

Drawing: Jay Forrester

# Simulation for Games

Simulation for Games (CMPS179, section 1)

*Instructor:* Chaim Gingold. cgingold@soe.ucsc.edu

*When:* Tuesday & Thursday, 2-3:45pm.

*Room:* J Baskin Engr 165

*Office Hours:* Wednesdays from 1-2pm, in E2, room 393. And by appointment: send me an email if you can't make this time. If you are planning on dropping into regular office hours, you might want to send me an email in advance so I can be more ready.

This class explores the vast representational power of the computer. Computers can be used to do so much more than simulating projectiles and manufactured landscapes—they are unlike any other medium in their ability to make playable complex systems about everything from ant colonies to cities, traffic jams, budgets, and geopolitics.

We will cover a spectrum of simulation approaches, from stock/flow systems to cellular automata, networks, physics, and agents. Lectures will introduce prototyping, visual design communication, and then go deep into the simulation topics by looking in detail at particular computer games, their design history, and source code (where possible), with a particular emphasis on SimCity. Readings and game playing will be assigned as appropriate.

This is a studio based course. Students will be expected to produce a working prototype for each topic covered in class in addition to a final project. The final project is an interactive simulation for Wikipedia, where students will pick and research a topic, develop a simulation, and incorporate it into a mock Wikipedia page. You need to be able to program to take this class, and should feel comfortable teaching yourself JavaScript (if you don't already know it) as we go.

Students will be expected to keep up with assigned readings, participate in class discussions and activities, produce prototypes, a final project, and have lots of fun stretching their brains and building cool new toys! This course should be a great precursor to 170, as you will expand your game design/coding vocabulary with simulation techniques, learn how to prototype efficiently, and visually articulate interactive design ideas.

## Projects & Assignments

All projects will be done in JavaScript/HTML5. We won't be covering JS programming or web development in class. Experienced programmers (everyone in the class) will be able to teach themselves these tools as we go. For assignments, students will be expected to turn in prototypes and one page design documents in to our version control system, and email a link to a web server where we can play a published build of the demo. The web page should explain the prototype on it, and link to (or embed) the design document, code snippets, research sources—as appropriate.

Assignments are due midnight the day before they are reviewed. (eg, A project due Tuesday is due Monday at midnight; A one page design document due Thursday is due Wednesday at midnight.) Students are encouraged to find an appropriate host for hosting their work, like DropBox or their SOE home page. For development, DropBox & SOE are fine, and one can also host locally, on their own machine. We will be using the paper.js canvas API in class as a graphics framework. Students wishing to use another framework need instructor approval. One page design documents should be submitted in .pdf format.

Prototypes will be done on a weekly basis, and employ concepts from the simulation techniques covered in for that week. Each prototype is assigned on a Tuesday. Its one page design document is due Wednesday at midnight, and the prototype is due Monday at midnight. We then start the process over. The last two weeks will be spent on the final project. The prototypes and final project will be discussed more in class.

## Readings & Playings

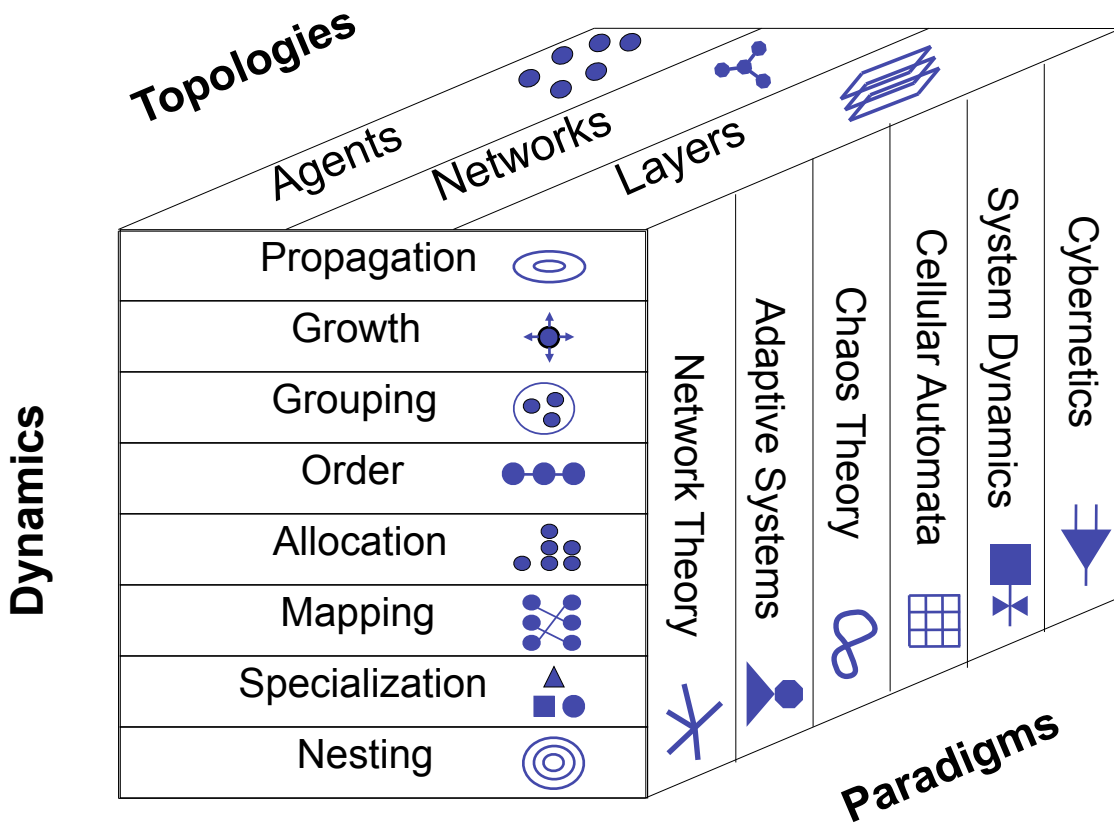
All required readings will be provided in one form or another (digital handouts or web links). For playing games, many links will be provided, but sometimes (rarely) students will be on their own, and need to find a playable version of a game. I've tried to minimize this, and picked easy to access games.

# Grading

Students will complete eight prototypes, with accompanying one page design documents. There is also a final project. Students are expected to keep up with required readings and playings for class discussion. Grades will be based upon:

- 10% class participation (discussion of readings, projects, and participation in activities; attendance).
- 20% final project
- 70% weekly prototypes (includes one page design documents; eight prototypes means 8.75% per prototype)

Diagram: Will Wright,  
*Dynamics for Designers*



# Schedule

## *Tue, Apr 2 — Introduction*

Read for today:

- Murray, *Inventing the Medium*. (selections; .pdf provided).
- Crawford, *Art of Computer Game Design*. (preface and chapter 1, p1-15).

Begin Prototype 1: Reactive Drawing Tool

Review class syllabus, policy, assignments, and reading.

Who are we? Introductions.

Discuss tools: JavaScript, paper.js, web hosting.

Lecture: Hello, Simulation.

- Computers as an Expressive Medium
- Living with Complexity (Janet, Licklider, & Engelbart)
- Feeling is knowing ('54 Rand paper, Lick, Papert, Tabrizi, Engelbart)
- Analog Simulation
- Rhetoric of Simulation
- Basic Design Considerations
  - Boundaries
- Dynamics for Designers (Wright & modes of simulation)
  - Mass parallelism (CA's, agents, ...)
  - Mass iteration (use history of Geology, Evolution, & Sea Shells; Blind Watchmaker: design v. emergence)
- Discuss first project.
- One page design docs (show my Mario/Wario Ware one; Stone).

## *Thu, Apr 4*

Review One Page Designs (due Wed at midnight)

Read for today:

- Rouse, R. "Interview: Will Wright." In *Game Design Theory and Practice*. (p408-448). <http://gamifique.files.wordpress.com/2011/11/5-game-design-theory-and-practice.pdf>

Play for today: SimCity

- Micropolis (PC, Mac, Linux) — open source SimCity <http://sourceforge.net/projects/micropolis.mirror/>
- (or) SimCity (or) SimCity 2000, on Mac Classic, DOS, SNES, & DS.

Lecture: SimCity & More

- History of SimCity
- Architecture of SimCity
- Simulation loops and time slicing
- Look at code for SimCity
- Research for simulation
- Intro to Prototyping



- Conway's Game of Life. <http://pmav.eu/stuff/javascript-game-of-life-v3.1.1/>

Begin Prototype 3: Cellular Automata

Activity: Go & the capture game.

Lecture: Self-replicating robots

- Self-replicating robots—fictional scenario (is there a RAND something or other moon scenario to work with here?)
- Conway's Game of Life
- von Neumann's self-reproducing automata
- Programming CA's 101
  - 1d, 2d, 3d
  - double buffering
  - boundary conditions
  - dx/dy
  - layering
  - map operations (smoothing, eg).
- Simulating the universe: Zuse, Turing, & Wolfram.

Thu, Apr 18

Review One Page Designs (due Wed at midnight)

Play for today:

- Powder Game Viewer <http://dan-ball.jp/en/m/dustviewer/> (iOS, Android, Kindle)   
<http://dan-ball.jp/en/javagame/dust/> (Java)
- OR, The Sandbox (iOS) <http://www.bulkypix.com/game/the-sandbox>

Lecture: SimCity's CA's

- Garden of Eden configuration (use Go as example).
- Procedural Space Generation (recursive subdivision; what does SimCity use?)
- Pollution
- Traffic
- Dynamics
  - Turing, Morphogenesis (?)
  - Diffusion
  - Reaction

Tue, Apr 23 — Networks

Review Prototype 3 (due Mon at midnight)

Read for today:

- Alexander, et. al. *A Pattern Language*. Selections: (+44 to get .pdf relative page numbers). [http://library.uniteddiversity.coop/Ecological\\_Building/A\\_Pattern\\_Language.pdf](http://library.uniteddiversity.coop/Ecological_Building/A_Pattern_Language.pdf)
  - Summary of the Language (xviii-xxxiv);
  - Independent Regions (10-14)
  - Interchange (183-186)



- approximations
- Springs
- Proper solvers
- Fluids with particles

Thu, May 2

Review One Page Designs (due Wed at midnight)

Lecture: Creative Physics

- Physics & Form
  - Shadow of the Colossus
  - Illusion of Life
  - Simulating squash and stretch
  - Animation Curves
- Non-kinematic physics (!)
  - Tectonics
  - Ice
  - Electricity

Tue, May 7 — Agents 1

Review Prototype 5 (due Mon at midnight)

Read for today:

- Braitenberg, Vehicles. (p1-28) <http://www.psych.ucsb.edu/~beall/vehicles.pdf>

Play for today:

- [Ms.] Pac-Man (original arcade game)

Begin Prototype 6: Agents

Show Film Clip: Baraka

Lecture: Particles, Flocks, & Ants

- Particles
- Flocking
- Godzilla (SimCity)
- Pac-Man
- SimAnt
- Guest Lecture: Particles (?)

Thu, May 9

Read for today:

- Resnick, Turtles, Termites, and Traffic Jams. (selection TBD).

Review One Page Designs (due Wed at midnight)

Lecture: Self-Organizing Agents

- Discuss Resnick selection.
- Ants
- Termites



- Slime Mold

## Tue, May 14 — Agents 2

Review Prototype 6 (due Mon at midnight)

Play for today:

- The Sims or The Sims 2. Multiple platforms. (Available at the library for Windows, and just about anywhere on anything).

Begin Prototype 7: Social Agents

Lecture: Characters

- Little Computer People
- Petz
- The Sims: Of Mice & Motives
  - History: Christopher Alexander
  - AI / UI / \$
- Guest Lecture: Prom Week (?)

Activity: Improv Game



free public a

Alexander, et. al.  
A Pattern Language

## Thu, May 16

Review One Page Designs (due Wed at midnight)

Lecture: Escaping Flatland

- Escaping Flatland (Tuft to Victor)
- Show: Eames math film
- Procedural graphics
  - Color
  - Waves & Animation

## Tue, May 21 — Layering

Review Prototype 7 (due Mon at midnight)

Read for today:

- Schneiderman, Direct Manipulation. (p57-68) (.pdf provided).

Play for today:

- Bill Budge's Pinball Construction Set (TBD)

Begin Prototype 8: Layering

Lecture: Composing Systems

- Discuss: Direct Manipulation.
- SimCity's layers
- Interaction Design
- Cross-cutting simulation, visualization, & interaction. (Use SimCity as an example).

## Thu, May 23

Review One Page Designs (due Wed at midnight)

Read for today:

- Turkle, Second Self. (Simulation, Games, & Holding Power: p78-85) [http://its.lnu.edu.ua/edocs1/new\\_doc/en/The%20Second%20Self%20-%20Computers%20and%20the%20Human%20Spirit.%2020th%20Anniversary%20Edition%20\(Turkle,%202005\).pdf](http://its.lnu.edu.ua/edocs1/new_doc/en/The%20Second%20Self%20-%20Computers%20and%20the%20Human%20Spirit.%2020th%20Anniversary%20Edition%20(Turkle,%202005).pdf)

Lecture: Touch & Feel

- Discuss Turkle
- Feel & Embodied Simulation
  - Embodied Simulation
  - iOS touch & feel

Tue, May 28 — Wikipedia

Review Prototype 8 (due Mon at midnight)

Read for today:

- “Kay, Alan. SimCity for OLPC.” (half page email). <http://www.donhopkins.com/drupal/node/134>
- Papert, Mindstorms. Foreword, and chapters 4-5. <http://www.arvindguptatoys.com/arvindgupta/mindstorms.pdf>

Begin Final Projects

Guest Lecture: Bret Victor on Interactive Explanations

Lecture: Discuss readings, projects.

- Discuss Kay’s DynaBook
- Discuss Papert, Kay.

Thu, May 30

Review One Page Designs (due Wed at midnight)

No Lecture. Project design presentations & discussion.

Tue, Jun 4

Review final project progress; in class demos.

Lecture: Weird genres

- Weird genres in history of games.
- Guest?

Thu, Jun 6

Review final project progress; in class demos.

Lecture: What is design?

- Eames, Alexander, & Simon.

Mon, Jun 10 (4-7pm) — Final Presentations

Final Projects due Tuesday at midnight

Final project presentation, playing, and review!