

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?

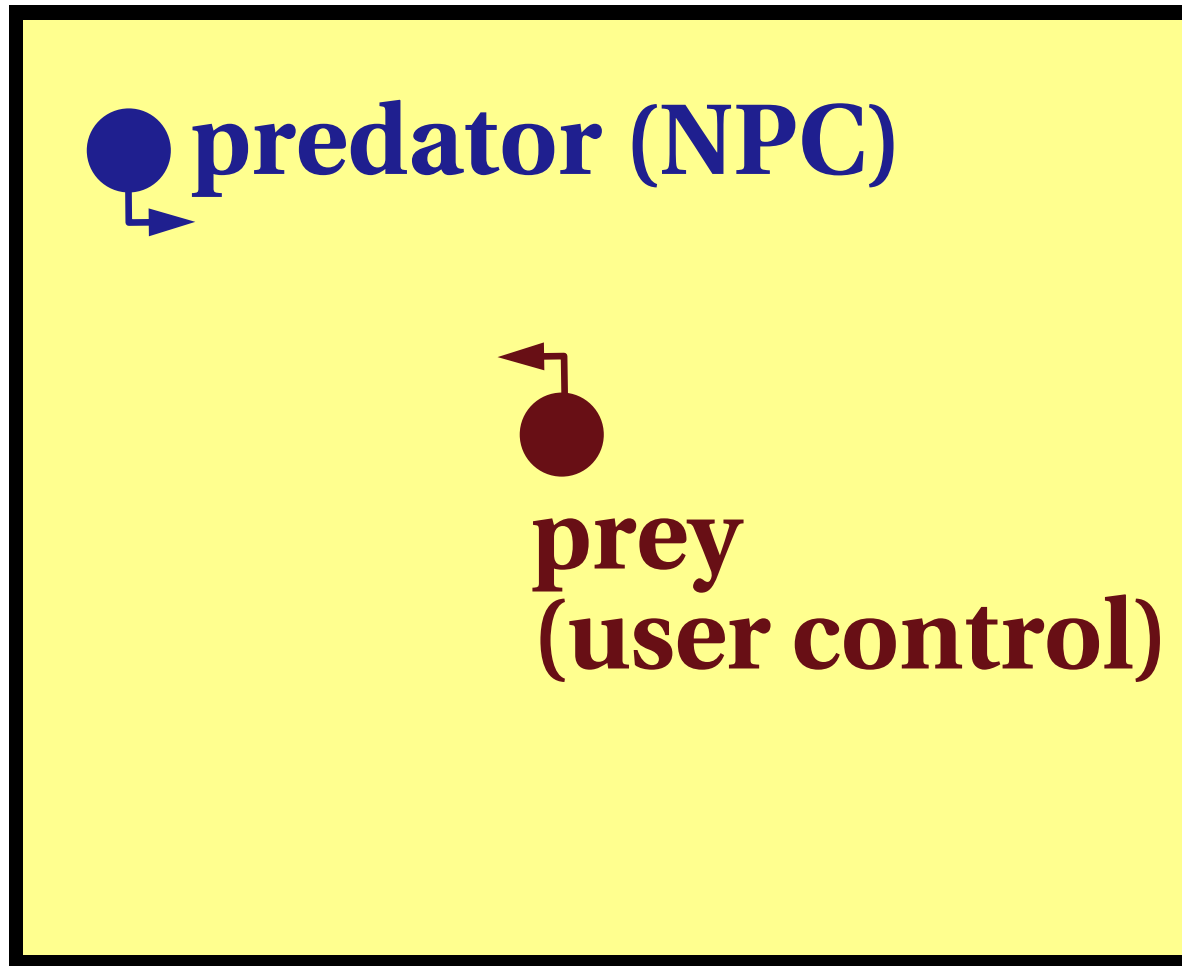
why are people more fun than NPC's?

will networked games reduce AI?

new directions for AI in games?

Chase/Evade

algorithm for the predator?



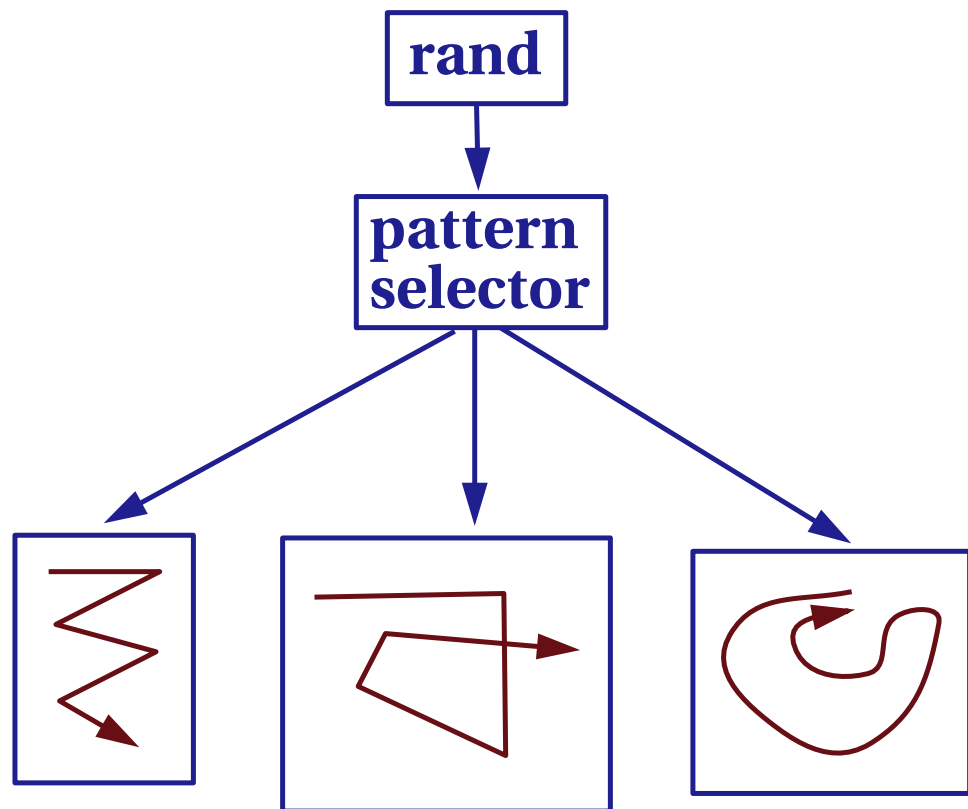
Enhancements to Chase

Speed Control

velocity, acceleration max/min
limited turning radius

Randomness

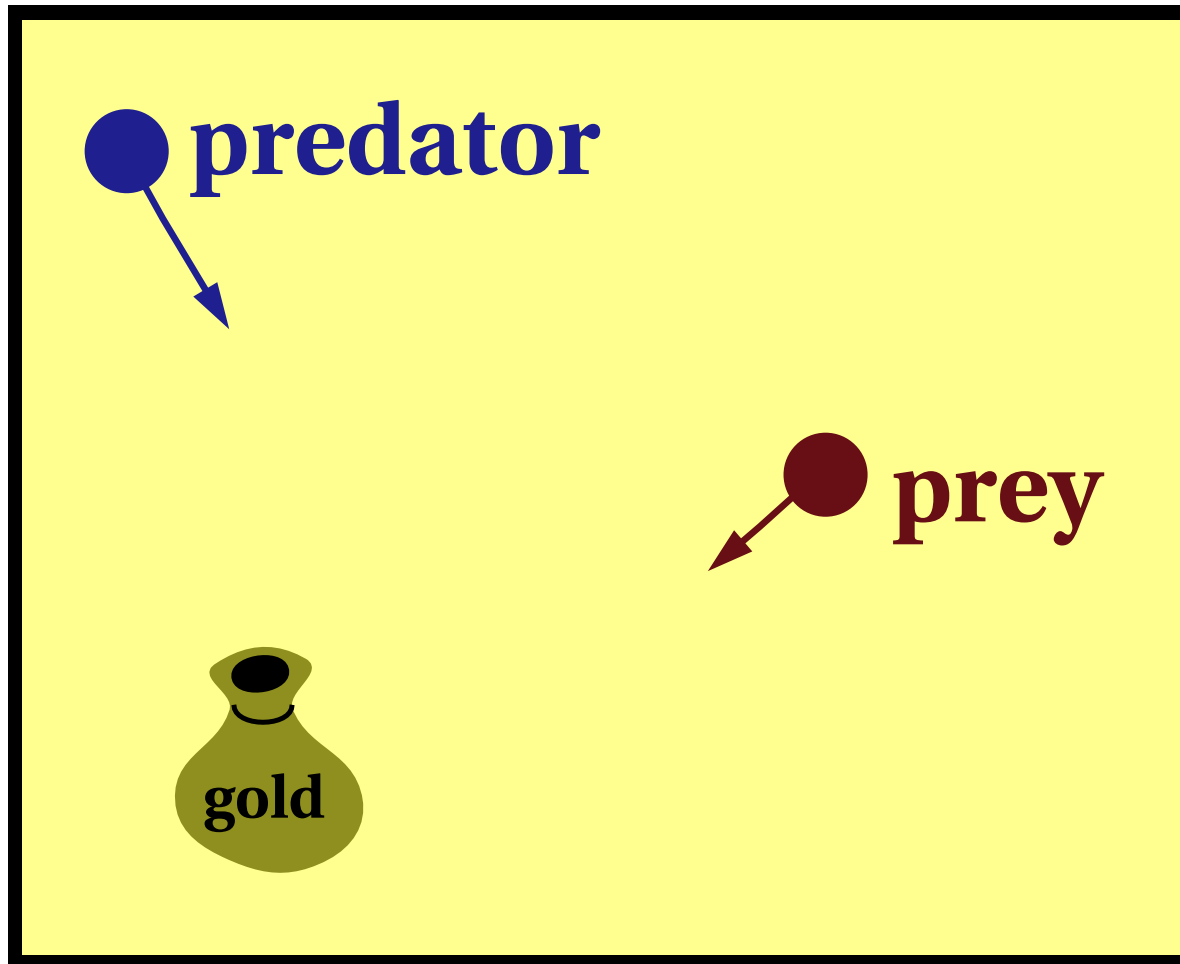
moves
patterns



Enhancements to Chase

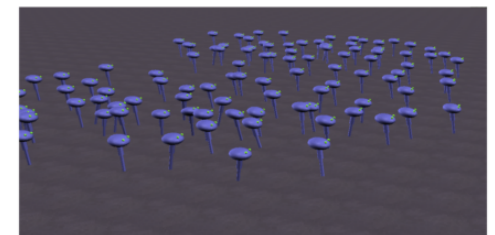
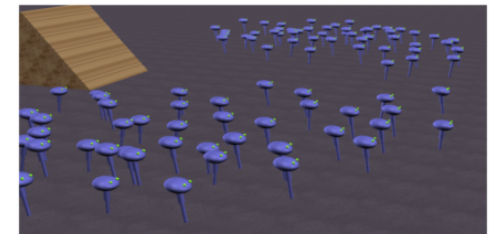
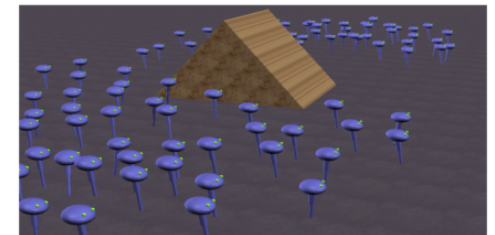
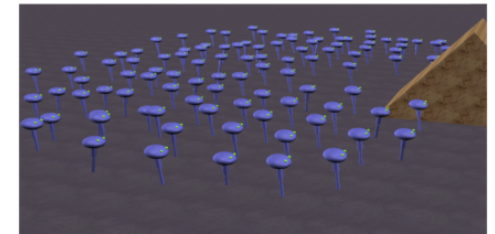
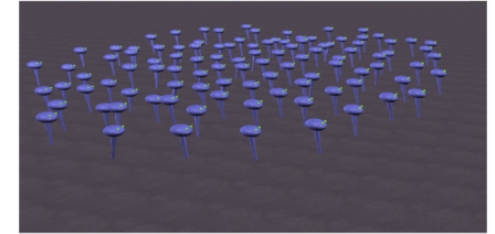
Anticipation

building a model of user's behavior

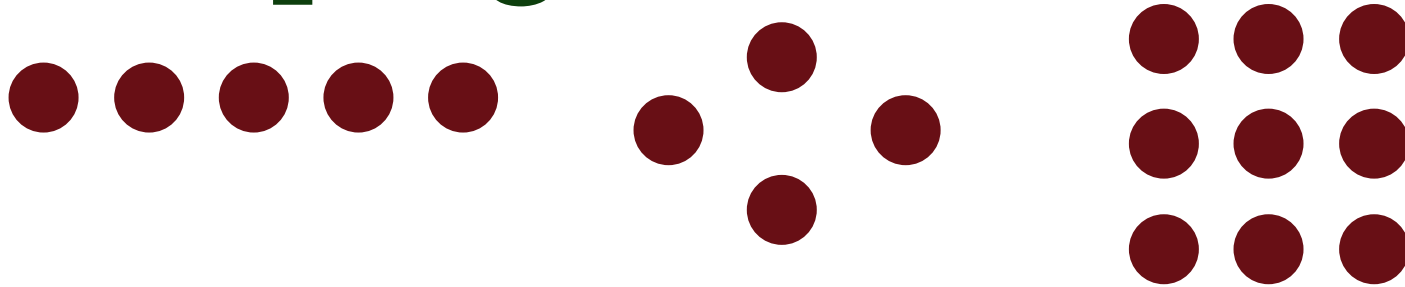


Group Behaviors

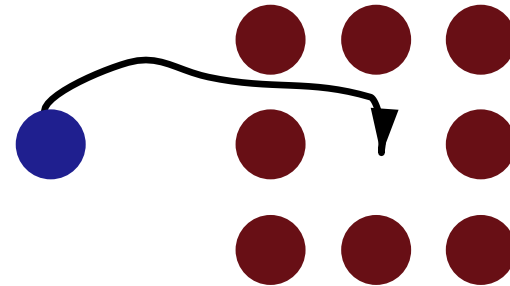
lots of background characters to create a feeling of motions, make area appear interesting



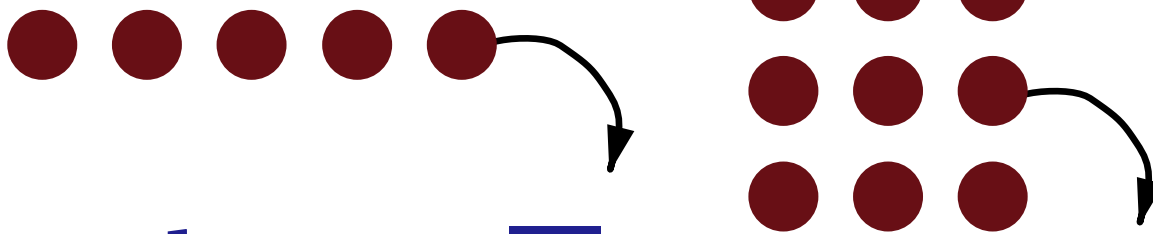
Pre-programmed Formations



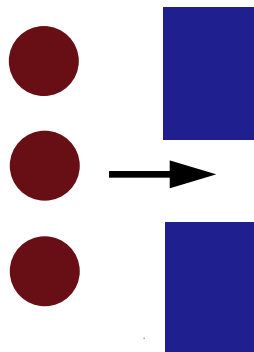
too tidy? -- randomness
getting into formation



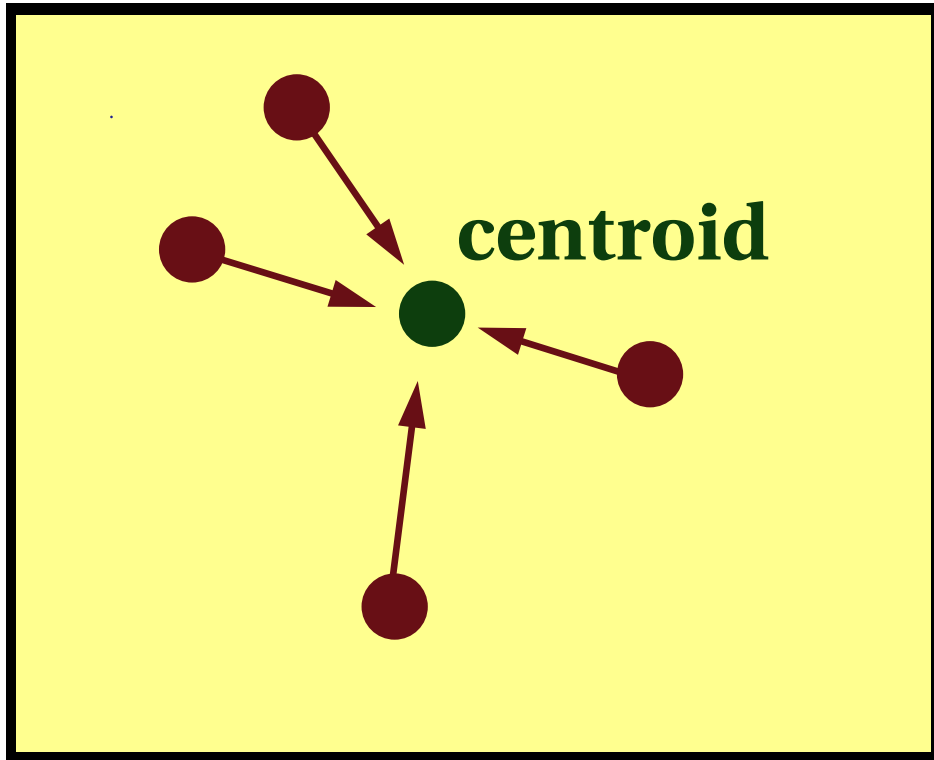
turning corners



obstacles



Flocking--HalfLife, Unreal



$$C = \Sigma p_i / n$$

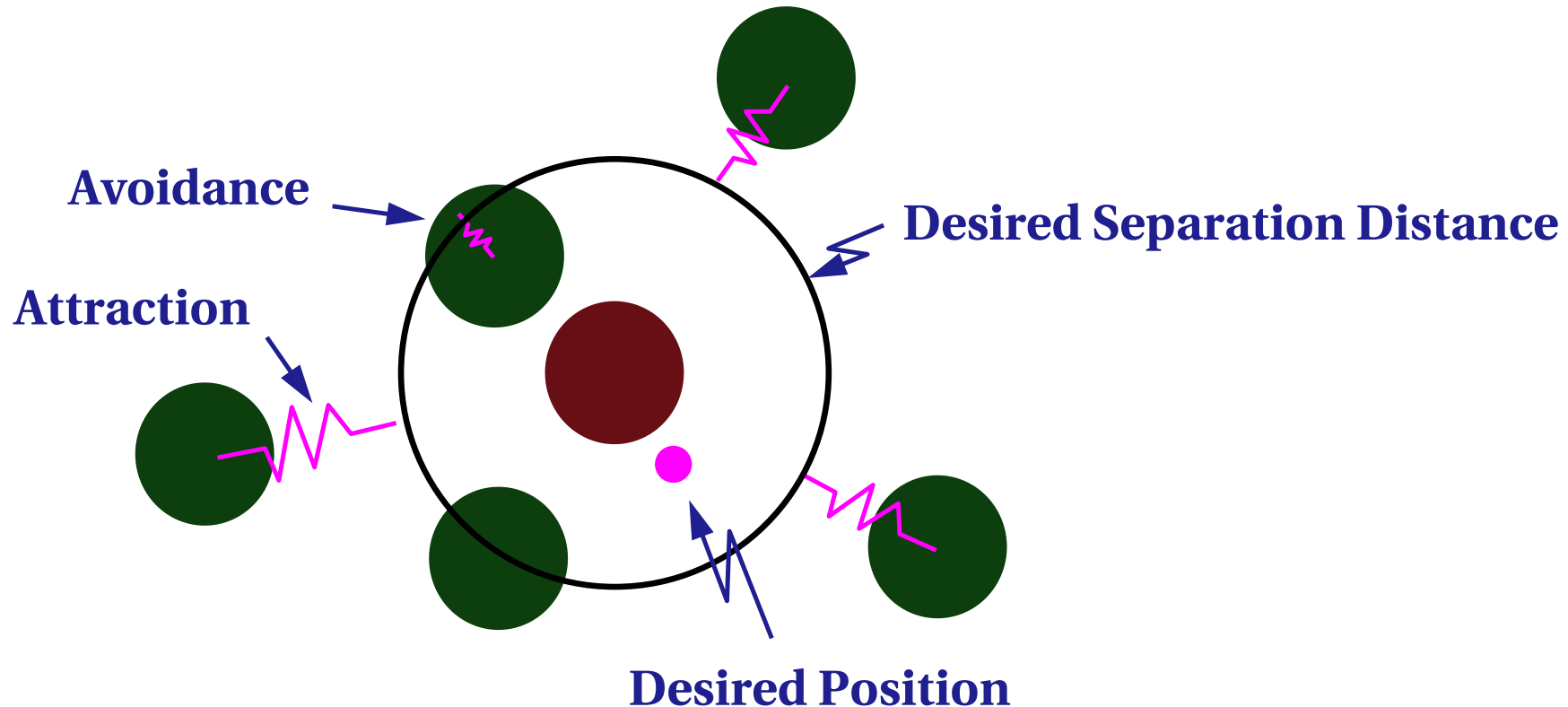
**compute trajectory
to head towards
centroid**

What might go wrong?

Group Behaviors

Craig Reynolds
SIGGRAPH 1987

Reaction to Neighbors



$$\begin{aligned} \text{Desired Velocity} = & \text{current velocity} + k_p(\text{error in position}) \\ & + k_v(\text{current velocity} - \text{nominal velocity}) \end{aligned}$$

Steering Behaviors

Craig Reynolds

pursue

evade

wander

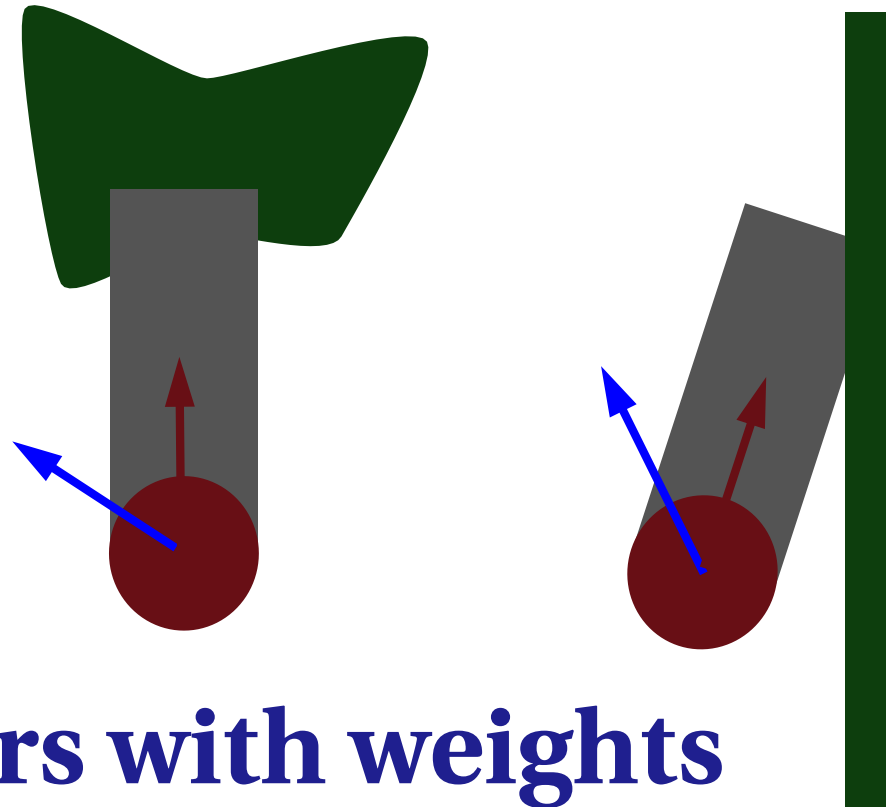
obstacle avoidance

wall/path following

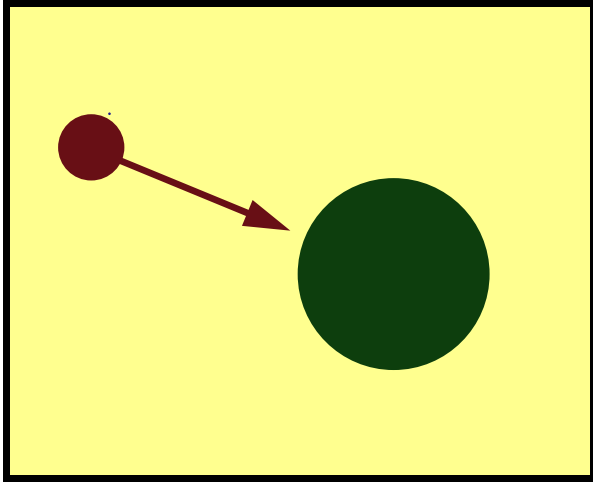
queuing

Combine behaviors with weights

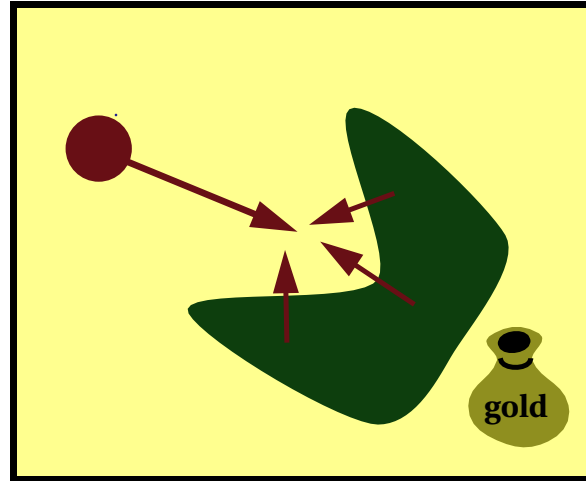
What could go wrong?



What might go wrong?



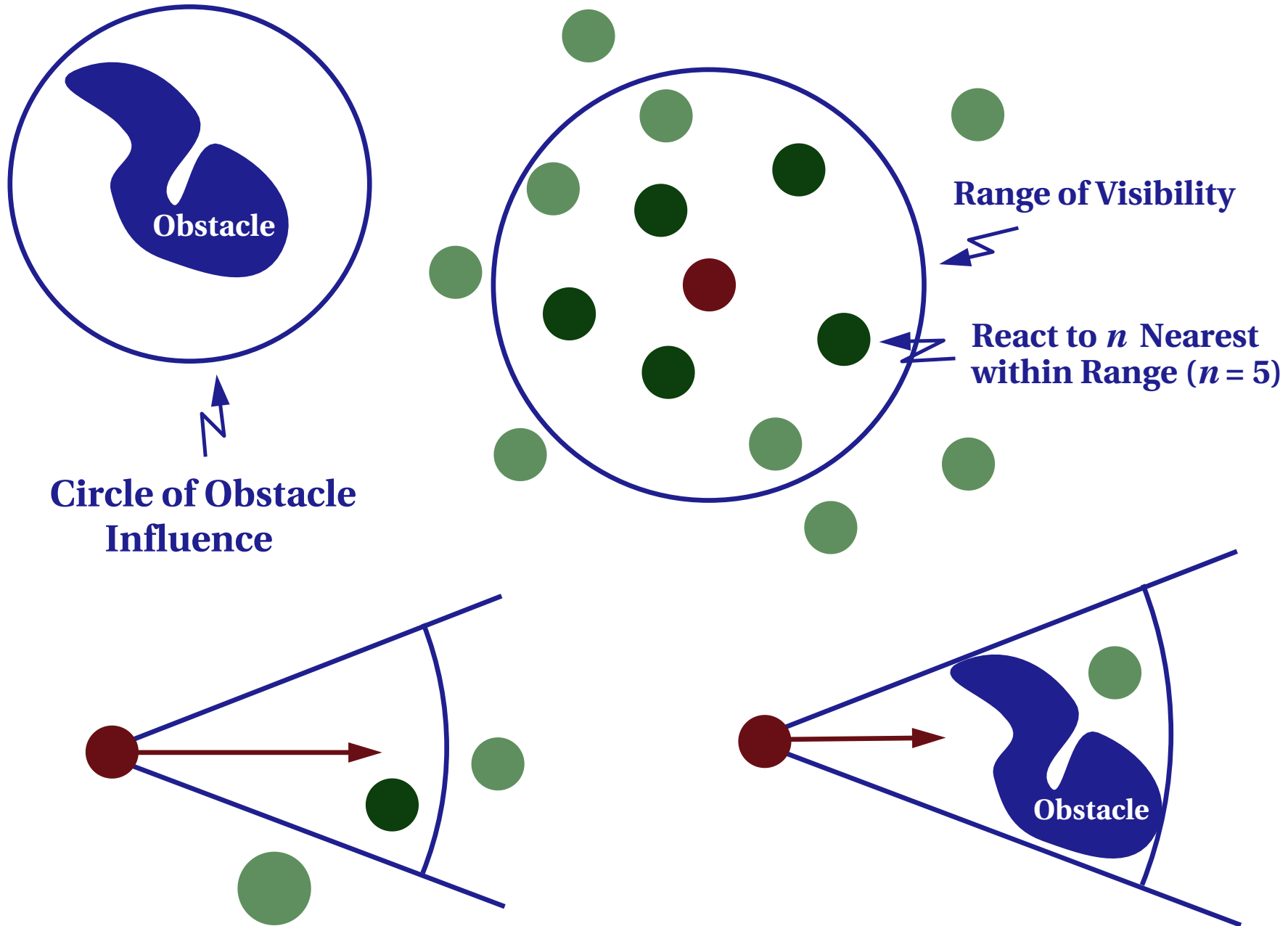
exactly aligned



**forces balance out
in dead end**

does not handle changes in strategy

Perceptual Models



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

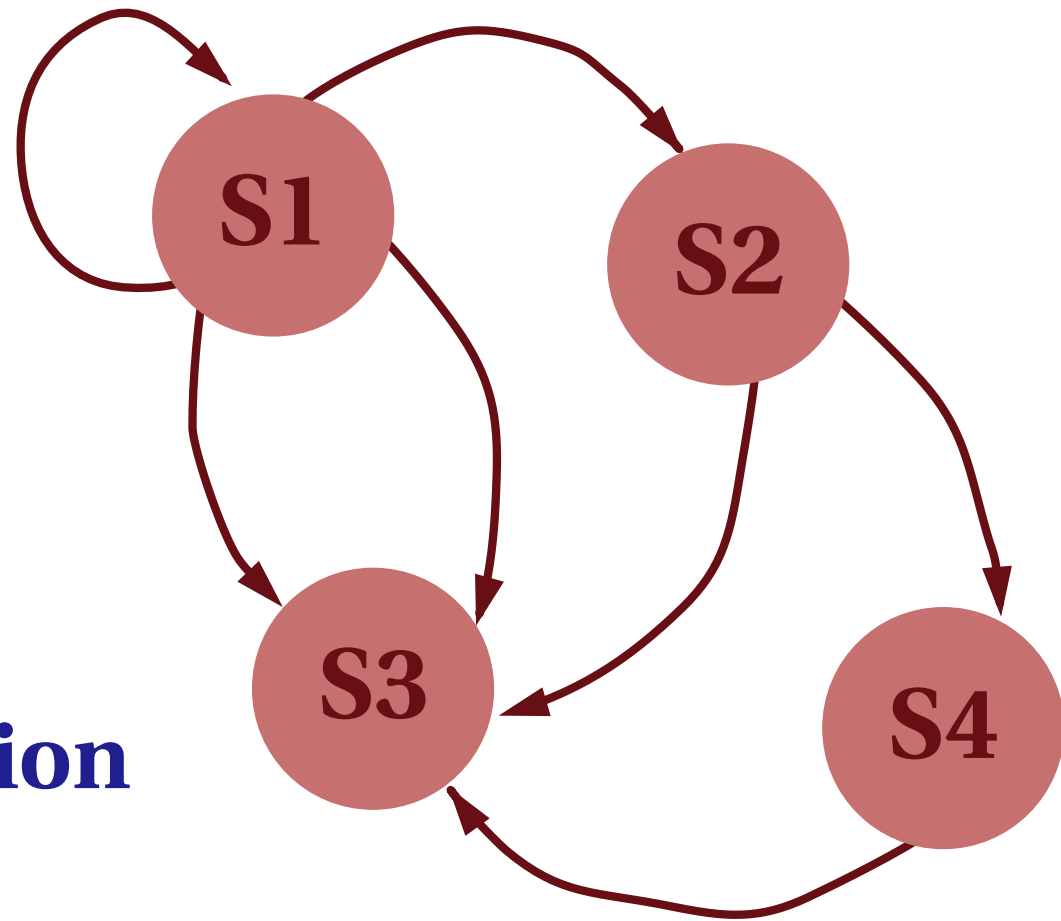
random selection

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

	aggressive	passive
Attack	50%	5%
Evade	5%	60%
Random	10%	20%
Flock	20%	10%
Pattern	15%	5%

sight
memory
curiosity
fear
anger
sadness
sociability

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)?

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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?