Notes

- Film today!
- Reminder: no office hours Thursday, no class Friday
- Home Suite Home CD - should have GLUT, Pixie, and ffmpeg
- Textbook reference for splines:
  - Section 3.1 and Appendix B4

Control

- Local control: adjusting a control point only changes curve locally
  - Far away, curve stays exactly the same
- Global control: adjusting one control point changes entire curve
  - Not as desirable - working on one part of the curve can perturb the parts you already worked out to perfection
  - But, for decent splines, effect is small---decays quickly away from adjustment

Controlling Cubics

- All three of the cubic splines we saw have local control
- But if we enforce $C^2$ smoothness and make it interpolating, we end up with global control

Example Motion Curves

- The position of an object: $X(t)$, $Y(t)$, $Z(t)$
  - Three separate splines
- The angle of a simple joint (e.g. elbow)
- The angles of a complex joint (e.g. hip)
  - Two or more splines
- The size of an object
  - Maybe separated along separate axes
- The colour of an object
- ...

Example Motion Curves
Using motion curves

- Simplest usage:
  - Look at every parameter that changes during the animation
  - Use Hermite interpolation (initialized as Catmull-Rom) based on time
  - Allow user to adjust values, adjust slopes, break continuity, add knots, move knots...

Problem

- Retiming animations is not so simple
  - If you adjust a knot position, it changes the shape of the curve, not just the speed
  - Particularly for Hermite curves - slopes will be off
  - Partial solution: separate the shape of the curve from its timing

Time as a Motion Curve

- Rename parameter of motion curves to “u”
  - This is now just a measure of how along the curve you are, not a real quantity (yet)
- Then make a motion curve for time: u(t)
  - At a particular time, say t=5/24 of a second, evaluate spline u(t)=u(5/24)
  - Then evaluate the other motion curves at this value of u
    - I.e. motion curves look like x(u(t))
- Could have one global timing curve u(t)
- Or separately adjust timing for each variable, or group of variables

Parameterization

- Unsatisfactory still: u doesn’t really have a good meaning
- For example, to make an object move with constant speed along an arc, u(t) may be quite complicated!
- Next class: we will introduce a new map based on arc length
  - Can easily control the speed of an object
  - Timing curve will now be s(t), where s means how far along the curve (in space)