

How to create character animations

Inverse Kinematic Poses

Inverse kinematics (IK) is a method for animating an object or set of objects in relation to each other using an articulated structure of bones. Bones allow symbol instances and shape objects to move in complex and naturalistic ways with a minimum of design effort. For example, inverse kinematics lets you create character animation, such as arms, legs, and facial expressions much more easily.

You can add bones to separate symbol instances or to the interior of a single shape. When one bone moves, the other connected bones move in relation to the bone that initiated the movement. When animating using inverse kinematics you need only specify the start and end positions of objects. Inverse kinematics lets you create natural motion much more easily.

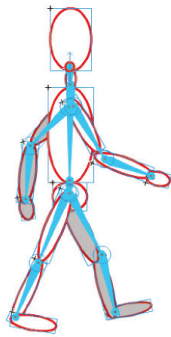


Figure 1 A group of several symbols with IK bones attached

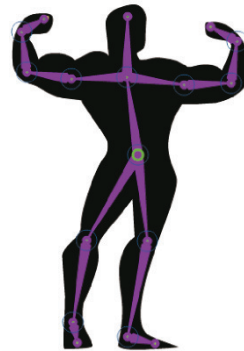


Figure 2 A shape with an IK armature added

A chain of bones is called an armature. The bones in an armature are connected to each other in a parent-child hierarchy. An armature can be linear or branched. Branches of an armature that originate at the same bone are called siblings.

You can use IK in Adobe Flash Professional CS5 in two ways. The first is to articulate a series of symbol instances by adding a single bone to each instance (**Figure 1**). The bones allow the chain of symbol instances to move together. For example, you might have a set of movie clips that each represents different parts of a human body. By linking the torso, upper arm, lower arm, and hand together, you can create a realistically moving arm. You can create a branched armature to include both arms, both legs, and the head.

The second way to use IK is to add an armature to the interior of a shape object (**Figure 2**). The shape can be created in merge drawing mode or object drawing mode. The bones allow you to move and animate parts of the shape without the need to draw different versions of the shape or create a shape tween. For example, you could add bones to a simple drawing of a snake to enable the snake to move and curve realistically.

When you add bones to symbol instances or shapes, Flash moves the instance or shape and the associated armature to a new layer in the Timeline. This new layer is called a pose layer. Each pose layer can contain only one armature and its associated instances or shape.

Flash includes two tools for working with IK. You add bones to symbol instances and shapes with the Bone tool. You use the Bind tool to adjust the relationships between individual bones and control points of shape objects.

You can animate armatures and their associated symbols or shapes either in the Timeline or with ActionScript 3.0. You animate in the Timeline by defining different poses for the armature in different frames. Flash interpolates the positions of the armature in the frames in between. For information about animating armatures with ActionScript, see the `fl.ik` classes in the ActionScript 3.0 Language and Components Reference.

Note: To use inverse kinematics, your FLA file must specify ActionScript 3.0 as the Script setting in the Flash tab of the Publish Settings dialog box.

To add IK bones and poses:

1. Start Flash and select File > New (ActionScript 3.0) .
2. Begin by creating and arranging on the stage multiple shapes in a rough spatial configuration of the object you wish to animate using IK.
3. Convert all of the shapes on the stage to symbol instances (**Figure 3**).

In this example, symbols have been arranged to form a muscle man.

4. Select the Bone tool from the Tools panel.
You can also press the X key to select the Bone tool.
5. With the Bone tool, click the symbol instance that is to be the root or head of the armature. Then drag to a separate symbol instance to link it to the root instance.

As you drag, a bone appears. When you release, a solid bone exists between the two symbol instances. Each bone has a head (the round end) and a tail (the pointed end). Each symbol instance can have only one attachment point. You can edit these attachment points later.

When dragging from one instance to another to create a bone, click the first instance at the specific point where you want to attach the bone to the instance. Release the mouse over the specific point on the second instance where you want the bone to attach. You can also edit these attachment points later.

The first bone in an armature is the root bone. It has a circle around the head of the bone.

By default, Flash moves the transformation point of each symbol instance to the location of the joint formed by each bone connection. For the root bone, the transformation point moves to the head of the bone. For the last bone in a branch, the transformation point moves to the tail of the bone. You can disable the automatic movement of the transformation point on the Drawing tab by selecting Edit > Preferences (Windows) or Flash > Preferences (Mac OS).

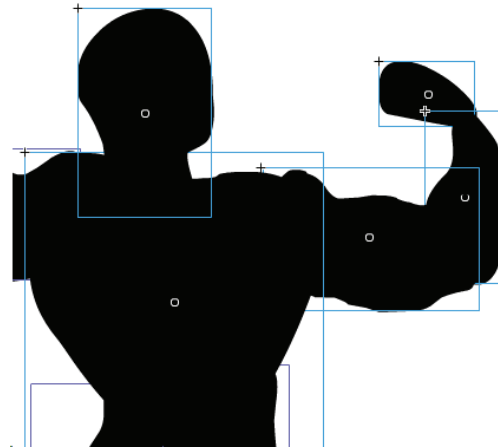


Figure 3 Symbol instances on the Stage

- To add another bone, drag from the tail of the first bone to the next symbol instance you want to add to the armature.

The pointer changes when you roll over the head or tail of an existing bone.

Link objects with bones in the order of the parent-child relationships you want to create (**Figure 4**).

You can move, add, delete, and edit control points of the contours in an IK shape by using the Subselection tool (**Figure 5**).

- To move the position of a bone without changing the IK shape, drag the endpoint of the bone.
- To display the control points of the IK shape boundary, click the stroke of the shape.
- To move a control point, drag the control point.
- To add a new control point, click a part of the stroke without any control points.

You can also use the Add Anchor Point tool in the Tools panel.

To delete an existing control point, click to select it, and then press the Delete key.

You can also use the Delete Anchor Point tool in the Tools panel.

As you add bones to instances, Flash moves each instance to a new layer in the Timeline. The new layer is called a pose layer (**Figure 6**). All the bones and symbol instances associated with a given armature reside in the pose layer. Each pose layer can contain only one armature. Flash adds the new pose layer to the Timeline between existing layers to maintain the previous stacking order of objects on the Stage.

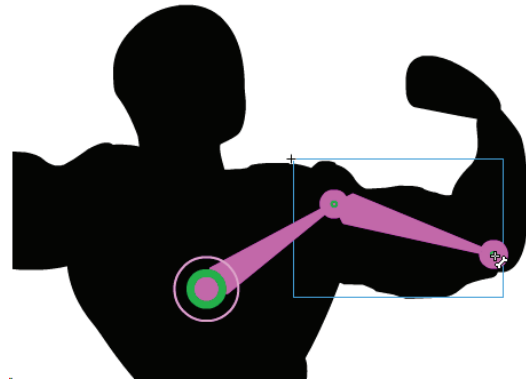


Figure 4 Linking symbols with the Bones tool

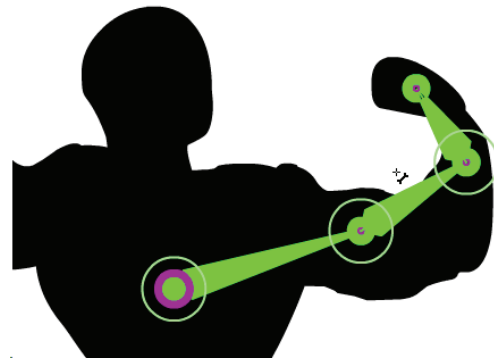


Figure 5 Moving linked objects with the Subselection tool

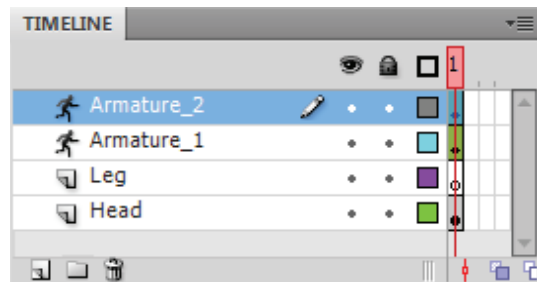


Figure 6 Pose layer

You can now animate this character and keep the relationship between the symbols by using the bones you have created.

7. Insert a Pose in an Armature layer at frame 10 by right-clicking (Windows) or Control-clicking (Mac OS) the frame and selecting Insert Pose (**Figure 7**).
8. Rearrange this pose as you like.
9. Select Control > Test Movie > In Flash Professional to preview the movie.

The symbols move in relation to each other. You can fine-tune this movement by shifting the anchor points in the bones.

10. Select File > Close to close the preview window.
11. Save the movie.
12. Close the movie.

To change pose properties:

1. Click an Armature layer to select it.
2. Click a bone to select it (**Figure 8**).
3. Make sure the Property inspector is open (**Figure 9**).
4. Change one or more of the following properties:
 - To enable *springiness*, drag the Strength and Damping scrubbers in the Spring section of the Property inspector. The higher the Strength, the more rigid the spring becomes. Damping determines how fast the spring is reduced: the higher the value, the faster the animation ends.
 - To disable *rotation* of the selected bone around the joint, deselect the Enable option in the Joint: Rotation section of the Property inspector. To *constrain* rotation of a bone, drag the Min and Max scrubbers in the Property inspector.
 - To disable *translation*, deselect the Enable option in the Joint: Translation section of the Property inspector. Translation refers to how the bone stretches as the joint moves. To limit the amount of motion enabled along the x or y axis, drag the Min and Max scrubbers in the Joint: Translation section of the Property inspector.

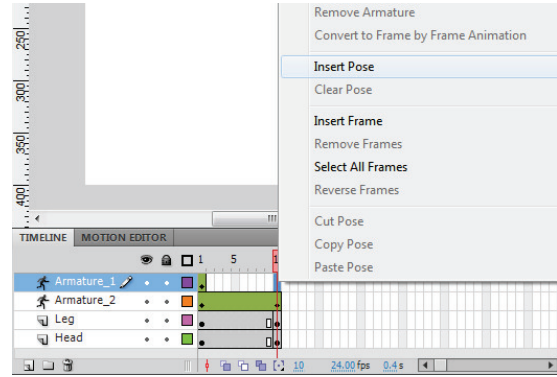


Figure 7 Insert Pose



Figure 8 Bone selected

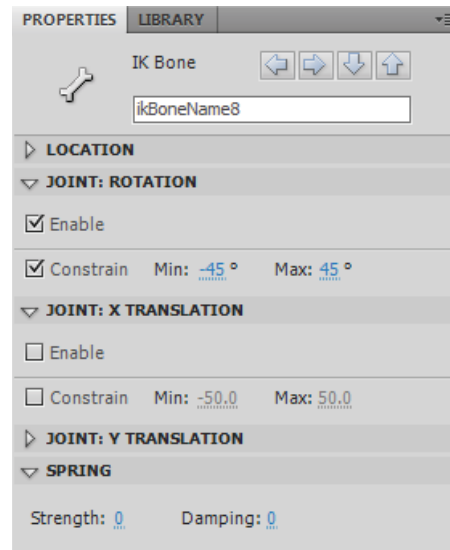


Figure 9 Bone Property inspector