

CS230

Game Implementation Techniques

Lecture 12

Questions?

- Binary Collision Map
 - Introduction
 - Initialization
- Sprite Collision using Hot Spots
- Snapping
- Normalized Coordinates System

Outline

- **Jumping**
 - Hard Coded
 - Linear
 - Accelerated

Jumping in Games

- There are several ways to implement jumping in games, ex:
 - Hard coded elevation:
 - Each elevation height is preset in some data table
 - Linear elevation:
 - Elevation speed is constant while going up and down
 - Accelerated elevation:
 - The elevation is controlled by forces

Accelerated Motion (1/2)

- **Jumping is:**
 - Applying a small upward force to the object, then allow the gravity to smoothly stop the object from going up and to start pulling it down



Accelerated Motion (2/2)

- The mathematical equation:

$$\mathbf{Pos}_1 = \frac{1}{2}a * t^2 + v_0 * t + \mathbf{Pos}_0$$

- a is the acceleration and is the result of the gravity force. Ex:

$$a(0, -g)$$

Accelerated Motion in Games

- In games we divide the previous equation into two parts:

$$v_1 = a * t + v_0$$

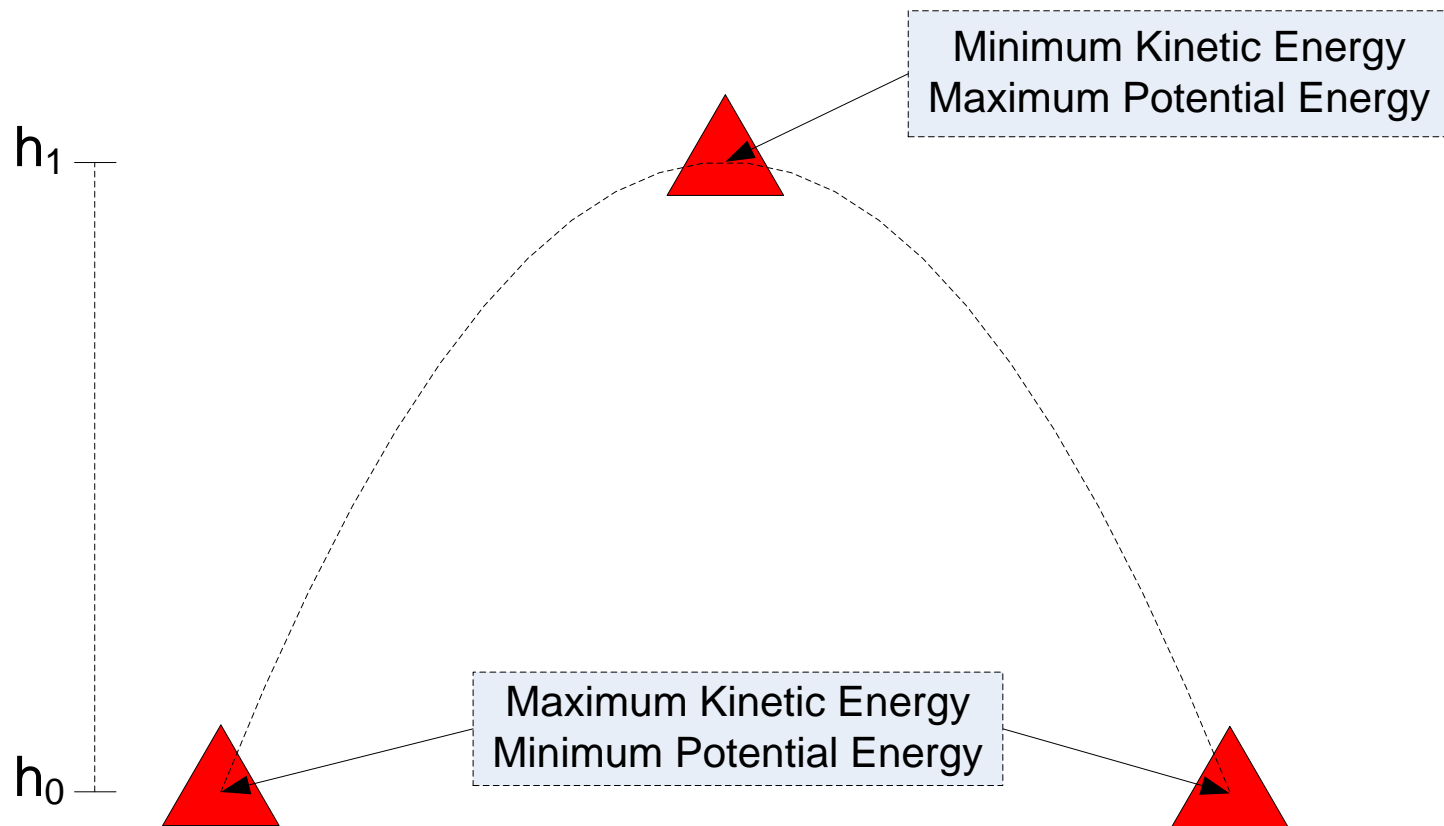
$$\text{Pos}_1 = v_1 * t + \text{Pos}_0$$

Projectile Motion

- How to get a nice projectile motion?
- How to control the elevation?
- Will it be too low? Too high?
- Goal:
 - To have the maximum height reached by the game object directly dependent on the initial velocity.
- Answer:
 - Conservation of energy



Conservation of Energy (1/4)



Conservation of Energy (2/4)

- The total energy (Kinetic and Potential) is constant throughout the entire jump.

$$\frac{1}{2}mv_0^2 + mgh_0 = \frac{1}{2}mv_1^2 + mgh_1$$

0 represents values at the beginning of the jump

1 represents values at the peak of the jump

Conservation of Energy (3/4)

- Removing the mass from the equation we get:

$$\frac{1}{2}v_0^2 + gh_0 = \frac{1}{2}v_1^2 + gh_1$$

- Jumping upwards, we get:

$$\frac{1}{2}v_{y0}^2 + gh_0 = \frac{1}{2}v_{y1}^2 + gh_1$$

Conservation of Energy (4/4)

- Since velocity at the peak of the jump is **0** on the Y axis therefore solving for v_{y0} we get:

$$v_{y0} = \sqrt{2g(h_1 - h_0)}$$

