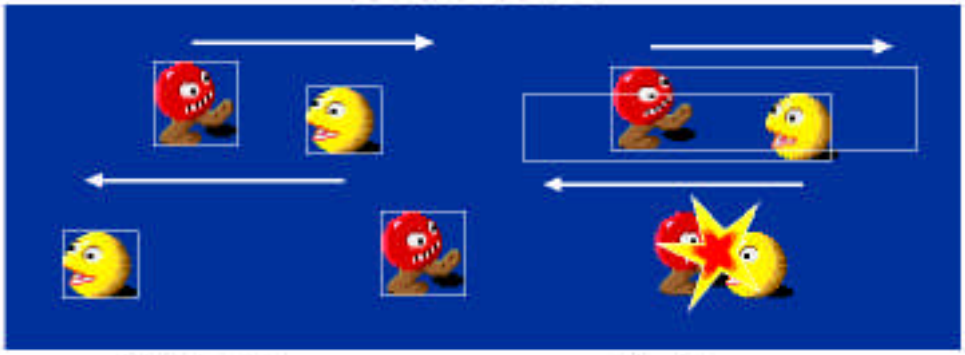
Moving objects

Fast moving objects may pass right through each other.



Wrong Right

An example of *temporal aliasing*

Fast-moving objects

- Test with elongated shapes (sweeping)
- Test several times along the trajectory (multisampling)

Collision handling

What to do once a collision is found.

- Separate
- Change velocities
- Deform
- Maintain constraints

Full (narrow-phase) tests are hard to resolve.

Simple particle physics (again)

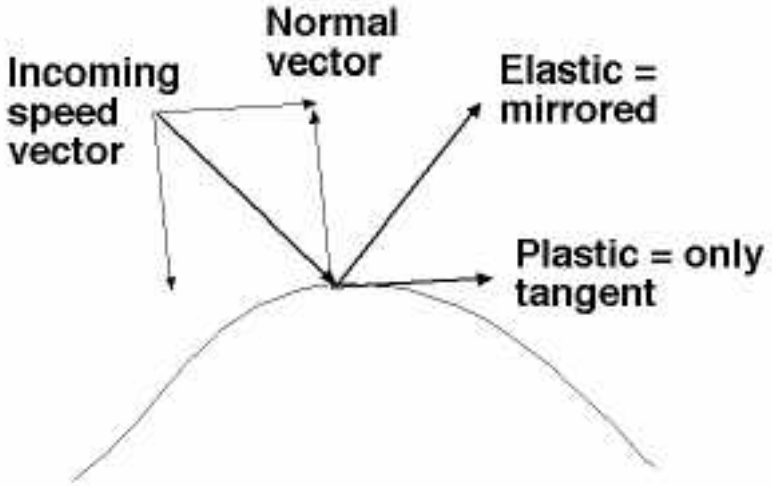
acceleration = gravity + forces/mass
speed = speed + acceleration
position = position + speed

$$a = g + \sum f/m$$
$$s = s + a$$
$$p = p + s$$

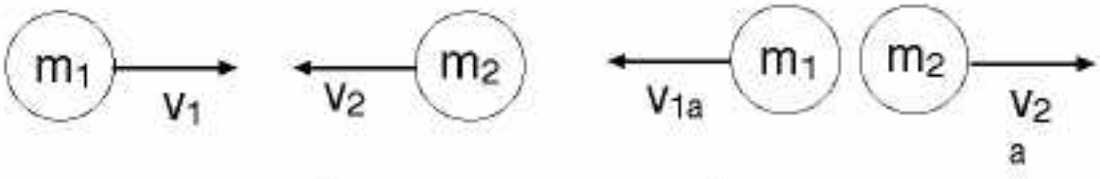
("Euler integration")

Modify speed and position in collisions

Simple particle-surface collision



Plastic and elastic collisions



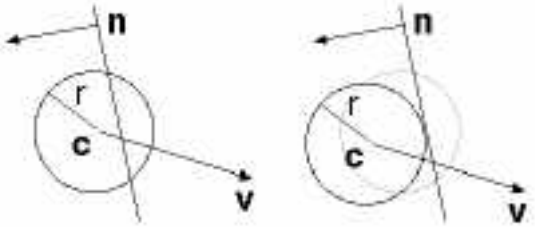
Preserve momentum

$$m_1v_1 + m_2v_2 = m_1v_{1a} + m_2v_{2a}$$

Elastic collisions also preserve kinetic energy

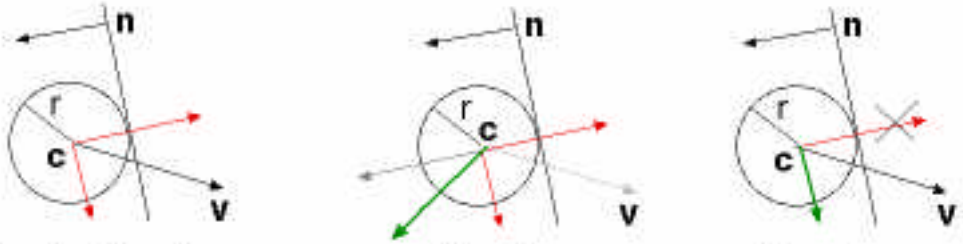
$$m_1v_1^2 + m_2v_2^2 = m_1v_{1a}^2 + m_2v_{2a}^2$$

Collision handling sphere-polyhedra



Assuming stationary polyhedra

Separate - move object away along normal vector

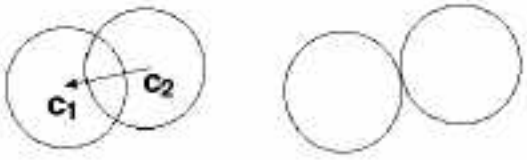


Split velocity along n

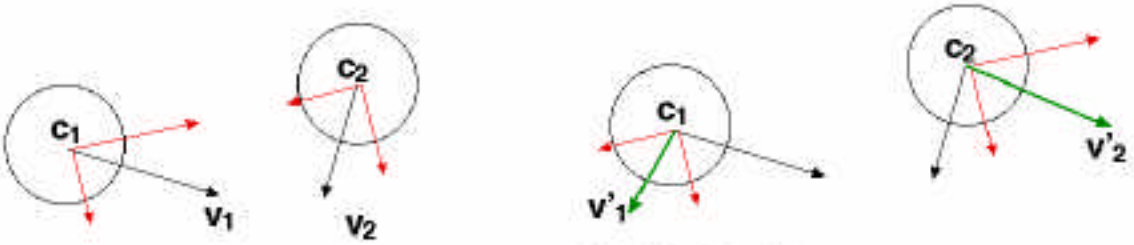
Elastic

Plastic

Collision handling sphere-sphere
(simplified, point masses)



Separate - move object away along vector through centers



Split velocities along vector though centers (c_2-c_1)

Elastic: Exchange components along c_2-c_1

Beyond point-mass mechanics

Rigid body mechanics
Better integration
Stacking
Applying forces and backing time to avoid overlap
Deformable bodies
Breakable bodies