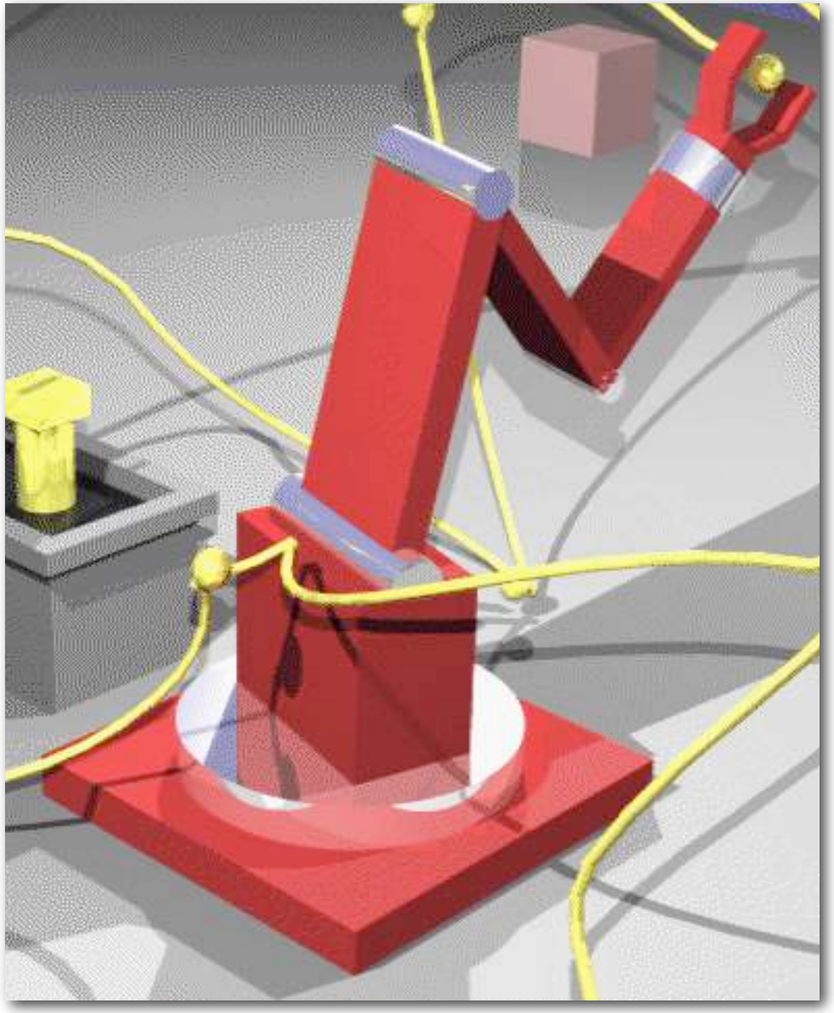
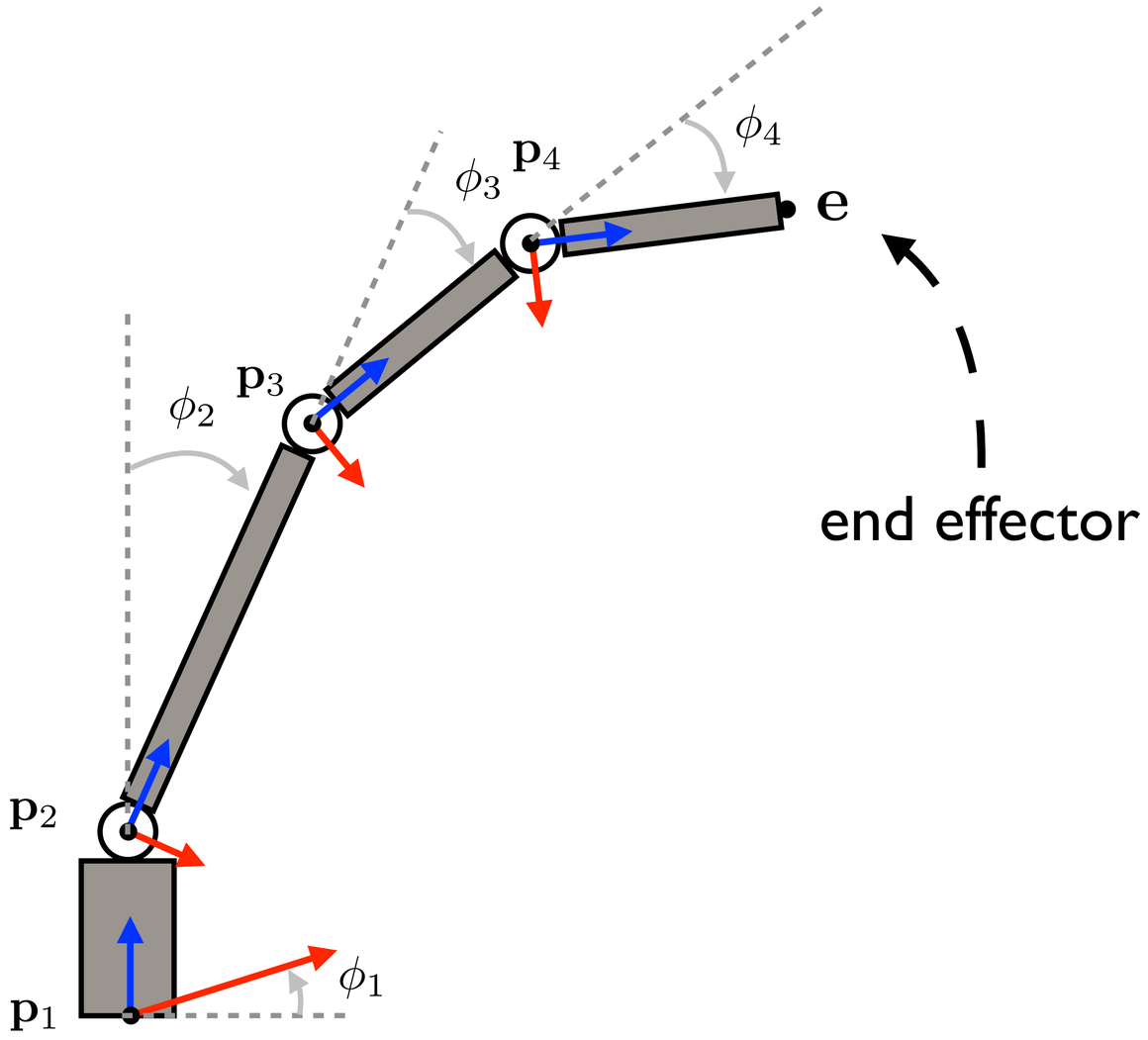
Animating a robot arm: Part 1

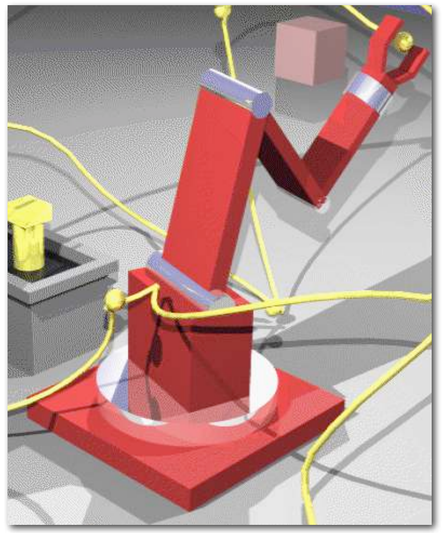


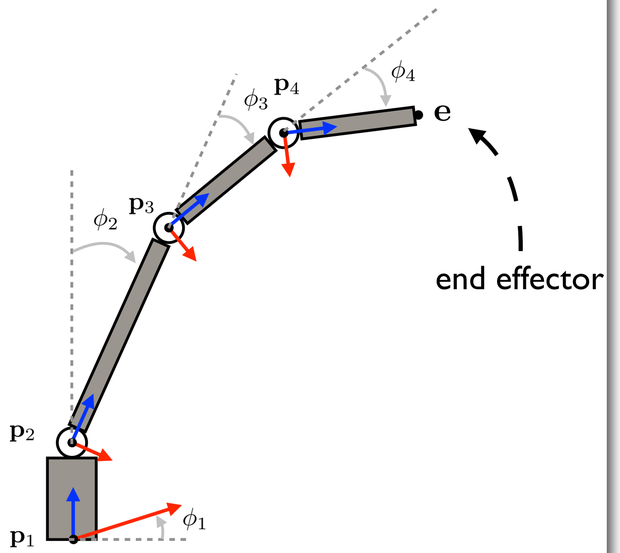


Overview

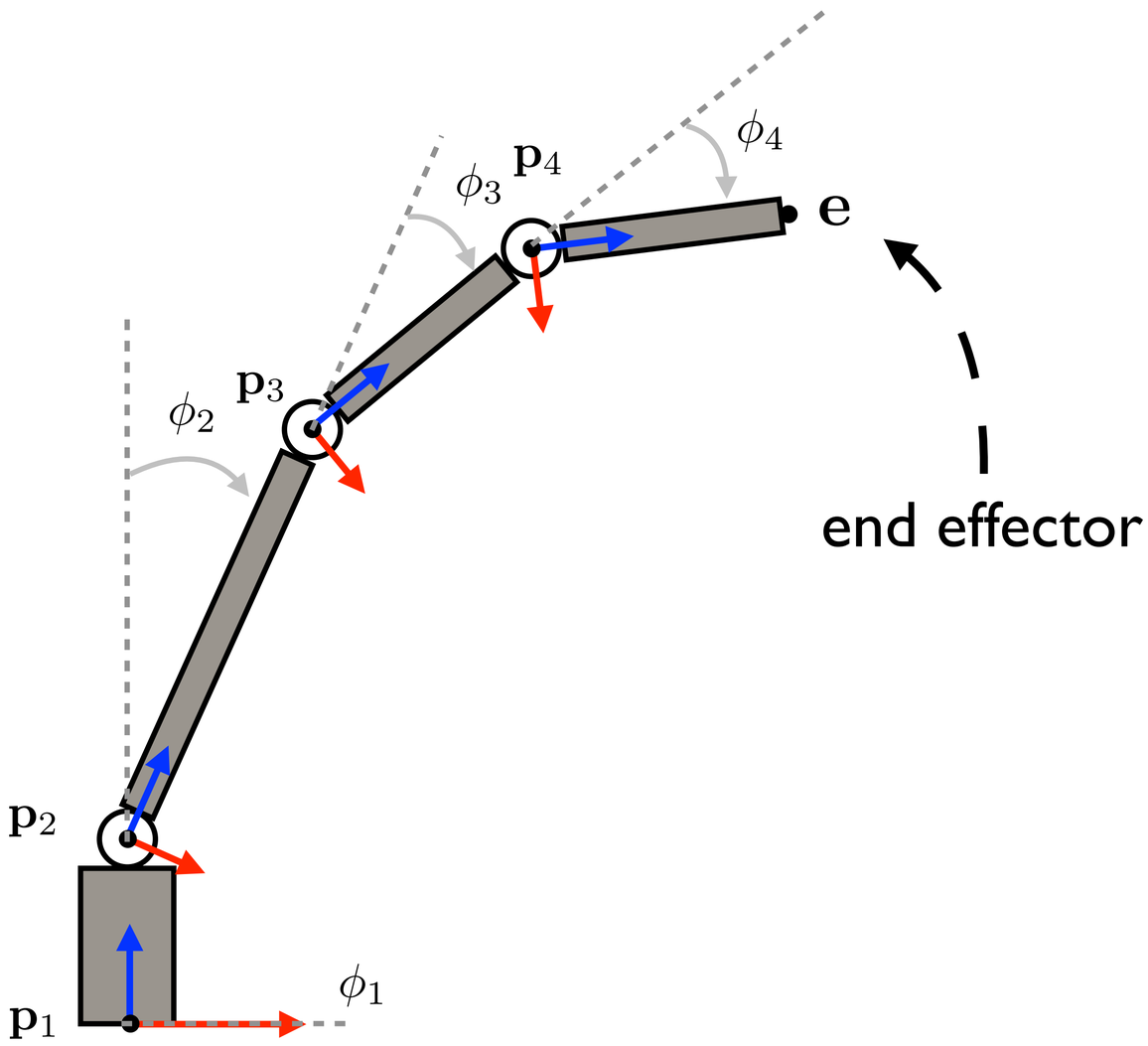
- The basic robot arm
- Joint points and joint angles
- End effector
- Local coordinates vs. world coordinates

Animating a robot arm





Animating a robot arm



Your next assignment is to create an animation of a robot arm.

You will draw the robot and calculate the best path for it to touch a number of target points.

Your robot arm will have 3 or 4 parts connected in a chain called a kinematic chain.

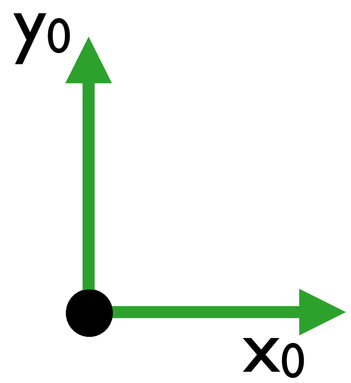
The robot's arm movement is controlled changing the value of the joint angles at each joint location.

In this example arm shown on the left-hand side, the arm has 4 parts and 4 joint angles.

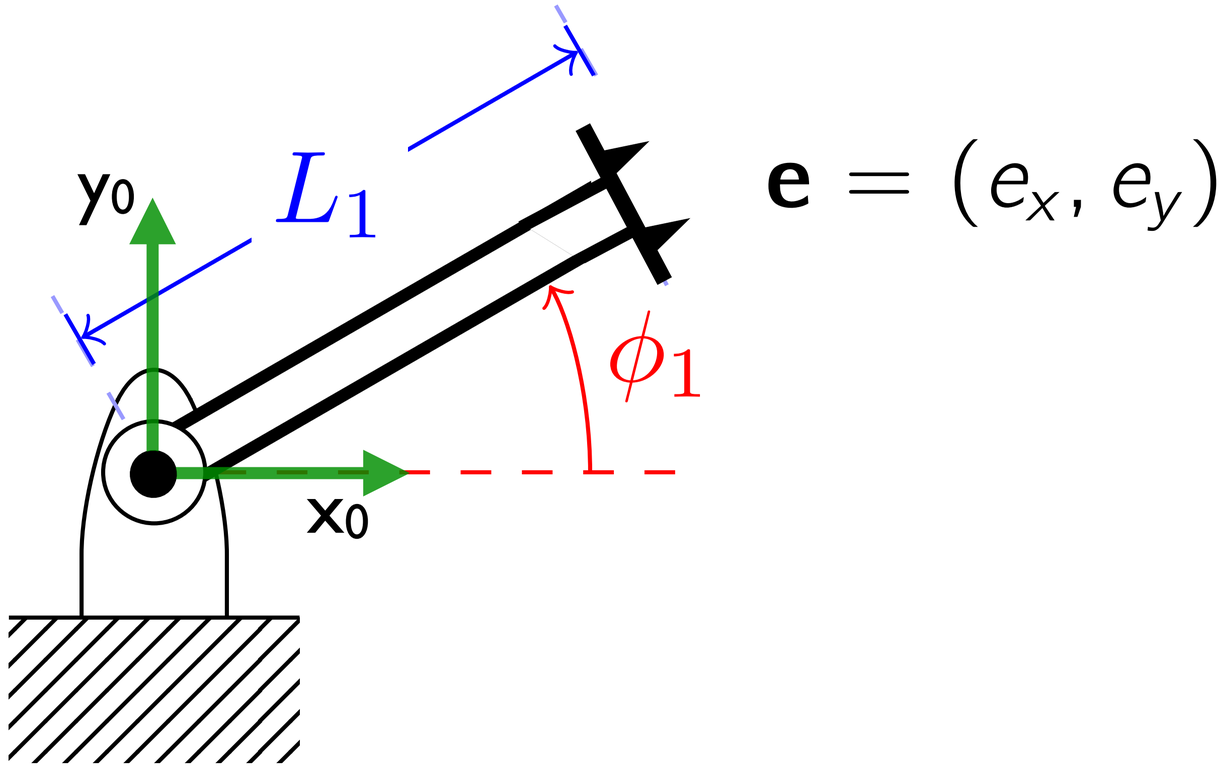
Each part has its own local coordinate frame. The point at the end of the arm is called the "end effector".

In the assignment, your goal is to calculate how we must change the arm's joint angles so that the end-effector reaches a desired position in space.

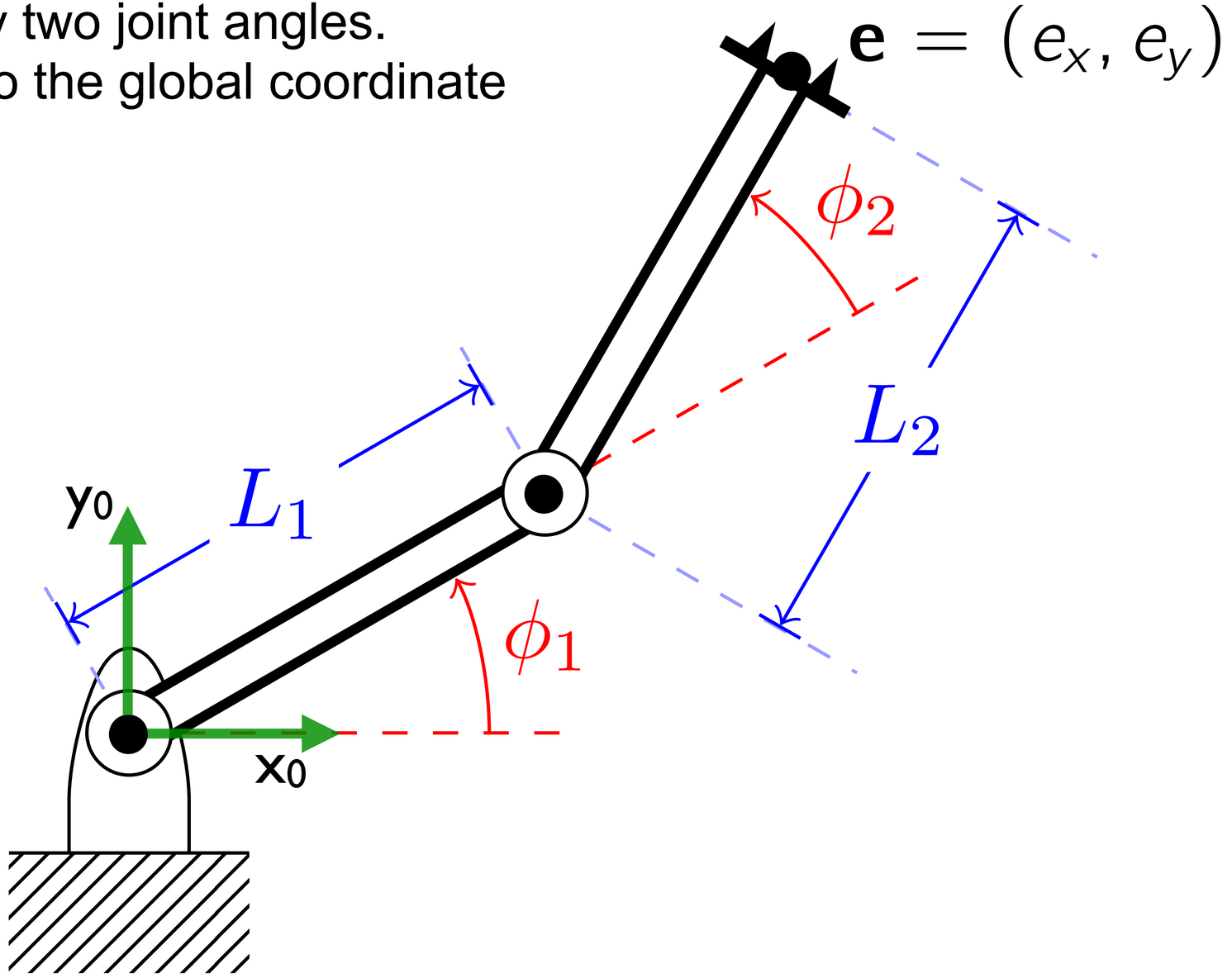
- We start with the global coordinate frame, i.e., Frame{0}.
- This is the only coordinate system known to the plot functions of our programming language.
- If the point is represented with respect to another (e.g., local) coordinate frame, then we need to convert its coordinates to the global frame first before we can plot them.



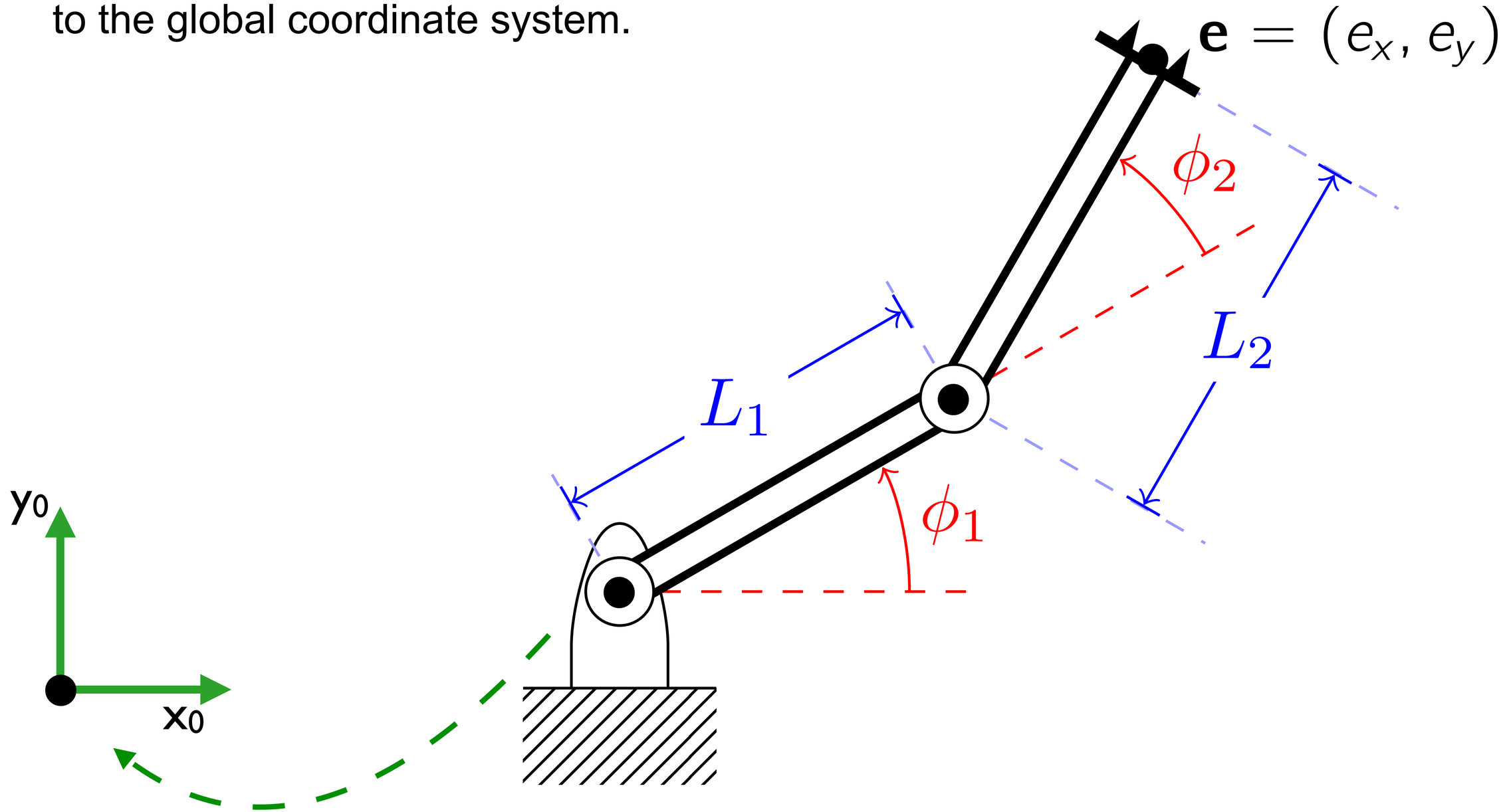
- This is the first part of the arm. It is described by a length and a joint angle. The joint angle control the motion of the part. By varying the angle, we can move the part.
- The tip of the arm is called the *end effector*.
- In this case, the end effector does not really move with respect to the part to which is connected.



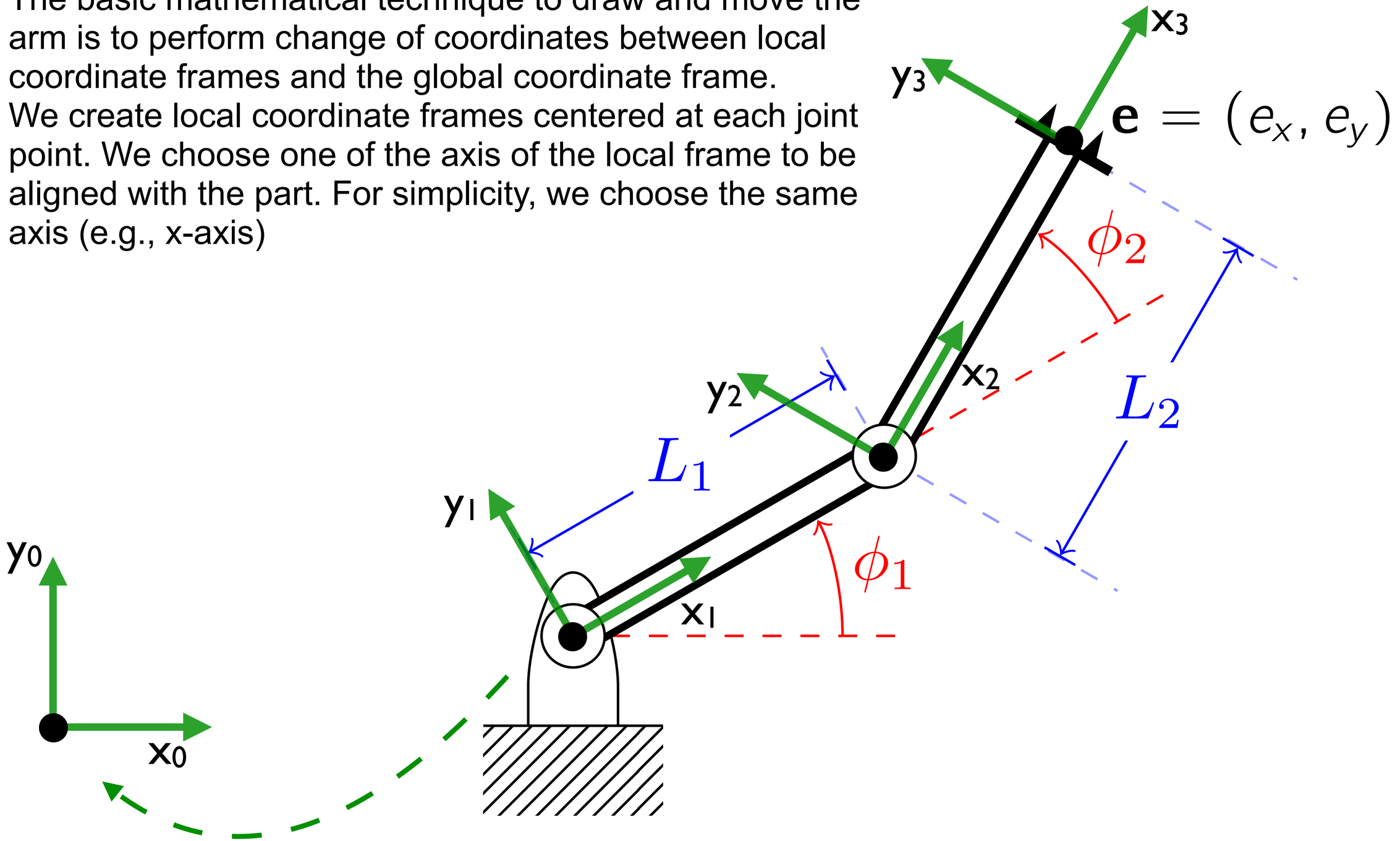
- We add another part to the arm. Part 2 is connected to the end of Part 1. Now, the motion of the arm is controlled by two joint angles.
- The arm is still attached to the global coordinate system.

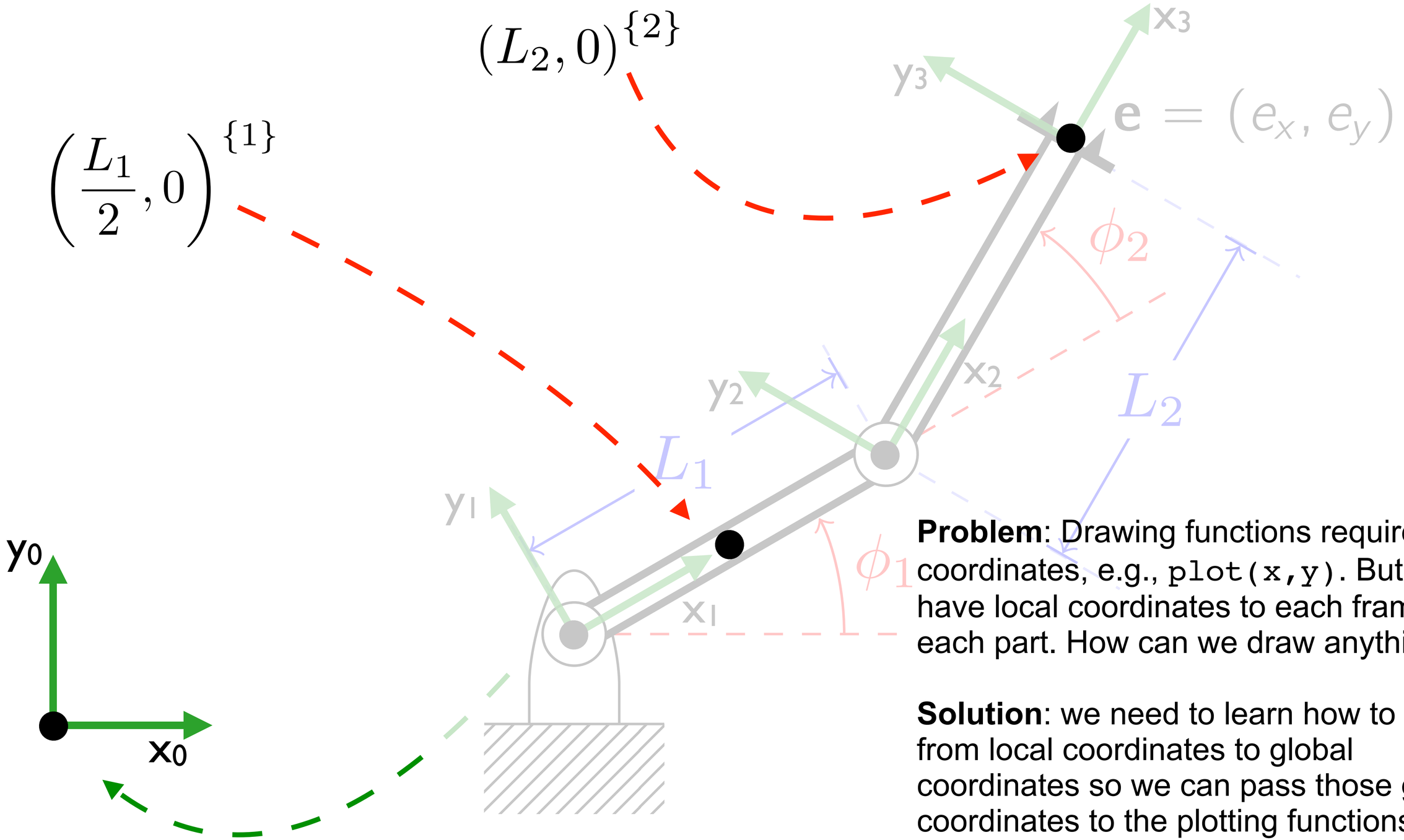


- Here, we moved the arm to another location in space. As a result, Part 1 is no longer attached to the global coordinate system.



- The basic mathematical technique to draw and move the arm is to perform change of coordinates between local coordinate frames and the global coordinate frame.
- We create local coordinate frames centered at each joint point. We choose one of the axis of the local frame to be aligned with the part. For simplicity, we choose the same axis (e.g., x-axis)





Problem: Drawing functions require global coordinates, e.g., `plot(x,y)`. But we only have local coordinates to each frame for each part. How can we draw anything?

Solution: we need to learn how to convert from local coordinates to global coordinates so we can pass those global coordinates to the plotting functions.

Review

- The basic robot arm
- Joint points and joint angles
- End effector
- Local coordinates vs. world coordinates

Animating a robot arm