Outline of Pac-Man Unit

Materials
One computer per student in computer lab or one laptop per student in regular class.
AgentSheets 3.0 program loaded on all machines.
Internet connectivity for each computer to access tutorials and upload final games
Pre- and post-survey links

Level 1 – Game with only random ghost behavior

Day 1: Game Design, Pac-Man Creation

- Share unit objective, end product requirements and grading rubric
- Optional: Have students play “Ultimate Pac-Man” as a lead-in activity
- Display Game description below and have students decide nouns/verbs and what agents/behaviors are necessary to make the game.

  The player guides the Pac-Man about the maze munching up the Dots in his path. Ghost Monsters - Inky, and Blinky - chase after the Pac-Man trying to capture and deflate him. The goal is to gobble up all the dots and escape the maze before being deflated.
  But what happens when the ghosts start using their sense of smell to track down Pac-Man? Things get even more challenging for Pac-Man. (Perhaps he shouldn’t use so much cologne!)

- Initially teacher to model each step rather than have students use the tutorial unassisted
- Create Pac-Man agent, rotate Pac-Man (4 views)
- Create a worksheet, fill in background color
- Pac-Man able to move in all four directions, and image of Pac-Man changes as he moves.

Day 2: Walls, Pellets & Random Ghosts

- Create wall and pellet agents
- Add walls and pellets to worksheet
  - Note that Pac-Man not moving now – must add to Pac-Man behavior to allow for walls and pellets
  - When Pac-Man moves he “eats” the pellets complete with munching sound
  - Make one new rule and then duplicate this rule for each direction (4 new rules total)
  - Test to make sure new rules work
- Create or import Ghost agents
- Add 3 ghosts to worksheet
  - Ghost behavior – random movement (Chance % [50]), slow ghost down (Once every [.2] seconds)
- Remind students not to spend too much time on artwork- can always modify the agents later

Day 3: The Ghosts deflate Pac-Man
• Goal – By the end of Day 3, students should have a playable game; ghosts with random behavior that deflate Pac-Man upon contact, Pac-Man can eat pellets.
• Create or import deflated Pac-Man agent
• Collision of ghosts and Pac-Man has two parts:
  1. Ghost Behavior - when ghost sees Pac-Man he sends message to Pac-Man to “deflate” himself
  2. Pac-Man Behavior – “deflate” method to change and disappear when receives message
• First test without adding the “deflate” method – notice error message “I am just a Pac-Man, I don’t know how to react to the message ‘deflate’”
• Then add method in Pac-Man agent to change into deflated Pac-Man icon and make a sound, then disappear, could display “You’ve been Deflated!” or some other message to indicate game over.
• Test to make sure all working
• Extension – regeneration of Pac-Man after deflated (optional instead of hitting reset button)

Level 2 – Game with “intelligent” ghosts

Day 4: Pac-Man Uses Cologne – Intro to Collaborative Diffusion
• Set the stage by spraying strong cologne or air freshener in one corner of the room while students watch and time how long it takes for the smell to reach those close by and those in the opposite corner. Talk about the strength of the smell close by and farther away.
• Activity: Lay out a grid on the floor and have people fill out the grid. Place a Pac-man and the people around him calculate their s value on a piece of paper.
• Link this to what students will be doing in Pac-Man today –
  o Explain the math behind the diffusion algorithm – roughly equivalent to the average of the four neighbors (s = scent)

    The 0.25 can be changed to change the rate of the smell spreading. This would be like how strong the cologne is or the conditions of the room – ventilation, high or low ceilings, etc.
    The initial scent for Pac-Man was set at 1000. This represents how much cologne he put on, which can also be changed.
  o This might be a great time to pair up with your content expert, team teach, guest teacher, have content teacher teach in own classroom if share same kids, etc.
**Day 5: Pac-Man Uses Cologne, Part 2 – Program Collaborative Diffusion**

- Add diffusion equation both to background and to pellets
- Set Pac-Man’s initial scent to 1000
- **NOTE:** Must erase and re-add Pac-Man in the worksheet so that the scent level is set (it only does this upon creation of a new agent)
- To visually check the level of scent currently in an agent, use tools > agent attributes. This brings up the Attribute Window. Click on different areas to see the amount of scent.

**Day 6: The Ghosts Get Smarter – Intro to Hill Climbing Algorithm**

- Yesterday Pac-Man started using cologne and stinking up the place, but the ghosts had no nose for it. Today this all changes… The ghosts become acquainted with their sense of smell!
- Show short video clip of artificial intelligence in action
- Add new rules to ghost behavior. Have ghosts move in the direction of greatest scent. Must slow down ghosts as well or they will give Pac-Man no chance!
- Have students compare the “winablity” of this version compared with the previous version where the ghosts where just randomly moving. Set this in the history of the game – Pac-Man’s ghosts just followed a certain pattern.
  - [http://www.youtube.com/watch?v=I33NJoq-Qks](http://www.youtube.com/watch?v=I33NJoq-Qks)
  - People could win this game blindfolded – literally! just by completing a memorized set of moves for Pac-Man.

Ms. Pac-Man made this much more challenging as her game came with ghosts with artificial intelligence!

Though some still could win this one blindfolded too:

I wonder how many times he had to shoot this video?!

**Day 7: The Ghosts Get Smarter, Part 2 – Program Hill Climbing Algorithm**

See tutorial
Final Assessment – each student uploads game to scalable game design arcade, can play each other’s games.

Extension activities: - link to other tutorials

• Make a winnable game:
  o Add counter agent to track number of pellets eaten, and
  o Add lives – begin with three and game over when third Pac-Man is deflated, and
  o Add power pellets and related behavior – reverse Hill Climbing Algorithm.

  o Or add doorway to escape maze

• Make the game more arcade authentic:
  o Make better looking walls – uses “run duplication” feature of AgentSheets
  o Add more advanced levels
  o Add special pellets (ex fruit) which are worth more points when gobbled