Robots II Final, Spring 2011.

T/F 4 points each

1. In all friction form closure grasps, every contact point can at least one other contact point in its friction cone.

2. Unit quaternions have 4 elements, but only three degrees of freedom.

3. Some LCPs arising in the Stewart-Trinkle time stepping method have non-unique solutions.

4. A* search with cost-to-come = 0 is equivalent to Best-First search.

5. Sample-based methods are preferred in motion planning, because the number of samples needed for a given resolution is independent of the dimension.
of C-space.

6. A robot with 7 joints and a position-controlled parallel-jaw gripper has an 8-dimensional C-space.

8 points each
Short Answer Questions

1. Sketch the curves in the workspace when the radio plots change qualitatively (these are known as critical curves). Label the curves (E₁, V₁), etc.

2. Describe how a randomized potential field method works and how it escapes local minima. Under what circumstances does it fail?
3. Let $C$ be the "disk" shown on the right. Without the identifications shown, $C$ has 4 components. How many components exist with the identifications shown?

4. For the $C$-space shown on the right, extend the idea of a visibility graph to curved objects.
   
   Draw the graph for the obstacles and $q_1$ and $q_6$.

5. Give pseudo-code defining a van der Corput sequence on a disc in $\mathbb{R}^2$.

6. Find the points of maximum dispersion in the region shown.
dispersion in the region shown on the right.

Compare results for two metrics: $L_1$ and $L_\infty$

7. Describe the main differences between sampling-based and combinatorial motion planning methods.

Analysis Questions (10 points each)

1. Let $X$ be a vector space and let $x \& x'$ be points in $X$. Prove that $\rho(x,x') = \text{abs}(x - x')$ is or is not a metric. Note that $\text{abs} = \text{absolute value}$, which applies to each element of a vector.

2. Define the most impressive analysis problem you prepared for, but I didn't ask. Then solve it.