CAP4630 Assignment 1

Andrew Iguina

a. If the state space consists of all positions (x,y) in any plane then the state space would contain x\*y states, or more accurately: (where A is the area of the first through the nth polygon ) as long as obstacles are considered solid. There could also be infinitely many paths to the goal.

b. The shortest path to the goal consists of vertices on the polygons because each vertex is the closest point to bypass the obstacle in a certain direction. Essentially, if you must go around an obstacle, then the end of an edge of the obstacle is the most efficient straight line around all or part of that obstacle. This however does kind of take advantage of the fact that the polygons are given as being convex.

c. I had to create many functions and classes to implement this project. Below is a list of what I consider the most important functions. My ACTIONS function is actually quite complex because I had to work around the implementation of java awt's intersect function. It must first allow paths along an edge of a polygon. Secondly, it must check if there are any intersections, this calls a personally designed intersection method to allow for paths which connect vertices. Finally, if there are no intersections, then the program must reject paths which travel inside obstacles ( because they are only defined by lines ). A Point is added to the list of possible actions if and only if it passes all of those criteria.

Most Important Functions:

ArrayList<Node> AStar() // This could take problem as a variable, but doesn't yet

ArrayList<Point2D> ACTIONS (Point2D from) // Point2Ds are can be used as Vectors

boolean intersection(Line2D l1, Line2D l2)

boolean isContained(Line2D line) // Checks if contained by an obstacle

Note: This method uses the midpoint of the line to determine if it's contained by a polygon,

it works because if a line is contained it will either have its midpoint contained by the polygon or it will have to intersect with a line in the polygon.

d. Below is my step by step solution:

start: [1, 3] f(x) = 36.6742 g(x)= 0

frontier:

[2, 6] f(x) = 37.7021 g(x)= 3.1623

[2, 1] f(x) = 38.9512 g(x)= 2.2361

[1, 9] f(x) = 40.4819 g(x)= 6

[0, 14] f(x) = 45.411 g(x)= 11.0454

[2, 6] f(x) = 37.7021 g(x)= 3.1623

frontier:

[7, 8] f(x) = 37.7022 g(x)= 8.5474

[2, 1] f(x) = 38.9512 g(x)= 2.2361

[10, 8] f(x) = 37.8092 g(x)= 11.4085

[0, 14] f(x) = 45.411 g(x)= 11.0454

[17, 6] f(x) = 39.5632 g(x)= 18.1623

[1, 9] f(x) = 40.4819 g(x)= 6

[14, 8] f(x) = 38.1532 g(x)= 15.3278

[7, 8] f(x) = 37.7022 g(x)= 8.5474

frontier:

[10, 8] f(x) = 37.8092 g(x)= 11.4085

[2, 1] f(x) = 38.9512 g(x)= 2.2361

[14, 8] f(x) = 38.1532 g(x)= 15.3278

[12, 15] f(x) = 39.5104 g(x)= 17.1498

[17, 6] f(x) = 39.5632 g(x)= 18.1623

[1, 9] f(x) = 40.4819 g(x)= 6

[9, 15] f(x) = 41.1455 g(x)= 15.8276

[0, 14] f(x) = 45.411 g(x)= 11.0454

[14, 19] f(x) = 41.5858 g(x)= 21.5858

[10, 8] f(x) = 37.8092 g(x)= 11.4085

frontier:

[14, 8] f(x) = 38.1532 g(x)= 15.3278

[2, 1] f(x) = 38.9512 g(x)= 2.2361

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[0, 14] f(x) = 45.411 g(x)= 11.0454

[14, 8] f(x) = 38.1532 g(x)= 15.3278

frontier:

[18, 10] f(x) = 38.1575 g(x)= 19.7999

[2, 1] f(x) = 38.9512 g(x)= 2.2361

[1, 9] f(x) = 40.4819 g(x)= 6

[20, 17] f(x) = 40.2866 g(x)= 26.1445

[12, 15] f(x) = 39.5104 g(x)= 17.1498

[14, 19] f(x) = 41.5858 g(x)= 21.5858

[9, 15] f(x) = 41.1455 g(x)= 15.8276

[0, 14] f(x) = 45.411 g(x)= 11.0454

[14, 13] f(x) = 41.2084 g(x)= 20.3278

[17, 6] f(x) = 39.5632 g(x)= 18.1623

[22, 19] f(x) = 40.9293 g(x)= 28.9293

[18, 10] f(x) = 38.1575 g(x)= 19.7999

frontier:

[2, 1] f(x) = 38.9512 g(x)= 2.2361

[12, 15] f(x) = 39.5104 g(x)= 17.1498

[22, 9] f(x) = 39.5435 g(x)= 23.923

[20, 17] f(x) = 40.2866 g(x)= 26.1445

[17, 6] f(x) = 39.5632 g(x)= 18.1623

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[0, 14] f(x) = 45.411 g(x)= 11.0454

[14, 13] f(x) = 41.2084 g(x)= 20.3278

[22, 19] f(x) = 40.9293 g(x)= 28.9293

[17, 1] f(x) = 53.6142 g(x)= 28.8553

[23, 6] f(x) = 43.2324 g(x)= 26.2031

[19, 3] f(x) = 48.8027 g(x)= 26.871

[9, 15] f(x) = 41.1455 g(x)= 15.8276

[25, 6] f(x) = 43.6736 g(x)= 27.8622

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[22, 9] f(x) = 39.5435 g(x)= 23.923

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[20, 17] f(x) = 40.2866 g(x)= 26.1445

[22, 19] f(x) = 40.9293 g(x)= 28.9293

[14, 19] f(x) = 41.5858 g(x)= 21.5858

[9, 15] f(x) = 41.1455 g(x)= 15.8276

[0, 14] f(x) = 45.411 g(x)= 11.0454

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[17, 1] f(x) = 53.6142 g(x)= 28.8553

[23, 6] f(x) = 43.2324 g(x)= 26.2031

[19, 3] f(x) = 48.8027 g(x)= 26.871

[6, 19] f(x) = 52.3609 g(x)= 24.3609

[22, 9] f(x) = 39.5435 g(x)= 23.923

frontier:

[17, 6] f(x) = 39.5632 g(x)= 18.1623

[20, 17] f(x) = 40.2866 g(x)= 26.1445

[1, 9] f(x) = 40.4819 g(x)= 6

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[14, 19] f(x) = 41.5858 g(x)= 21.5858

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[32, 8] f(x) = 45.1533 g(x)= 33.9729

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[17, 1] f(x) = 53.6142 g(x)= 28.8553

[23, 6] f(x) = 43.2324 g(x)= 26.2031

[19, 3] f(x) = 48.8027 g(x)= 26.871

[28, 9] f(x) = 41.5849 g(x)= 29.923

[29, 8] f(x) = 43.0772 g(x)= 30.9941

[25, 2] f(x) = 50.7742 g(x)= 31.5388

[0, 14] f(x) = 45.411 g(x)= 11.0454

[17, 6] f(x) = 39.5632 g(x)= 18.1623

frontier:

[20, 17] f(x) = 40.2866 g(x)= 26.1445

[22, 19] f(x) = 40.9293 g(x)= 28.9293

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[29, 8] f(x) = 43.0772 g(x)= 30.9941

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frontier:

[1, 9] f(x) = 40.4819 g(x)= 6

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[9, 15] f(x) = 41.1455 g(x)= 15.8276

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[19, 3] f(x) = 48.8027 g(x)= 26.871

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[18, 20] f(x) = 45.7812 g(x)= 29.75

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[32, 8] f(x) = 45.1533 g(x)= 33.9729

[25, 6] f(x) = 43.6736 g(x)= 27.8622

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[28, 9] f(x) = 41.5849 g(x)= 29.923

[18, 20] f(x) = 45.7812 g(x)= 29.75

[6, 19] f(x) = 52.3609 g(x)= 24.3609

[0, 14] f(x) = 45.411 g(x)= 11.0454

[17, 1] f(x) = 53.6142 g(x)= 28.8553

[23, 6] f(x) = 43.2324 g(x)= 26.2031

[19, 3] f(x) = 48.8027 g(x)= 26.871

[25, 2] f(x) = 50.7742 g(x)= 31.5388

[29, 8] f(x) = 43.0772 g(x)= 30.9941

[22, 19] f(x) = 40.9293 g(x)= 28.9293

frontier:

[28, 19] f(x) = 40.9293 g(x)= 34.9293

[14, 13] f(x) = 41.2084 g(x)= 20.3278

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[32, 8] f(x) = 45.1533 g(x)= 33.9729

[25, 6] f(x) = 43.6736 g(x)= 27.8622

[14, 19] f(x) = 41.5858 g(x)= 21.5858

[28, 9] f(x) = 41.5849 g(x)= 29.923

[18, 20] f(x) = 45.7812 g(x)= 29.75

[6, 19] f(x) = 52.3609 g(x)= 24.3609

[0, 14] f(x) = 45.411 g(x)= 11.0454

[17, 1] f(x) = 53.6142 g(x)= 28.8553

[23, 6] f(x) = 43.2324 g(x)= 26.2031

[19, 3] f(x) = 48.8027 g(x)= 26.871

[25, 2] f(x) = 50.7742 g(x)= 31.5388

[29, 8] f(x) = 43.0772 g(x)= 30.9941

[28, 19] f(x) = 40.9293 g(x)= 34.9293

frontier:

[31, 19] f(x) = 40.9293 g(x)= 37.9293

[9, 15] f(x) = 41.1455 g(x)= 15.8276

[28, 9] f(x) = 41.5849 g(x)= 29.923

[14, 13] f(x) = 41.2084 g(x)= 20.3278

[25, 6] f(x) = 43.6736 g(x)= 27.8622

[14, 19] f(x) = 41.5858 g(x)= 21.5858

[29, 8] f(x) = 43.0772 g(x)= 30.9941

[29, 17] f(x) = 42.5505 g(x)= 37.1653

[6, 19] f(x) = 52.3609 g(x)= 24.3609 h(x)= 28

[0, 14] f(x) = 45.411 g(x)= 11.0454 h(x)= 34.3657

[17, 1] f(x) = 53.6142 g(x)= 28.8553 h(x)= 24.7588

[23, 6] f(x) = 43.2324 g(x)= 26.2031 h(x)= 17.0294

[19, 3] f(x) = 48.8027 g(x)= 26.871 h(x)= 21.9317

[25, 2] f(x) = 50.7742 g(x)= 31.5388 h(x)= 19.2354

[31, 6] f(x) = 61.6126 g(x)= 48.2709 h(x)= 13.3417

[18, 20] f(x) = 45.7812 g(x)= 29.75 h(x)= 16.0312

[32, 8] f(x) = 45.1533 g(x)= 33.9729 h(x)= 11.1803

[31, 19] f(x) = 40.9293 g(x)= 37.9293

frontier:

[34, 19] f(x) = 40.9293 g(x)= 40.9293

[9, 15] f(x) = 41.1455 g(x)= 15.8276

[28, 9] f(x) = 41.5849 g(x)= 29.923

[14, 13] f(x) = 41.2084 g(x)= 20.3278

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[29, 17] f(x) = 42.5505 g(x)= 37.1653

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[31, 6] f(x) = 61.6126 g(x)= 48.2709

[18, 20] f(x) = 45.7812 g(x)= 29.75

[34, 16] f(x) = 45.1719 g(x)= 42.1719

[6, 19] f(x) = 52.3609 g(x)= 24.3609

goal: [34, 19] f(x) = 40.9293 g(x)= 40.9293