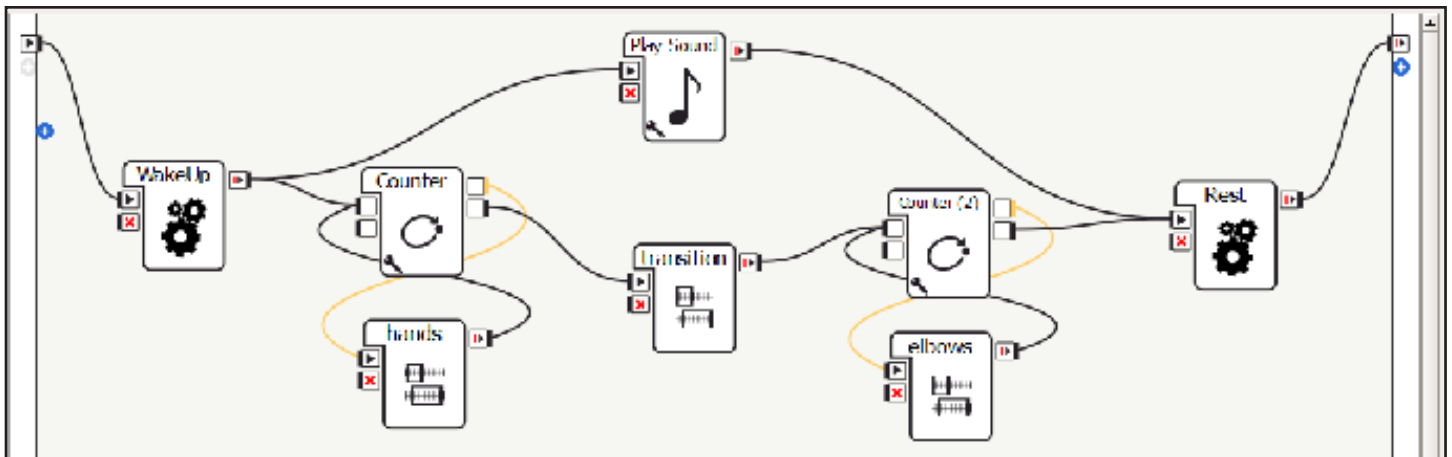


During this lesson, your students will create a program similar to the one pictured below. The goal of this program is for the NAO to move his arms in unison and to transition between at least two looped motions. This reference sheet will focus on...

1. Mirroring feature
2. Why loop timelines?
3. NAO's arm motors
4. Transitions



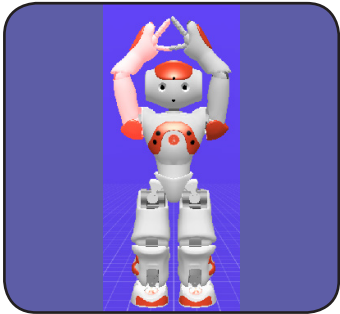
1. Mirroring

Make sure that you are connected to the virtual robot. Click one of NAO's arms. The arm motor pop-out box will appear. At the bottom of this box is a check box labeled Mirroring. Click it.

Change the angles and see what happens. The other arm moves too! This feature is useful for getting the NAO to move naturally. Us humans move in a mirrored fashion all the time. To make NAO move more human-like, use this mirroring feature.



Not Mirrored



Mirrored

2. Why Loop Timelines?

If you notice, keyframes stored in timelines do not have labels. This makes it very difficult to do anything complicated in a timeline. You don't know which box controls which motions! For this reason it is best to do simple things in timelines and have the complicated structure outside.

When looping timelines, it is important that the first and last frames are identical. If they are not the same, the NAO will try to change positions in zero seconds. If you give him time to transition he will do so smoothly.

Note: looping timelines causes a slight lag between repeats. You can solve this by putting everything in one timeline. This is not recommended, however, because it is hard to keep track of your work.

LESSON 3

3. NAO's Arm Motors

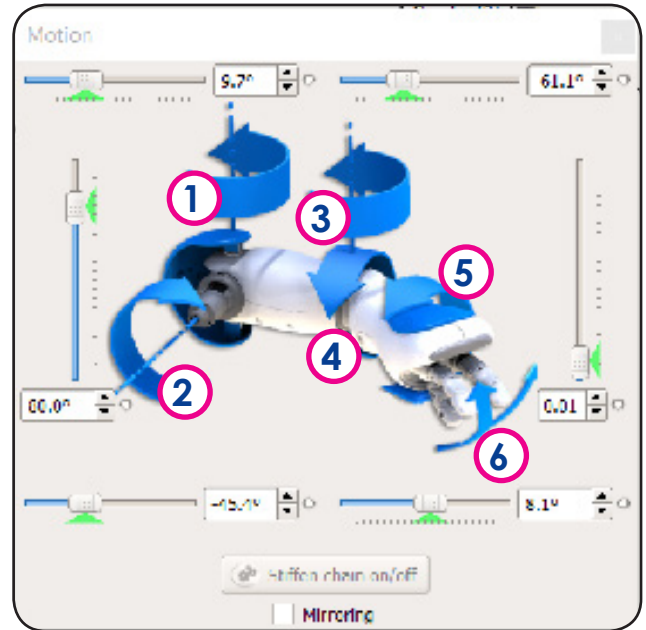
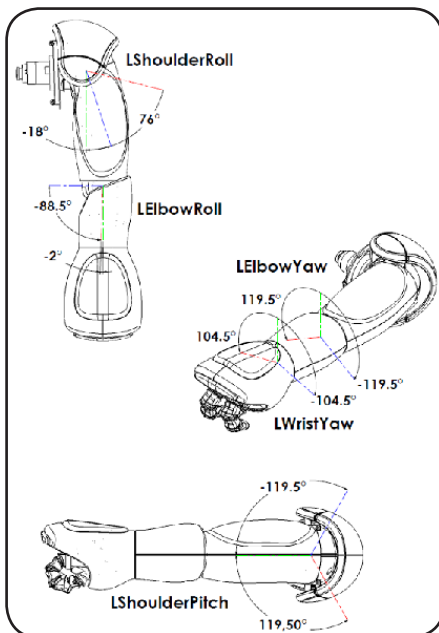
The NAO has six motors in each arm. They are called...

1. Shoulder Roll
2. Shoulder Pitch
3. Elbow Roll
4. Elbow Yaw
5. Wrist Yaw
6. Hand

The terms yaw, roll and pitch refer to the orientation of the axis of rotation of each motor. Refer to the diagram on the right or below.

When you click on the arms you might notice that the right and left arms control boxes are mirror images. Additionally some angle measures are negative of one another. This is because angles are commonly measured so that counterclockwise is the positive direction and clockwise is negative.

Play around with the angles to get a feel for the different motions NAO can do.



4. Transitions

When moving between looped motions you need a transition timeline. All the transition timeline should do is give NAO time to transition from the last frame of the most recent motion to the first frame of the upcoming motion.

To do this, go into the most recent timeline. Select the final keyframe and copy it by right clicking the keyframe and selecting copy. Go back to the root workspace, then into the transition timeline. Paste this keyframe in the first frame in the timeline.

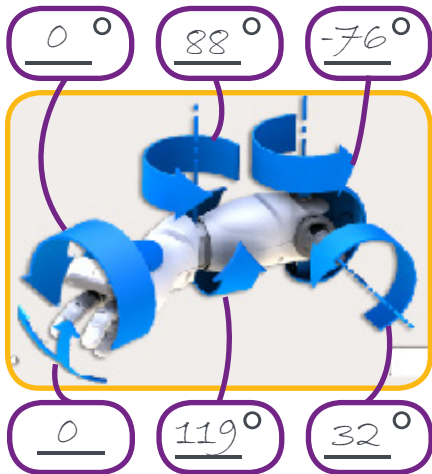
Follow the same procedure to copy the first frame in the upcoming timeline. Paste this keyframe into the transition timeline making sure there are a few blank frames in between. This gives NAO time to transition between the motions.



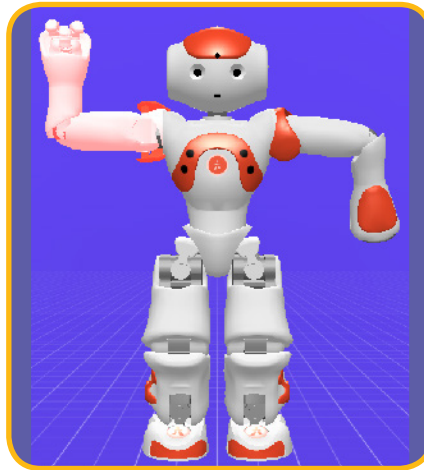
Here is a possible solution for the Simon Says! activity. Students may get different answers.

Click on the virtual NAO's arms to change the positions. Try to match your virtual NAO to the pictures below. Fill in the motor angle measures, rounding to the nearest integer (whole number).

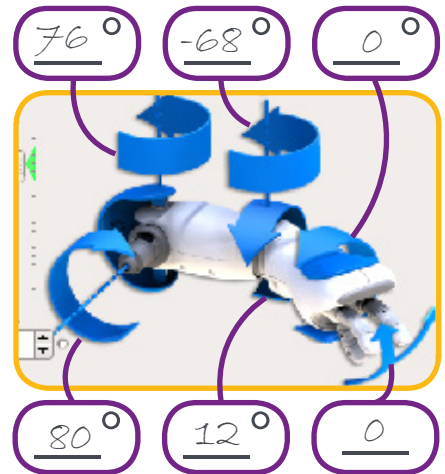
RIGHT ARM



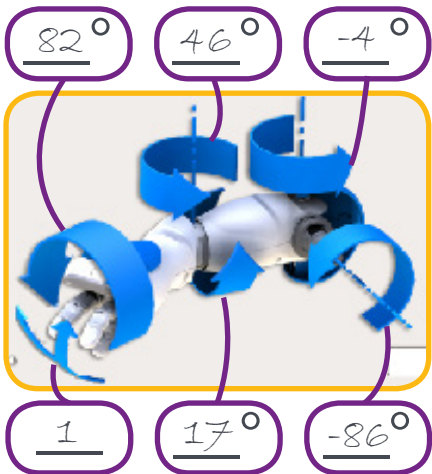
POSE 1



LEFT ARM



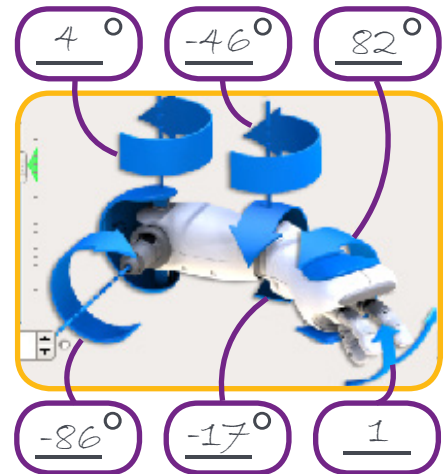
RIGHT ARM



POSE 2



LEFT ARM



Explain why, when you look at NAO, his right arm is on your left and his left arm is on your right.

If I put NAO in front of me so his back was to me then his left hand would
be on my left too. When I face him, his left is on my right and his right is
on my left.