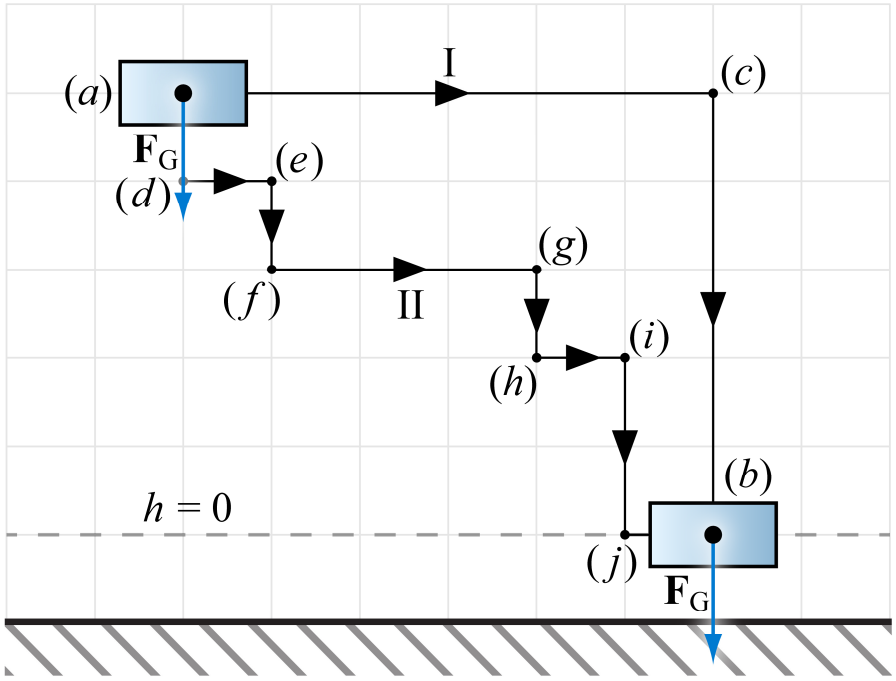
Potential energy

When the relative spatial arrangement of a collection of objects is changed, the total work performed by a given collection of third-law force pairs might or might not depend on the specific paths objects take to get from old to new positions. If this total work is **path-independent** for all combinations of initial and final positions in a domain of interest, we can choose to call this total work the negative of the change in the **potential energy** associated with the given collection of third-law force pairs.

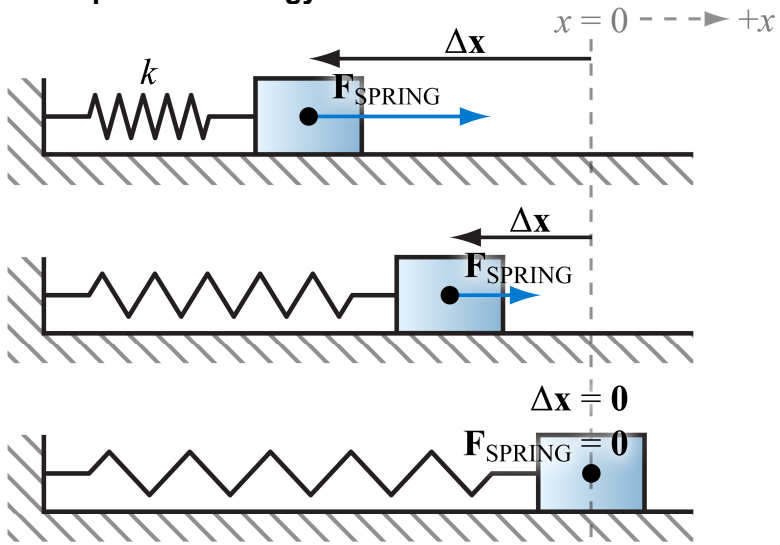
$$-\Delta U_{\mathrm{F},1\ldots N} := \Delta W_{\mathrm{F},2 \text{ ON } 1} + \Delta W_{\mathrm{F},1 \text{ ON } 2} + \cdots + \Delta W_{\mathrm{F},N-1 \text{ ON } N}$$

Gravitational potential energy near the surface of the Earth



$$\Delta U_\mathrm{G} = mg\Delta h$$

Elastic potential energy



Consider the work that the spring force would perform while pushing back from an initial distance of $|\Delta\vec{\mathbf{x}}|$ to a final distance of $|\Delta\vec{\mathbf{x}}| = 0$.

$$|\vec{\mathbf{F}}_\mathrm{SPRING}| = k|\Delta\vec{\mathbf{x}}|$$

$$\Delta U_\mathrm{S} = \frac{1}{2}k(\Delta x)^2$$