Higher–Level Behaviors

AI in videogames

1–5% of CPU and growing

chase/escape behaviors
group behaviors
finite state machines
adaptation/learning

Related Applications

synthetic actors in VE
avatars
digital extras

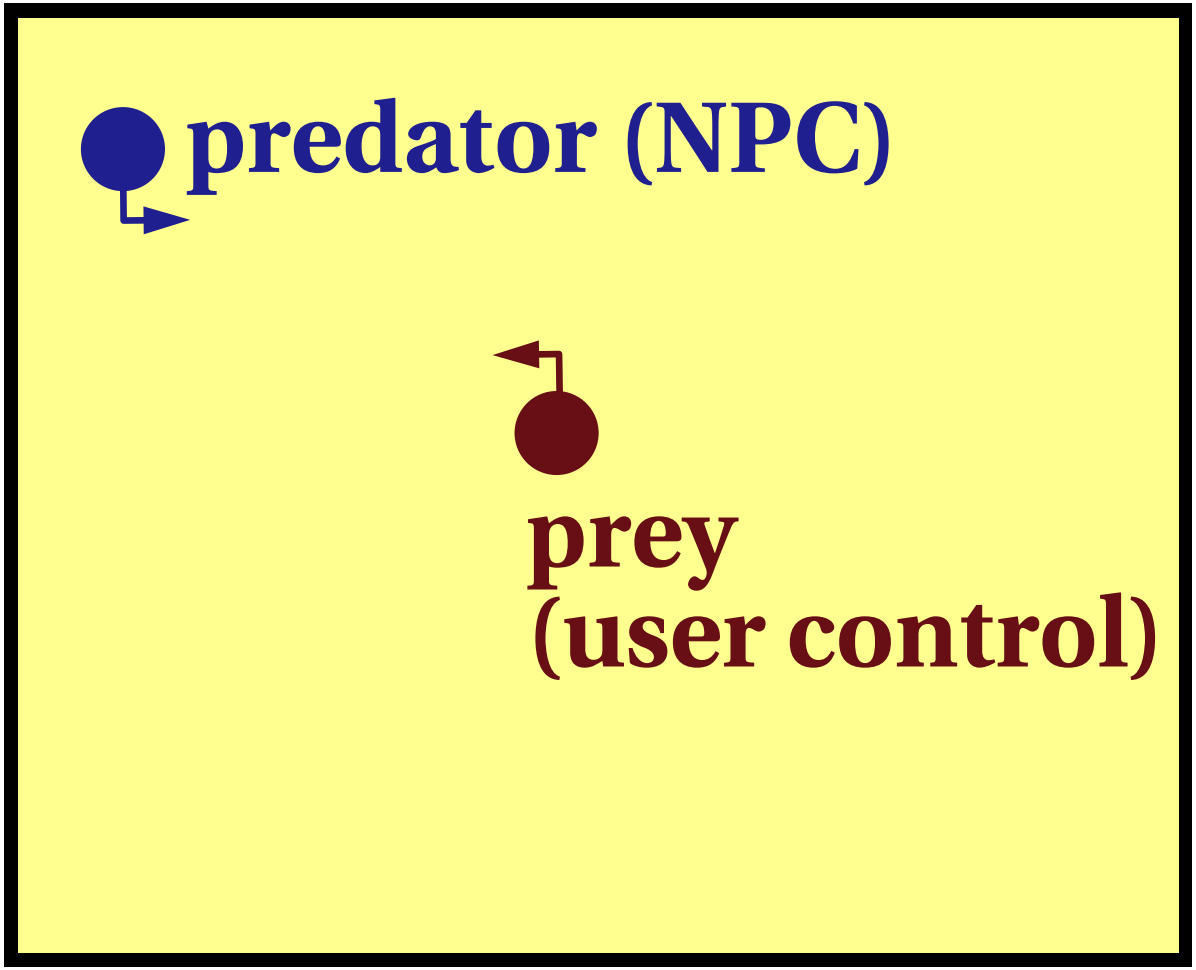
Questions to think about

- has AI in games lived up to the hype?
- how good should the AI be?
- why are people more fun than NPC's?
- new directions for AI in games?
  - digital personalities
  - more adaptation to user

What games have used AI effectively?

Chase/Evade

algorithm for the predator?



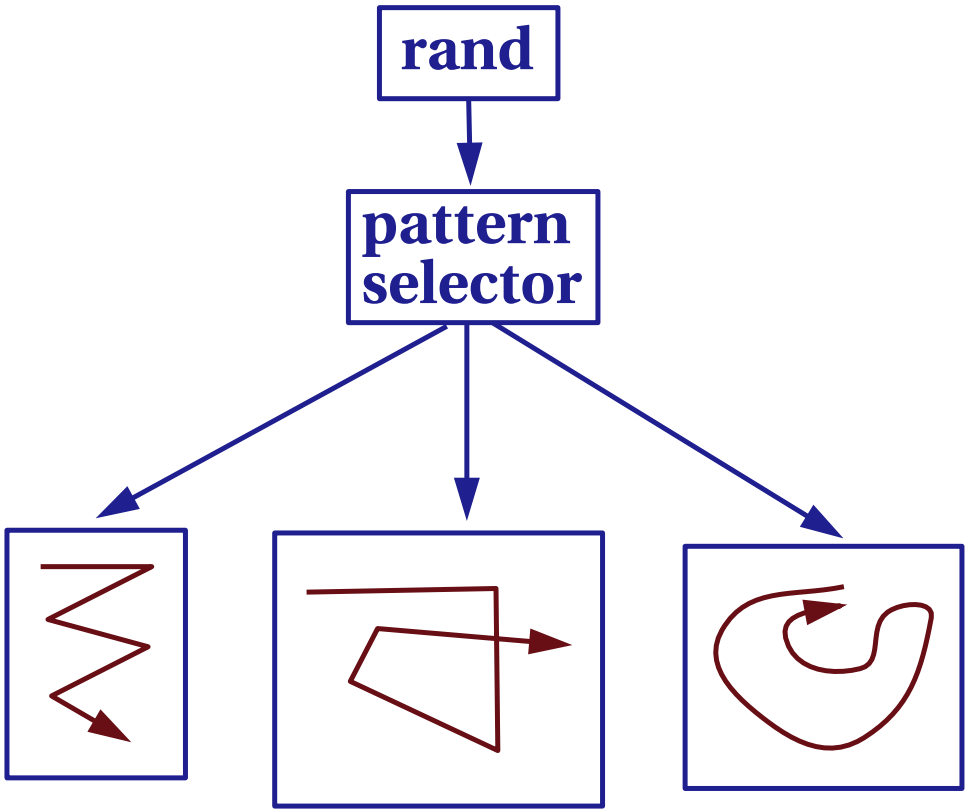
Enhancements to Chase

Speed Control

velocity, acceleration max/min
limited turning radius

Randomness

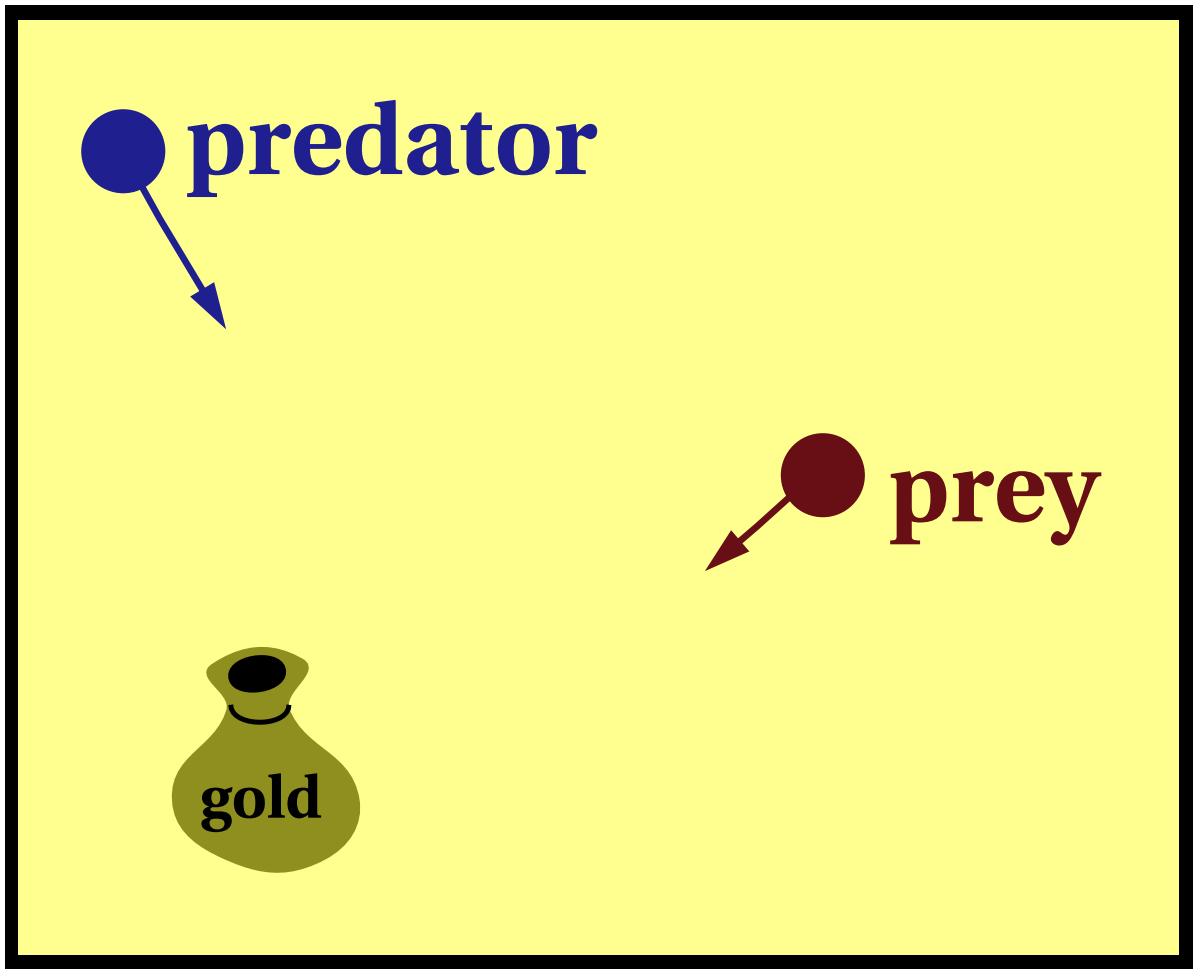
moves
patterns



Enhancements to Chase

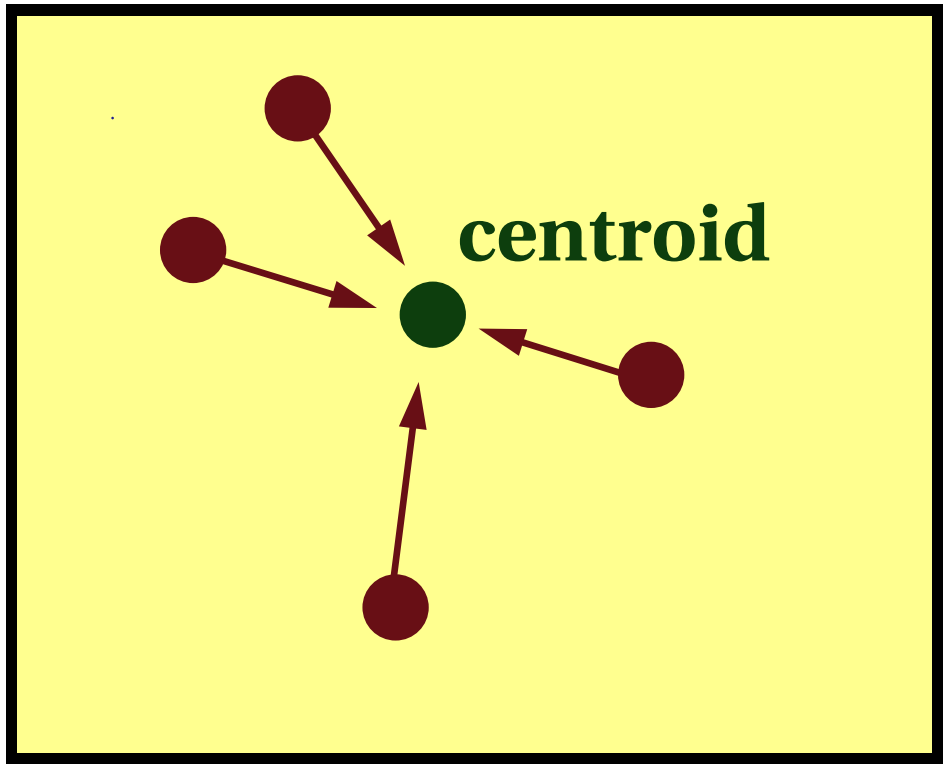
Anticipation

building a model of user's behavior



Flocking

safety in numbers?



$C = \Sigma\, p_i / n$

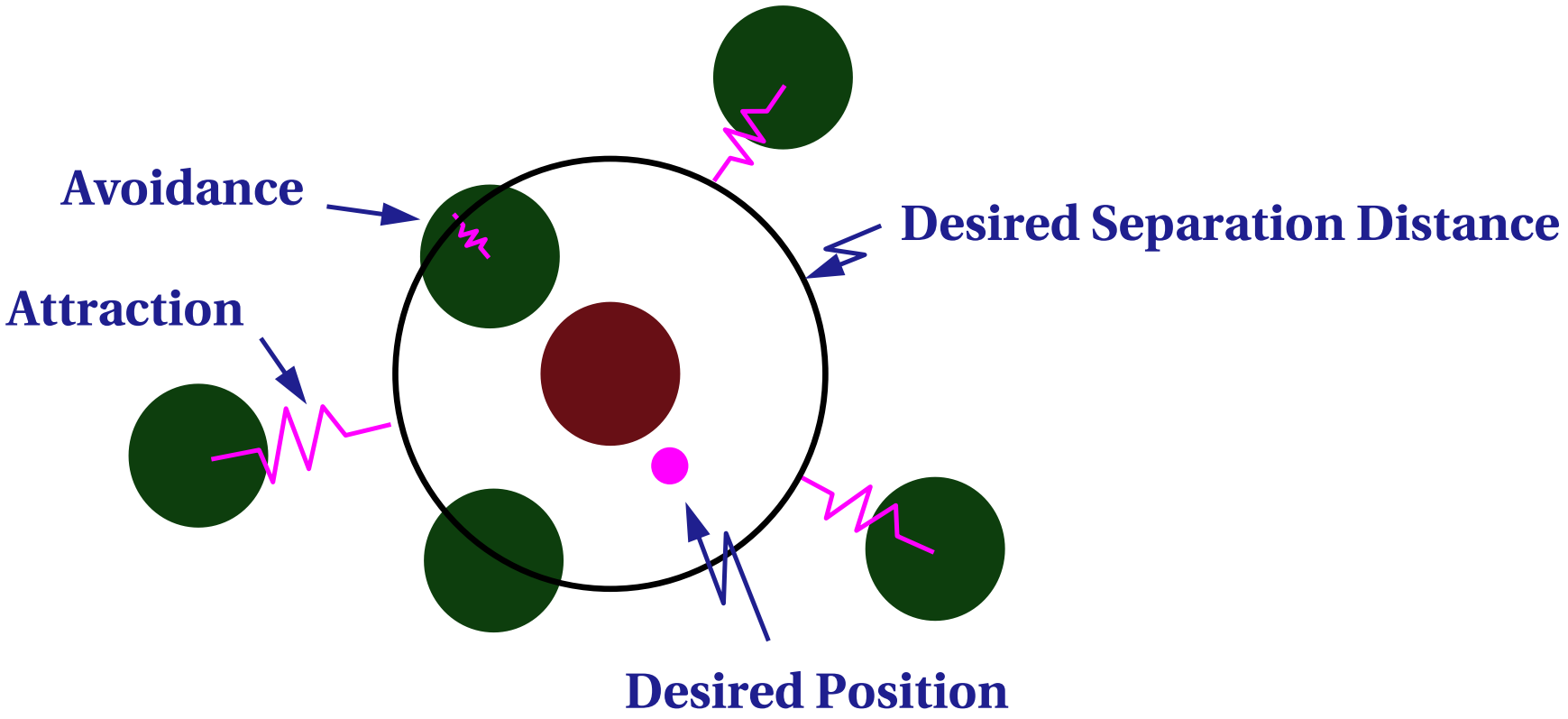
compute trajectory to head towards centroid

What might go wrong?

Group Behaviors

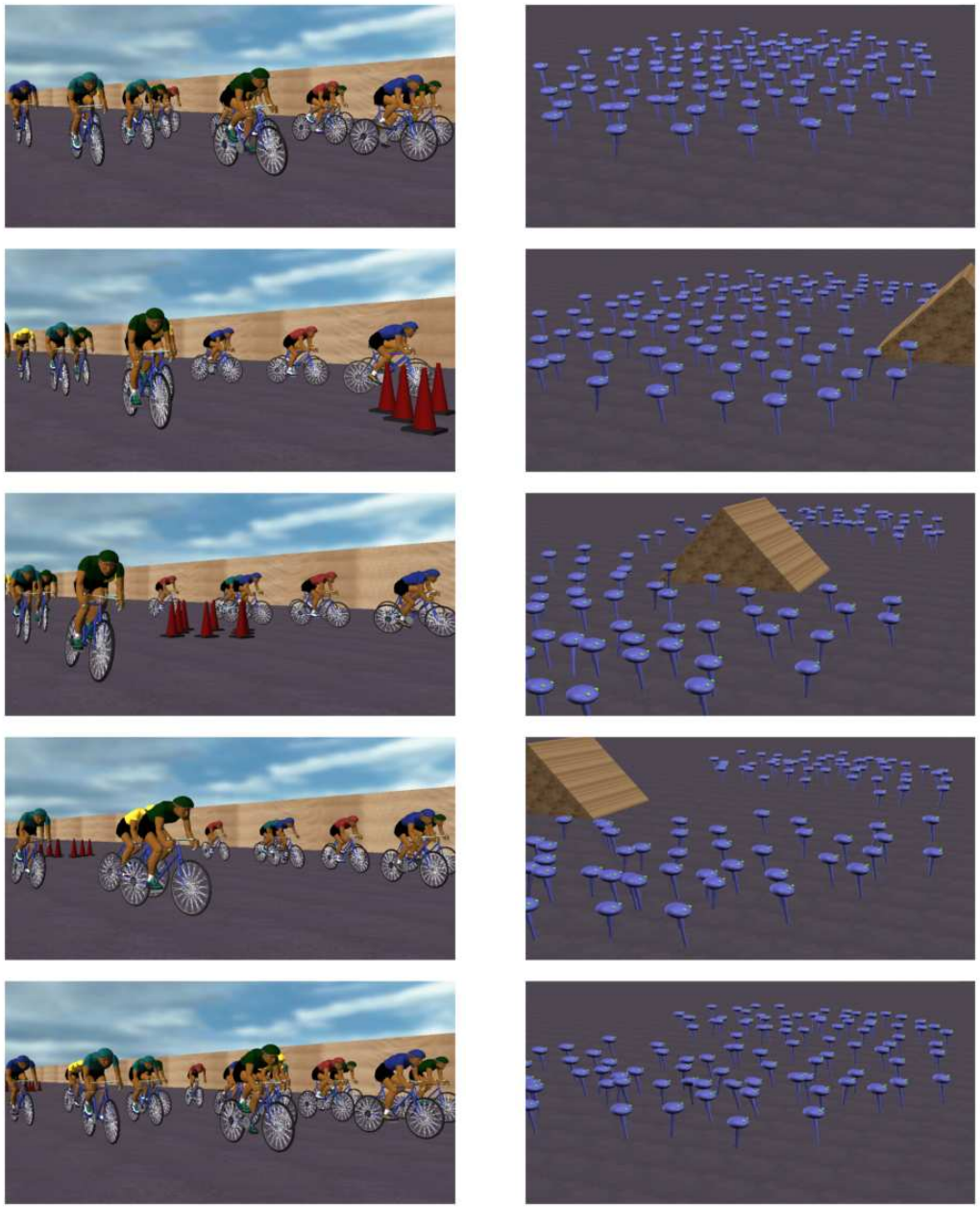
Craig Reynolds
SIGGRAPH 1987

Reaction to Neighbors



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

Group Behaviors



Steering Behaviors

Craig Reynolds

pursue

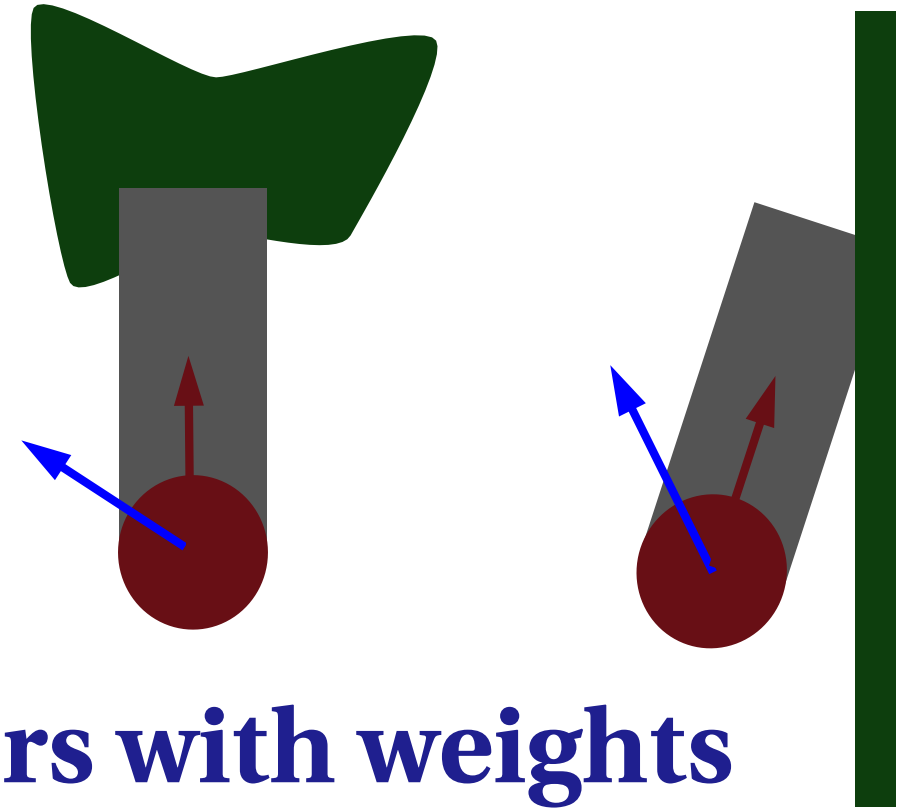
evade

wander

obstacle avoidance

wall/path following

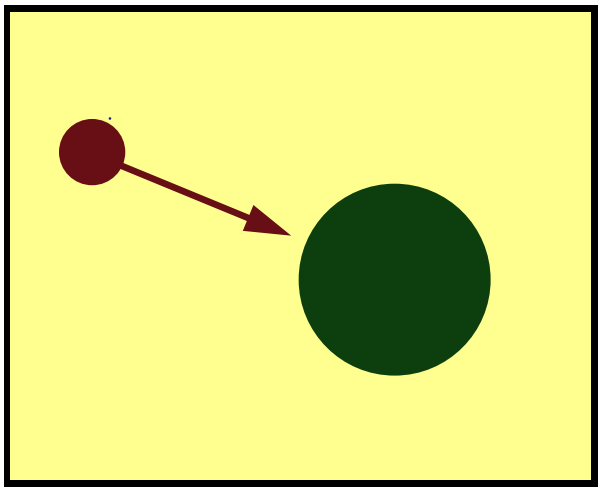
queuing

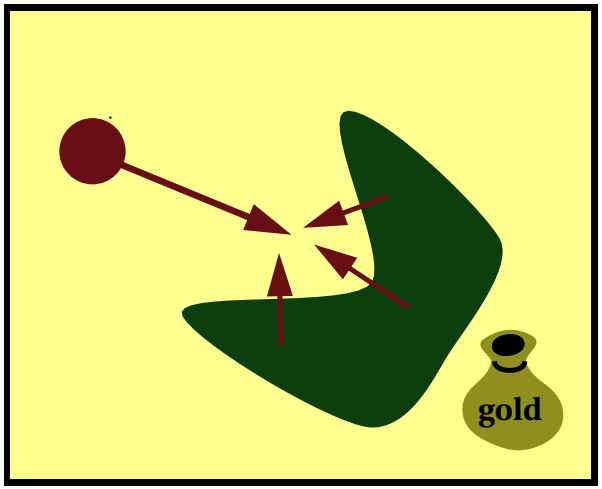


Combine behaviors with weights

What could go wrong?

What might go wrong?



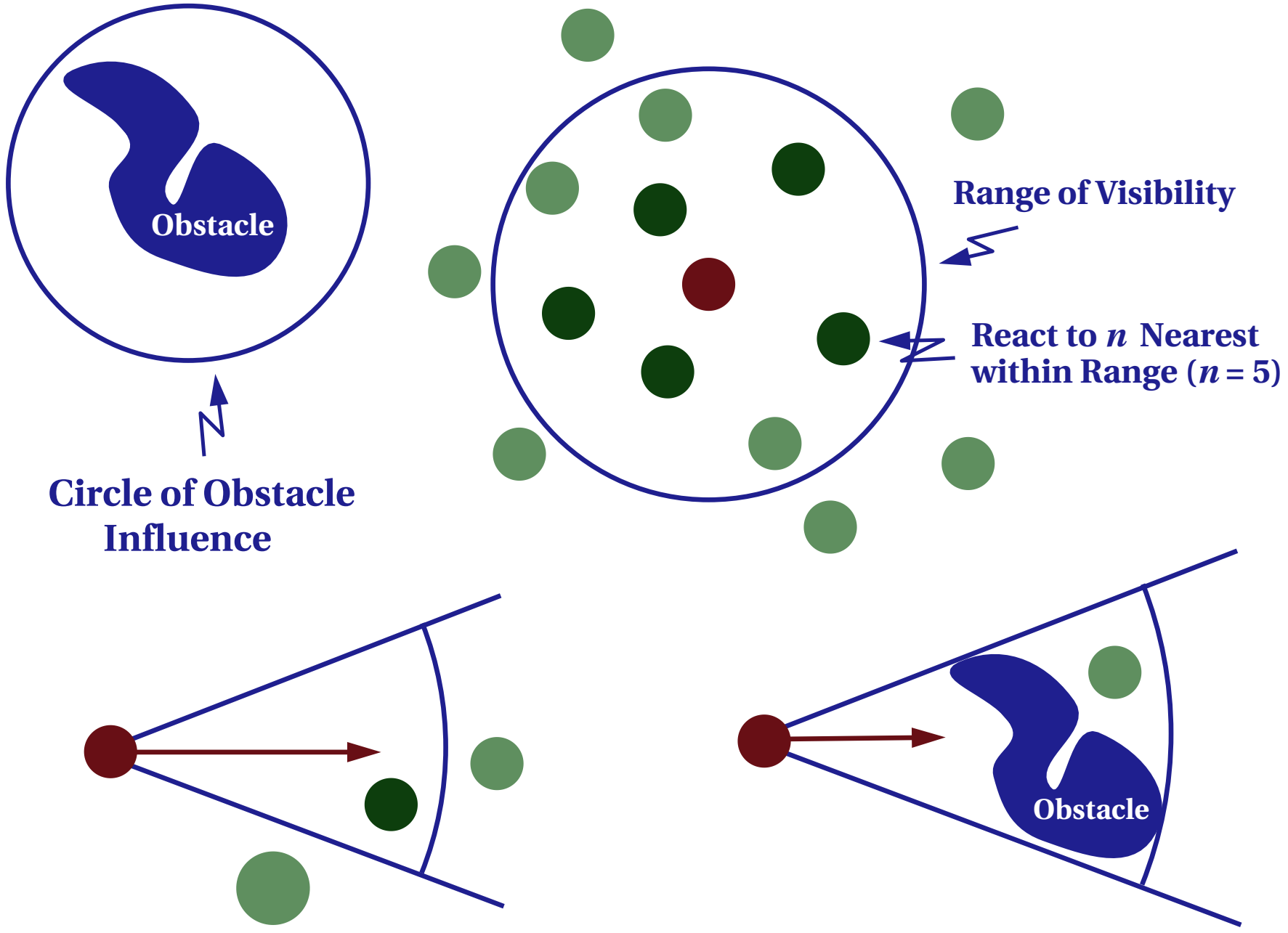


exactly aligned

forces balance out in dead end

does not handle changes in strategy

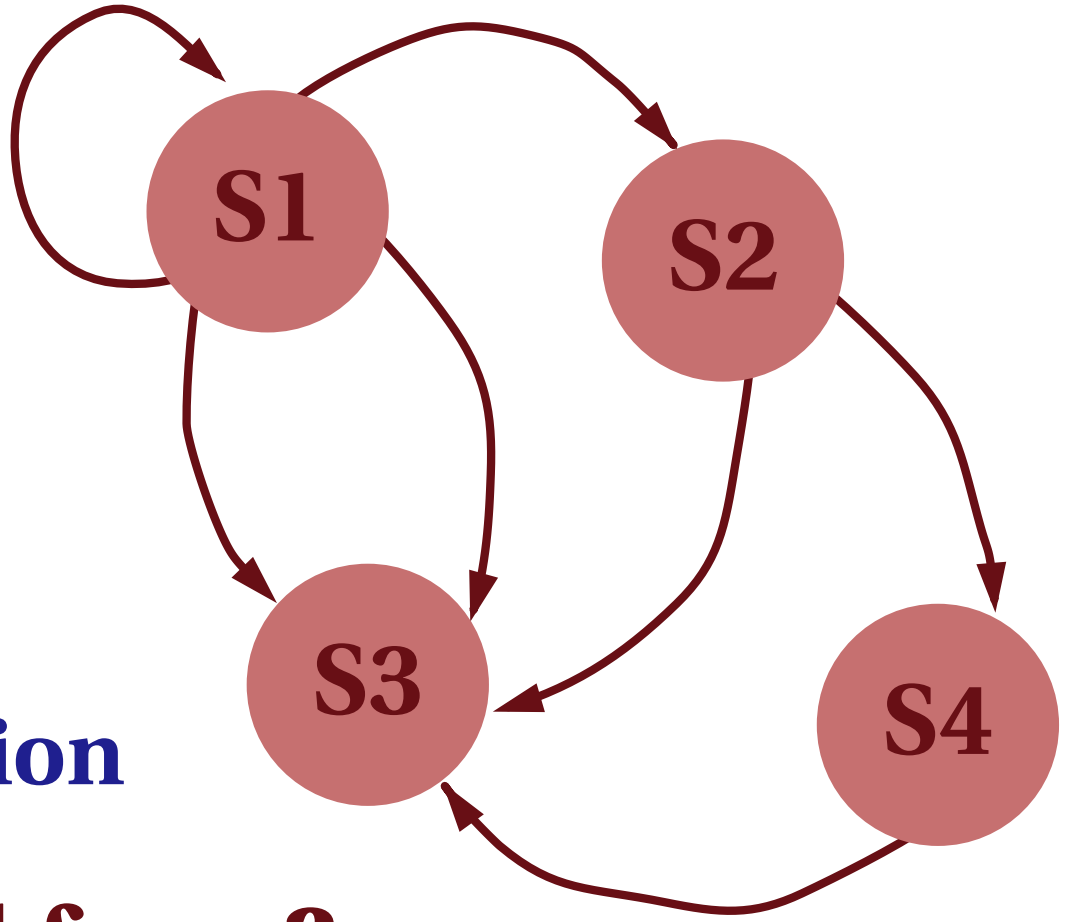
Perceptual Models



Finite State Machines

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

Transitions:
- time
- events
- completion of action



When do we need fsms?
- **new strategies**

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)?

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

Cheating?

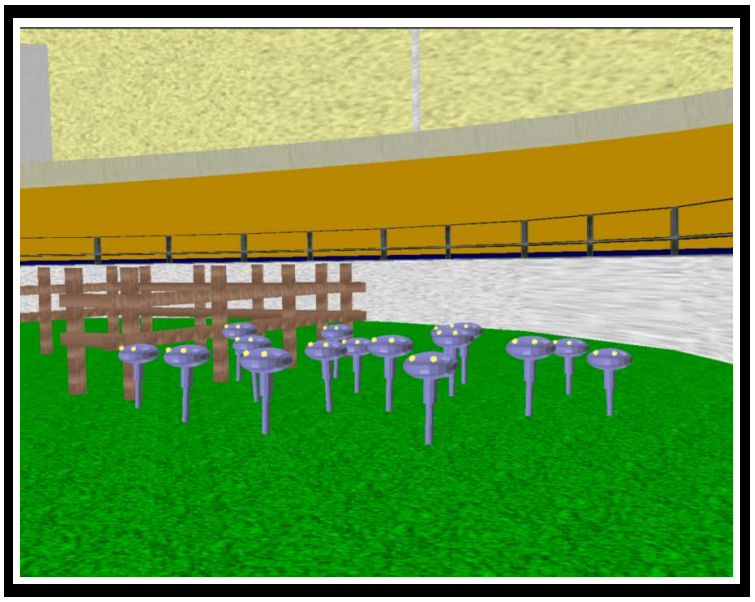
What is cheating?

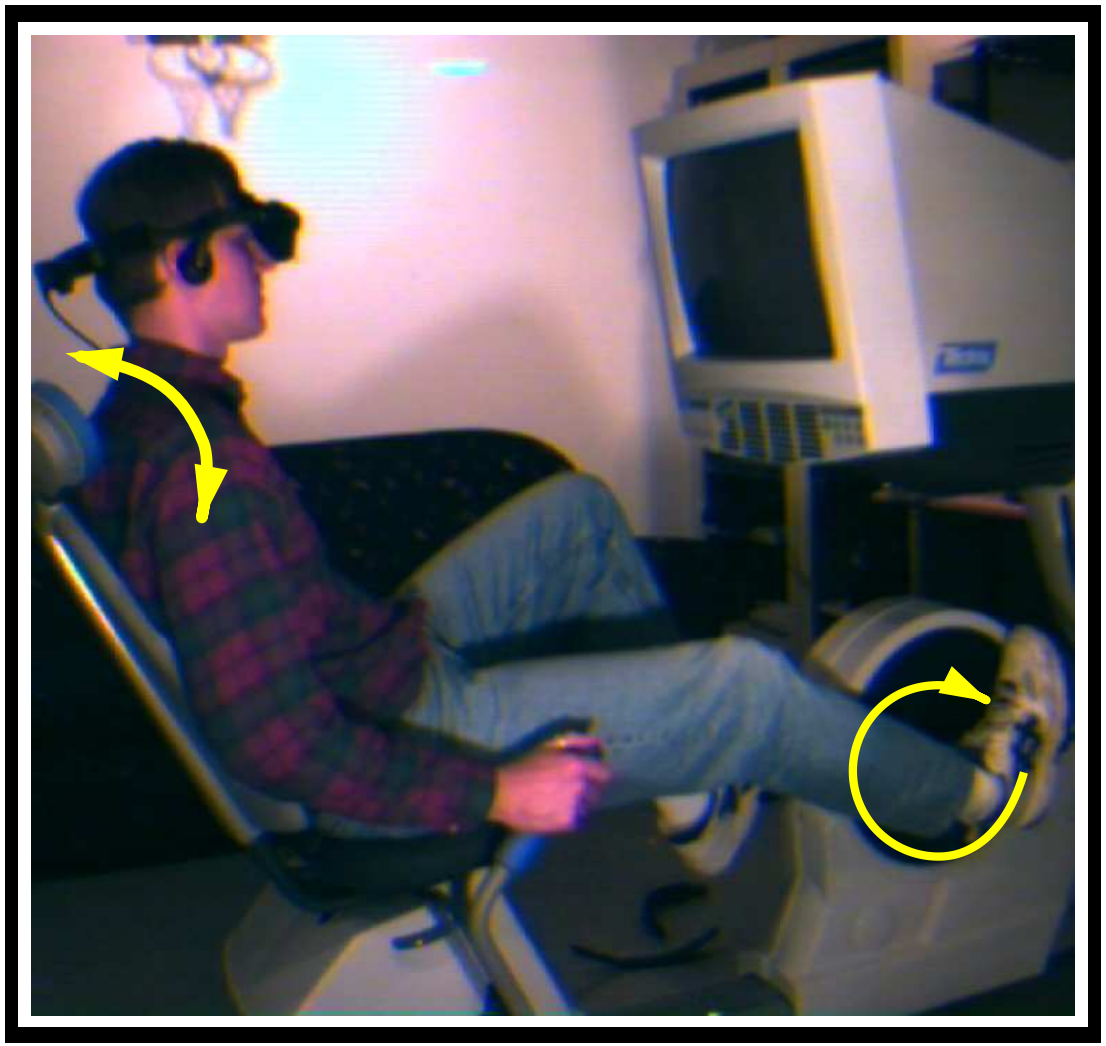
- **too much vision/strength/speed**
- **teleporting**

When should the AI cheat?

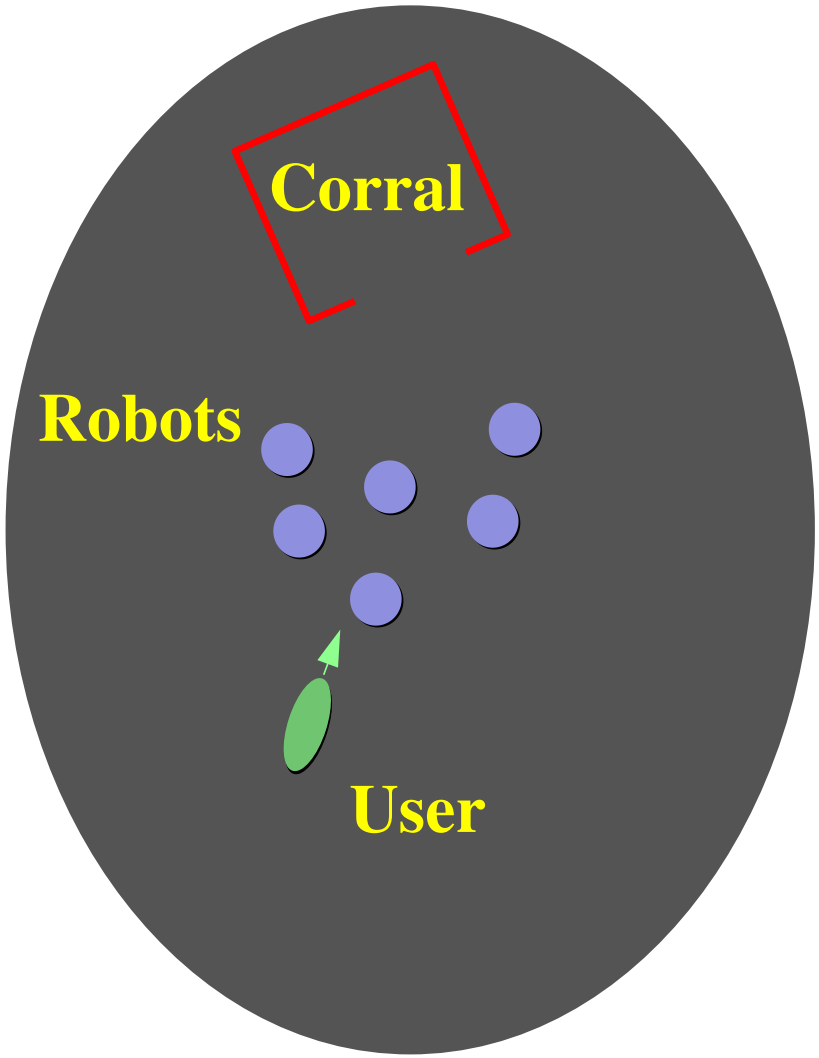
Border Collie Environment

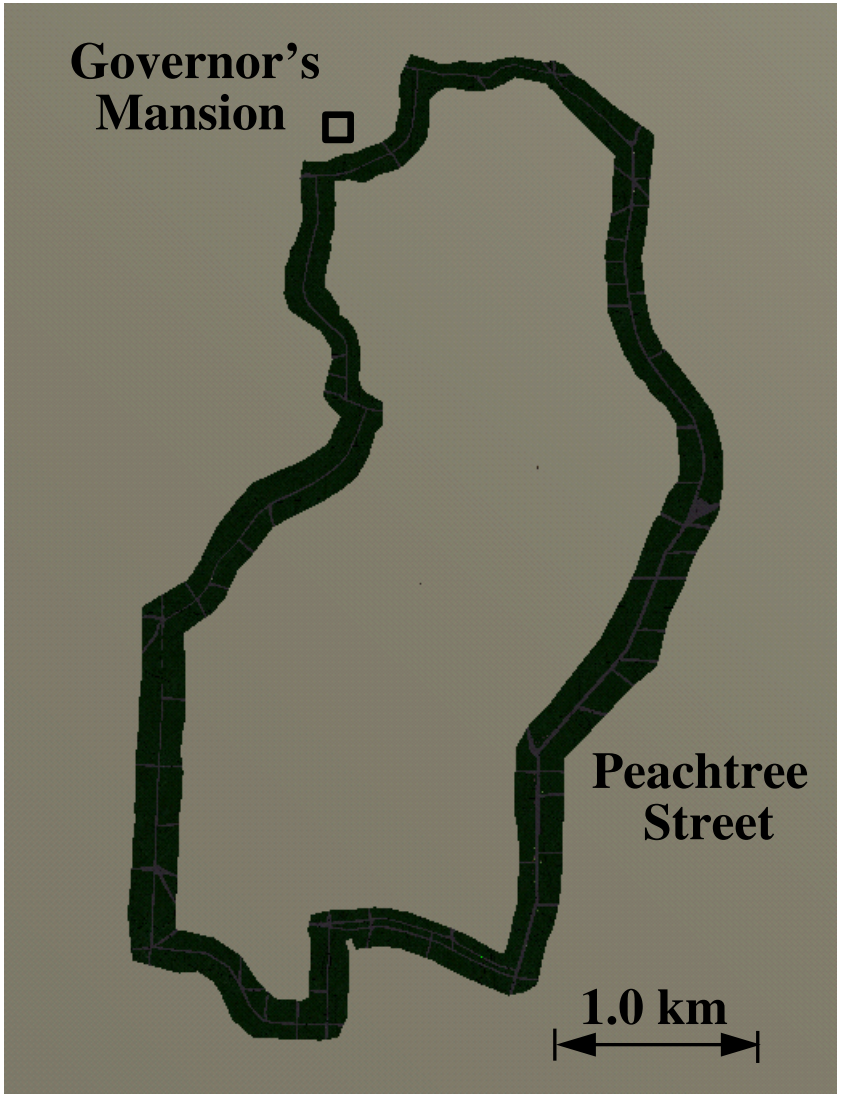
real–time
responsive
"intelligent"





Olympic Road Race Environment


Corral
Robots
User

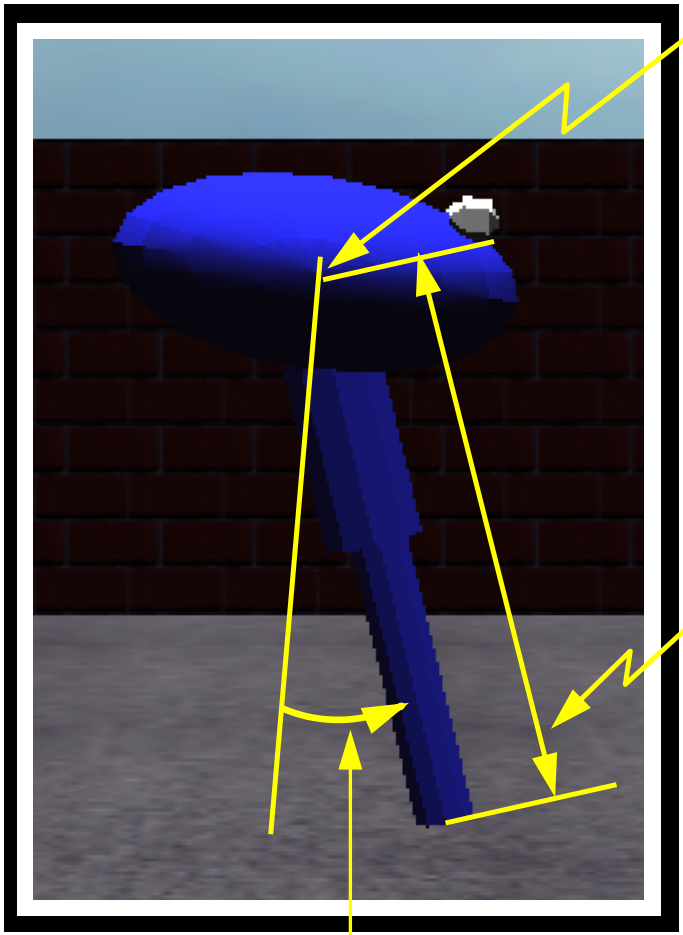

Governor's
Mansion
Peachtree
Street
1.0 km

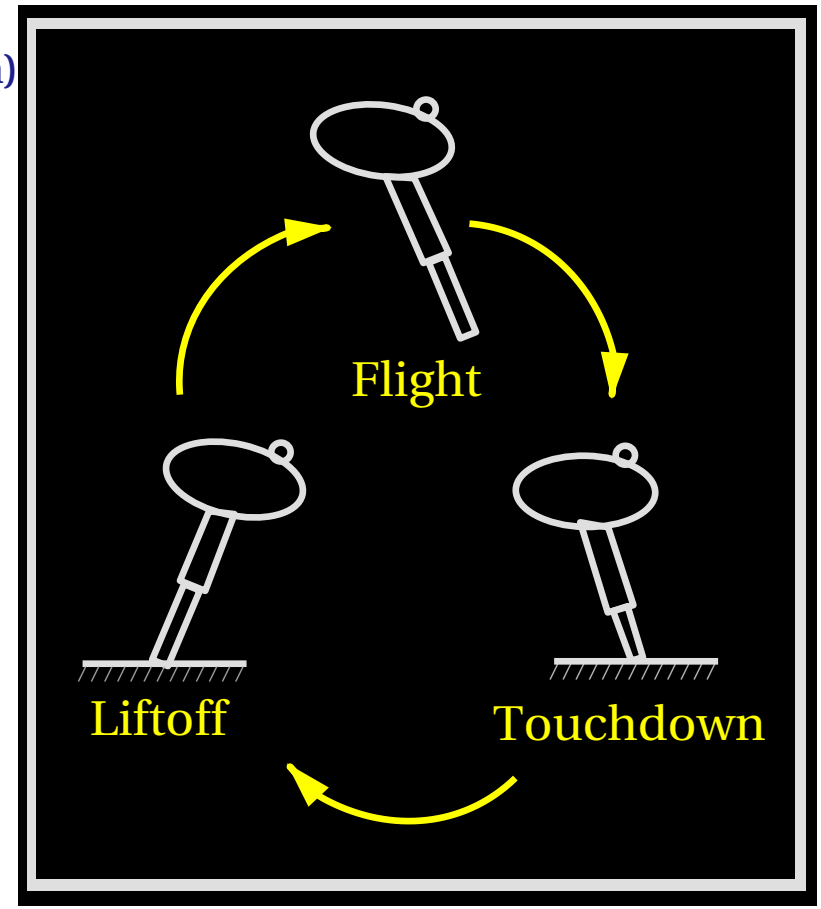
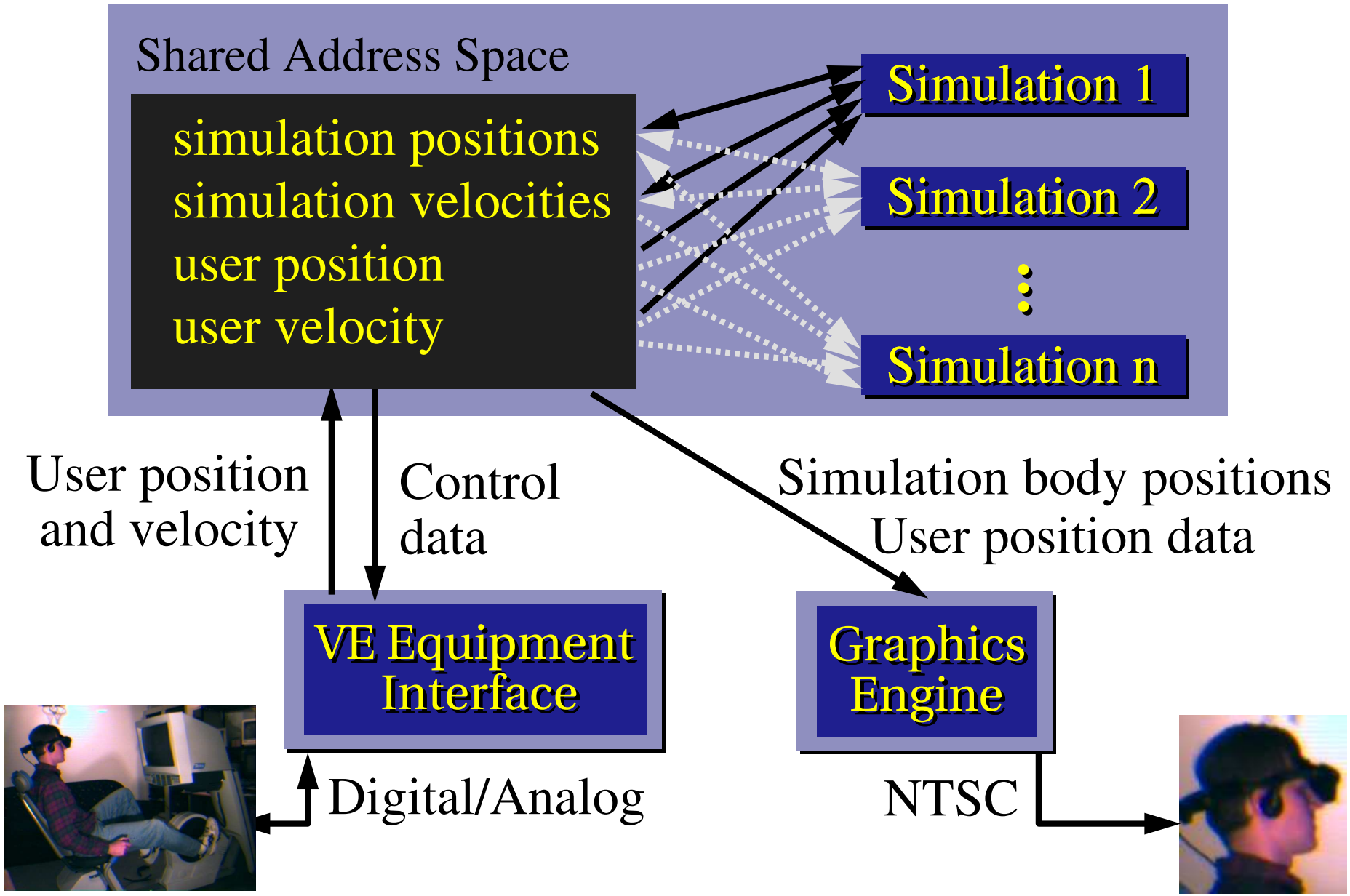
Forces applied by rider on handlebars turn the fork and steer the bike

Wheels roll on ground without slipping

Forces applied by rider on pedals are applied to crank and then to rear wheel

Low–level Robot Control





System Integration