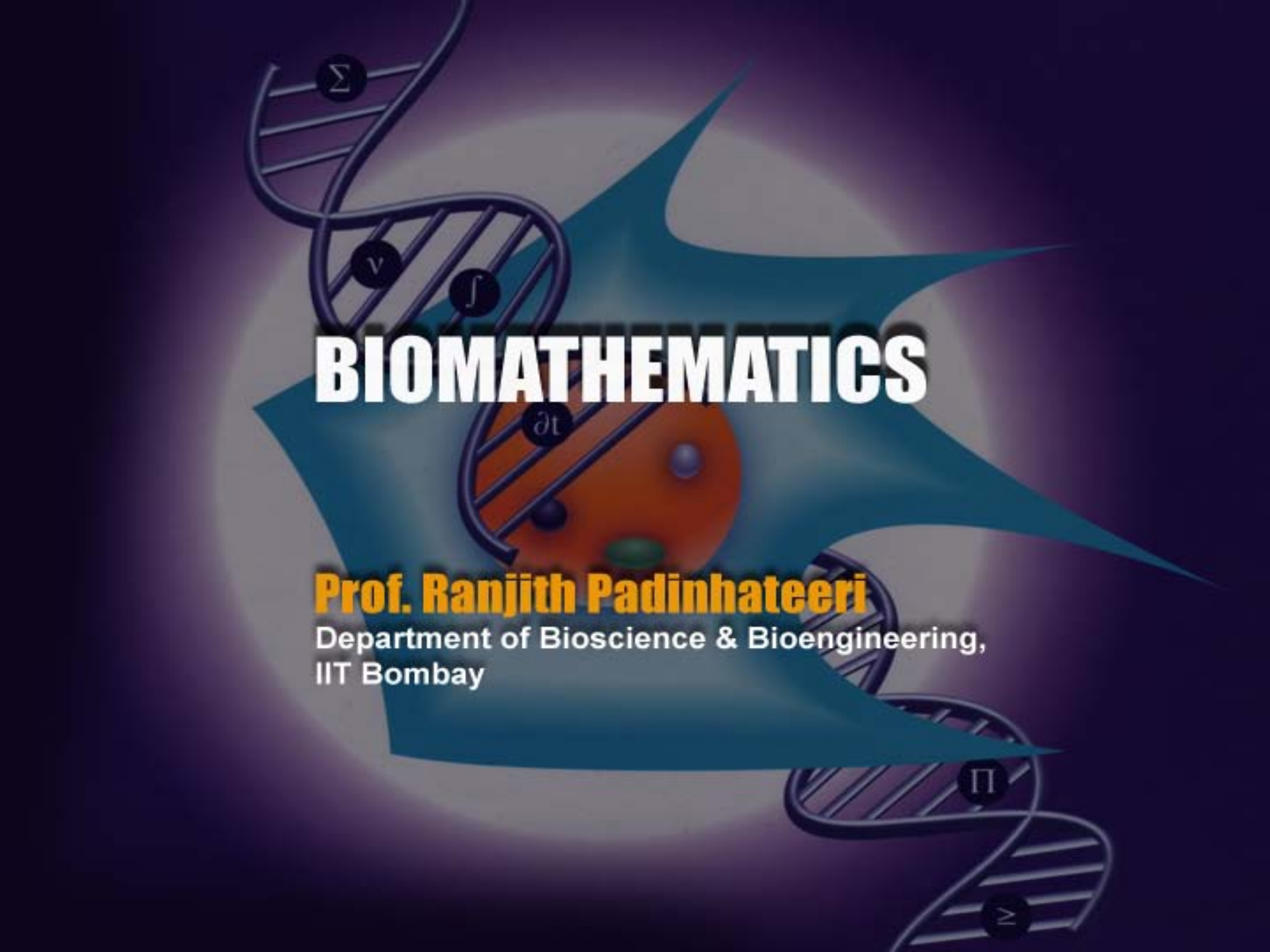

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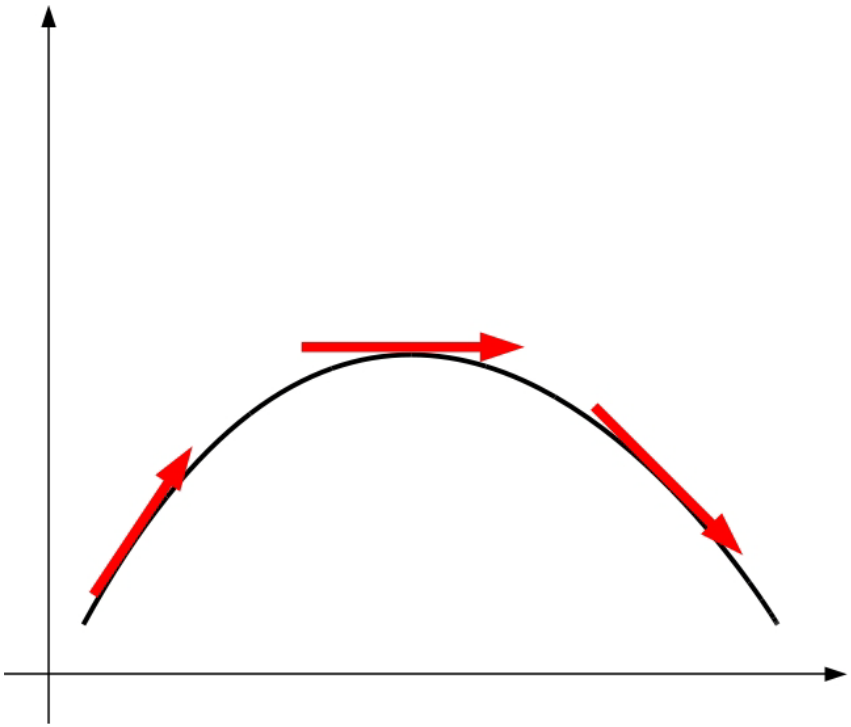
Differentiation and its applications

Curvature: Change in slope



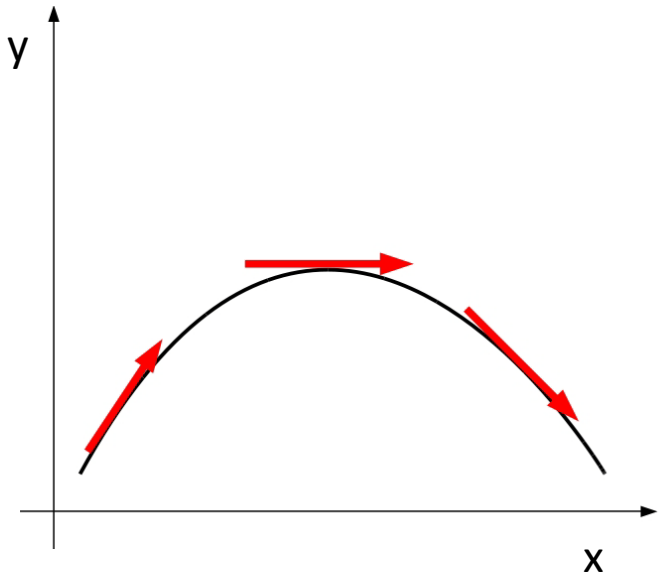
Positive slope

Zero slope

Negative slope

Slope decreases as we go along x (convex)

Curvature, C(x)



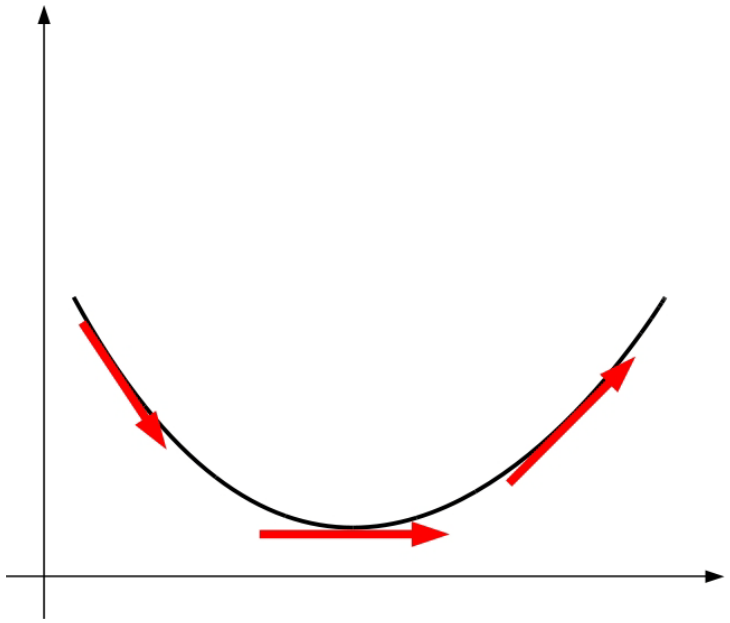
$$m(x) = \frac{dy}{dx}$$

$$C(x) = \frac{d}{dx}(m(x)) = \frac{d}{dx}\left(\frac{dy}{dx}\right) = \frac{d^2y}{dx^2}$$

C(x) is negative

Slope decreases as we go along x

Curvature: Change in slope



Negative slope

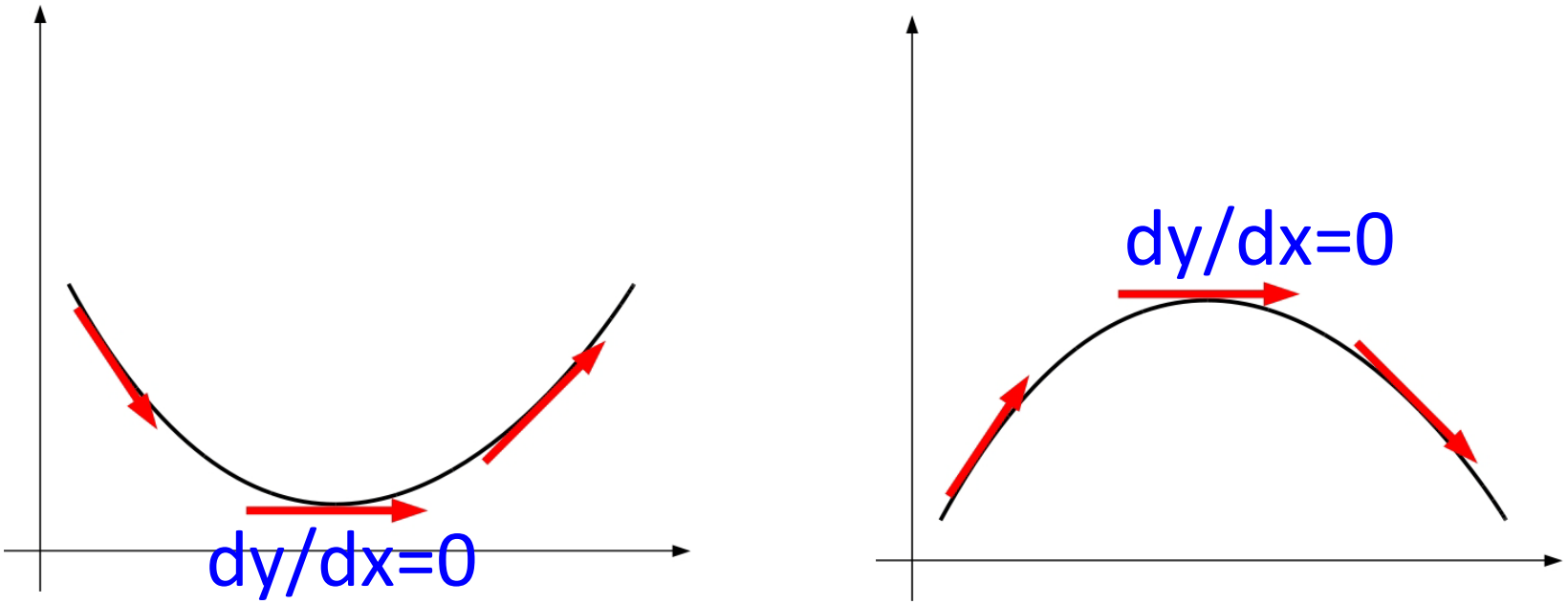
Zero slope

Positive slope

C(x) is positive

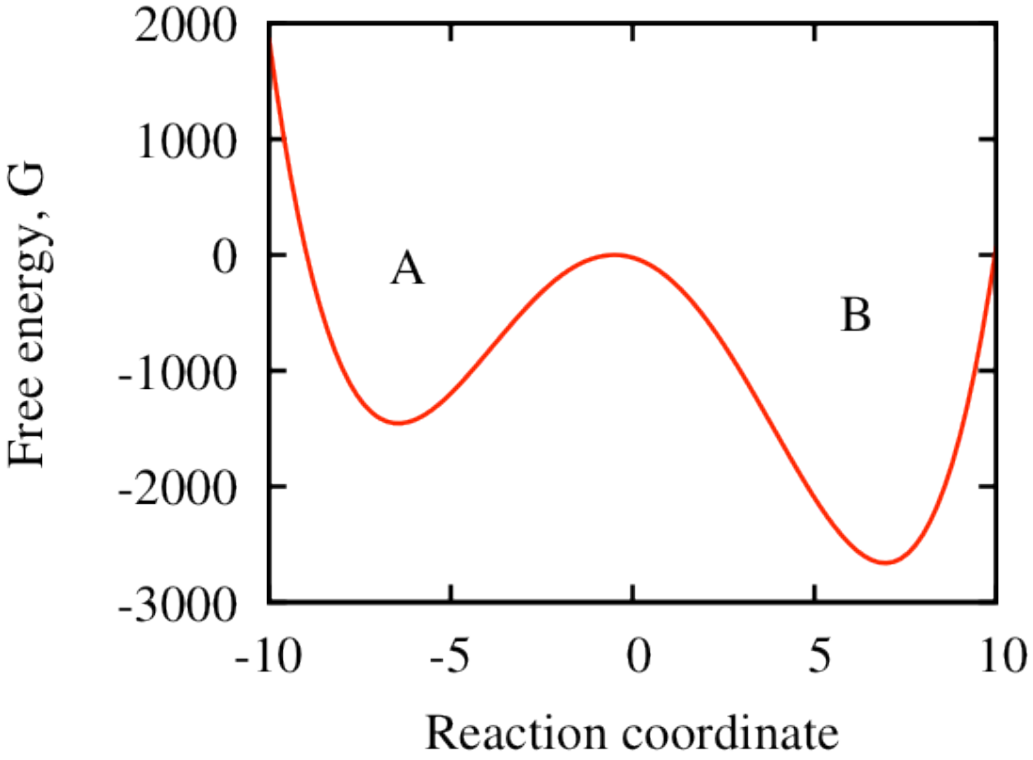
Slope increases as we go along x (concave)

Curvature: Change in slope



First derivative (slope) is zero
at maximum and minimum

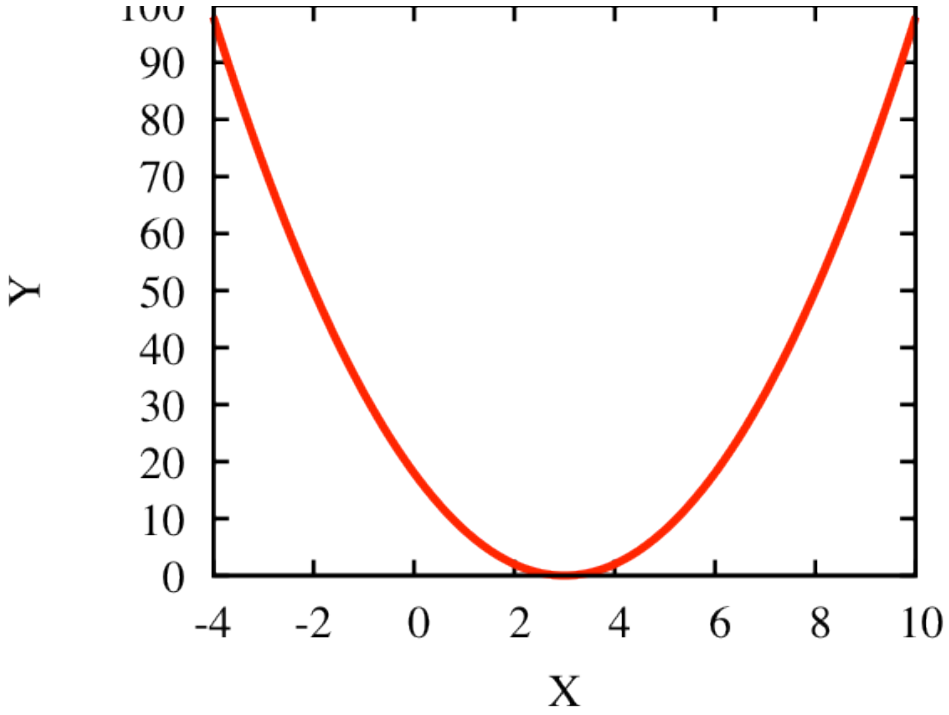
Minima of free energy



$$Y = pX^4 - qX^2 - mX + c$$

p,q,m, and c are some numbers

Energy of a spring-like protein

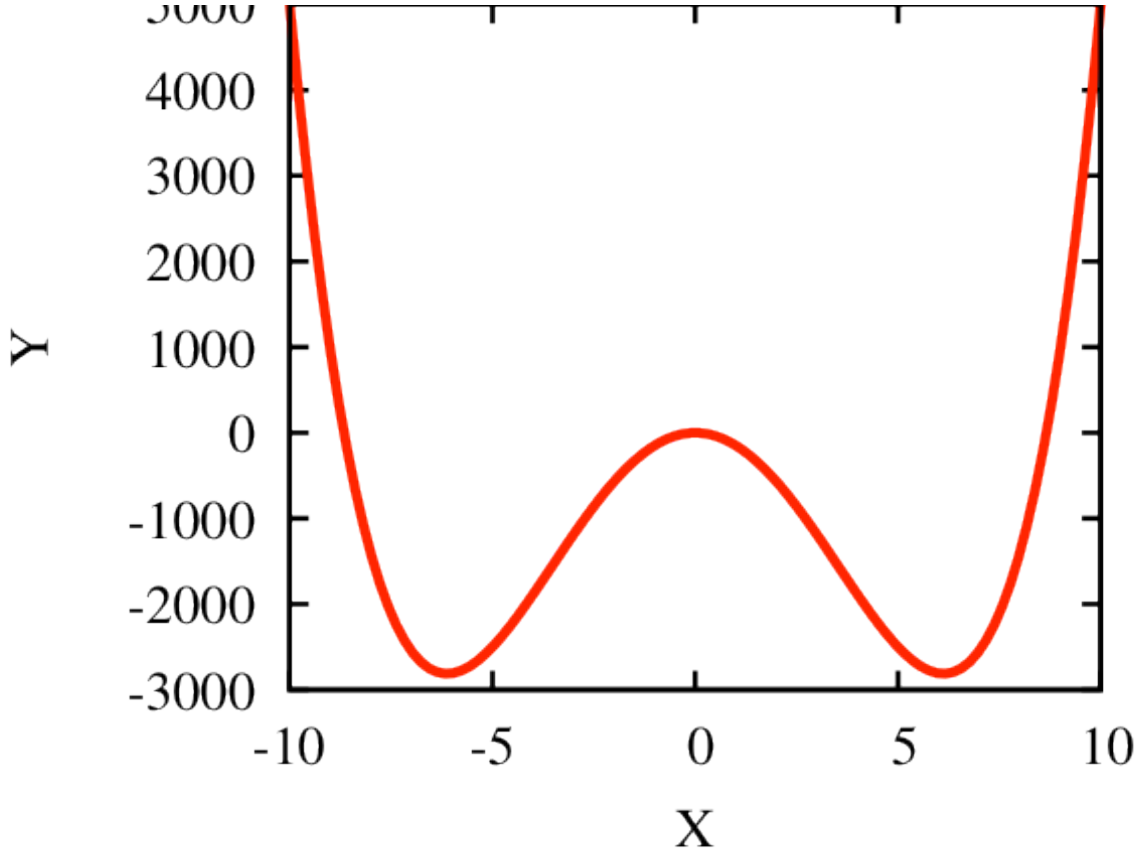


$$Y = 2(X - 3)^2$$

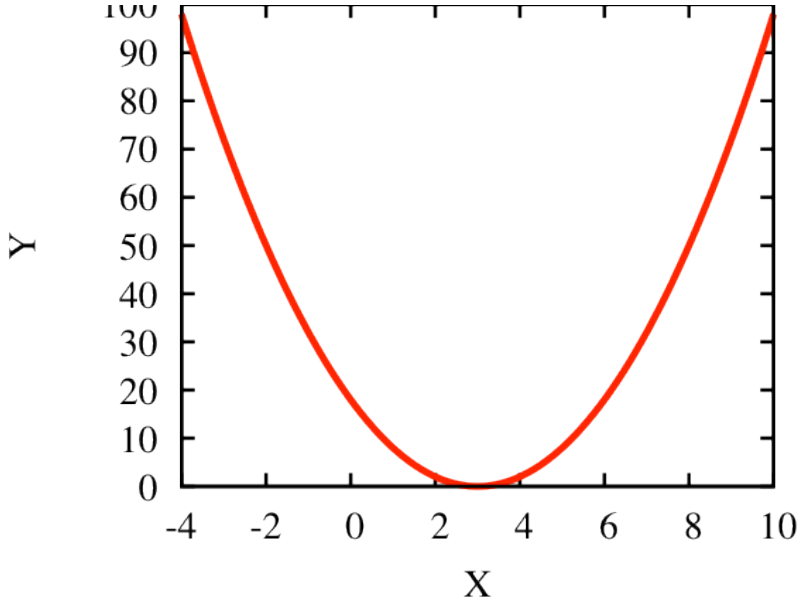
Chain rule

$$\frac{dy(u(x))}{dx} = \frac{dy}{du} \cdot \frac{du}{dx}$$

$Y=2X^4-150X^2$



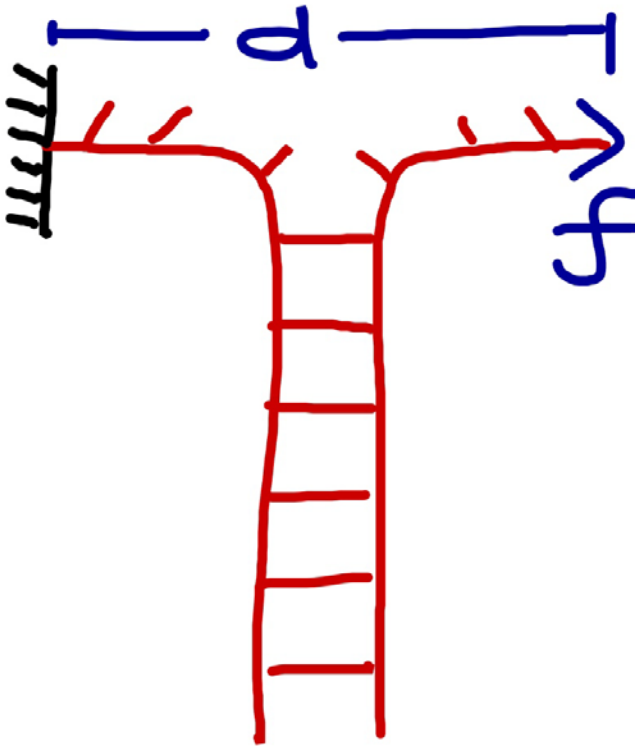
Force: derivative of energy



$$E = \frac{1}{2} k x^2$$

$$f = -\frac{dE}{dx} = -kx$$

DNA unzipping by force



G(f) : Gibb's free energy

If we know Gibb's free energy we can predict distance vs force relation

$$d = \frac{dG(f)}{df}$$