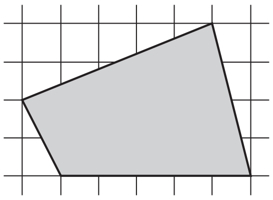
CSCI 4964/6963 Advanced Robotics, Spring 1999
Assignment 2; out Monday January 25, due Monday February 8

1. For the part shown below:

   (a) Place three contacts on the object so that the object is not immobilized. Use Reuleaux's method to construct the region of CORs about which the part can move (also indicate whether the rotations can be positive or negative).

   (b) Add a fourth contact and use Reuleaux's method to show that the object is immobilized.

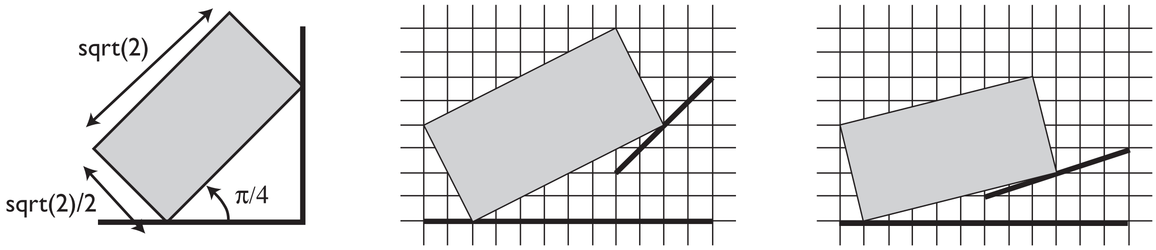


2. In the diagrams below, a rectangular block is tilted so that one corner contacts the support surface and the other corner contacts a wall (figure (a)) or a "palm" (figures (b) and (c)).

   (a) For figure (a), what is the minimum coefficient of friction (μ) required in order for the block to remain in equilibrium, i.e./ not slip? Although it is possible to solve this part using a free body diagram, you should use friction cones and arguments about resultant forces in order to develop insight that will make the rest of this problem simple.

   (b) For figure (b), assume that the coefficient of friction is $\frac{1}{4}$. Does the object slip or remain in equilibrium? Justify your answer.

   (c) For figure (c), assume that the coefficient of friction between the block and the support surface is $\frac{1}{3}$, but that we have replaced the palm material so that the coefficient of friction between it and the object is $\frac{3}{4}$. We will slowly move the palm to the right. Will the object move with the palm[1] or will it slide off? Justify your answer. You should assume quasistatic manipulation.



(a) (b) (c)

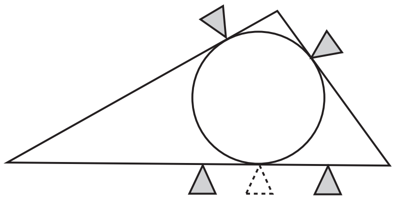
3. Here is an algorithm for grasping a planar triangular object:

   - Inscribe the largest possible circle inside the triangle. The circle will contact each of the sides at a single point.
   - Place a finger at two of these points.
   - On the third side, place two fingers, one on each side of the contact point.

   Do one of the following:

   (a) Prove that this algorithm generates a force closure grasp for any triangle.

   (b) Prove that this algorithm generates a form closure grasp for any triangle.



[1] i.e. the corner on the palm stays fixed with respect to the palm and the corner on the support surface slides