CS3451. Fall 08. Homework 2. Due Feb 6 in class. NAME: ____________________ Grade:______ / 10.

Individual test. Do not look at other students' work. Please type and write legibly. Bring to class. All 2D.

/2 1) Write the code for EE(pt A, pt B, pt P, pt Q) {…}, which returns *true* when edge(A,B) and edge(P,Q) intersect. If your code uses other functions (except for dot() and other trivial point and vector operators), please provide the code for them as well. (You should test your code in Processing before including it here.)

```
boolean EE(pt A, pt B, pt P, pt Q) {boolean hit=true;
   if (isLeftTurn(A,B,C)==isLeftTurn(A,B,D)) hit=false;
   if (isLeftTurn(C,D,A)==isLeftTurn(C,D,B)) hit=false;    return hit; }
boolean isLeftTurn(pt A, pt B, pt C) {return dot(R(V(A,B)),V(B,C))>0; };  // R(U) = U rotated 90°
```

/3 2) Write the code for EC(pt A, pt B, pt C, float r) {…}, which, if edge(A,B) does not intersect circle(C,r) returns –1, and otherwise returns the value of the parameter t of the point X=A+tAB which is the first intersection where the ray from A to B hits the circle. If your code uses other functions (except for dot() and other trivial point and vector operators), please provide the code for them as well. (You should test your code in Processing.)

```
float EC (pt A, pt B, pt C, float r) {
  vec T = V(A,B); float n = n(T); T.normalize();   vec AC = V(A,C);
  float d = dot(AC,T);   float h = dot(AC,R(T));  float t = -1;
  if (h<r) { float w = sqrt(sq(r)-sq(h)), t1 = (d-w)/n, t2 = (d+w)/n;
         if ((0<=t1)&&(t1<=1)) t = t1;     else if ((0<=t2)&&(t2<=1)) t = t2;  }
  return t; }
```

/2 3) Consider a control polygon P. Explain the 4-point subdivision technique. Assume that consecutive vertices at one subdivision levels are named A, B, C, D…. Explain how you obtain the new vertices B_1 and B_2 corresponding to B and the edge BC, using the linear interpolation function s(P,t,Q). Point out the advantages and limitations of this scheme.

B_1 = B; B_2 = S(S(A,9/8,B),1/2,S(D,9/8,C)). Interpolating, but only C^1.

/2 4) Consider a control polygon P. Explain the cubic B-spline subdivision technique. Assume that consecutive vertices at one subdivision levels are named A, B, C, D…. Explain how you obtain the new vertices B_1 and B_2 corresponding to B and the edge BC, using the linear interpolation function s(P,t,Q). Point out the advantages and limitations of this scheme.

B_1 = S(S(B,1/4,A),1/2,S(B,1/4,C)); B_2 = S(B,1/2, C). C^2, but not interpolating.

Span(BC) lies in the convex hull of (A,B,C,D), which is useful for collision and clipping.

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5) Suggest a good approximation of the velocity (tangent vector) V at point B in a sequence …A,B,C…. of a polyloop :

/1 V=S(0.5,V(A,C)); // V=AC/2;
