# Mechanics Simulations With JavaScript

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# Overview - Why Did I Choose This Topic?

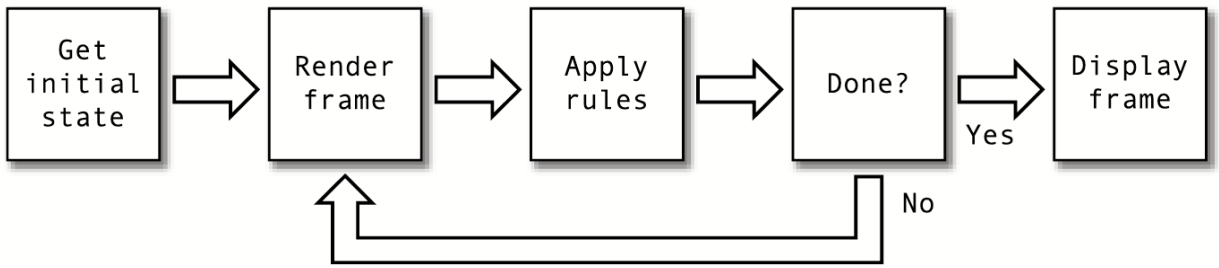


- I hope to use programming as a lens to view physics
- Examine mechanics in more detail
- Solve physics problems through simulations
- JavaScript high level language - viewable easily in web browser

# What is a simulation?



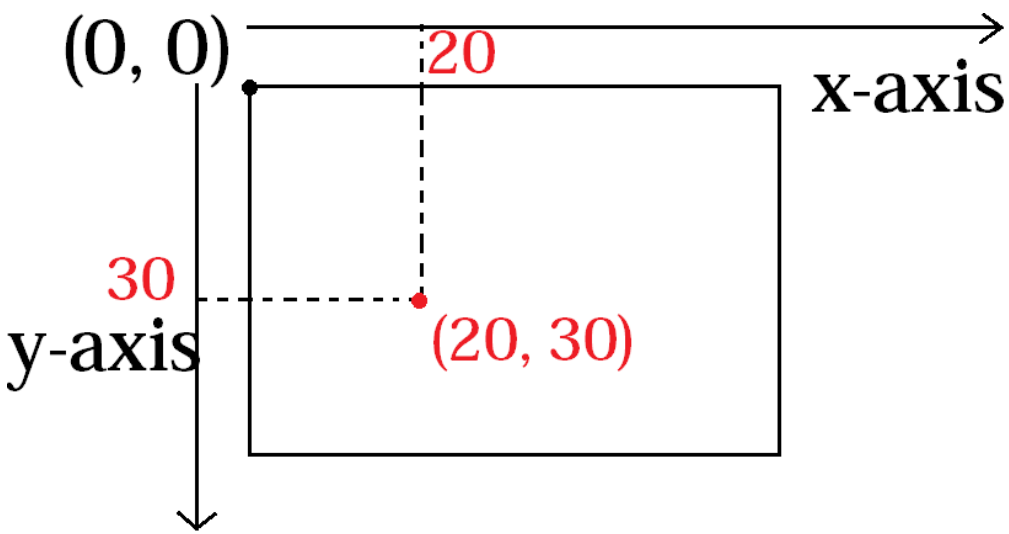
- Animation vs. Simulation
- Frames per second
- File size



# Method of Basic Simulation



- HTML5 canvas application programming interface (API)
- Timer for each frame



# Chapter 1: Basic kinematics and aerodynamic drag



- Three simulations
- Simulation #1: Basic bouncing ball
- Simulation #2: Bouncing ball with aerodynamic drag
- Simulation #3: Multiple bouncing balls

# Simulation #1: Basic Bouncing Ball



- Realistic g value
- $9.81 \frac{px}{s^2} = .1635 \frac{\frac{px}{s}}{frame} \times \frac{60 frame}{s}$

- Coefficient of restitution ($C_r$)
- $C_r = \sqrt{\frac{KE_f}{KE_i}} = \sqrt{\frac{\frac{1}{2}mv_f^2}{\frac{1}{2}mv_i^2}} = \frac{v_f}{v_i}$
- $v_f = v_i * C_r$

# Simulation #2: Bouncing Ball With Aerodynamic Drag

# Simulation #1: Study of Fluid Dynamics



$$F_D = \frac{1}{2}\rho v^2 C_D A$$

- $F_D$ = force of drag
- $\rho$ = density of fluid
- $v$ = speed of object relative to fluid
- $C_D$ = drag coefficient (affected by texture, shape, viscosity, lift, etc)
- $A$ = cross-sectional area of object

I will examine the drag coefficient in more detail and simulate various objects' flight path with different resistances.

# Simulation #2: Study of Charged Particles in Magnetic Fields



Lorentz Force Law: $F = q\vec{v} \times \vec{B}$

I will examine situations where the magnetic field $\vec{B}$ isn't uniform.

Other physics topics I want to pursue: gyroscope, a complex astronomy simulation, rigid-body mechanics.

# Thank You