



welcome to

GAMELET DESIGN

for education

Objectives

- ◆ Game AI: Collaborative Diffusion
 - ◆ Advance from simple game to very sophisticated games
- ◆ Project: The Sims



game AI

◆ single Agent

- ◆ A-Life: agent acts intelligent: develops goals based on needs, pursues goals.
- ◆ path finding (e.g., A*):
 - ◆ artificial opponents finds ways through maze to get you
 - ◆ Sims: find refrigerator in house and food inside
- ◆ learning: artificial opponents learn about your behavior making game play progressively harder

◆ multi Agents

- ◆ flocking, emergence
- ◆ collaboration



challenges

◆ Computational:

- ◆ AI needs to “run” at 60 frames per second
- ◆ symbolic AI is (mostly) non-incremental

◆ Psychological:

- ◆ AI needs to “look” right
- ◆ often very simple, e.g., random, e.g. Mt. Vetro’s eyes





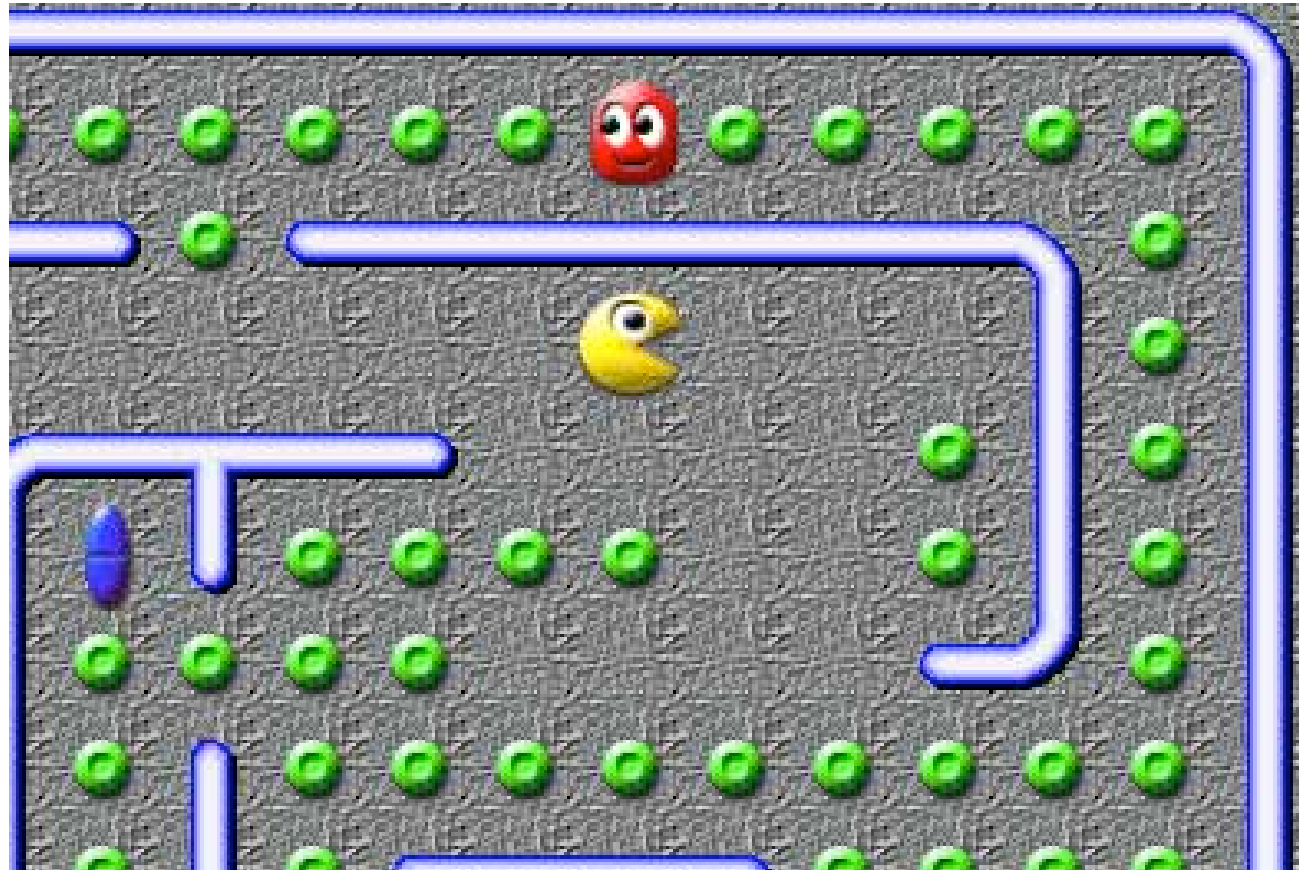
more pointers:

- ◆ good site: <http://www.gameai.com/>
- ◆ book: AI for Game Developers, David M. Bourg



Collaborative Diffusion

how to track Pacman?



Programming the computational background

- ◆ Break with the traditional approaches: Put computation where OOP or robotics would NOT put it
 - ◆ Not the object or agent embodying the main actor
 - ◆ Not the robot
- ◆ First step: embedding artifice – Simon:
 - ◆ “An ant, viewed as a behavior system, is quite simple. The apparent complexity of its behavior over time is largely a reflection of the complexity of the environment in which it finds itself.”
- ◆ Second step: put the computation into the environment

diffusion is a powerful idea

- ◆ An idea highly relevant to science AND game design
- ◆ Definition by Turing (1952): “each [chemical agent] moves from regions of greater to regions of less concentration.”
 - ◆ Turin programmed diffusion system on computer before he worked on Enigma: one of the first documented use of computers
- ◆ Physics: gas, heat and particle diffusion
- ◆ Biology: growth, morphogenesis
- ◆ Ecology: migration
- ◆ Artificial Intelligence: Collaborative Diffusion





Why use diffusion for AI?

- ◆ Allows the simple implementation of extremely sophisticated AI
- ◆ But requires:
 - ◆ Complete re-conceptualization of programming/computation
 - ◆ Powerful computers, e.g, CM2
 - ◆ No problem for modern PC
 - ◆ Can be executed on GPU

diffusion equation

$$u_{0,t+1} = u_{0,t} + D \sum_{i=1}^n (u_{i,t} - u_{0,t})$$

where:

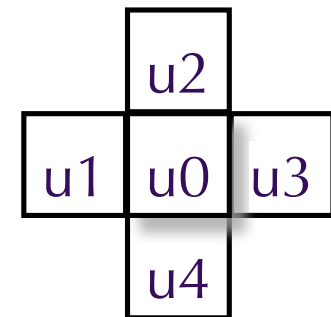
n = number of neighboring agents used as input for the diffusion equation

$u_{0,t}$ = diffusion value of center agent

$u_{i,t}$ = diffusion value of neighbor agent ($i > 0$)

D = diffusion coefficient [0..0.5]

Simple case ($D=1/4$): $u_0 := 0.25 * (u_1+u_2+u_3+u_4)$



Collaborative Diffusion demos

- ◆ Basic diffusion: control the speed of diffusion with the diffusion coefficient
- ◆ Hill Climbing: Mr Sim finds the refrigerator
- ◆ Collaboration by Goal Obfuscation: why do the ghosts collaborate with each other?
- ◆ Collaborative Diffusion: Soccer



characteristics

- ◆ Simple to Program: algorithms are computationally expensive but relatively simple to built and tweak.
- ◆ Ecological
 - ◆ traditional AI: AI in agent, e.g., robot
 - ◆ distributed AI: AI in agents \Rightarrow flocking...
 - ◆ ecological AI: AI everywhere: agents & environment
- ◆ Parallel: no chess-like turn taking
- ◆ Incremental: AI state is part of environment and continuously updated
- ◆ Robust: likely to work with situations not anticipated, e.g., soccer with n goals, m balls for $n, m \neq 2$





Homework # 4

The Sims

Description

Screen Shots: **The Sims**



Latest Shots | **All Shots**

You can choose to have your characters move around independently, or you can take control of every aspect of their lives--from using the toilet to eating and watching TV. Take snapshots of your family and upload them to the Web or download objects and people off the Web to enhance and spice up your game world.

The Sims, a virtual-life simulator from Maxis, provides computer users the opportunity to raise a virtual family. Originally intended as an architectural simulation, the game has grown over 4.5 years of development into something more like a soap opera. Design and decorate a house, fill it with stuff, and then let a family loose in it. By controlling and guiding the interactions of the family members with every aspect of their environment and the people around them, you get to totally manage their lives.

Publisher: **Electronic Arts**

Developer: **Maxis**

Release Date: **February 2000**

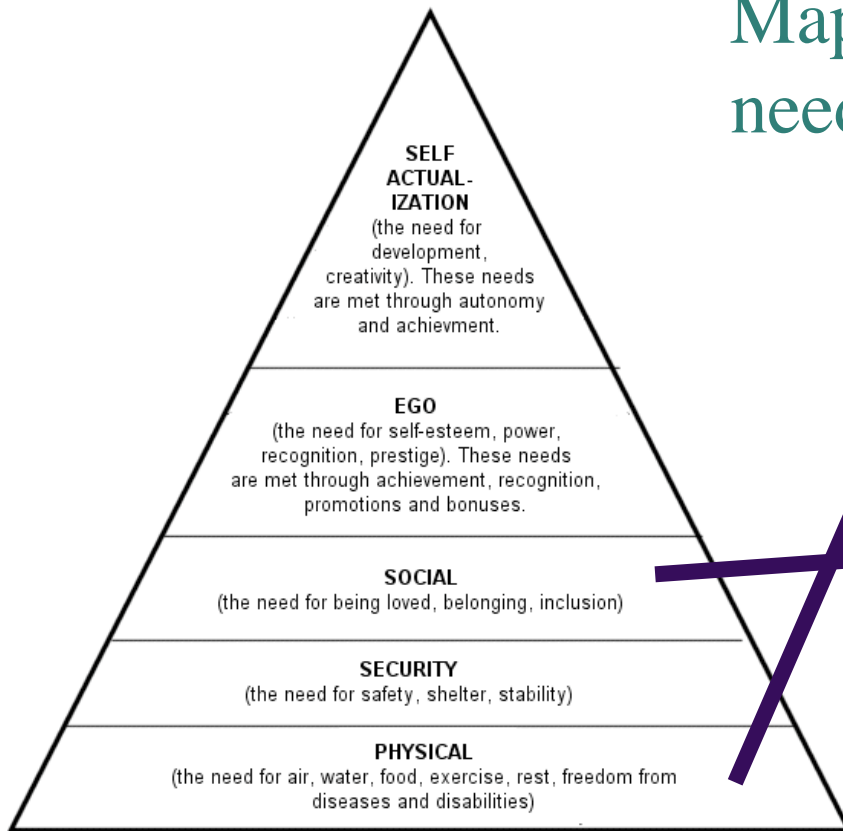
Homework

- ◆ Due: Feb 13: 11:59pm in GORP
- ◆ 100 points
 - ◆ At least two level of diffusions
 - ◆ Does not have to be a sims-like game, e.g, Tron, battlefield sim, heating simulation, fire escape,
- ◆ 20 extra
 - ◆ Educational ideas

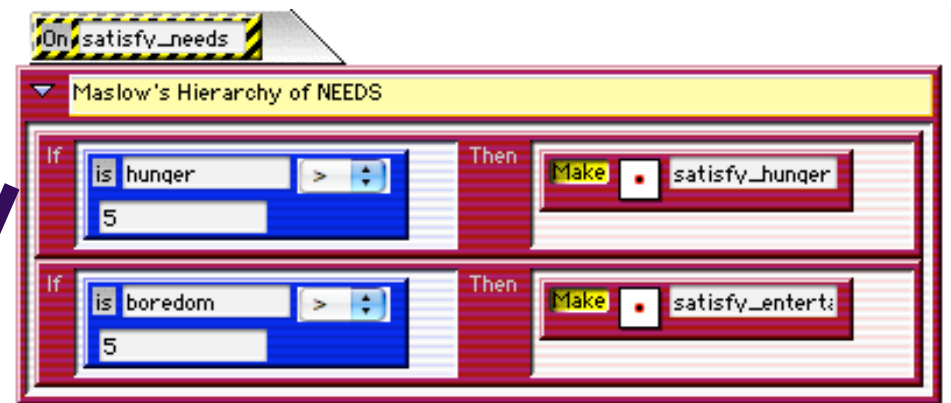


How to make a sim

Map Maslow's hierarchy of needs to rules



MASLOW'S HIERARCHY OF NEEDS



<http://en.wikipedia.org/wiki/Maslow>