Higher-Level Behaviors

AI in videogames

5–10% of CPU for realtime
25–50% of CPU for turn-based

chase/escape behaviors
group behaviors
finite state machines
adaptation/learning
Questions to think about

has AI in games lived up to the hype?
how good should the AI be?
why are people more fun than NPC’s?
will networked games reduce AI?
new directions for AI in games?
Chase/Evade

algorithm for the predator?

predator (NPC)

prey
(user control)
Enhancements to Chase

Speed Control
velocity, acceleration max/min
limited turning radius

Randomness
moves patterns

Diagram:
- rand
- pattern selector
- Three different patterns
Enhancements to Chase

Anticipation
building a model of user’s behavior

predator

prey

gold
Group Behaviors

lots of background characters to create a feeling of motions, make area appear interesting
Pre-programmed Formations

too tidy? -- randomness
getting into formation

turning corners

obstacles
Flocking--HalfLife, Unreal

Centroid

$C = \sum \frac{p_i}{n}$

compute trajectory to head towards centroid

What might go wrong?
Desired Velocity = current velocity + $k_p$ (error in position) + $k_v$ (current velocity – nominal velocity)
Steering Behaviors

Craig Reynolds

pursue
evade
wander
obstacle avoidance
wall/path following
queuing

Combine behaviors with weights

What could go wrong?
What might go wrong?

exactly aligned
forces balance out
in dead end

does not handle changes in strategy
Perceptual Models

Circle of Obstacle Influence

Obstacle

Range of Visibility

React to $n$ Nearest within Range ($n = 5$)

Obstacle
Production Rules

if (enemy in sight) fire

if (big enemy in sight) run away

if (---) ---
if (---) ---

selecting among multiple rules
priority weighting for rules or sensor events
random selection

no state (in pure form)
Finite State Machines

States: action to take
- chase
- random walk
- eating

Transitions:
- time
- events
- completion of action
Problems with Finite State Machines

predictable—fuzzy, probabilistic

simplistic—hierarchies of fsm’s (HalfLife)
**Probabilistic State Machines**

**Personalities:**
change probability that character will perform a given action under certain conditions

<table>
<thead>
<tr>
<th></th>
<th>aggressive</th>
<th>passive</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attack</td>
<td>50%</td>
<td>5%</td>
</tr>
<tr>
<td>Evade</td>
<td>5%</td>
<td>60%</td>
</tr>
<tr>
<td>Random</td>
<td>10%</td>
<td>20%</td>
</tr>
<tr>
<td>Flock</td>
<td>20%</td>
<td>10%</td>
</tr>
<tr>
<td>Pattern</td>
<td>15%</td>
<td>5%</td>
</tr>
</tbody>
</table>

Modify probabilities on the fly?
Learning/Adaptation

For example, increment aggressiveness if player is doing well.

Levels are a pre–programmed version of adaptation.

Tuning

Stability

How might adaptation make play better (or worse)?
How might adaptation make play better (or worse)?

Do you want the monsters in Quake to get smarter as you get better?

Force user to live with the consequences of his/her actions

Can surprise the designer (Creatures)

Pit AI creatures against each other to find bugs or tune actions
Genetic Algorithms

Creatures
Cloak, Dagger, and DNA

DNA for rules governing strategy
record of performance
rules for mutation, cross-over

Use either for on-line tuning or as part of development cycle

Get players that are adapted to user’s style?
What is good AI?

perceived as challenging by the user but in a fair way

user surprised by the game but later understands why

feeling that reality will provide answers (able to make progress solving problem)

What games have used AI effectively?
The Future?

extensible AI
stronger personalities
combining AI with user actions
complementing user’s skills
more adaptation to the user

What else?