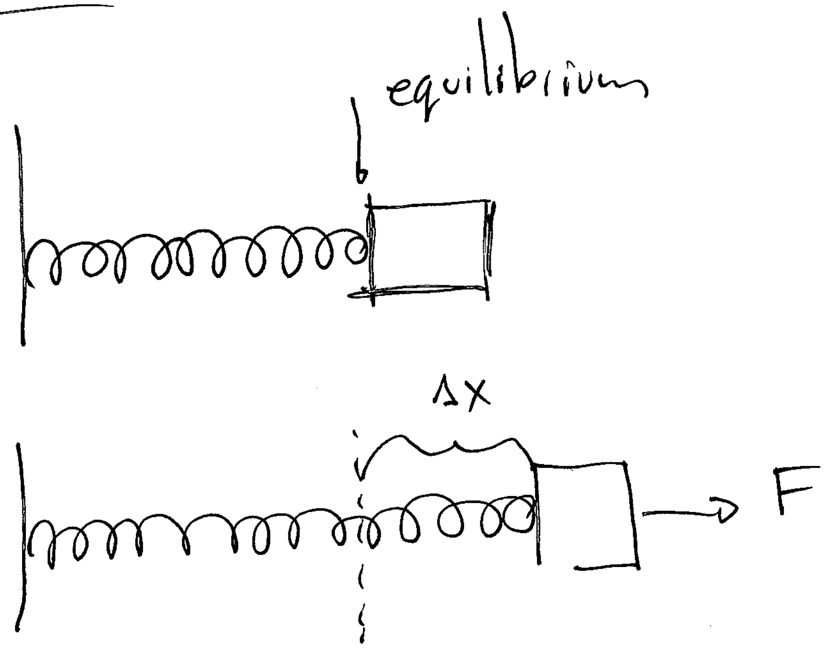
LAST CLASS:

Conservation of Energy (from time-translation symmetry)

total energy before = total energy after

↑ for isolated system.
Can always make system bigger.

Hooke's Law



$$F = -k|\Delta x|$$

The potential energy from this is

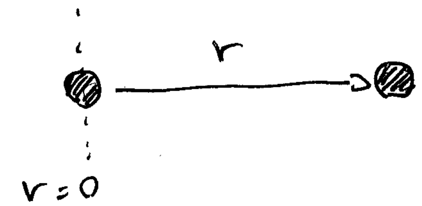
$$U = \frac{1}{2} k (\Delta x)^2$$

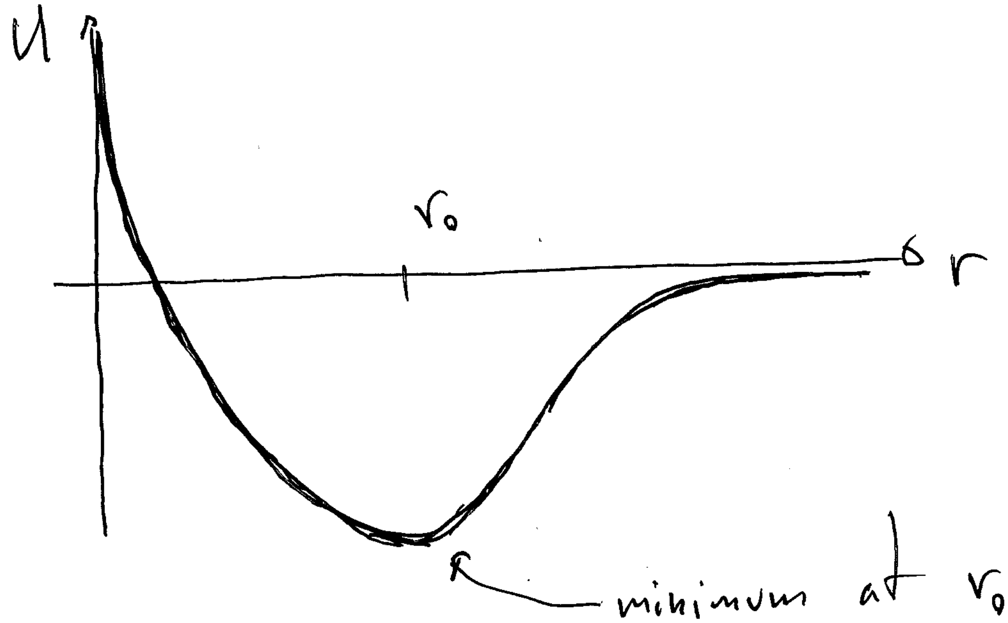
note: $F = -\frac{dU}{dx}$ is allways true!

.... for a conservative Force.
(i.e. energy isn't lost)

Why is it only sort of true?

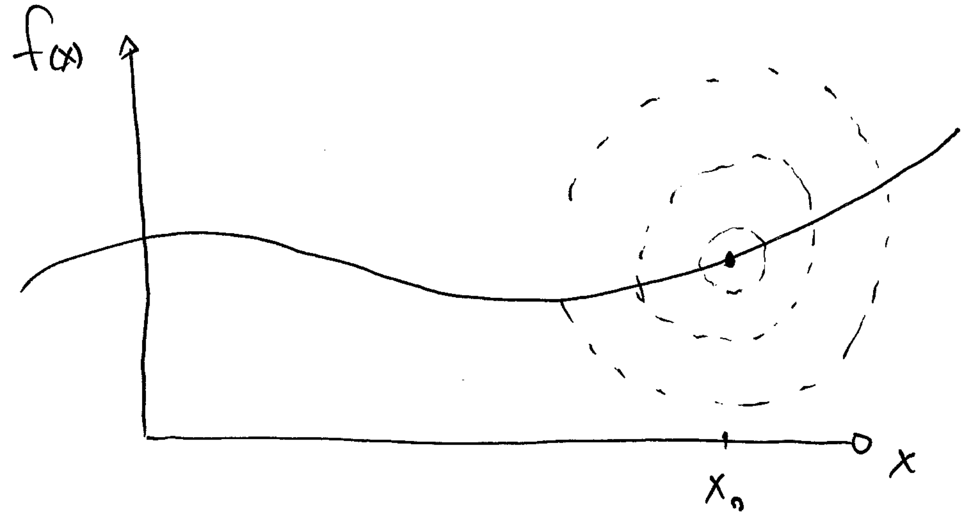
Interaction between molecules

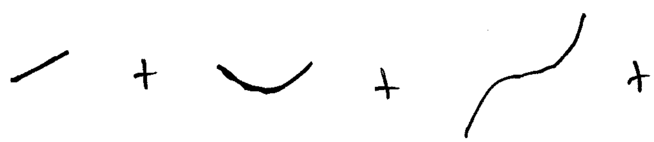




Not a parabola, but close to one at r_0.

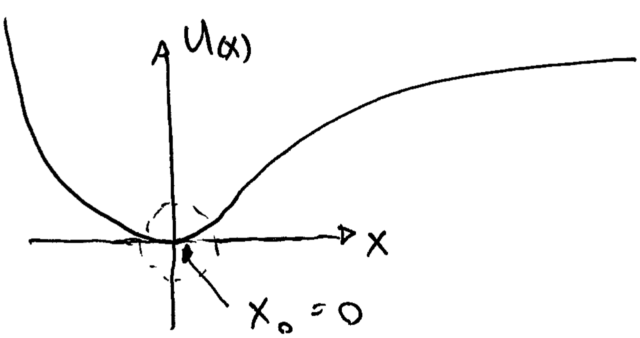
APPROXIMATING A FUNCTION NEAR A POINT:



$f(x) \approx$  $+ \ldots$

$$\approx f(x_0) + c_1(x - x_0) + c_2(x - x_0)^2 + \ldots$$

For molecular potential:



Choose axis centred at minimum. Near zero

$$U(x) \simeq U(0) + c_1 x + c_2(x^2) + \ldots$$

$U(0)$ → 0 because $U(0)$ is zero

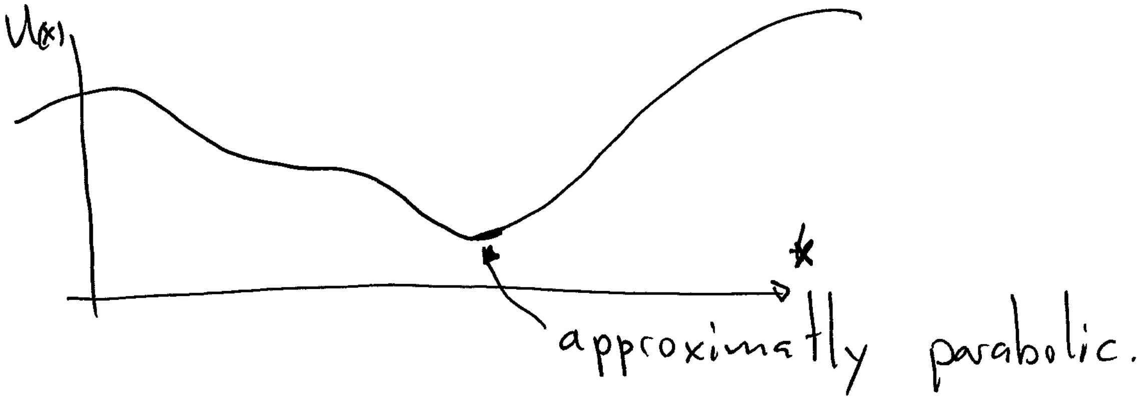
c_1 → 0 because slope is zero

$$\approx c_2 x^2 + \ldots$$

$c_2 = \frac{k}{2}$

very close to $x = 0$ $U(x)$ looks like Hooke's law.

Everything Wiggles:



$$U(x) \approx \frac{1}{2} k x^2$$

At the bottom of any potential.

Almost everything can be described with simple harmonic motion (sinusoids). Also called periodic motion.