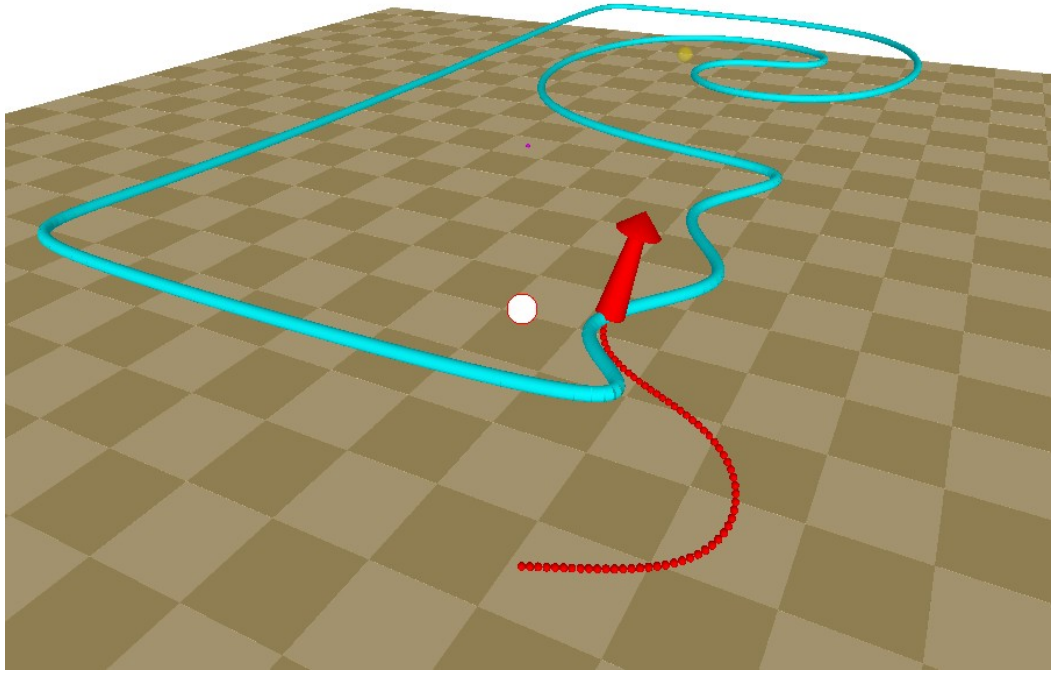


3D geometry

Cross product

Polyloop subdivisions in 3D

- FourPoint
- Cubic Bspline
- Quadratic Bspline
- Quintic Bpline

Acceleration and gravity

Physically plausible motion

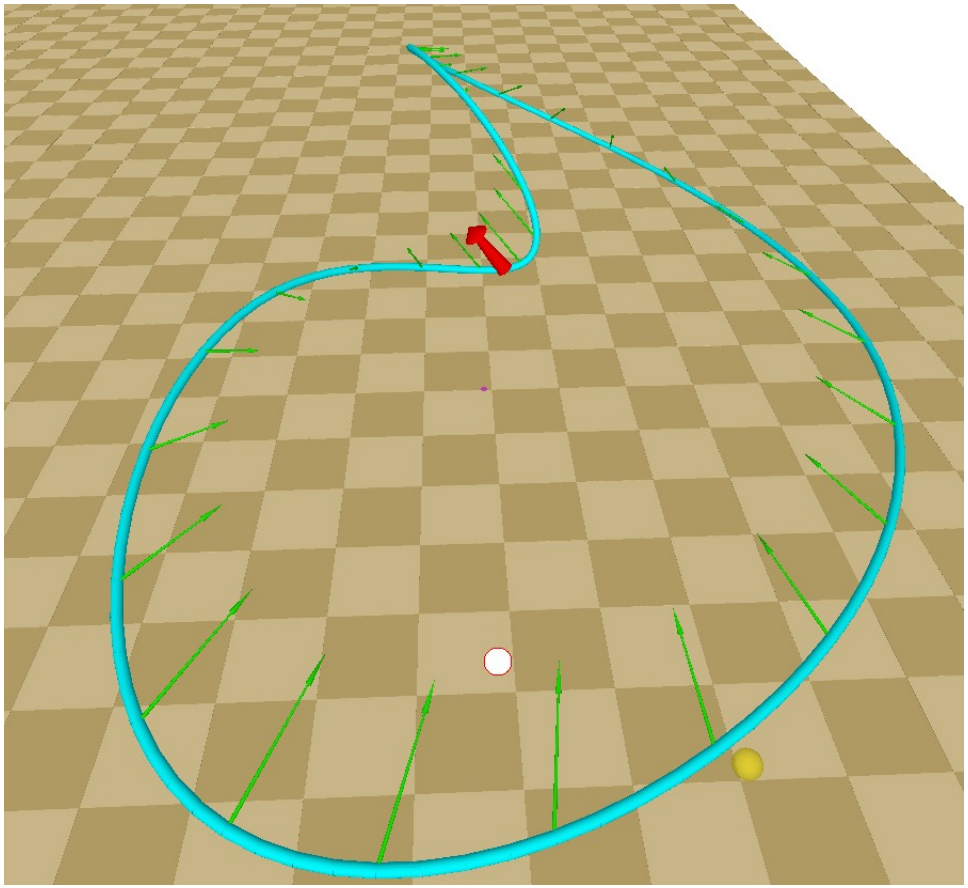
Skater on 3D curve

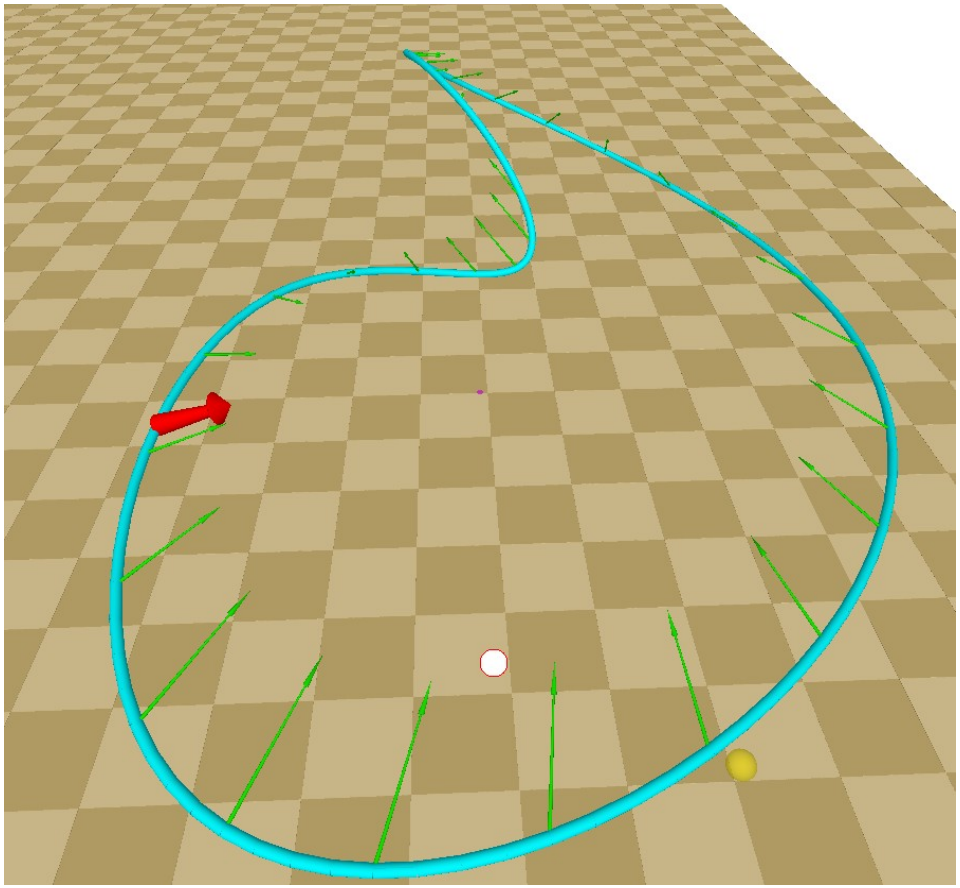
P4 Cloud Skater:

Individual

Overall objective

Interactive animation system that animates an articulated character running on a curve and leaning to balance the momentum of acceleration forces and gravity forces.





Learning objectives

Read research paper on subdivision curves

Implement several simple polyloop subdivision schemes

Compute acceleration

Understand stationary physics

Practice 3D geometry constructions (cross-product…)

Produce physically plausible animation of skater

Module 1 (20 pts): Curve subdivision in 3D

Read/understand paper on J-Splines

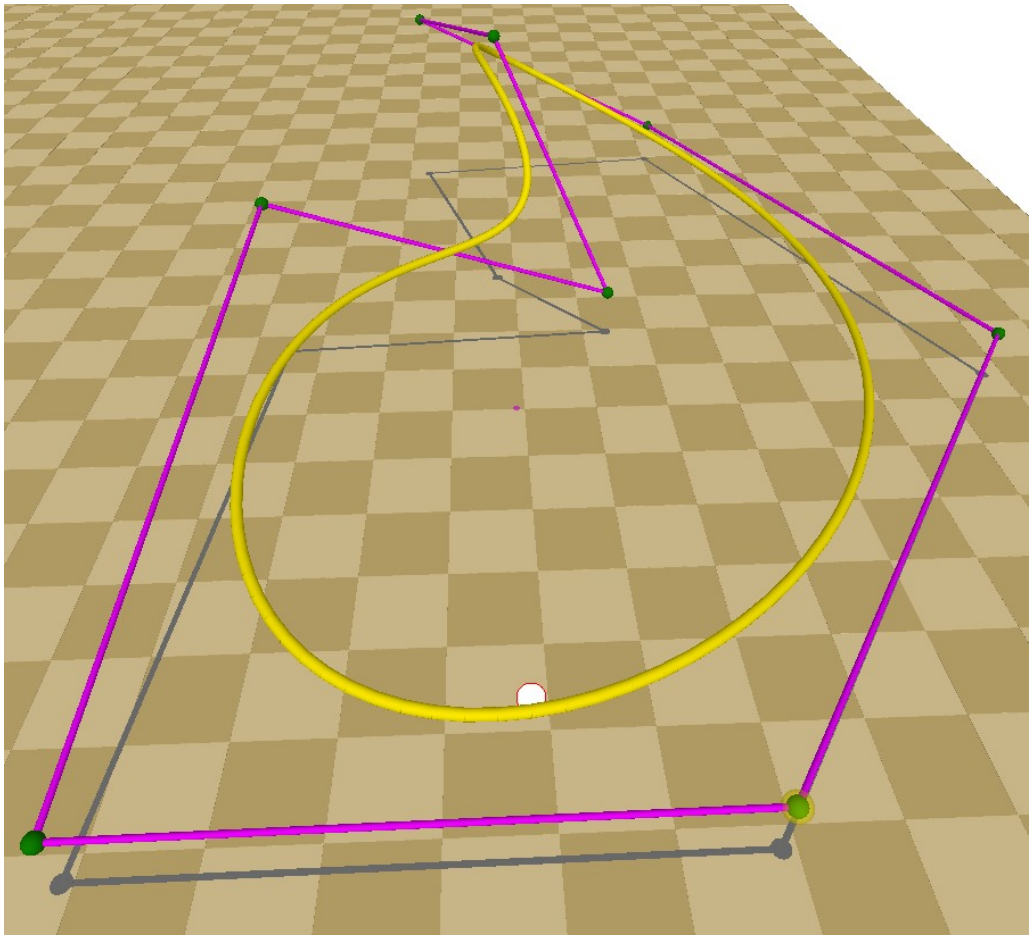
Implement common subdivision schemes:

- Quadratic B-spline
- FourPoint
- Cubic B-spline
- Quintic B-spline

Show curve using a tube

Extra credit:

- Interactive editing
- Retrofitting (see paper)



Module 2 (20 pts): Offset vectors and path

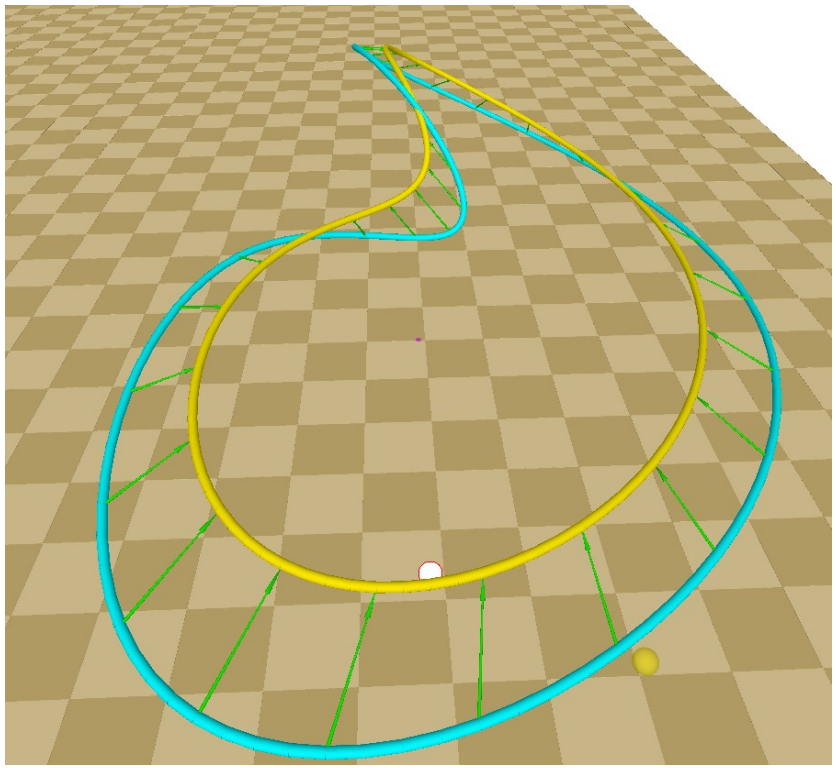
For each point C_i of subdivided curve C display $V_i = G - C_i''$

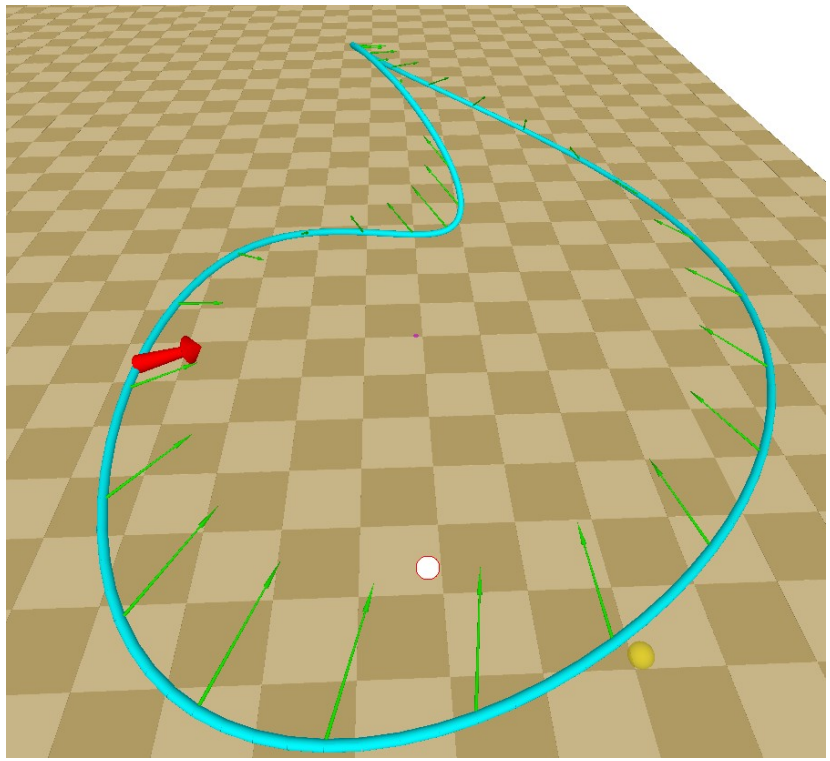
C_i'' = acceleration at C_i , G = constant gravity vector

Display arrows(Fi,Ci) and curve F using $F_i = C_i + aG - bC_i''$

Select coefficients a and b (b depends on subdivision level)

Animate red arrow of **constant length** from F_i towards C_i

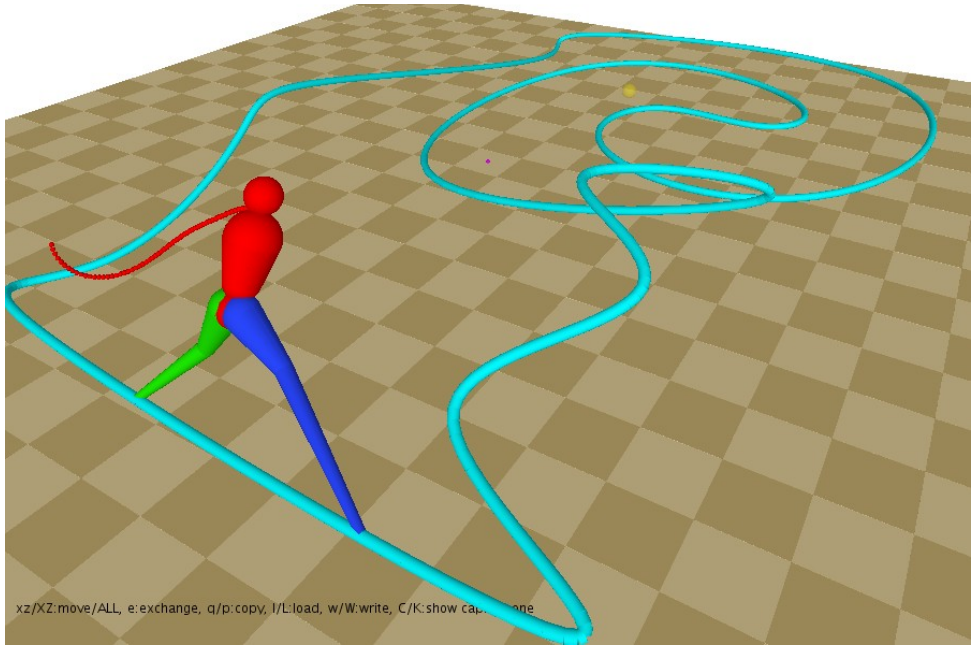


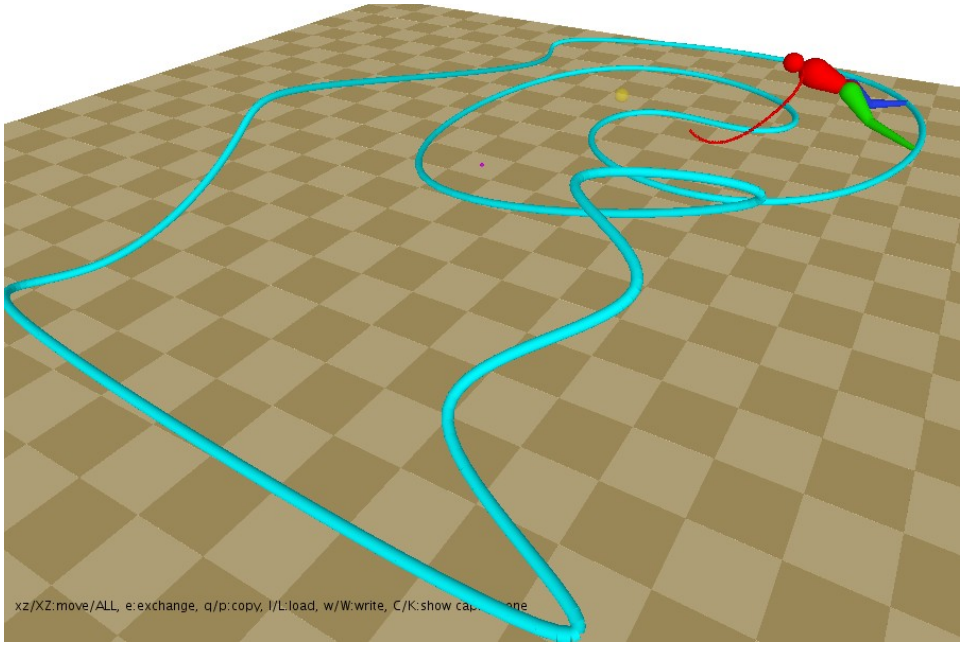


Module 3: Skate Border

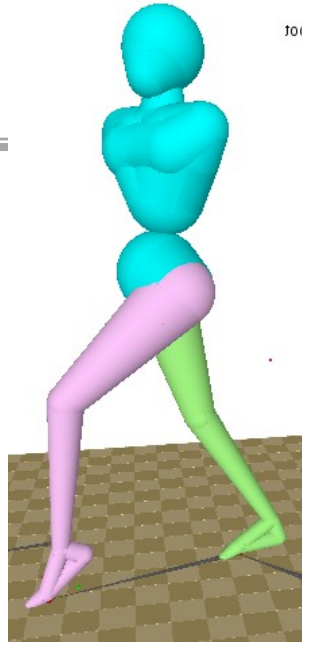
Show simple skate border sliding along the curve with bend knees with body center at the tip of the arrow (of module 2) and with feet at B_{i-k} and B_{i+k}

Pick k and lengths of the leg limbs to ensure reach





Extra credit: Cloud Runner



Replace skater with runner:

- Increment i at each frame to animate C_i
- Facing the tangent C_i' at C_i
- Keep body axis parallel to B_iC_i
- Use 2 hips and 2 legs (hip, knee, ankle)
- Keeping hip-knee and knee-ankle distances constant
- Move free foot (as in Project 3 or some plausible manner)
- Pick foot steps B_j carefully so that the runner can AIM, TRANSFER, COLLECT without lifting the feet from curve B
- Animate the runner

Deliverables: Due Dec 1 before class

Zip of source code (make sure that your name and face appear on the canvas)

Video (less than 2 mns) with:

- Usual header (CS3451, 2016, student name, P4: Cloud Runner)
- Segment titles ("Module 1: Curve subdivision"… , "Extra credit: XXX")
- One short (up to ~15 secs) segment per module
- Additional segments for each extra credit module

Grading: out of 40

Each one of the 3 modules is worth **10** points

Extra credit can bring you a **maximum** of **40 additional** points

For example:

- Retrofitting a quintic B-spline: up to 10 points
- Automatic resampling so that the runner accelerates progressively downhill and slows down uphill: up to 10 points
- Cloud Runner: up to 15 points
- Sinusoidal up&down motion along B_iC_i : up to 5 points
- Jump between foot prints: up to 10 points
- Moving arms in synch with runner's feet: up to 5 points