Cs425 Lecture #4

- Flocking

Flock/Crowd/Group

Programming Assignment 1

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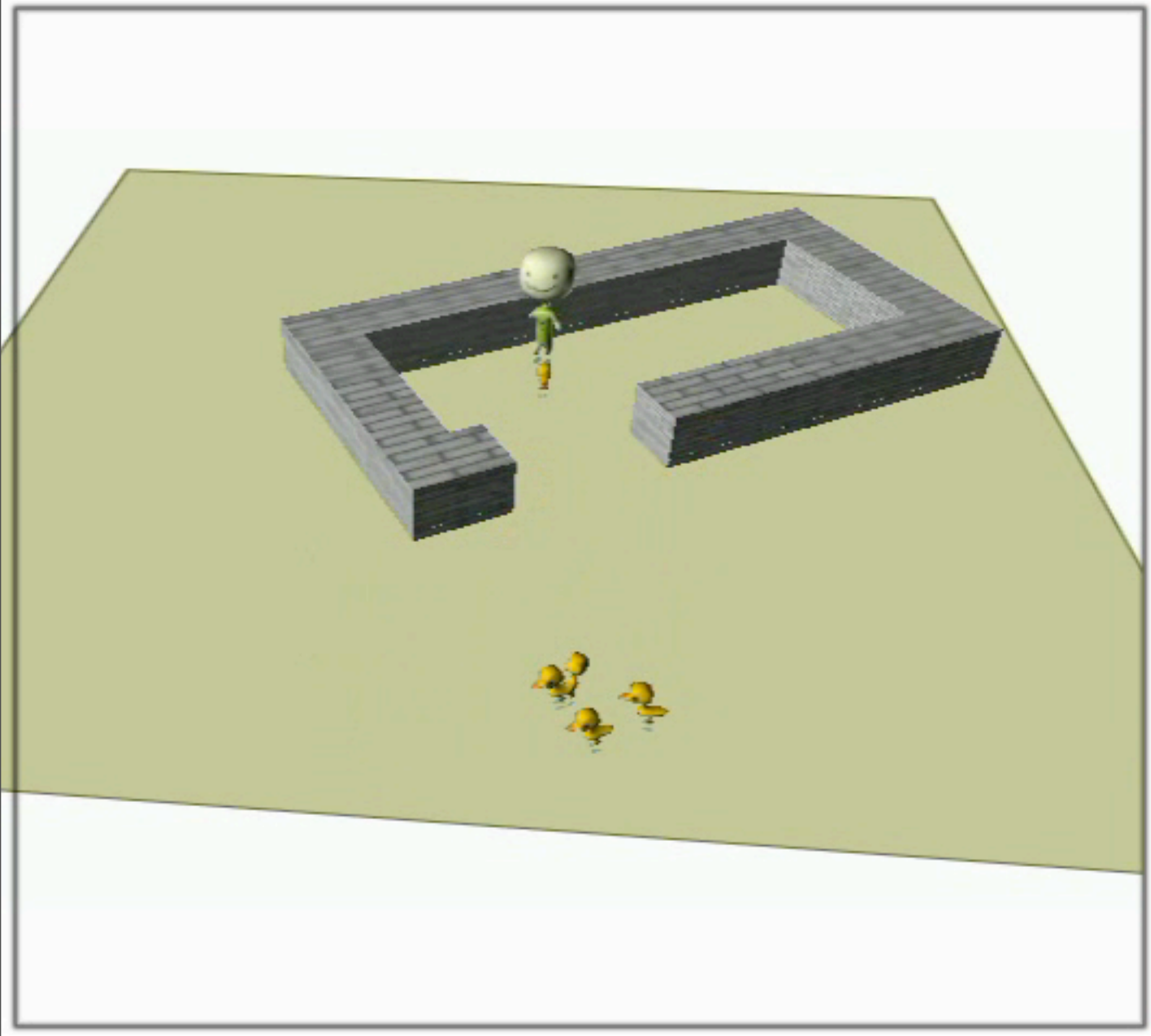
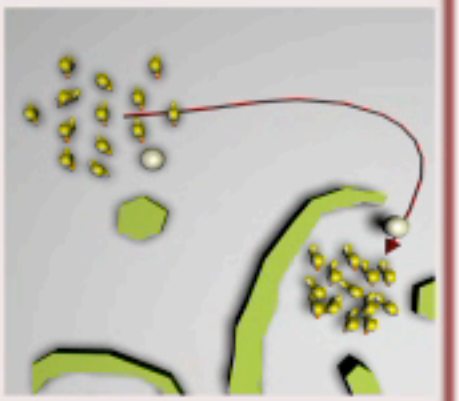


Herding



Moving flock from the current position to the goal

Programming Assignment 1

- 2D shepherding
  - User controls a sheepdog through a spring-mass force
  - Sheep runs away from the dog
  - Sheep exhibits flocking behaviors and avoids obstacles
  - A level is finished when all sheep are in the pen.
- Implement physics engine using
  - Euler's method
  - Midpoint method
  - RK4
- Using **Html 5 canvas** & **javascript**
  - Skeleton code will be provided
  - Crash course this Wed (**bring your laptop**)
- Create 3 game levels with increasing difficulty

Programming Assignment 1

- **Time**:
  - starting Sept. 11. 4:30 pm,
  - end: Oct 1st. 3pm (right before the class).
    - We will have you demo your game in class.
- Total is **100** points.
- **Bonus points**
  - Create 1 additional level with predators, wolfs (patrol from points A to B), tigers (circle around an obstacle), dinosaurs (stand at point A) that run after sheep when the sheep is too close 10%
  - Create 1 additional level with ducks, cows, geese that can get mixed into the sheep. The shepherd's goal is to separate them so only sheep are herded into the pen. 10%

Flocks

- Exhibits many contrasts
  - Made of discrete birds yet overall motion seems fluid
  - Randomly arrayed, yet magnificently synchronized
  - Intentional centralized control
  - Local perception of the world

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- Exhibits many contrasts
  - Made of discrete birds yet overall motion seems fluid
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  - Intentional centralized control
  - Local perception of the world
- Basic Features
  - Flocking
  - Avoid Obstacles
  - React to predators

Natural Flocks

- Natures 2 opposing forces
  - Stay closer to flock
    - Protection from predators
    - Easy availability and detection of food
  - Avoid collisions with peers.

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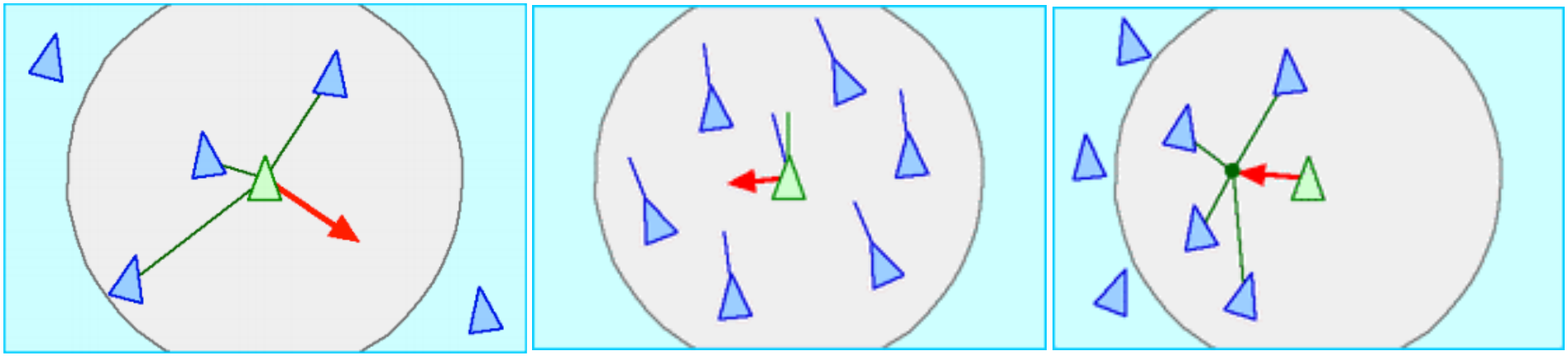
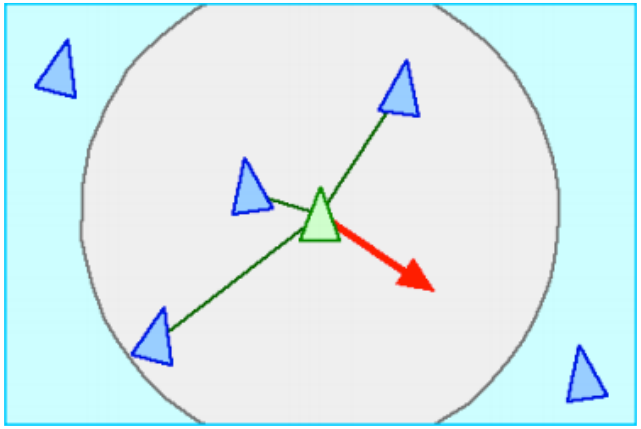
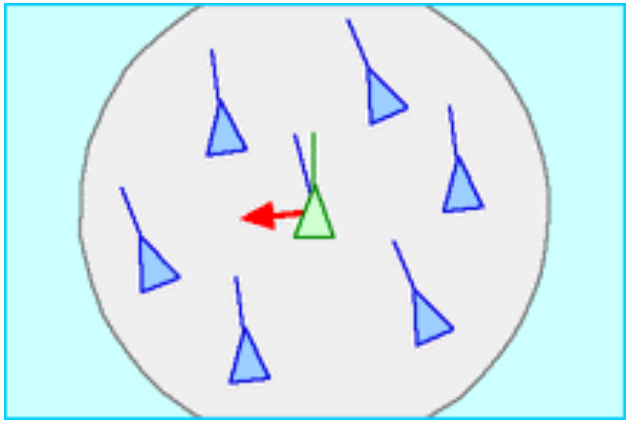
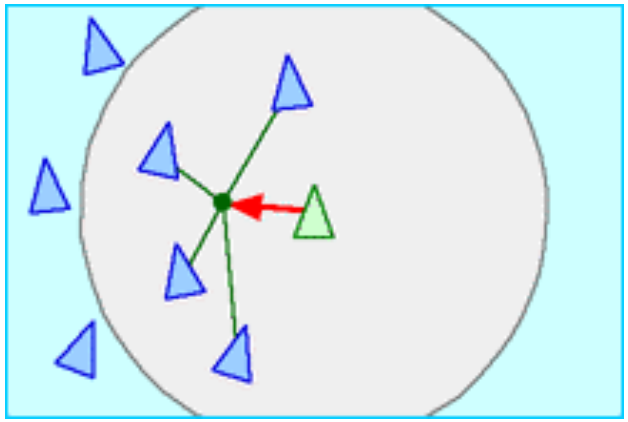
- Individual bird has localized and filtered perception of the rest of the flock.

Simulated Flocks

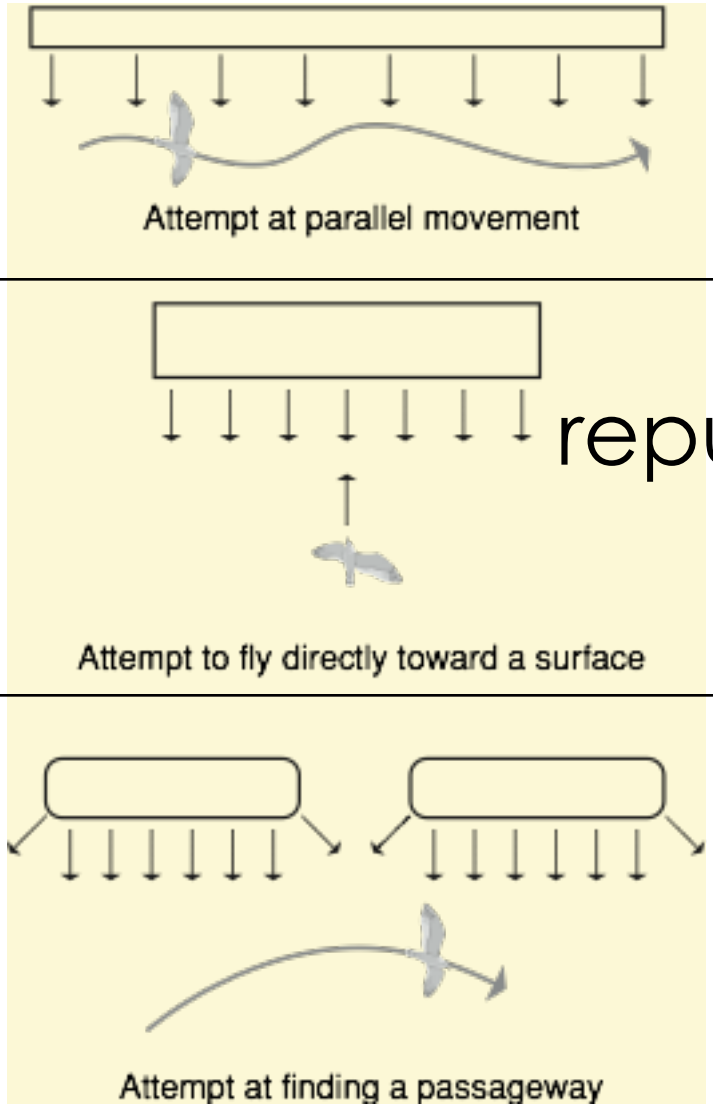


Simulated Flocks

- The Rules are stated as
  - Collision avoidance
  - Velocity Matching
  - Flock Centering

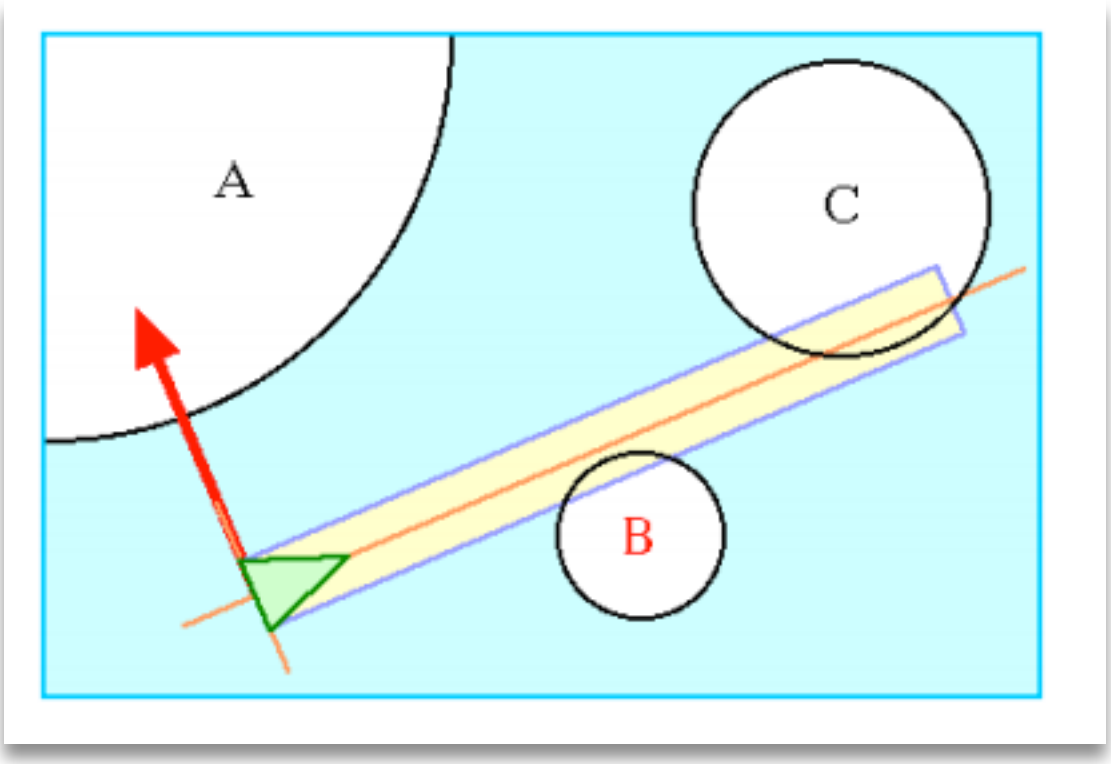
Navigating Obstacles



repulsive forces

Avoiding Obstacles

- Steer-to-avoid approach
  - Boid only considers obstacles **directly in front** of it



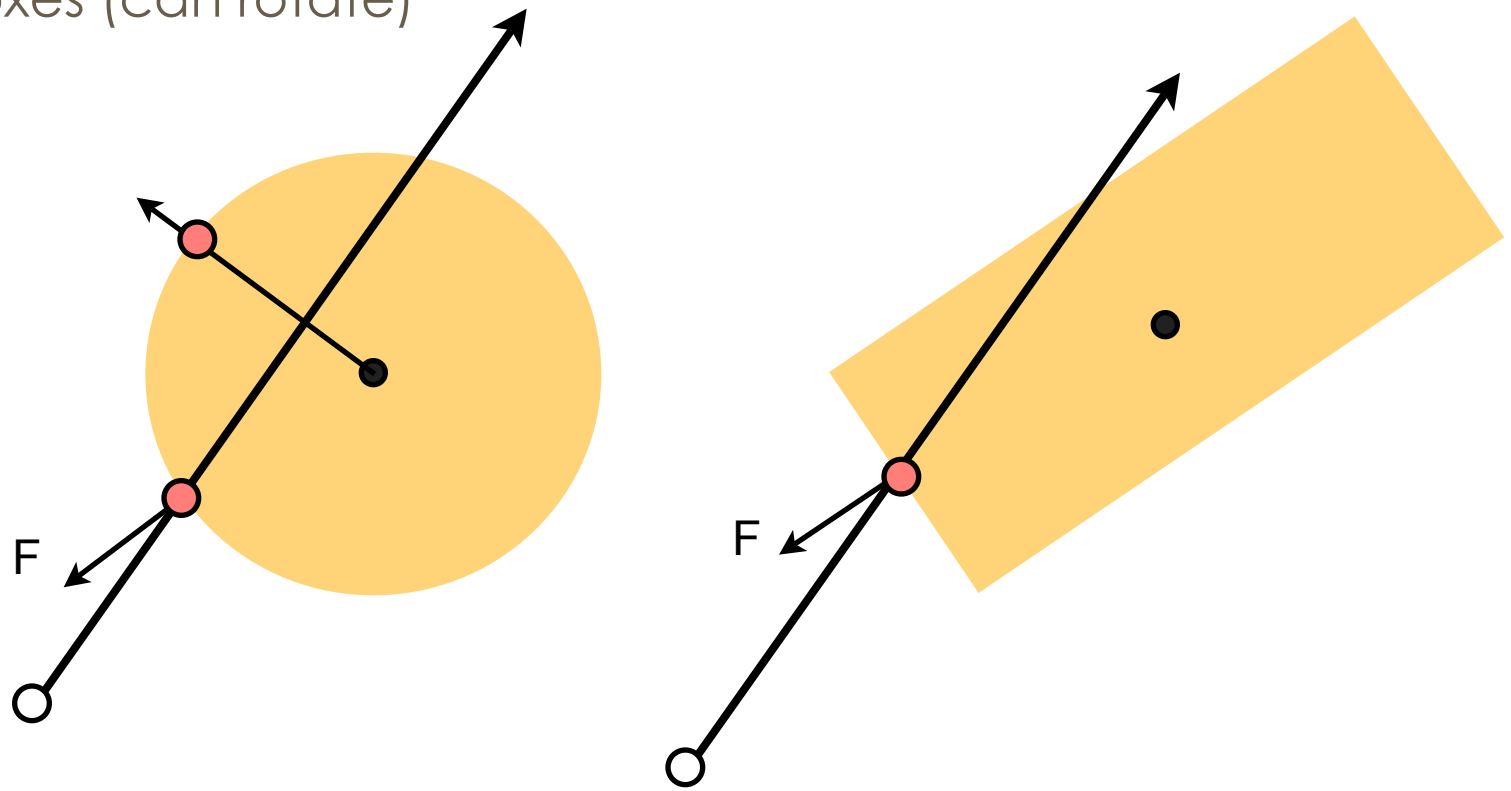
Avoiding Obstacles

Avoiding Obstacles

- Steer-to-avoid approach
  - Boid only considers obstacles **directly in front** of it
  - Finds **silhouette edge** of obstacle closest to point of eventual impact
  - A vector is computed that will aim the boid at a point one body length beyond the silhouette edge

Obstacles in PA1

- We will only have two types of obstacles
  - Disks
  - Boxes (can rotate)

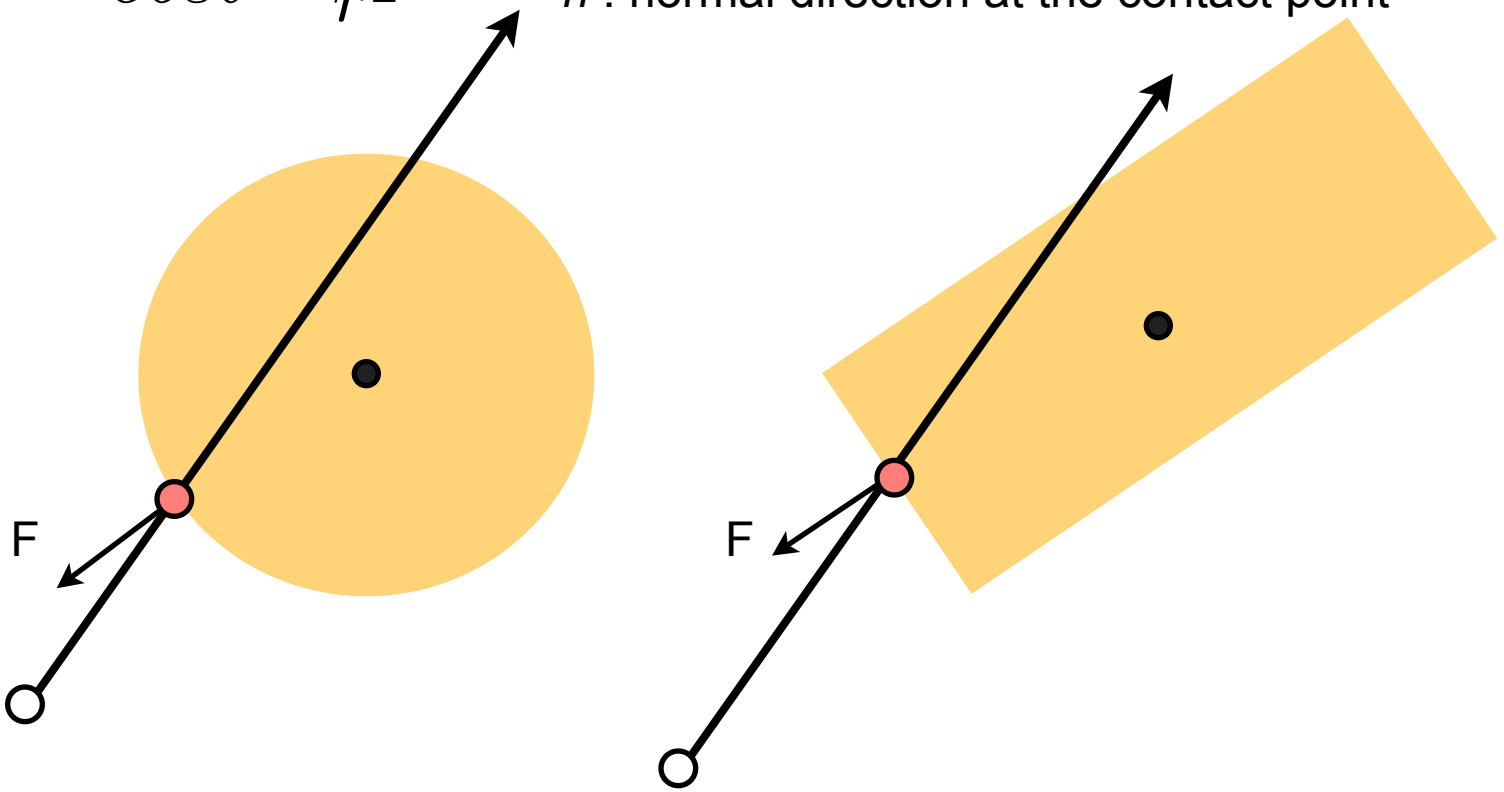


Obstacles in PA1

- We will only have two types of obstacles

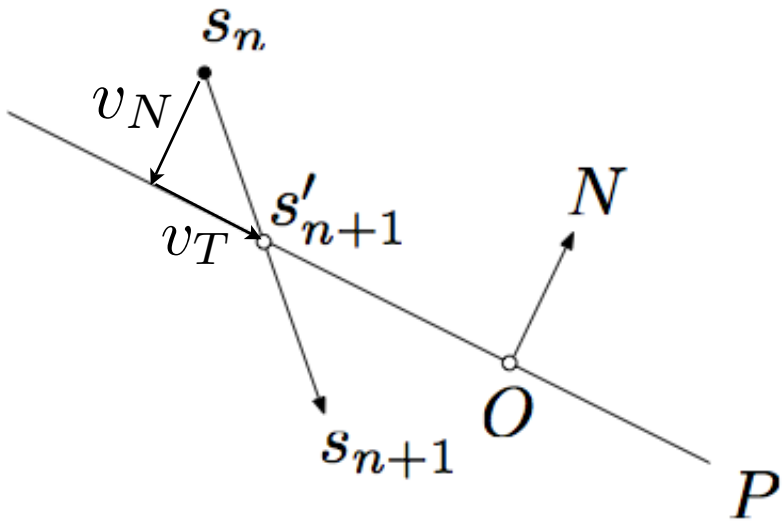
$$F = K_{obst} \cdot \frac{n}{r^2}$$

r : distance to the obstacle
n : normal direction at the contact point



Collision

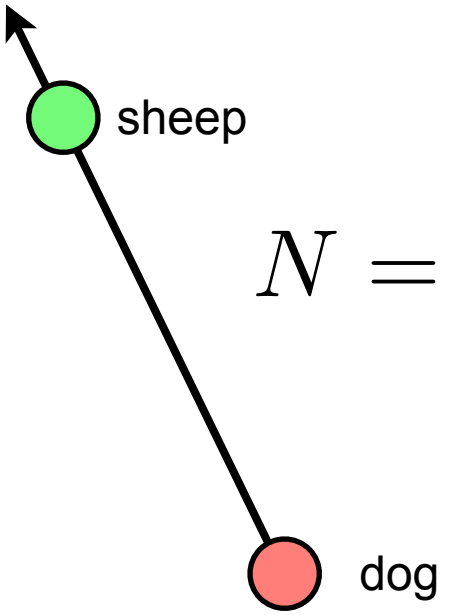
- When you find your sheep/dog is inside the obstacle
  - Compute the collision state s'_{n+1}
  - Find the collision time $t' = \frac{s'_{n+1} - s_n}{s_{n+1} - s_n}$
  - Find the new velocity $v'_{n+1} = v_T + k_r(-v_N)$
    - v_T is the velocity parallel to P at t'
    - v_N is the velocity perpendicula
  - Simulate from t' to t



Sheep/Dog

- Repulsive force from dog to sheep

$$F = k_{dog}\left(\frac{N}{|N|^2}\right)$$



$$N = Pos_{sheep} - Pos_{dog}$$