CS529
Fundamentals of Game Development

Lecture 11b

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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:

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

- ***a*** is the acceleration and can contain the gravity force. Ex:

$$\boldsymbol{a}\,(0,-\boldsymbol{g})$$

Accelerated Motion in Games

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

$$v_1 = a * t + v_0$$

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

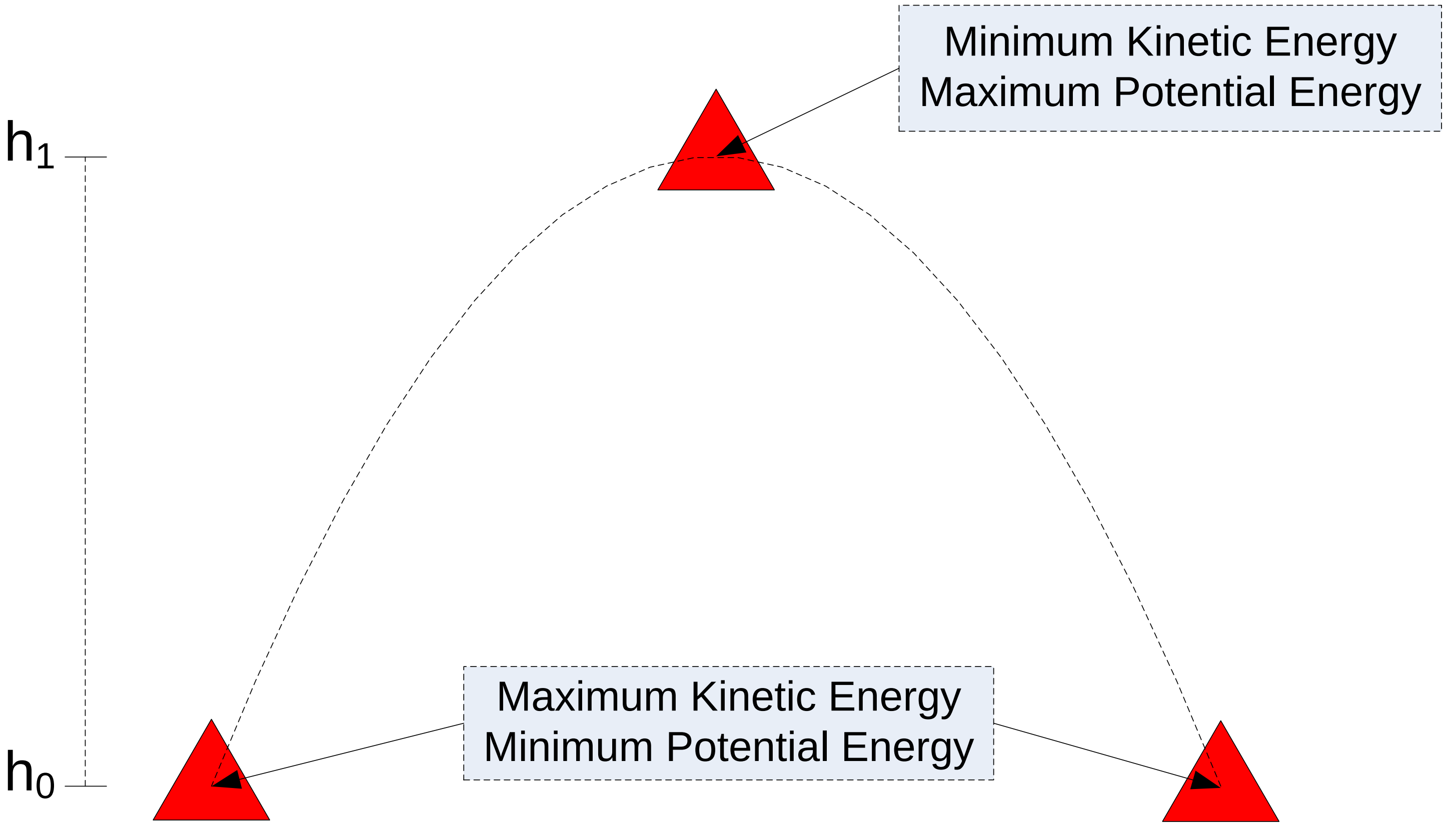
Projectile Motion

- 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 $\mathbf{0}$ on the Y axis therefore solving for v_{y0} we get:

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