Welcome to Computer Animation

Algorithms and Techniques

First Things First

- This is 4003-590-04 / 4005-769-04 (Computer Animation – Algorithms & Techniques)
- I am Joe Geigel…your host!

Plan for this evening

- Logistics
- What is this course about?
- Requirements for course
- But first…
  - Student Information Forms

Logistics

- Course Web Site:
  - http://www.cs.rit.edu/~jmg/animation
- Everything you need to know
  - Syllabus
  - Projects
  - Assignments
  - Schedules
  - Reading List
  - Diary
  - Top 10

Logistics

- Course Web Site:
  - http://www.cs.rit.edu/~jmg/animation
- Contact:
  - office hours: MWR 3-4 (or by appt)
  - Office: 70 (GCCIS) Rm 3527
  - e-mail: jmg@cs.rit.edu
  - phone: 475-2051
- Slides:
  - Will be available (in B&W – PDF) on Web site.

Logistics

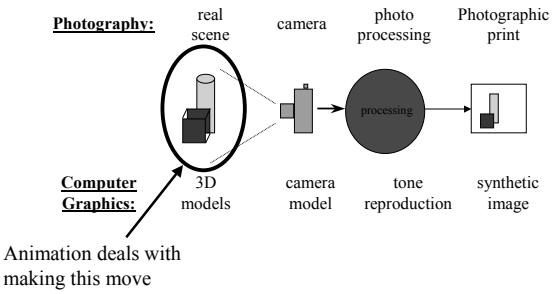
- The LDAP database
  - Be sure that your e-mail is correct.
- myCourses
  - Links to readings
  - File dropoff

Logistics

- Textbooks
  - Computer Animation: Algorithms and Techniques by Parent
  - Physics for Game Developers by Bourg
  - Selected papers from CG literature
- Supplement lectures
  - Not necessary, but nice to have as references.

What is this course about?

Remember this from CGII?



Definition of animation

an·i·ma·tion (n)

a motion picture made from a series of drawings simulating motion by means of slight progressive changes in the drawings

Early Animation

- The Zoetrope

Simple Animation

- The flip book

What is this course about?

- Techniques and algorithms for making items in our 3D world move.
  - Apply these algorithms by implementing them in code
  - Prerequisites:
    - CGII / 2D Graphics Programming
    - Essentially: Proficiency in a 3D API.

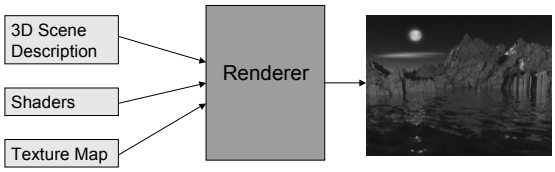
What this course is not!

- A course on how to use Maya, 3DSM, or SoftImage to make animations
  - Instead, the course will cover the algorithms and technique you would need to know to *build* a tool like Maya, 3DSM, or SoftImage

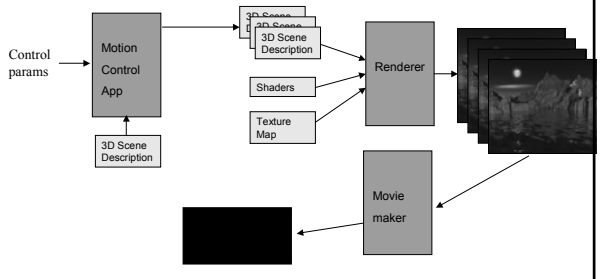
Animation

- Animation frames
  - The result of animation is a series of still images assembled together in time to give the appearance of motion.
- Real-time vs Batch

Programming Animation -- Batch



Programming Animation -- Batch



Projects – Renderers

- Renderman
  - Created by Pixar…Used in Pixar films.
  - BMRT – Ray tracer / radiosity renderer that adheres to the Renderman Standard
    - Available for UNIX, Windows, SGI
    - Unavailable as of Summer 2002…but…
  - Aqsis
    - Open Source Renderman renderer
    - Runs under Windows and Mac OS X.
  - References
    - The Renderman Companion by Upstill
    - Advanced Renderman by Apodaca/Gritz

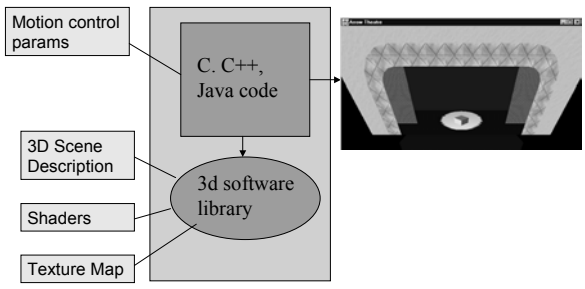
Projects – Renderers

- Persistance of Vision (POV)
  - Freeware Ray-Tracer
  - Available for most platforms (even Amiga!)

Projects – Renderers

- Radiance
  - "a suite of programs for the analysis and visualization of lighting in design."
  - Physically-based
  - Emphasizes accuracy
  - Available on UNIX platforms
  - Reference
    - Rendering With Radiance by Ward Larson/Shakespeare

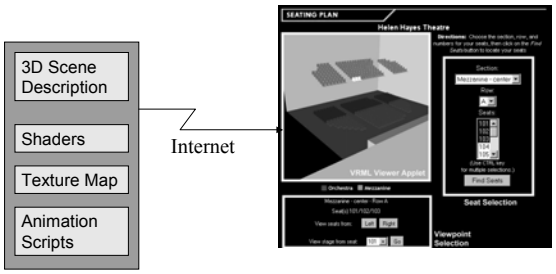
Programming Animation -- Realtime



Projects – Application

- 3D APIs
  - OpenGL
    - Standard – available for most platforms
    - Computer Graphics Using OpenGL, Hill
  - Java3D
    - For Java
    - The Java 3D API Specification, Sowizral, et al.
  - GL4Java
    - OpenGL wrappers in Java
    - http://www.jausoft.com/gl4java.html
  - DirectX / Direct 3D
    - For Microsoft Platforms
    - Any favorite references?

Programming Animation -- Web



Projects – Web Based

- Several proprietary formats
  - Viewpoint, MM Shockwave, Abobe Atmosphere
- VRML
  - ISO Standard for Web Based 3D Worlds
  - Latest incarnation is X3D
- Reference
  - The Annotated VRML 2.0 Reference Manual by Carey / Bell

Goals of course

- The range of Computer Animation is broad:
  - Can't cover everything in 10 weeks.
  - Topics:
    - Some we will cover in depth
      - Know well enough to code
    - Some we will cover broadly
      - Know where to look for more info
    - Some we won't get to at all.
      - Perhaps Computer Animation – Part II?

Topics

- In depth
  - Keyframing / Interpolation
  - Rigid Body Dynamics
  - Motion of Articulated Figures
    - Forward Kinematics
    - Inverse Kinematics
    - Walking
  - Behavioral Motion
    - Flocking

Topics

- Broad topics
  - Advanced character animation
    - Use of genetic algorithms
    - Procedural Gesturing
    - Levels of Control
    - Motion Capture
- Particle Systems
- Facial Animation
- Animation and Sound

Topics

- Interesting topics we won't get to:
  - Good fodder for projects
    - Automatic Camera Control
    - Animated Lighting
    - Animation of Natural Phenomenon (Fire, Smoke, Plants)
    - Animating surfaces
    - Soft objects
    - Cloth Animation
    - Hair and Fur
  - Questions so far?

Goals of course

- Ulterior motive
  - Appreciation for the "classic" computer animated shorts
  - Start each class with an animation.
  - Jogle Top 10
    - The best classic animated shorts shown at SIGGRAPH
    - IMHO.
- Questions?

Grading

- Assignments
- Projects
- Reading of CG Literature (graduate only)

Grading

	Graduate	Undergrad
Assignments	35%	40%
Project	50%	60%
Readings	15%	Extra Credit

Assignments

- 4 Programming Assignments:
  - Corresponds to in-depth topics
    - Assn 1: Keyframing
    - Assn 2: Rigid Body Dynamics
      - A Night at the Pool Hall
    - Assn 3: Walking
      - A Walk in the Park
    - Assn 4: Flocking
      - Animation is for the boids
- Must do Assn #1. Choose 2 of the 3 remaining assignments

Assignments

- Ground rules
  - Can be realtime or batch (or Web based…beware!)
  - Can use the language / toolkit / API of your choice
    - OpenGL
    - DirectX
    - Java3D / Java2D / JAI
    - VRML / Web3D
  - Can use the Renderer of your choice
    - POV-Ray
    - Renderman (BMRT, aquis)
    - Radiance

Assignments

- Ground rules (cont'd)
  - Can work in groups of 2 (but not required)
    - Each team member will receive the same grade
  - Code should readable
    - Well documented
    - Use style guidelines of CS2/3/4
  - Deliverables
    - Code
    - User documentation
      - Tell me how to run and use your program

Assignments

- Grading
  - Each assignment is worth 20 points:
    - 5 points – for something that compiles
    - 10 points – for something that runs incorrectly
    - 15 points – for something that runs correctly
    - 20 points – something that runs + extras
      - Additional bells and whistles
      - Defined for each assignment

Assignment

- Posting Dates:
  - Keyframing: March 24th
  - Rigid Body Dynamics: April 7th
  - Walking: April 16th
  - Flocking: April 21st

Assignments

- Due Dates
  - Keyframing: April 9th
  - Rigid Body Dynamics: April 23rd
  - Walking: May 7th
  - Flocking: May 14th
- Late deliverables penalized 25% per week (unless otherwise arranged)
  - One week grace period.
- Questions?

Reading of CG Literature

- Grad only
  - Undergrads encouraged but not required.
- To familiarize yourself with the animation literature
- Each lecture will have a list of papers associated with it.
  - Papers electronically available via myCourses
  - Listed in READING LIST section of Web site

Reading of CG Literature

- Each class:
  - Choose 1 paper from list and summarize
  - Summary
    - 1-2 pages
    - Basic idea presented in the paper
    - Personal critique
      - Was the paper well written / understandable
      - Did you care for the topic presented
      - Did you like the work as a whole
      - Other comments

Reading of CG Literature

- Summaries
  - Due at the start of each lecture
  - No late submissions, please!
  - Grading
    - √
    - √+
    - √-

Reading of CG Literature

- Have a favorite related CG paper not on the list? Let me know.
- Acceptable sources
  - SIGGRAPH Proceedings
  - Communications of the ACM
  - ACM Transactions on Graphics
  - IEEE Computer Graphics & Applications.
  - Others? See me first.

Reading of CG Literature

- Questions so far
- Break before discussing projects?

Relics from my attic

- The year was 1991
  - My state of the art desktop PC was:
    - 60MHz w/Intel 386 processor
    - Whopping 40M hard drive
    - The latest operating system: DOS 4.0
    - And…
  - I took a course in Computer Animation!

Projects

- Purpose of the project
  - Hands on experience with programming computer animation
  - Study an area of computer animation, in depth

Projects

- Option 1:
  - Implementation of an animation algorithm or technique.
    - Implementation of an algorithm described in a research paper
    - Application of a techniques to a particular domain
  - Must involve programming
    - Batch – Final result of project is a single animation. (Using a renderer such as POV or Radiance).
    - Real-time – Use a 3D API to create an application involving a 3D scene
    - Web based – Use a Web based 3D scene description mechanism (e.g. VRML) to allow for viewing/interaction with a 3D scene using the Web

Projects

- About using an Animation package
  - E.g. Maya, 3DS Max, etc.
  - Ground rules:
    - Okay for modeling
    - Not okay for animation
- Projects will be graded on how well they demonstrate the programming of an animation technique.
  - CS not art.
  - Functionality over production value

Projects

- Option 2:
  - Survey Paper
    - In-depth study into an area of animation
    - Survey the state of the art via summary of journal/conference papers.
    - At least 10 pages
    - Suggested for those planning to do Graduate study in the field of animation

Project

- Project Web site
  - Each project will have it's own Web site.
  - Encourage and enable others to see what you are doing.
  - Web site must be "set up" by mid-quarter report.
  - Content
    - Up to you.
    - Suggestions
      - Description
      - Progress
      - Your app / animation
      - Final report

Projects

- Group projects
  - Accepted and encouraged.
  - Max: 3 members/group
  - Work must reflect number of members in a group
  - All team members will share the same grade for a project.
  - Proposals for group projects must include responsibilities of each group member.

Projects

- Helpful hints
  - Pick a topic that really interests you.
  - Extension of CGII project okay.
  - Choose a renderer/API that you really would like some experience with.
  - This is more than a project, it is an opportunity.
  - Be creative!
  - Have fun!

Projects

- Deliverables
  - Proposal – Due March 24th
  - Mid-Quarter Update (with Web site URL) – Due April 21st
  - Final Report – Due May 12th
  - Code – Due date of presentation
  - Presentation / Demonstration
    - Peer evaluations/ last 4 class periods
  - Team member evaluations
- Late deliverables penalized 25% per week (unless otherwise arranged)

Projects

- Proposal
  - Description of project
  - Work Plan
  - Responsibilities of group members
  - Demo/Presentation plans
- Proposals will be individually approved via e-mail.
- Need help? Just ask!

Projects

- Mid-Quarter Update
  - 1-2 page status report of progress
    - On track / behind / ahead
    - Too-much work?
  - Preliminary results (if any)
  - Last chance to change the scope of the project
  - URL of Web site

Projects

- Report / Documentation
  - Description of project
    - What techniques the project is set out to illustrate
    - Goals of the project
  - Approach Taken
    - In general -- How you went about solving the problem
    - Algorithms / techniques used (with references)
  - Implementation Details
    - High level system architecture (if application)

Projects

- Report / Documentation
  - Results
    - Animation (MPEG, AVI) if batch
    - User documentation (if real-time)
  - Future Enhancements
    - If I were to continue with this, what would you tackle next?

Projects

- Demo / Presentation
  - Show off your system and/or animation
  - Oral summary of your report
    - Use visuals (Powerpoint, HTML, PDFs)
  - Peer evaluations
  - Timing / dates TBD

Projects

- Team member evaluations
  - If you are a member of a team
  - Evaluate your team members

Projects

- Grading
  - Project worth 100 points
    - Proposal – 15 points
    - Mid-quarter Update – 10 points
    - Final Report – 20 points
    - Code – 30 points
    - Demo / Presentation – 25 points
    - Team member evaluations – bonus points

Projects

- So you're looking for project ideas…

Project Ideas

- Marla Schwepe
  - Visualization Studies – School of Imaging Arts & Science
  - mkspph@ritvax.isc.rit.edu
  - Interests:
    - Sign Language System
    - Graphics + Performance
  - Possible projects
    - Compositing of 3D with video footage
    - Scene manipulation from motion
      - Flock of birds – talk to Chris!

Project Ideas

- Andy Phelps
  - Information Technology
  - amp@it.rit.edu
  - http://andysgi.rit.edu/
  - Interests:
    - Gaming
    - Real time graphics

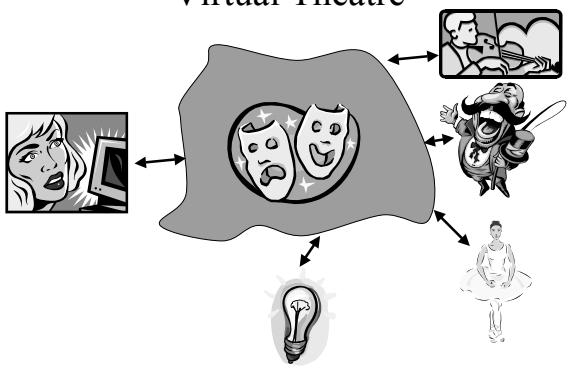
Project Ideas

- Susan Lakin
  - Photography -- **School of Photographic Arts and Sciences**
  - **srlpph@rit.edu**
  - **Interests**
    - **Photography + Computers**
    - **Digital Photography**
    - **Animated Portraits**
  - **Possible project**
    - **Image Manipulator**
    - **Will be here next week to talk about her interests**

My own personal interest

- My ultimate pipe-dream:
  - Virtual Theatre
    - A distributed computer system whereby performers, stage crew, and audience can be in physically separate places yet share in the same live theatrical performance.

Virtual Theatre



Virtual Theatre

- Possible projects:
  - Directing
    - Distributed actor control
    - High level actor direction (w/AI perhaps)
  - Real time realistic image synthesis
    - Perhaps using gaming technologies
  - Staging
    - Animated lighting effects
    - Animated stage effects (e.g. fog, rain, etc).
    - Synchronized sound effects.
  - Collaborative Virtual Environments

For next time

- Be sure that your e-mail in LDAP is correct.

For next time

- How animation is done in the real "Hollywood" world.
- Think about your projects…Proposals are due before you know it.

Oh, by the way

- In case you're wondering

Remember

- Class Web Site:
  - http://www.cs.rit.edu/~jmg/animation
- Any questions?