

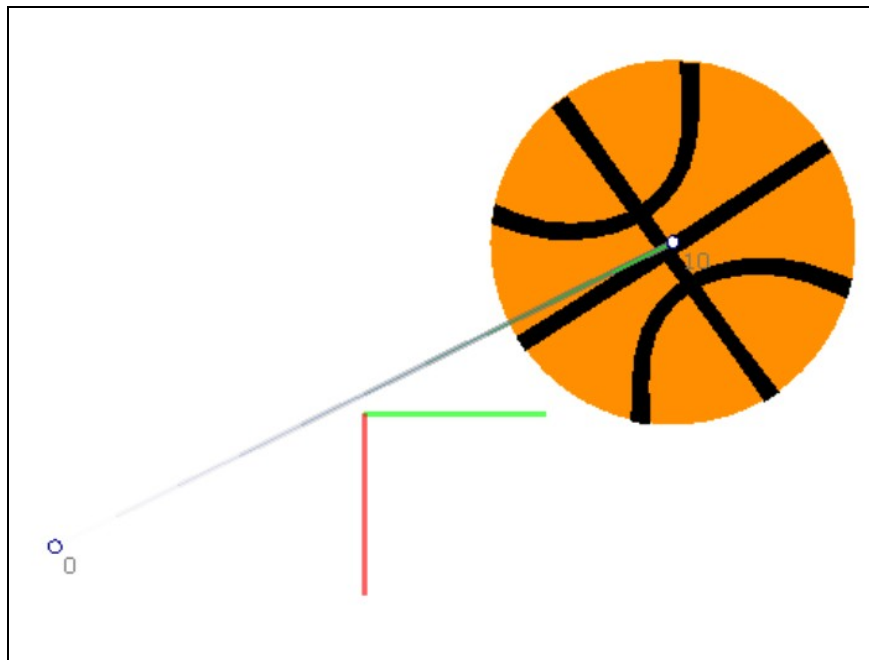
# Computer Animation Basics

by Sven Nilsen, the creator of Stickman & Elemento

## 1. Keys

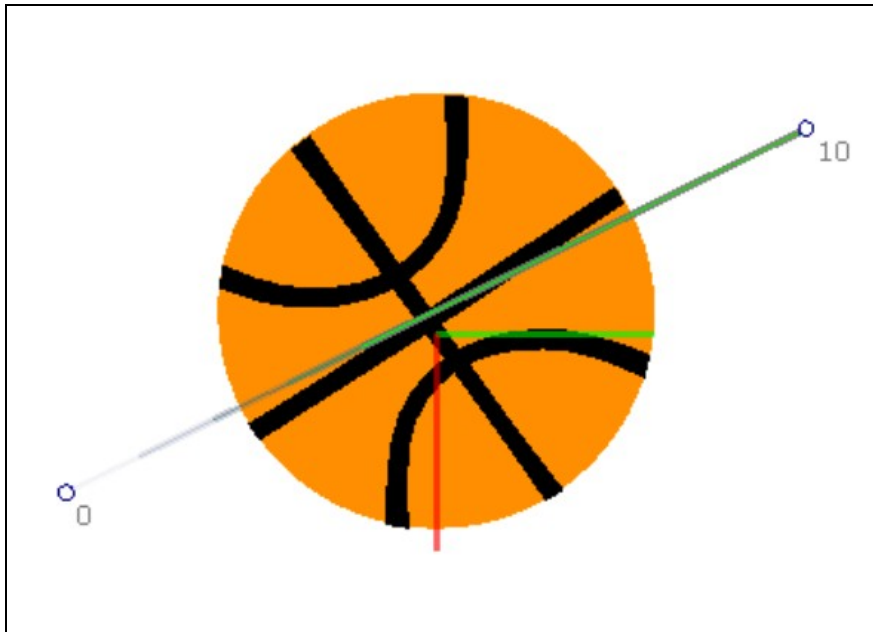
The movement is controlled by «keys» in computer animation. A «key» contains information that the software use to compute the movements between the «keys». The simplest movement is a straight line (*Figure 1.1*):

*Figure 1.1*



We are starting at a point in frame 0. Frame 0 is at the beginning of the animation. We move the ball to a new position at frame 10. The computer is now able to compute the movement between frame 0 and frame 10. For example: Frame 5 gives the position at the middle between frame 0 and frame 10 (*Figure 1.2*).

Figure 1.2

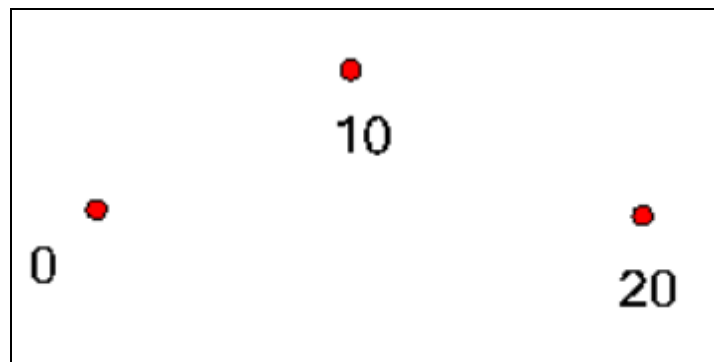


We need only two keys to create a straight line movement. If we made the movement frame by frame, it would take more time and gives less exact result.

## 2. Smooth Movement

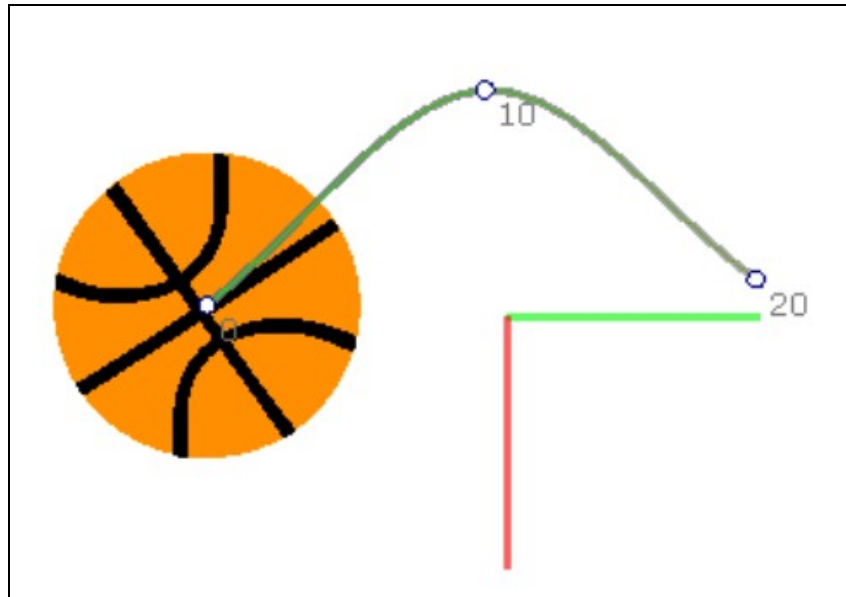
Imagine we created three keys instead of two. The first in frame 0, the second in frame 10 and the last one in frame 20.

Figure 2.1



How would you draw the movement from frame 0 to frame 20?

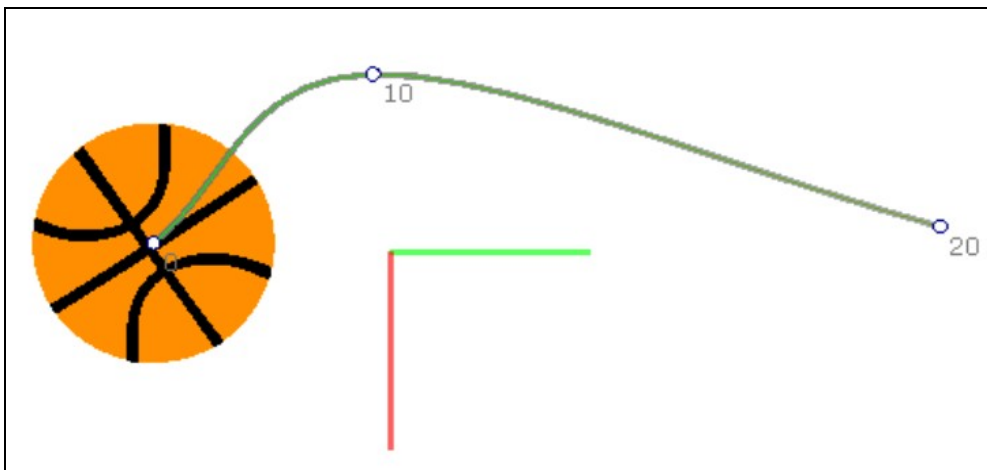
Figure 2.2



The most natural way is to move in a smooth curve (*Figure 2.2*).

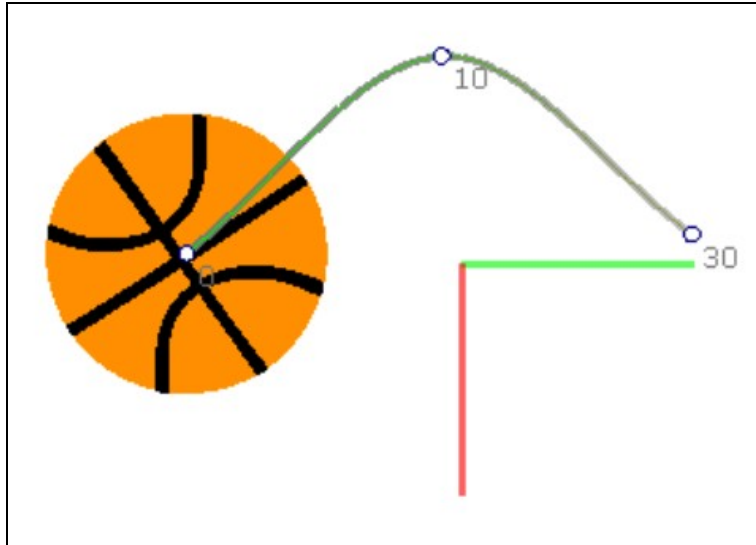
If we move the position at frame 20 longer away, the speed will be faster between 10 and 20 compared to the speed between 0 and 10 (*Figure 2.3*).

Figure 2.3



If we got the same distance and changes the key at frame 20 to frame 30, the speed will be slower between 10 and 30 because of more frames between the keys (*Figure 2.4*).

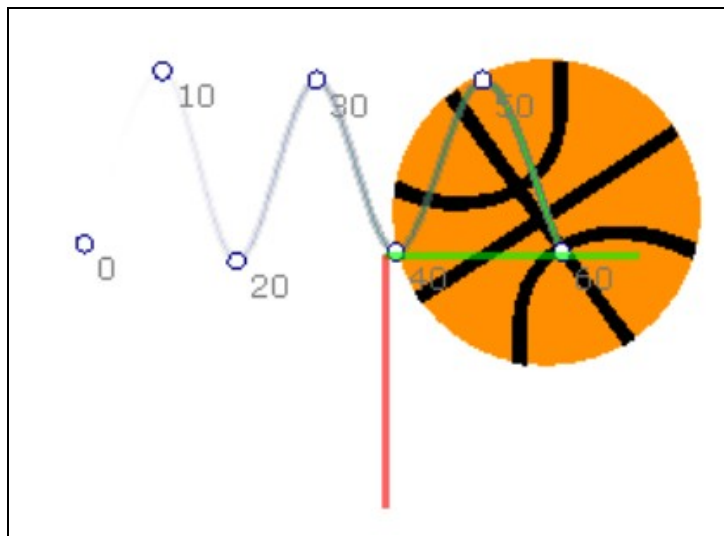
*Figure 2.4*



### 3. Compound Movements

Let us add many keys (*Figure 3.1*). Which keys are important to decide the movement between frame 20 and frame 30?

*Figure 3.1*



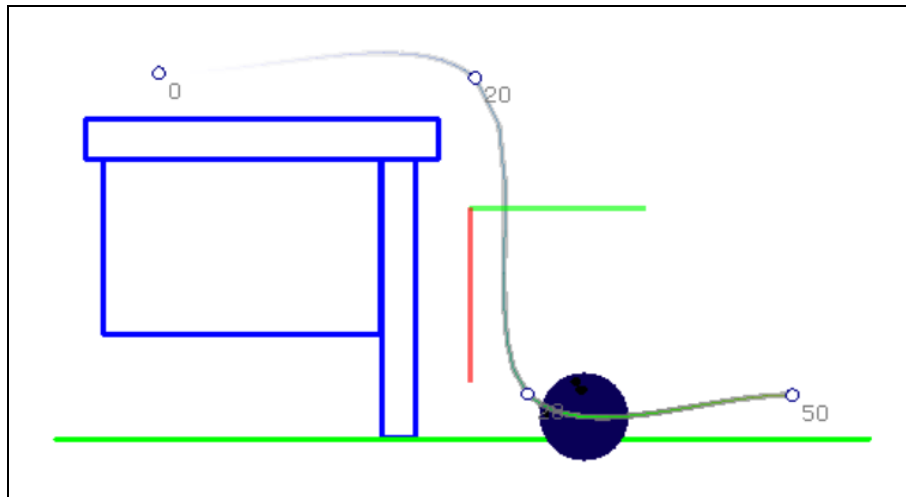
The correct answer is the keys at frame 10, 20, 30 and 40. The keys at frame 10 and 40 is used to control the curve movement. One movement leads to the next and creates an effect of seamless animation.

## 4. Tangents

You have learned about how the computer use positions in keys to compute a movement. The problem is, in some cases, the movement is too smooth.

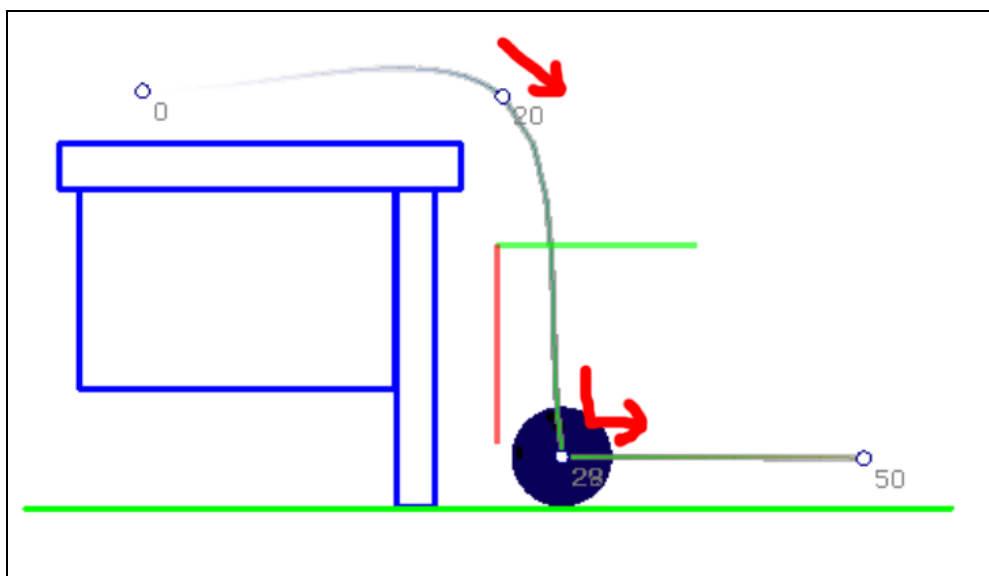
Example:

Figure 4.1



We want a bowling ball to fall of a table, hit the ground and continue rolling. When using 4 keys, the ball goes trough the floor and comes up. To solve this we need something called «tangents».

Figure 4.2

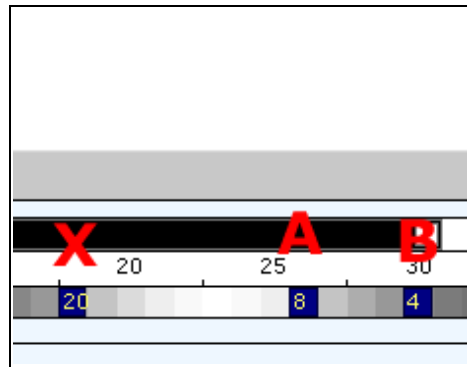


A «tangent» is kind of an arrow that goes trough the key position (*Figure 4.2*). If the tangent is broken the movement gets hard and a straight tangent gives a smooth movement.

## 5. Tangents in Stickman

Stickman computes tangents automatically by using the number of empty frames between the keys. If we are moving from A to B, the movement will be harder the closer B is from A compared to X and A. If the number of empty frames between the keys are equal, the movement will be smooth.

Figure 5.1



If X and A have equal positions the X does not have an effect on the curve between A and B. Stickman always create a linear movement between keys that are similar so extreme values does not create extreme curves.

If there is no empty frames between two keys the movement is «jumping» to the next key. That is useful when animating parent relations such as picking up an item with another figure.