Abteilung Algorithmik
Institut für Betriebssysteme und Rechnerverbund **SS 13**
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Online-Algorithms
5th Homework Assignment, 18. June 2013

Due on 3. July 2013 until 13:00 in the box in front of IZ 338
Don't forget to label each sheet with your name!

Exercise 1 (Star Search):
We generalize the problem of searching on a line: searching on a star, which consists of m rays emanating from the starting point of the search. It is unknown on which of the m rays the search item is located.
Our algorithm has the following strategy: Starting at some ray we explore the rays in circular order, where the step width for the ith ray is the following:

$$x_i = \left(\frac{m}{m-1}\right)^i$$

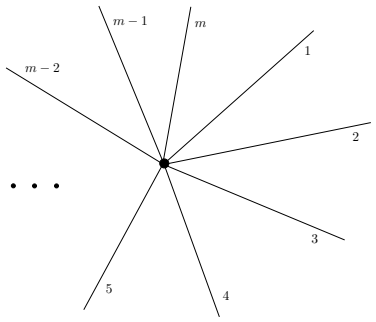

Figure 1: m rays emanating from the starting point.

Show that this strategy cannot achieve a competitive factor better than:

$$1 + 2\frac{m^m}{(m-1)^{m-1}}$$

(20 points)

Exercise 2 (DOUBLE COVERAGE algorithm for k-server problem):
We have seen that the GREEDY-algorithm for the k-server problem is not necessarily competitive. Let's look at the following algorithm for k servers on a line:

DOUBLE COVERAGE

- If the request lies outside the convex hull of all servers, move the closest server to serve the request.
- Else the request lies between two servers. Move both of them - with the same velocity - towards the request, until (at least) one server reaches the request point.

Reconsider the worst-case example of Exercise 2.2 (3 request points on a line). Why does the DOUBLE COVERAGE algorithm not produce an arbitrarily bad result in this instance?
(10 points)

Exercise 3 (Visibility in Polygons):

a) Given some simple polygon P: Show that any watchman route that sees the entire boundary of P, can also see the entire interior of P.

b) Give a counter example of a non-simple polygon, a polygon with holes, for which this is not the case.

(20+10 points)