For any T/F question, if you give some reasonable explanation/note, you'll get the point!

1. Answer the following with true (T) or False(F) *1 point each*

F The term "distributed ray tracing" refers to a method for parallel computation of images. X In the midterm already

T One of the things that anti-aliasing helps prevent is the stair-step appearance of rasterized lines.

T The Z-buffer hidden surface algorithm can be modified to account for transparency by simply adding an α-buffer.

F B-spline curves have both the convex hull property and they interpolate control points. X The curve having both properties doesn't exist.

T Catmull-Clark subdivision is a generalization of B-spline surfaces.

F Hermite and Bezier bases functions can be used to describe different classes of curves. They desepibe the same classes of curves by different forms.

F The Bresenham line drawing algorithm only became practical once fast floating point hardware was commonly available. In the midterm review already.

T Rotation about an arbitrary axis can be expressed as a series of axis-aligned rotations.

F The Phong reflectance model can be used to describe X any real surface's reflectance properties.

F Motion capture is often used for animating smoke, X water, and other fluid phenomena. obviously absurd

F Ray tracing can be used to compute global illumination phenomena.

T In a perspective projection, a sphere can have an outline shaped like an ellipse In the midterm review already

17. **I wish to ray-trace a scene containing a complex space station. The image will be 1000x1000, each pixel with be supper sampled on a 10x10 jittered grid. I have two point light sources in the scene (two distant suns). Each bounce will use 10 rays to sample diffuse reflections. I will include shadows. What is the minimum number of rays I will have to trace? Explain why.** *3 points*

$1000 \times 1000 \times 10 \times 10 \times (1 + 2 + 10 + 10 \times 2)$

- 1000×1000: sub-pixel number
- 10×10: jittered grid
- 1: eye ray
- 2: light rays
- 10: Rays to diffuse reflectors
- 10×2: Rays from diffuse reflectors to lights

1. Answer the following with true (T) or False(F) *1 point each*
[Continued]

F When applying transformations to a 3D scene, the transformation applied to normal vectors should have any translation part doubled. ✗

F Most useful cubic basis functions have both the interpolation and convex hull properties.

F The human eye has three types of light receptor. ✗

F Pixel-based image representations have infinite resolution. ✗

T A good scan-conversion algorithm has the property that when given a set of non-overlapping polygons, every pixel "belongs" to at most one single polygon.

T Non-zero winding number and parity testing will produce the same result for a polygon with non-self-intersecting boundary. I'm doubting it was covered in the lecture.

F A series of transformations which are all 3D rotations can be permuted and the result will not change. cases in 2D are true.

T Bump-mapping will not change an object's silhouette.
Displacement-mapping will change ...

T Tensor-product surfaces are built by letting the control points of a curve vary according to some other curves.

F Catmull-Clark subdivision only works on regular meshes.
... irregular meshes as well. with extraordinary vertices.

F Cubic polynomial basis functions can be used to build interesting C^5 curves.

F Particle systems simulate objects such as waterfalls by modeling the interactions between individual molecules.

T Particles can be used to render smoke. → if crossed out, true.

F Motion graphs are plots showing where joints are located in a figure.
↳ Were Motion graphs covered in the lecture?

F The result of applying subdivision to a cubic curve is two quadratic curves. ✗
(Cubic still)

T Raytracing can be accelerated using BSP-Trees or K-D Trees.

1. Answer the following with true (T) or False(F) *1 point each*

T — C^0 continuity does not always imply C^1.
G^1 Continuity : the tangents are the same.
C^1 ... : ... and their modes (the speed of change) are the same.

T — The Bezier basis functions are affine invariant.

T — The Hermite basis functions have local support.

T/F — Cubic spline surfaces can be ray-traced without first polygonizing them.
If we ray-trace the intersection between the rays and the convex hull of the surfaces first, the statement could be true; but anyway, we need to polygonize the surface in the subsequent steps!

F — Key frame animation becomes trivially easy when inverse kinematics are used.

F — Animation of human characters rarely (X) often done using motion capture.

F — Generating high-quality animations requires either Arwen (joke!) sampling or Aragorn filtering to remove motion blur.

F — Advanced methods for rendering arbitrary images in constant time exist, but we did not cover them in class. never heard of it, although a great idea!

T — The fully implicit version of Euler's method (a.k.a. backwards Euler) is unconditionally stable.

F — The singular values of a rotation matrix are the amounts of rotation abut the X, Y, and Z axes. ↓ absolute values of the eigenvalues

F — The human eye is uniformly sensitive to all frequencies of visible light.
Obviously false.

F — Perspective transformations distort straight lines into circles.
Actually, it might be true when the reception planes are distorted :)

T — Radiosity methods are optimized for rendering scenes with diffuse surfaces.

T — Final gathering can be used with both photon mapping and radiosity.

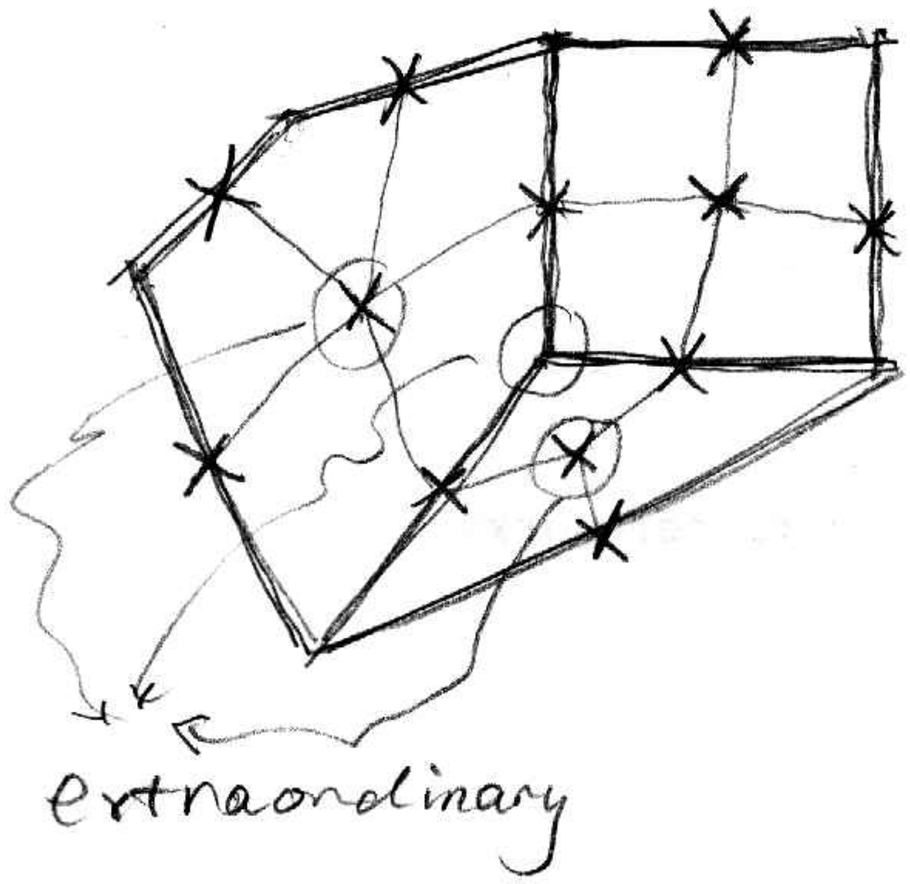
T — Some motion capture systems use magnetic fields to determine the location and orientation of tracker objects.

T — Cubic B-Splines can be exactly converted to quartic B-splines.
↳ four-degree

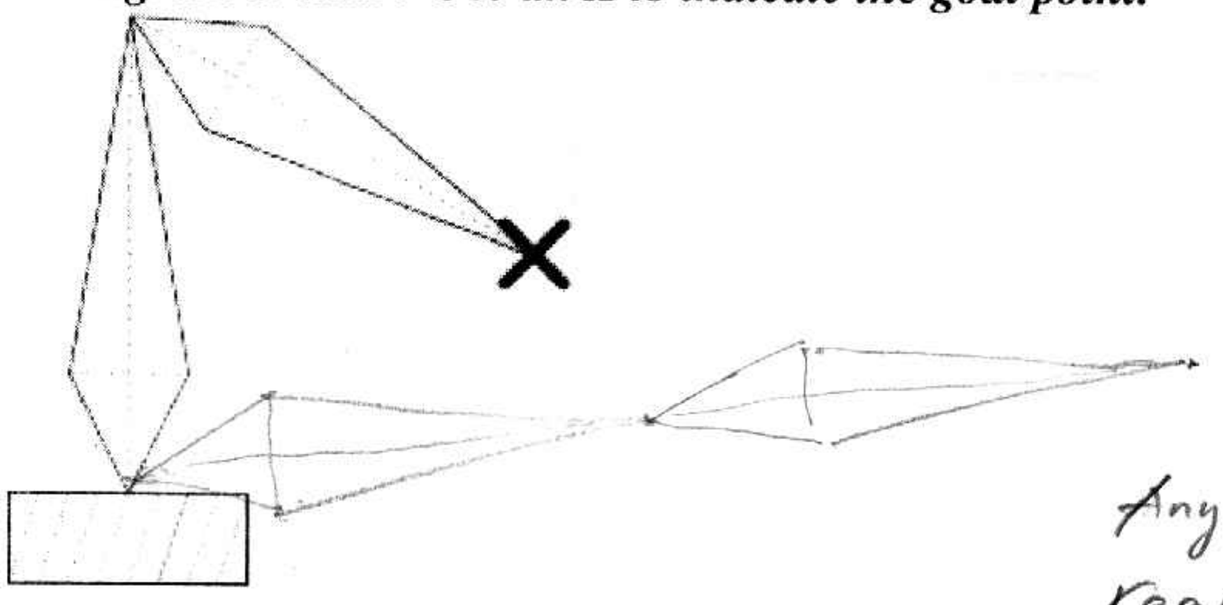
For Q8 in final-F04 & Q16 in final-F05: Catmull-Clark subdiv.

1. Count the number of edges around a vertex. if it's not 4, the vertex is extraordinary.

2. Count the number of edges of a polygon. if it's not 4, it will produce an additional extraordinary vertex after subdividing.



8. **In the context of doing inverse kinematics problems, when is the Jacobian singular? Draw an example using a two-link arm whose links are connected by a rotation joint and whose root link is attached to ground with a rotation joint.** ***Make sure your diagram is clear. Use an X to indicate the goal point.*** *4 points*



Example figure