Homework 9: Stability, Path Planning

Assigned: Mon. 24-April
Due: Fri. 28-April (Submit no later than 5PM in my mailbox)

1. (6 points total) Find all of the equilibrium points $\tilde{\mathbf{x}}$ for each of the following systems:

   (a) (2 points)

   $$\begin{pmatrix} \dot{x}_1 \\ \dot{x}_2 \end{pmatrix} = \begin{pmatrix} 8x_1 + x_2 \\ x_2^2 - 1 \end{pmatrix}$$

   (b) (2 points)

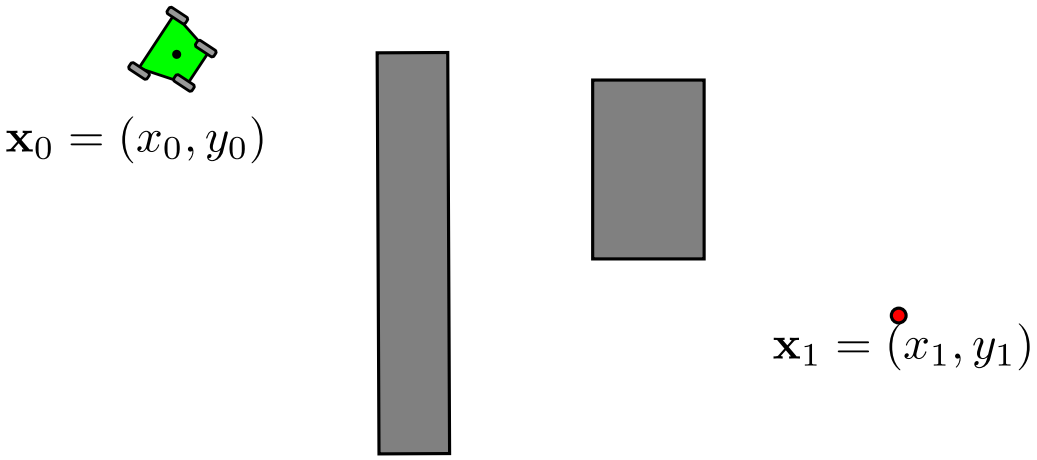
   $$\begin{pmatrix} \dot{x}_1 \\ \dot{x}_2 \end{pmatrix} = \begin{pmatrix} 3x_1 + x_2 \\ x_1 - 5x_2 - 1 \end{pmatrix}$$

   (c) (2 points)

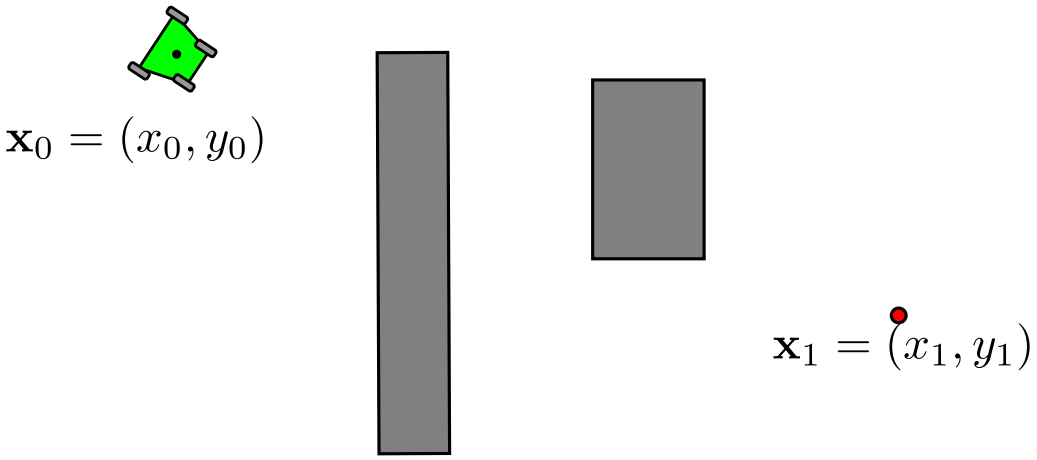
   $$\begin{pmatrix} \dot{x}_1 \\ \dot{x}_2 \end{pmatrix} = \begin{pmatrix} \cos x_1 \\ x_2 - x_1^2 \end{pmatrix}$$

2. (6 points total) Sketch the path the robot would take from the start to the goal using the Bug 0, Bug 1, and Bug 2 algorithms. Indicate the hit H_i and leave L_i points for the i-th obstacle:

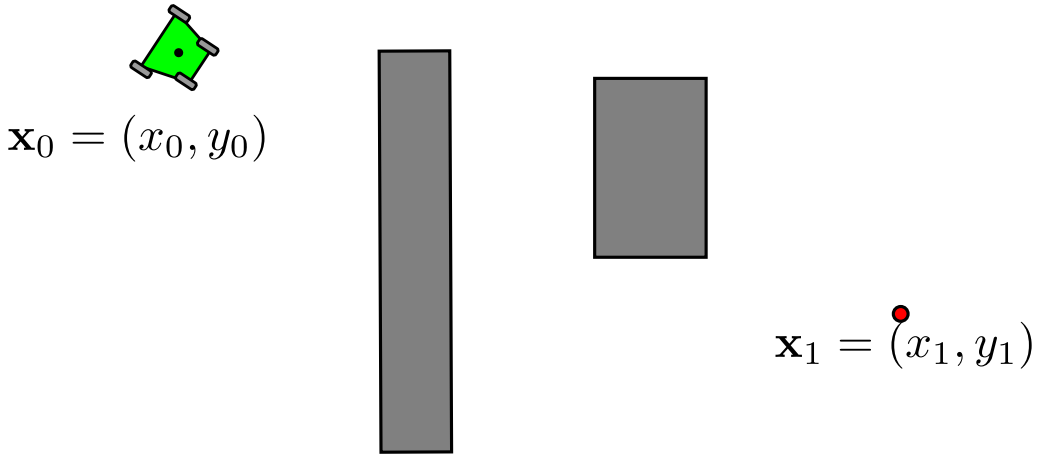
   (a) (2 points) Bug 0:



   (b) (2 points) Bug 1:



(c) (2 points) Bug 2:



3. (15 points) Construct the nearest-neighbor path that connects a series of 100 randomly distributed points. Randomly generate the x and y locations of each point (constrained such that $(x, y) \in [0, 100] \times [0, 100]$ using the following MATLAB code:

```
N = 100;
xmax = 100;
ymax = 100;
x = rand(N,1)*xmax;
y = rand(N,1)*ymax;
```

The path should begin at the first city generated at location `x(1)` and `y(1)`.

(a) (10 points) Submit a hardcopy of your MATLAB code. Include comments.

(b) (5 points) Submit a plot that uses circular markers to indicate each city and solid lines to connect each point along the path. Clearly label your axes.

Hints: Refer to the pseudocode in the notes.