Lagrangian Mechanics/Dynamics

In Chronological Order,

- Newtonian
- Lagrangian
- Hamiltonian

We define a new function, called the *Lagrangian*:

$$L(q, \dot{q}, t), \text{ WHERE}$$

- q is the generalized coordinates
- $\dot{q}$ is the generalized velocity.
- $\dot{q} = \frac{dq}{dt}$. The dependence on time is implicit, not explicit.

The energy represented in a Lagrangian is:

$L = K(q) - U(\dot{q})$

Of many paths that can be taken in between 2 states $(q_1, \dot{q_1})$ **and** $(q_2, \dot{q_2})$ **the path taken is the *Path of least action***

Deriving Lagrange's Equations of Motion:

Consider 2 paths: POLA and a neighbouring. Let δq be difference in the two's qs. We get

$\frac{\partial L}{\partial q} - \frac{d}{dt}(\frac{\partial L}{\partial \dot{q}})$

Now, next step:

Relation between Lagrangian and Hamiltonian:

$H = \sum_i (\dot{q}_i \frac{\partial L}{\partial \dot{q}_i} - L)$