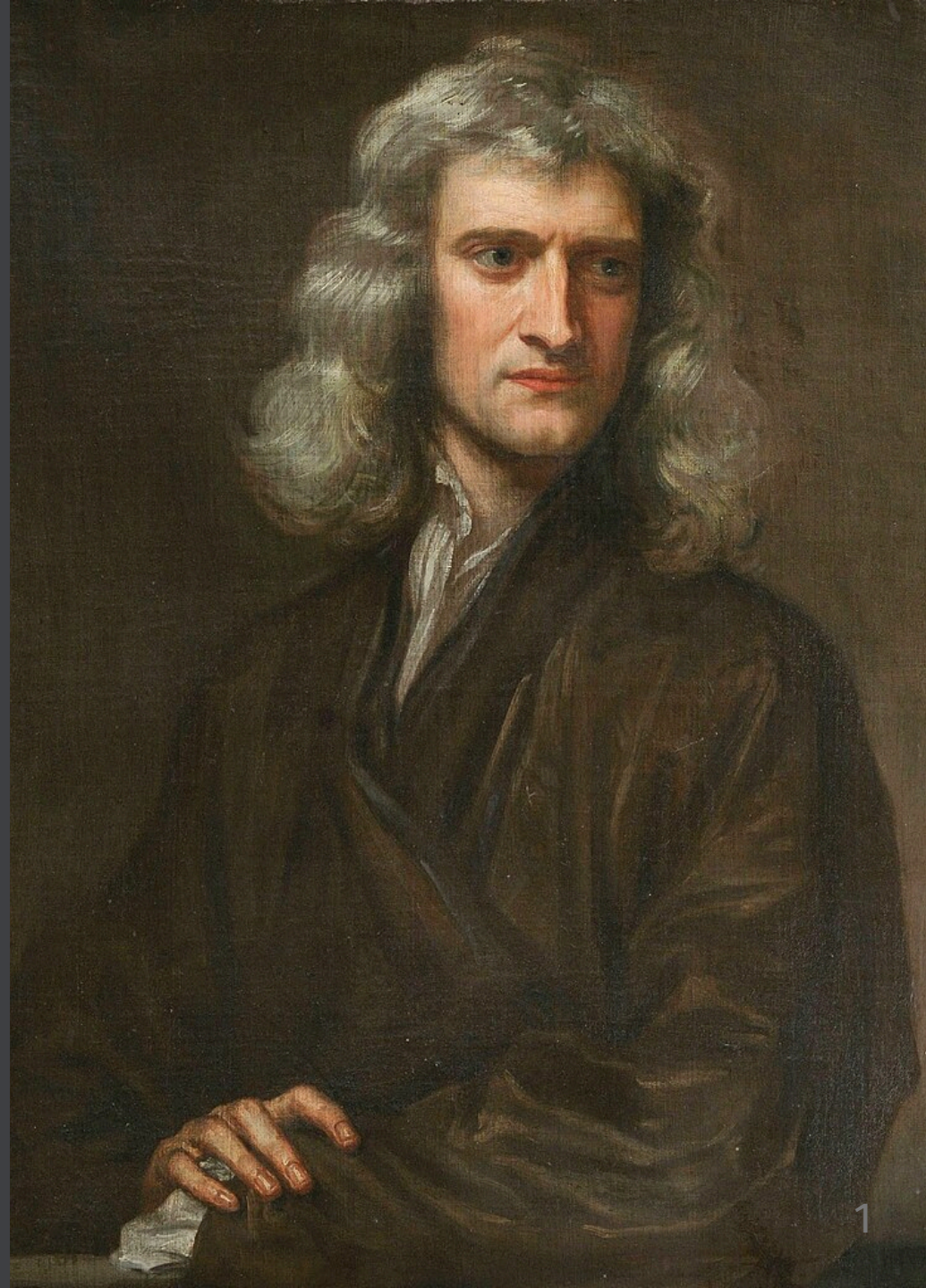
Day 02 - Newton's Laws

$$\mathbf{F}_{net} = m\mathbf{a}$$



Announcements

- Homework 1 is due next Friday
- Help sessions will start next week
- Friday's class will include AI policy discussion
    - We will work Problem 1 together and start discussing Problem 6

Goals for this week

Be able to answer the following questions.

- What is Classical Mechanics?
- How can we formulate it?
- What are the essential physics models for single particles?
- What mathematics do we need to get started?

Take 2 min to write down what comes to mind when asked:

What is "Classical" Physics?

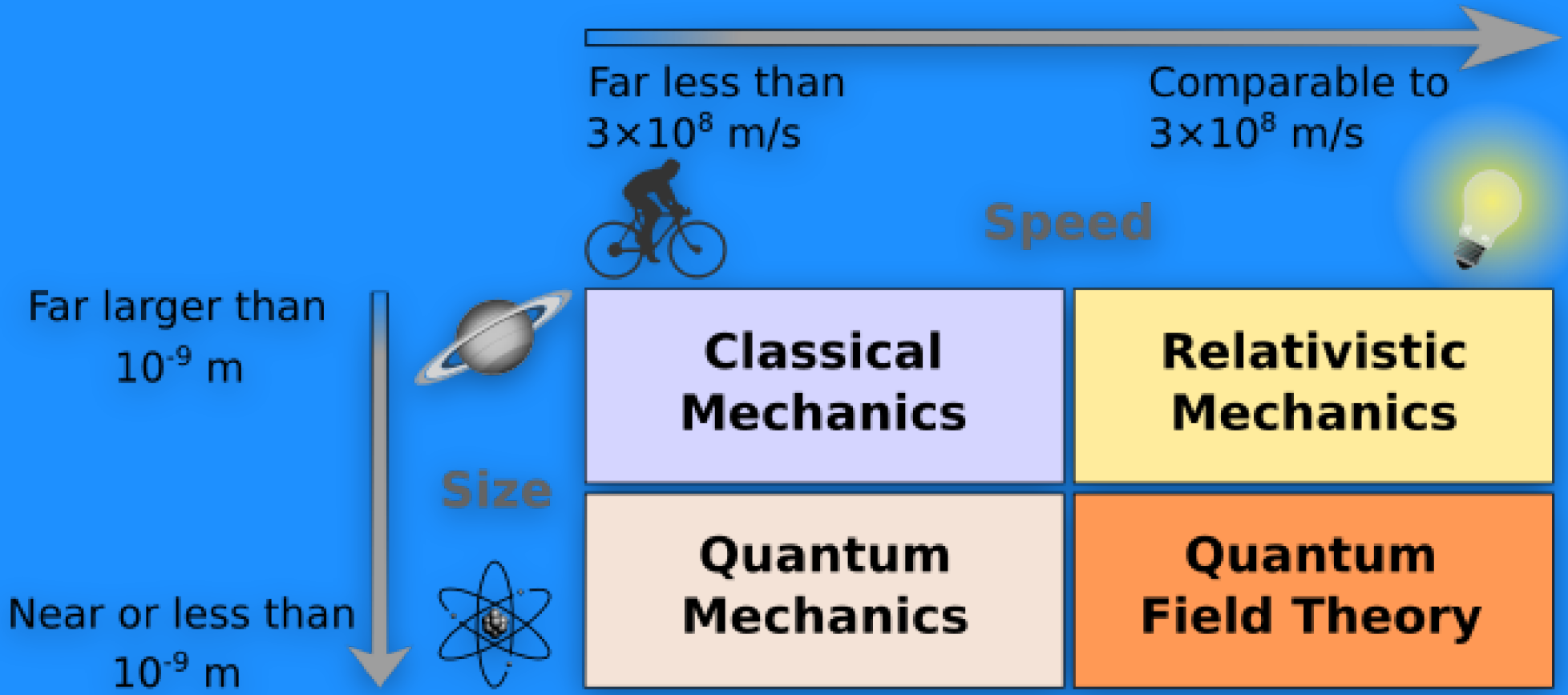
Classical Mechanics

Modeling large, slow-moving objects

Newton's Laws are but one of a number of formulations:

- Lagrangian Mechanics
- Hamiltonian Mechanics
- Dynamical Systems Theory
- ...

An Overview of Different Physics



Classical Mechanics is still very relevant

Tiny Limbs and Long Bodies: Coordinating Lizard Locomotion

Research Lab

Source: https://youtu.be/Qme07fA3Fj4

Think-Pair-Share

We used a tilted coordinate system ($x-y$ plane) to analyze the motion of a block on an inclined plane. How can we check that we did the gravitational force decomposition correctly?

Recall:

- $F_{\text{gravity}}, x = mg\sin(\theta)$
- $F_{\text{gravity}}, y = mg\cos(\theta)$

Come up with at least two checks.

Clicker Question 2-1

The formal definition of a Taylor series expansion around a point a is:

$$f(x) = f(a) + f'(a)(x-a) + \frac{f''(a)}{2!}(x-a)^2 + \frac{f'''(a)}{3!}(x-a)^3 + \dots$$

This formula makes me feel:

1. Confident, I got this.
2. A little nervous, but I think I remember.
3. Uncomfortable, I don't remember this.
4. I have no idea what this is.

Think-Pair-Share

We derived the following differential equation for the falling ball in one-dimension:

$$\frac{d^2y}{dt^2} = +g - \frac{b}{m}\frac{dy}{dt} - \frac{c}{m}\left(\frac{dy}{dt}\right)^2$$

Let's assume the turbulent drag term is negligible. Is there an anti-derivative of the right-hand side of this equation? If so, what is it?

$$\frac{dv}{dt} = +g - \frac{b}{m}v$$