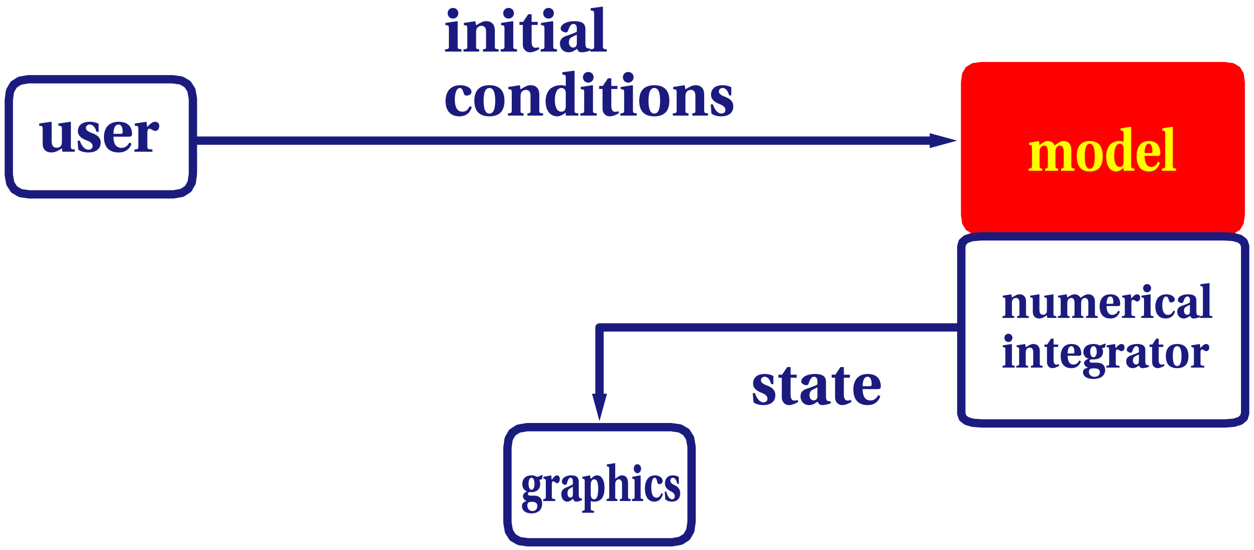
Simulation

modeling the real world with simple physics

- realism
- a set of rules
- better interactivity

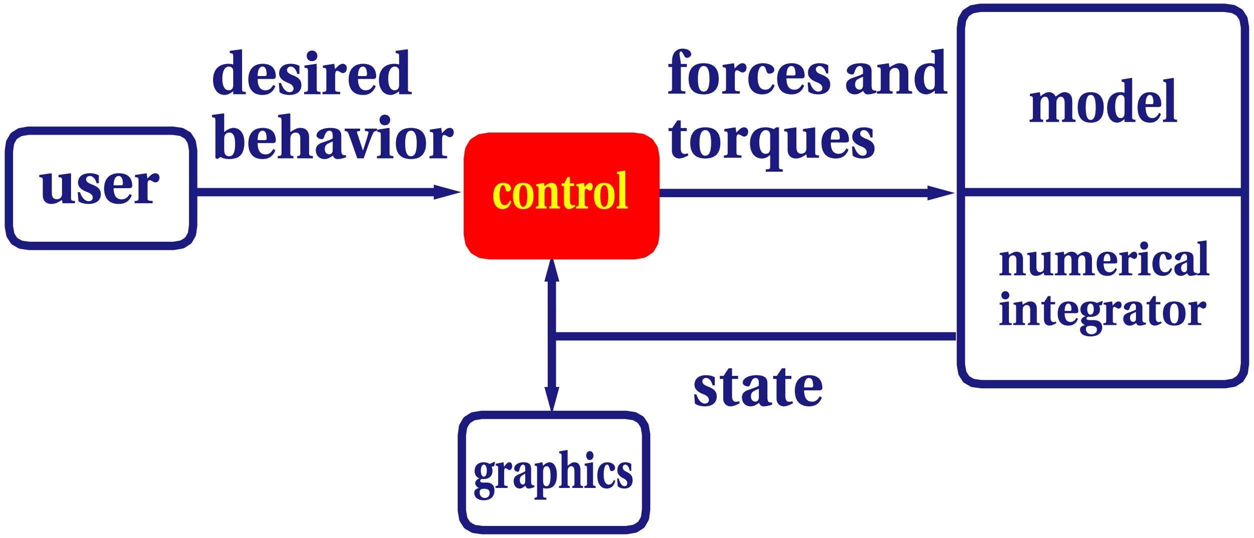
Objects or Characters?

Passive--no muscles or motors



particle systems
leaves
water spray
clothing

Active--internal source of energy



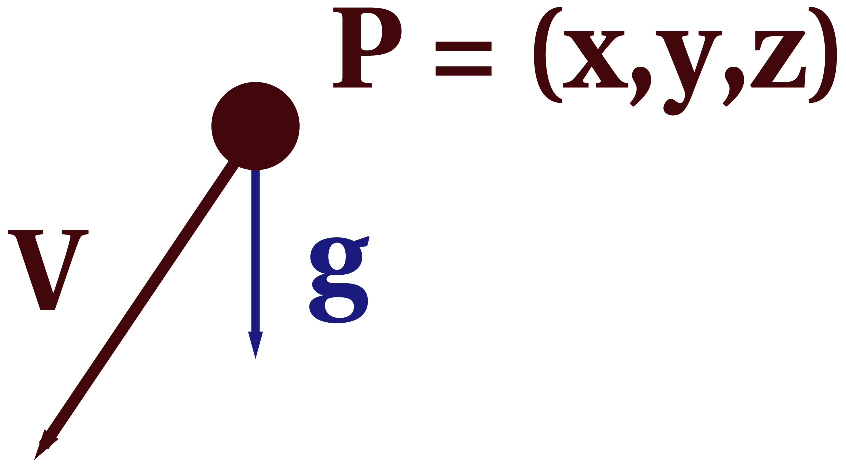
running human
trotting dog
swimming fish

Equations of Motion:

$A = g$

$V' = V + A\Delta t$

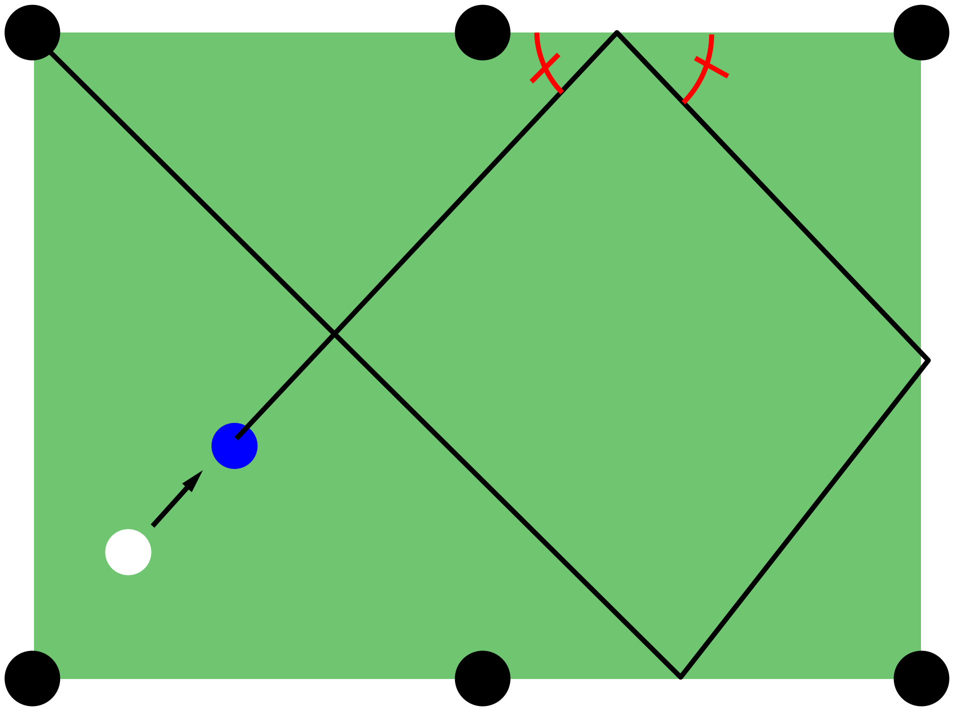
$P' = P + \frac{V+V'}{2}\Delta t$



Integrating in a 2d world

object.x += 2
object.xd = 2 pixels/timestep = 60p/s
timestep = 1/30fps

Pool Game



vertical wall:
xd = –xd
horizontal wall:
yd = –yd

Collision Detection

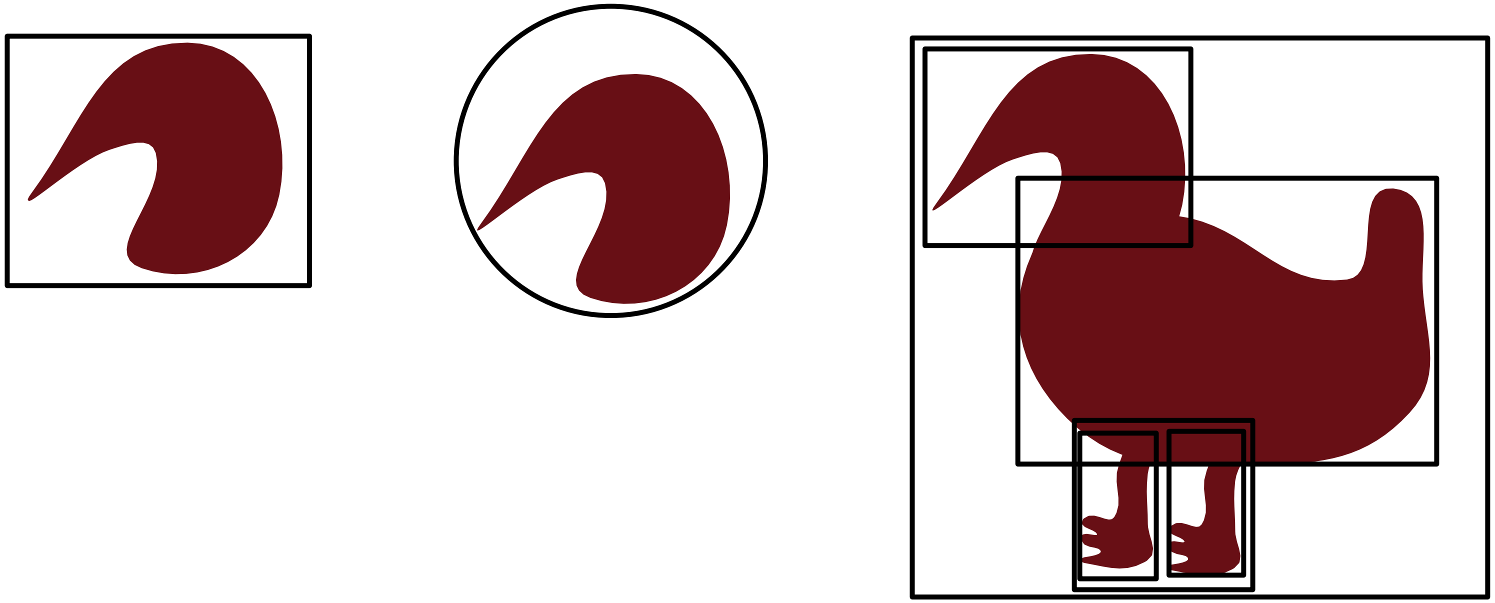
- essential for many games
  - shooting
  - kicking
  - car crashes

expensive -- n^2 tests

Efficiency Hacks/Cheats

fewer tests

do only selected objects/characters
use bounding boxes/spheres



Efficiency Hacks/Cheats

cheaper distance calculation

$$d = \mathrm{sqrt}\,((x_1 - x_2)^2 - (y_1 - y_2)^2)$$

$$d' = \mathrm{abs}(x_1 - x_2) + \mathrm{abs}(y_1 - y_2) - \min(\mathrm{abs}(x_1 - x_2), \mathrm{abs}(y_1 - y_2))/2$$

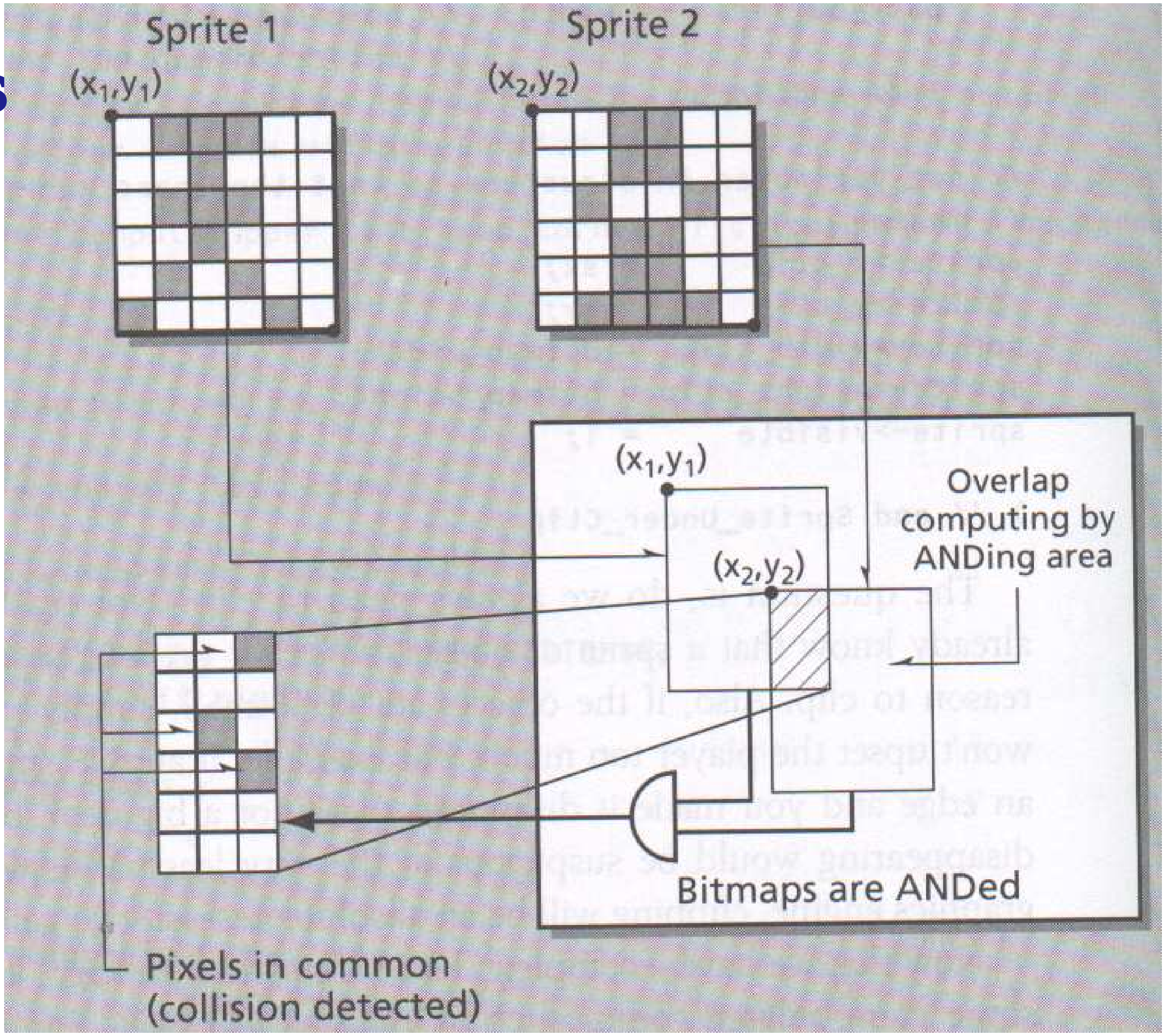
Manhattan distance – shortest side

$x=3, y=4 \Rightarrow d = 5$

$d' = 3 + 4 - 1.5 = 5.5$

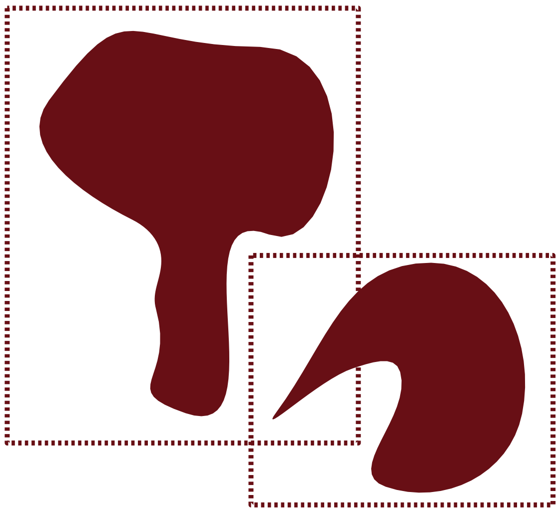
Collision detection: sprites

AND for each pixel in sprites



Efficiency Hacks/Cheats

bounding boxes for sprites



Integration of Technologies

- layering
  - add hand/finger motion later
  - facial animation
- use keyframing to modify data
  - fix holes in data