Hamiltonian Mechanics (one of Analytical Mechanics)

- Example of "Free Fall"

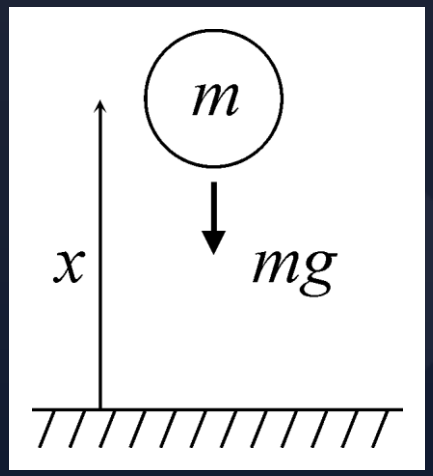
$$H = \frac{1}{2}mv^2 + mgx = \frac{p^2}{2m} + mgx$$

Hamilton's canonical equation

$$\frac{dq}{dt} = \frac{dH}{dp} \qquad \frac{dp}{dt} = -\frac{dH}{dq}$$

$$\frac{dx}{dt} = \frac{p}{m} \qquad \frac{dp}{dt} = -mg$$

$$m\frac{d^2x}{dt^2} = -mg$$



Newtonian Mechanics
Equation of Motion

$$m\frac{d^2x}{dt^2} = f$$