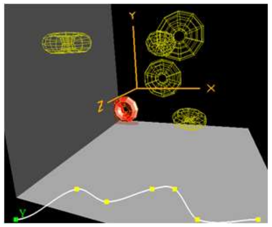
Simple Keytime Animation for CS 450/550



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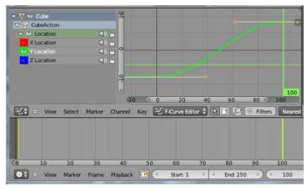

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Approaches to Animation

1. Motion Capture (“MoCap”)

2. Using the laws of physics (F=ma)

3. Using functional (target-driven) animation

4. Using keyframing

We'll talk more about these in the Animation notes!

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Keyframing

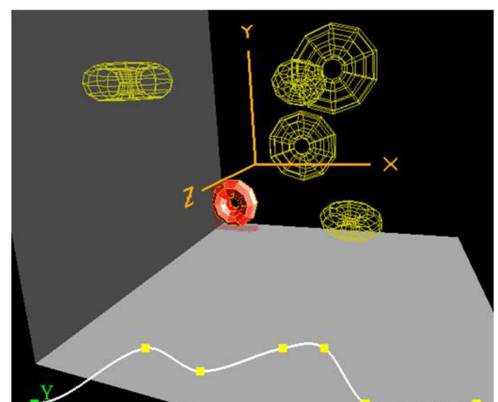
Keyframing involves creating certain *key* positions for the objects in the scene, and then the program later interpolating the animation frames *in between* the key frames.

In hand-drawn animation, the key frames are created by the senior animators, and the in-between frames are developed by the junior animators.

In our case, you are going to be the senior animator, and the computer will do the in-betweening.

3

The General Idea is to Interpolate the In-between Frames from the Smooth Curves Fit through the Key Frames



To make this simple to use, our goal is to just specify the keyframe *values*, not the *slopes*. We will let the computer compute the slopes for us, which will then let the in-between frames be computed.

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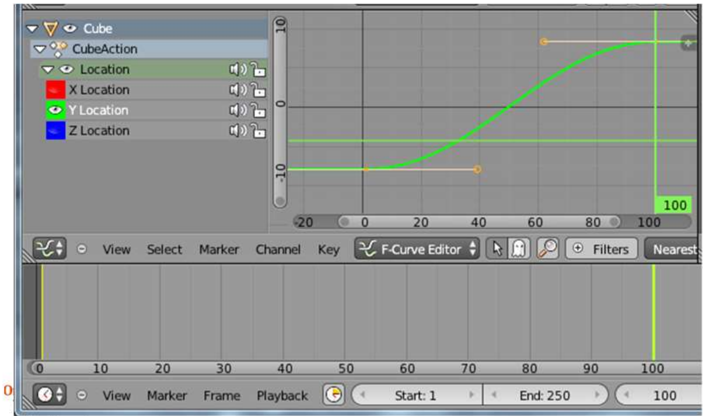
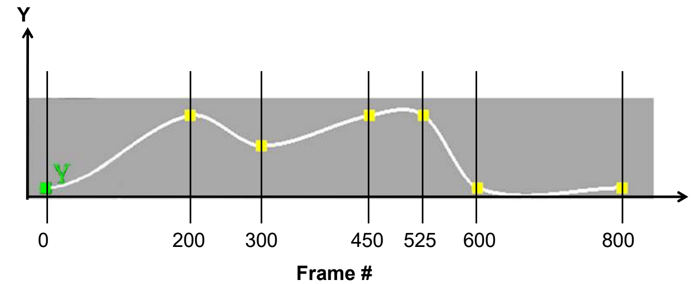
Many Professional Animation Packages Make You Sculpt the Slopes (but we won't . . .)

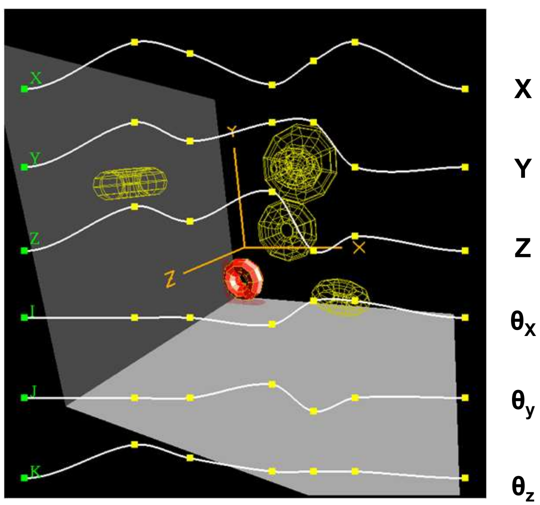
Blender:



The "Y vs. Frame" Curve Looks Like This



Do This Same Thing for the X, Y, and Z Translations and the X, Y, and Z Rotations



Instead of Key *Frames*, I Like Specifying Key *Times* Better

We created a C++ class to do the interpolation for you

```
class Keytimes:

        void   AddTimeValue( float time, float value );
        float  GetFirstTime( );
        float  GetLastTime( );
        int    GetNumKeytimes( );
        float  GetValue( float time );
        void   Init( );
        void   PrintTimeValues( );
```

Instead of Key *Frames*, I Like Specifying Key *Times* Better


```
Keytimes Xpos;

int
main( int argc, char *argv[ ] )
{
	Xpos.Init( );
	Xpos.AddTimeValue(  0.0,  0.000 );
	Xpos.AddTimeValue(  2.0,  0.333 );
	Xpos.AddTimeValue(  1.0,  3.142 );
	Xpos.AddTimeValue(  0.5,  2.718 );
	fprintf( stderr, "%d time-value pairs:\n", Xpos.GetNumKeytimes( ) );
	Xpos.PrintTimeValues( );

	fprintf( stderr, "Time runs from %8.3f to %8.3f\n", Xpos.GetFirstTime( ), Xpos.GetLastTime( ) );

	for( float t = 0.f; t <= 2.f; t += 0.1f )
	{
		float v = Xpos.GetValue( t );
		fprintf( stderr, "%8.3f\t%8.3f\n", t, v );
	}
}
```

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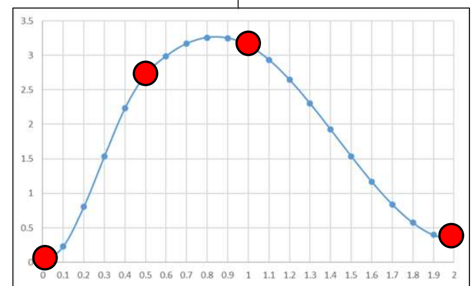
Instead of Key *Frames*, I Like Specifying Key *Times* Better


```
( 0.00,  0.000)
( 0.00,  0.000)  ( 2.00,  0.333)
( 0.00,  0.000)  ( 1.00,  3.142)  ( 2.00,  0.333)
( 0.00,  0.000)  ( 0.50,  2.718)  ( 1.00,  3.142)  ( 2.00,  0.333)
4 time-value pairs
Time runs from    0.000 to    2.000
   0.000      0.000
   0.100      0.232
   0.200      0.806
   0.300      1.535
   0.400      2.234
   0.500      2.718
   0.600      2.989
   0.700      3.170
   0.800      3.258
   0.900      3.250
   1.000      3.142
   1.100      2.935
   1.200      2.646
   1.300      2.302
   1.400      1.924
   1.500      1.539
   1.600      1.169
   1.700      0.840
   1.800      0.574
   1.900      0.397
   2.000      0.333
```



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Using the System Clock in Display( ) for Timing


```
#define MSEC        10000                       // i.e., 10 seconds
Keytimes Xpos, Ypos, Zpos;
Keytimes ThetaX, ThetaY, ThetaZ;

// in InitGraphics( ):

<< init the Keytime classes and add the keyframe values >>
. . .

// in Display( ):

	// # msec into the cycle ( 0 - MSEC-1 ):
	int msec = glutGet( GLUT_ELAPSED_TIME )  %  MSEC;

	// turn that into a time in seconds:
	float nowSecs = (float)msec  / 1000.f;
	glPushMatrix( );
		glTranslatef( Xpos.GetValue(nowSecs), Ypos.GetValue(nowSecs), Zpos.GetValue(nowSecs)  );
		glRotatef( ThetaX.GetValue(nowSecs),   1., 0., 0. );
		glRotatef( ThetaY.GetValue(nowSecs),   0., 1., 0. );
		glRotatef( ThetaZ.GetValue(nowSecs),   0., 0., 1. );
		<< draw the object >>
	glPopMatrix( );
}
```

Number of msec in the animation cycle

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