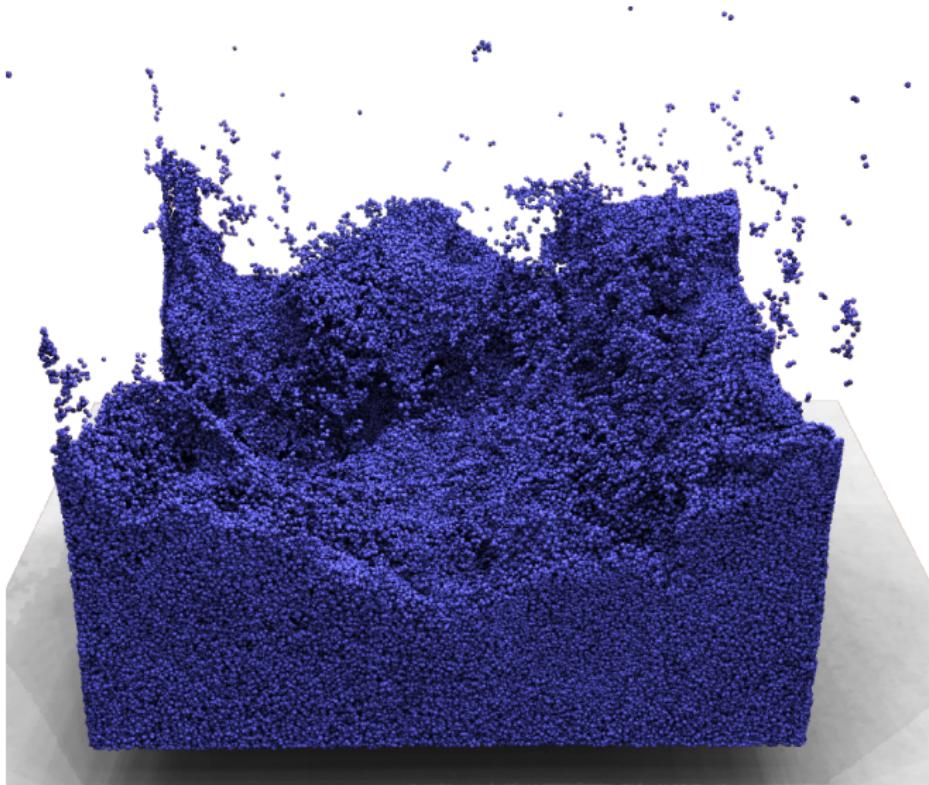


Particle-based simulation

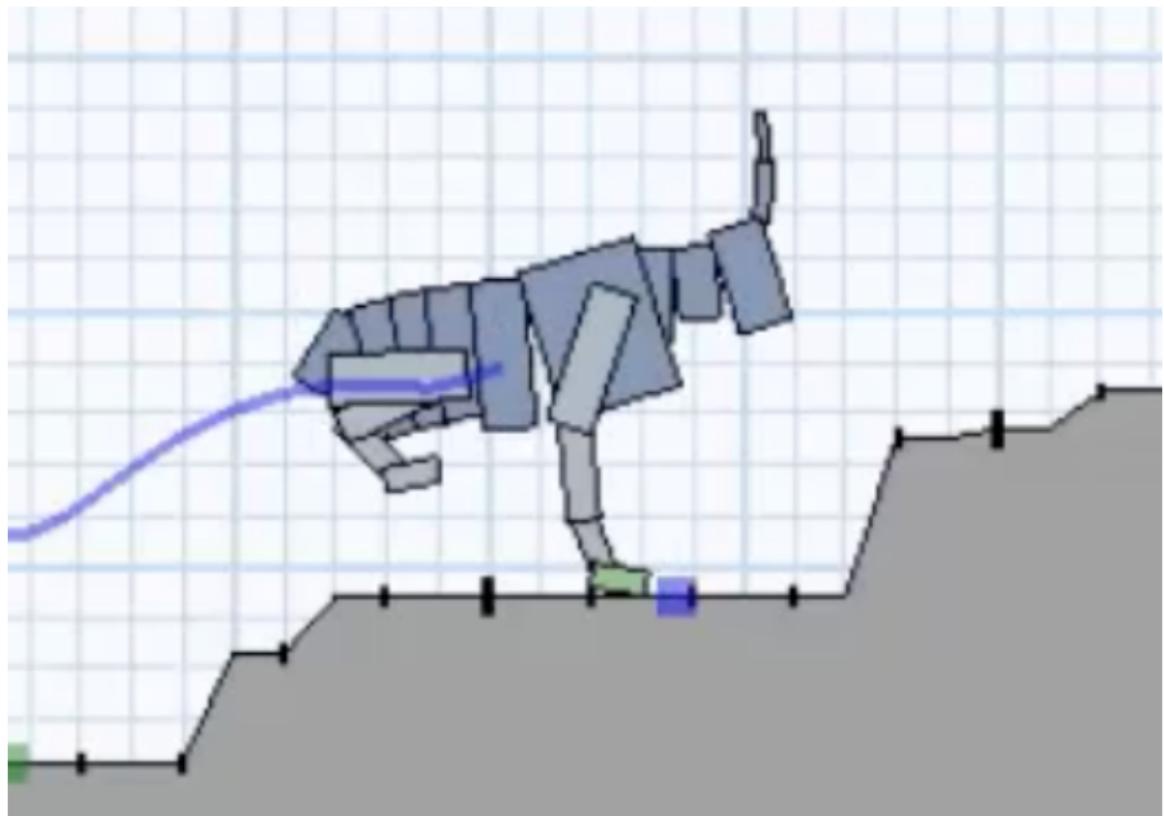
- ▶ Particle system: A collection of point particles that obey rules dictating their creation, movement, deletion, and other attributes and behaviors



Particle-based simulation



Learning-based :-)



Next class

- ▶ Final lecture :-)
- ▶ **5th** November - 9 to 10
- ▶ Topic: Course Wrapup
- ▶ Last written assignment - Quaternions
- ▶ Deadline: **9th** November midnight
- ▶ Seminars of 59 (Sachin Giri), 27 (Kadam Kiran), 78 (Vineet Malik)?

Project evaluation

- ▶ Marks will be based on:
 - ▶ How good the idea is?
 - ▶ Complexity/intuitiveness
 - ▶ Your modification (what can you claim as your own?)
 - ▶ Explanation/presentation (must include the difficulties you faced)
 - ▶ Implementation/Results
 - ▶ Report and code (with all necessary files - executable in Linux)