Newton's Laws

• **Newton's 1ˢᵗ Law (Same as Galileo's law of inertia): No force => no acceleration.**

"An object at rest stays at rest and an object in motion stays in motion with the same speed and in the same direction unless acted upon by a force."

$$\vec{F} = 0 \quad \Rightarrow \quad \vec{v} = const$$

• **Newton's 2ⁿᵈ Law:**

"Force equals mass times acceleration"

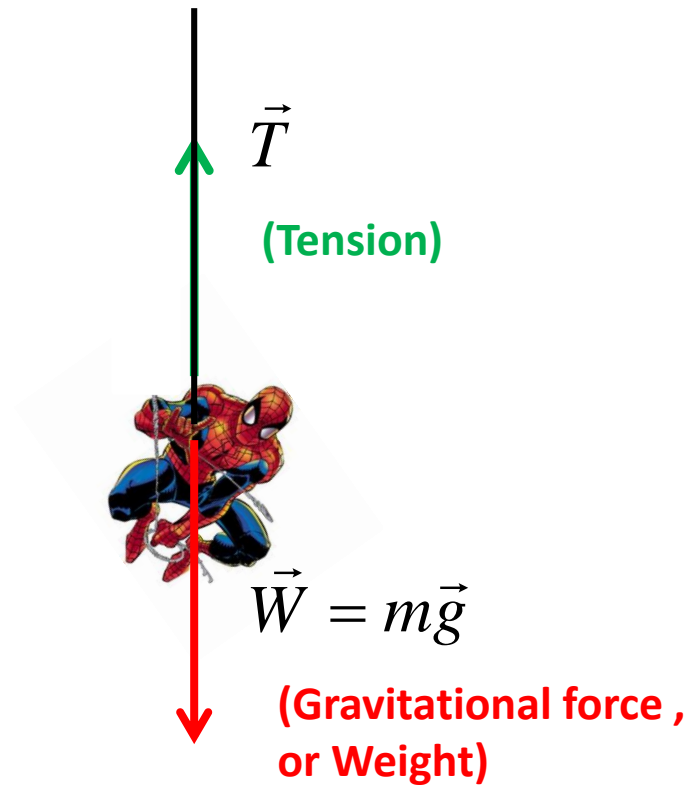$$\vec{F} = m\vec{a}$$

• **Newton's 3ʳᵈ Law:**

"Any Force of action has an equal and opposite Force of reaction "

$$\vec{F}_{B \rightarrow A} = -\vec{F}_{A \rightarrow B}$$

Unit of force is called Newton (N)

$$1N = 1\frac{kg \cdot m}{s^2}$$

Examples of Forces
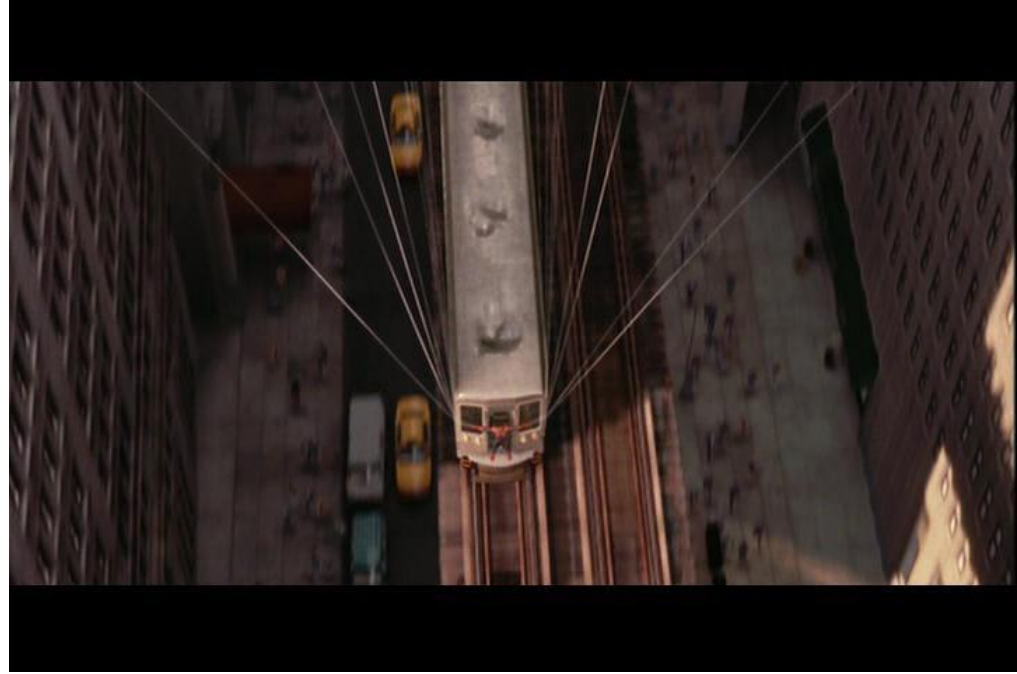
$$\vec{T}$$

(Tension)

$$\vec{W} = m\vec{g}$$

(Gravitational force , or Weight)

Forces a vectors! The total force is the *vector sum* of all applied forces:

$$\vec{F}_{total} = \vec{N} + \vec{W}$$

Homework

In the movie Spiderman 2, Peter Parker aka Spiderman manages to stop the train by using his web. (search youtube for "**Peter Stops The Train!**" clip). It takes t=45s of screen time. The initial speed of the train is approximately v=80 km/hr (you'll need to convert to m/s!).

Find the average acceleration of the train, and the force that Spiderman can hold. This force   is of strategic importance for any villain: you can see from the video that the superhero is close to his limit. Mass of the NYC subway train (full of people) is 300,000kg.