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."

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

Modern interpretation: "there exists a reference frame called inertial, in which the above statement is correct."

- **Newton's 2nd Law:**

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

"Force equals mass times acceleration"

- **Newton's 3rd Law:**

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

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

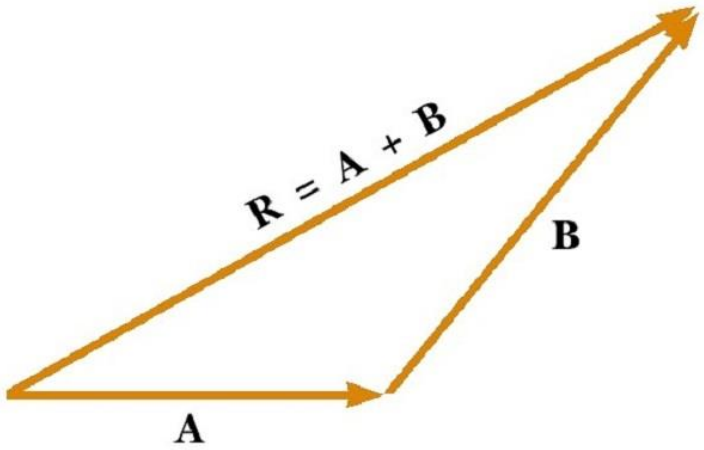
Unit of force is called Newton (N) $1N = 1\frac{kg \cdot m}{s^2}$

Adding Forces

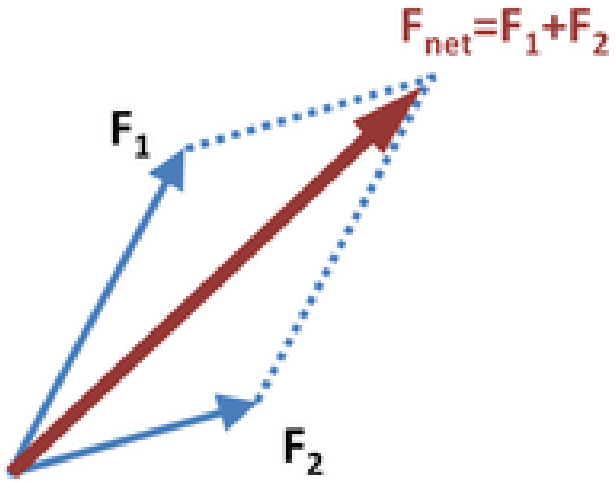
- Force is a measure of interaction. It is a vector (has direction)
- When several forces are acting on an object, they **are added as vectors**

There are two equivalent ways of adding vectors graphically:

Triangle rule
(best for displacements)



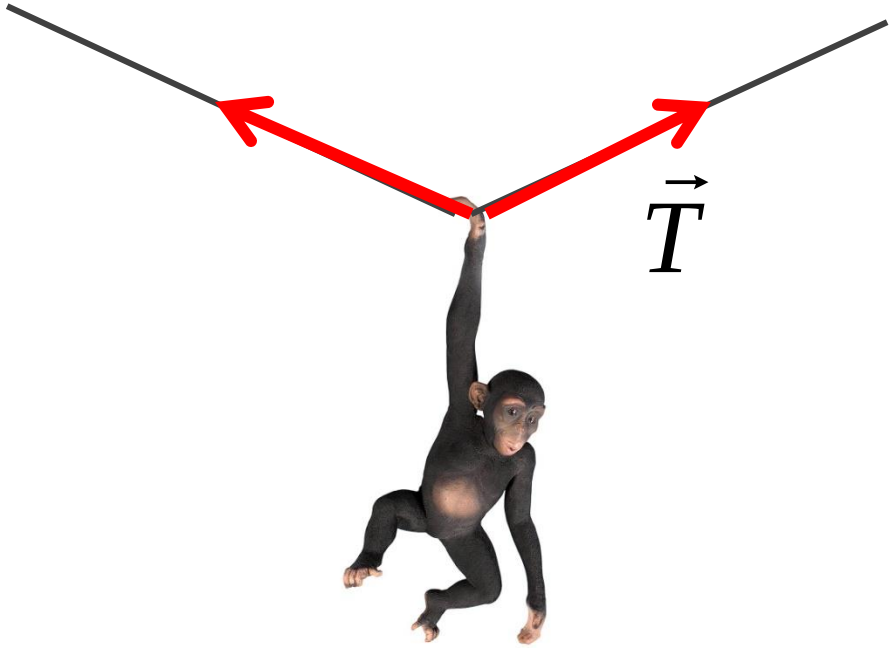
Parallelogram rule
(best for forces)



Homework

Problem 1.

A monkey is hanging on a wire as shown in the figure. Find the tension force **T** (shown as red arrows), by using the graphical method of force addition. The mass of monkey is ***m=10 kg***. Remember that gravity acts on it with a downward force ***mg.***



Problem 2.

A rocket shown in the figure has mass ***m=10 kg***. In addition to gravity, there is a thrust force ***F= 200N*** applied to it, directed forward.

a) Sketch both forces (gravity and thrust) as vectors, up to scale to each other.
b) By adding forces graphically, find the total force acting on the rocket, and its acceleration.