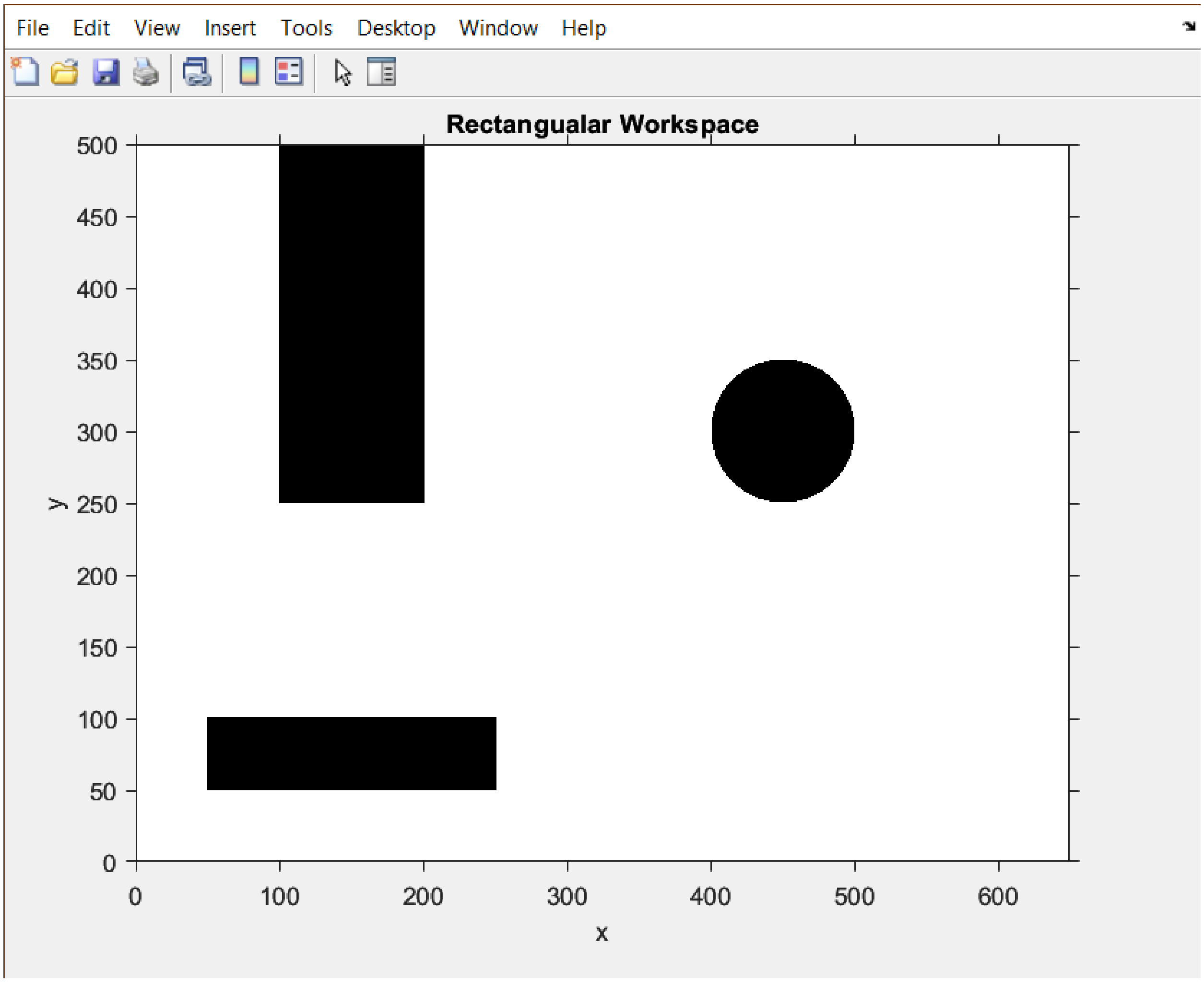
Potential Field Method

Aryan Raj 200202

1. Generate a rectangular workspace with three or more obstacles



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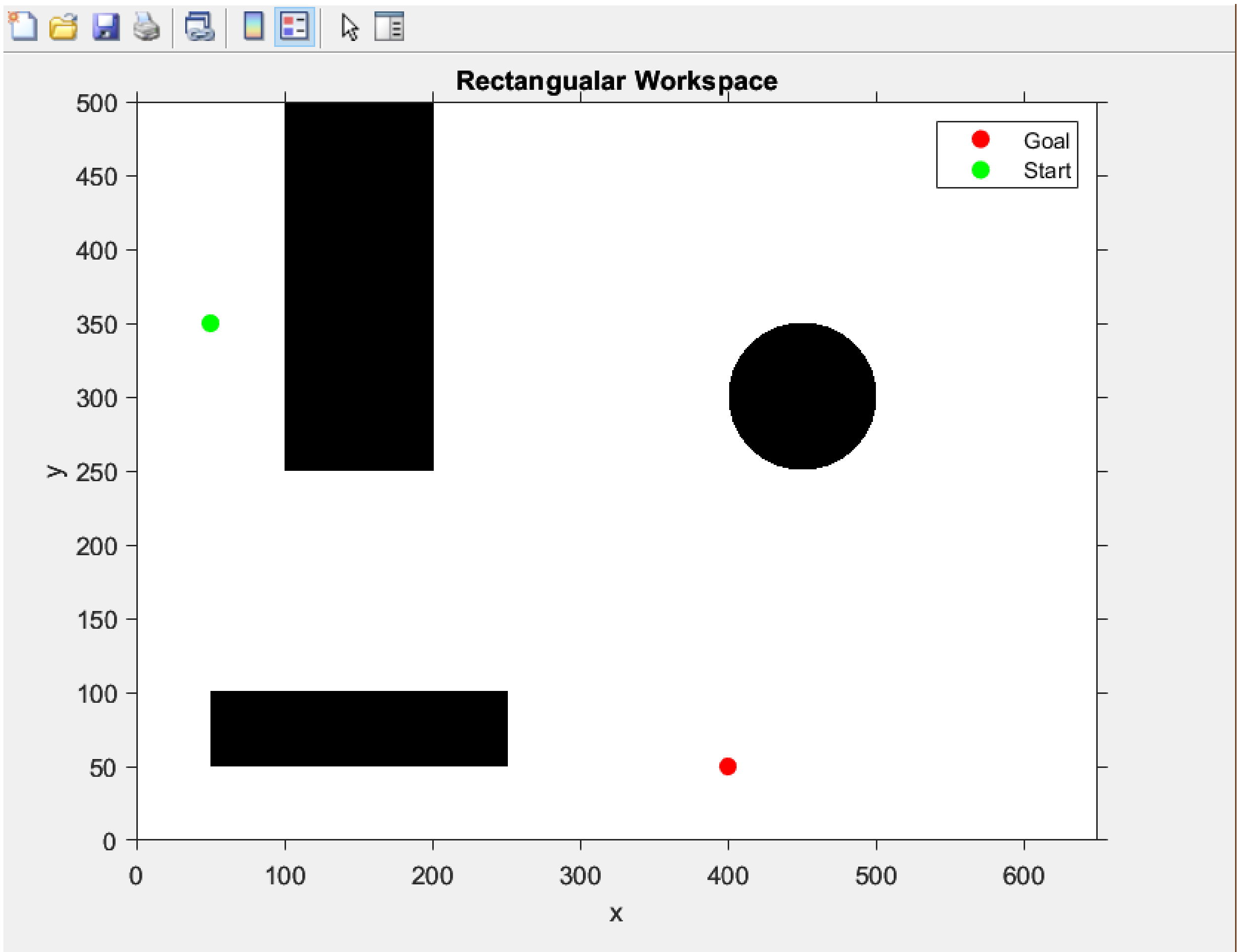
2. Mark the start point and the goal point in the workspace.



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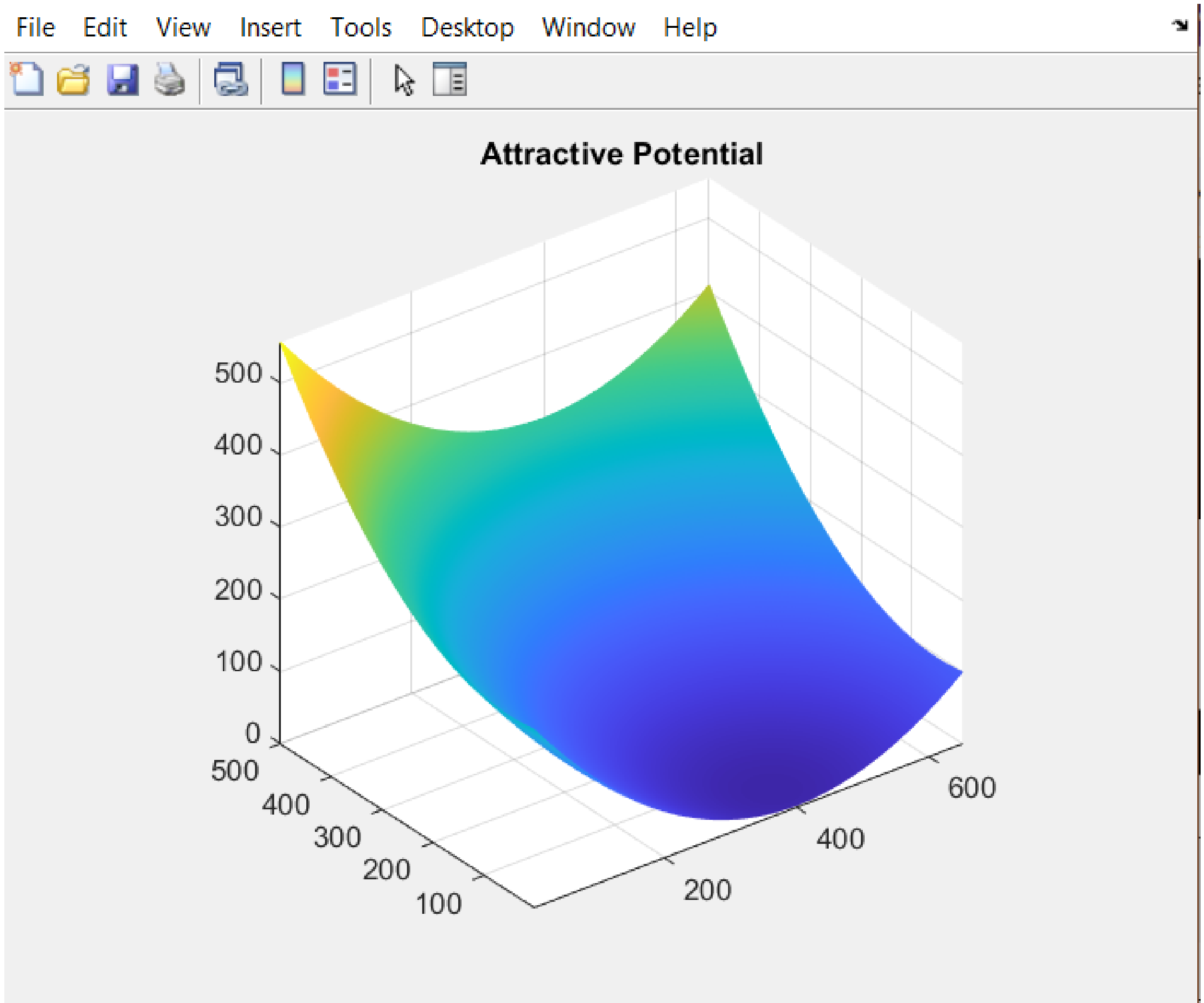
3. Define the potential field functions for attractive and repulsive fields.

Attractive :-

```
zita = 1/650; %constant can be changed
attr = zita * ( (x - goal(1)).^2 + (y - goal(2)).^2 );
```



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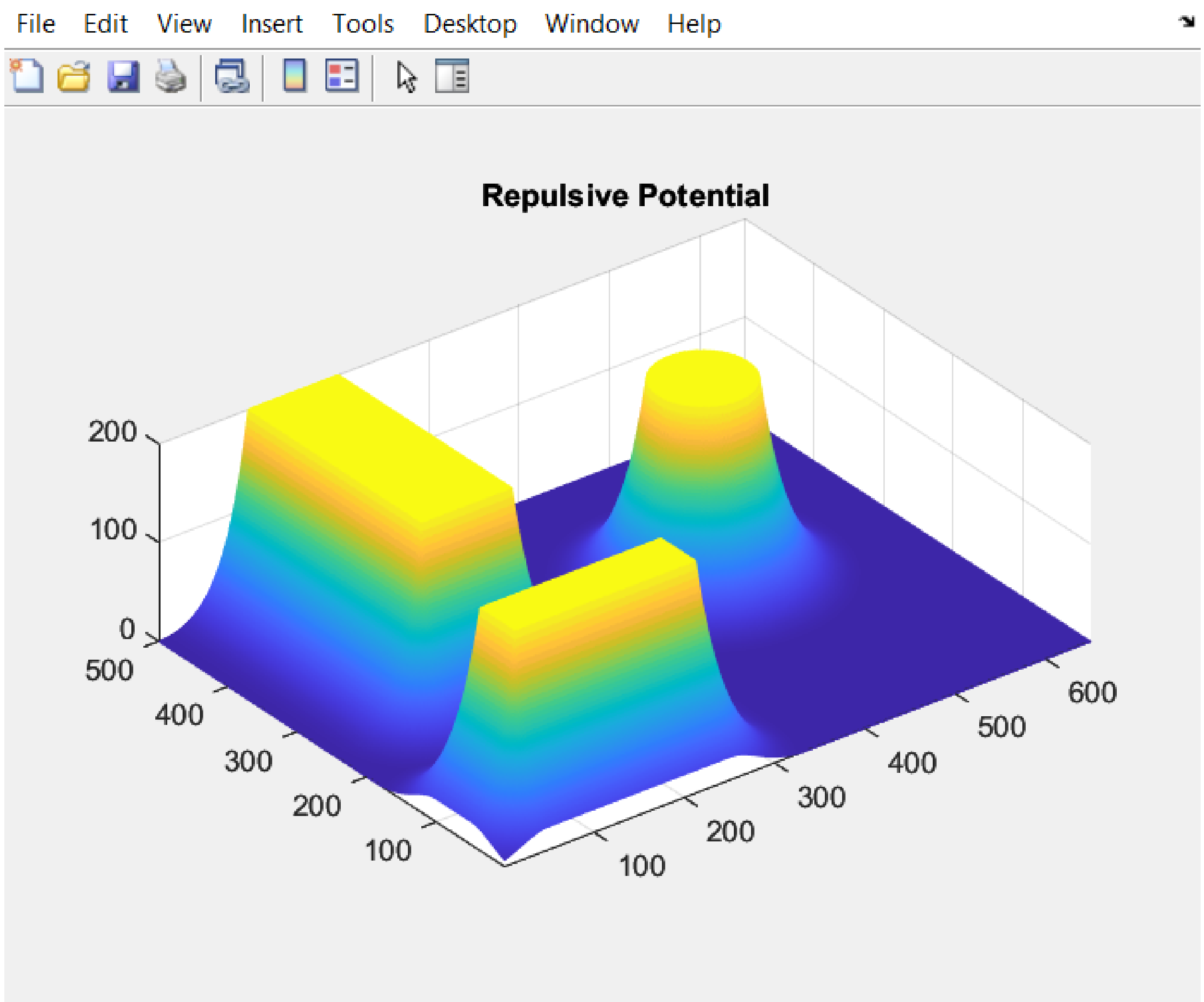
Repulsive:-

```
d1 = (d/100) + 1;d0 = 2;nu = 800;
repul = nu*((1./d1 - 1/d0).^2);
repul (d1 > d0) = 0;
```



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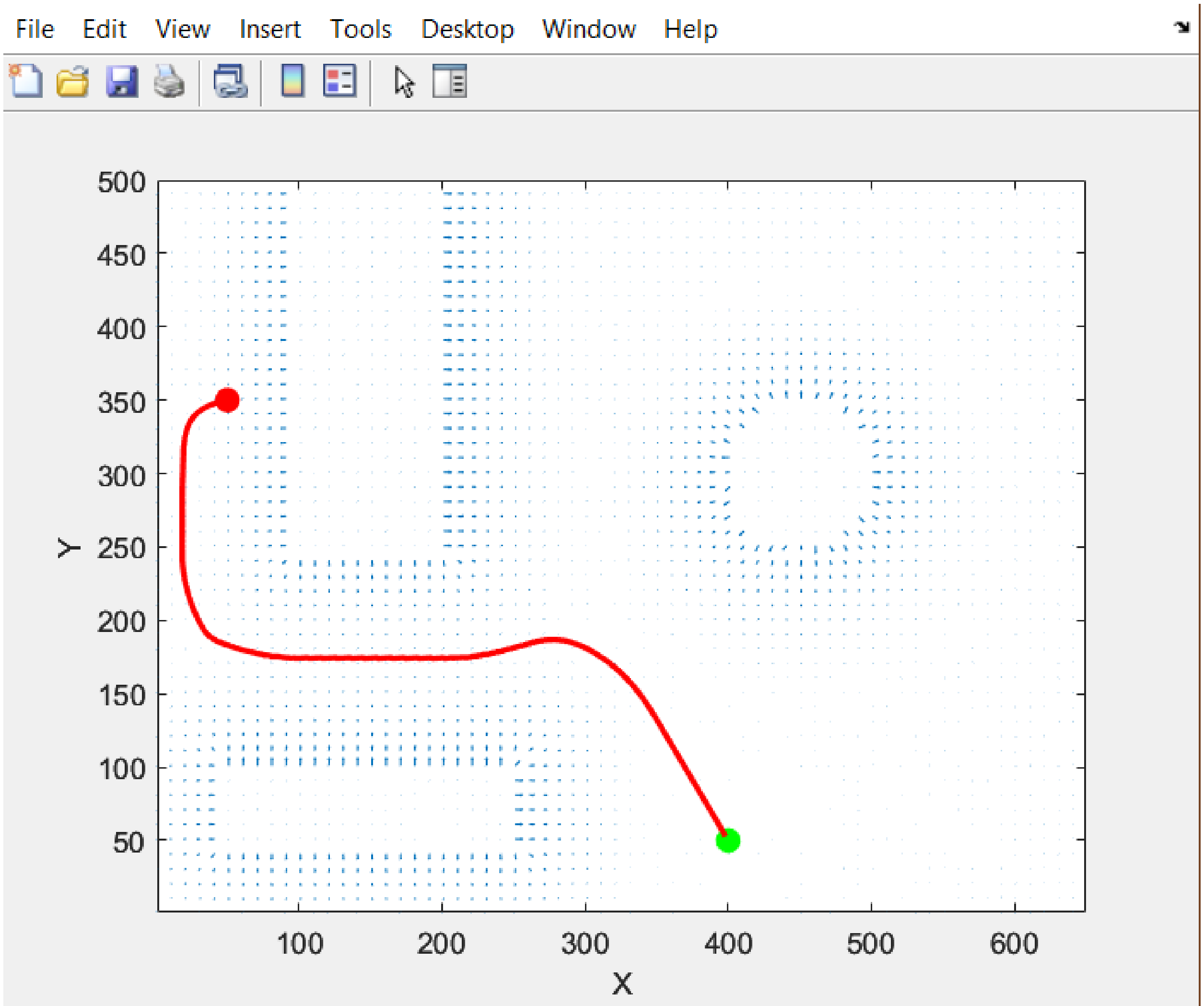
4. Generate feasible paths for different values of the constants in the attractive and repulsive fields.Which is the best path.

1)

```
nu = 1200;
zita = 1/1200;
```



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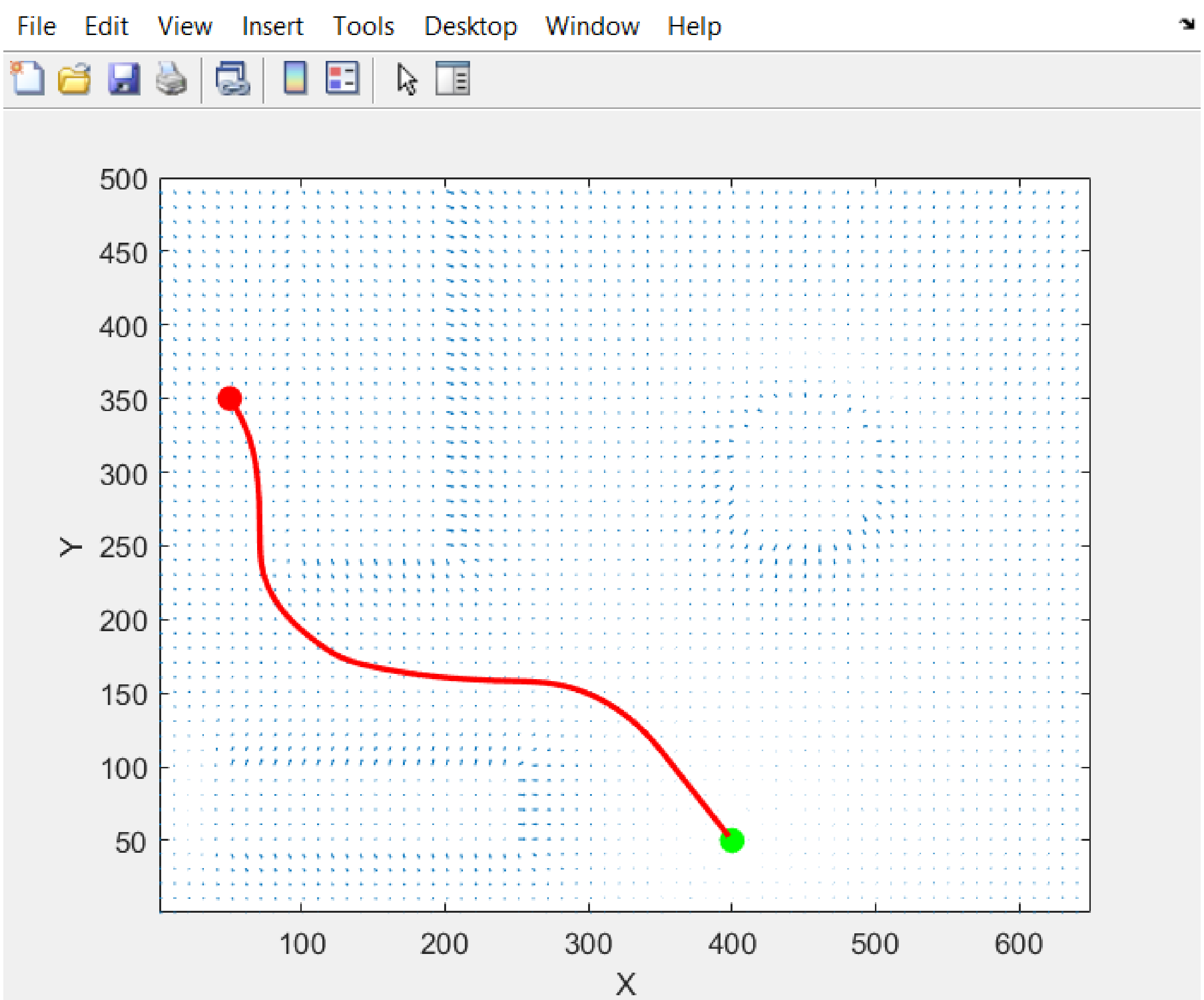
2)

```
nu = 300;
zita = 1/650;
```



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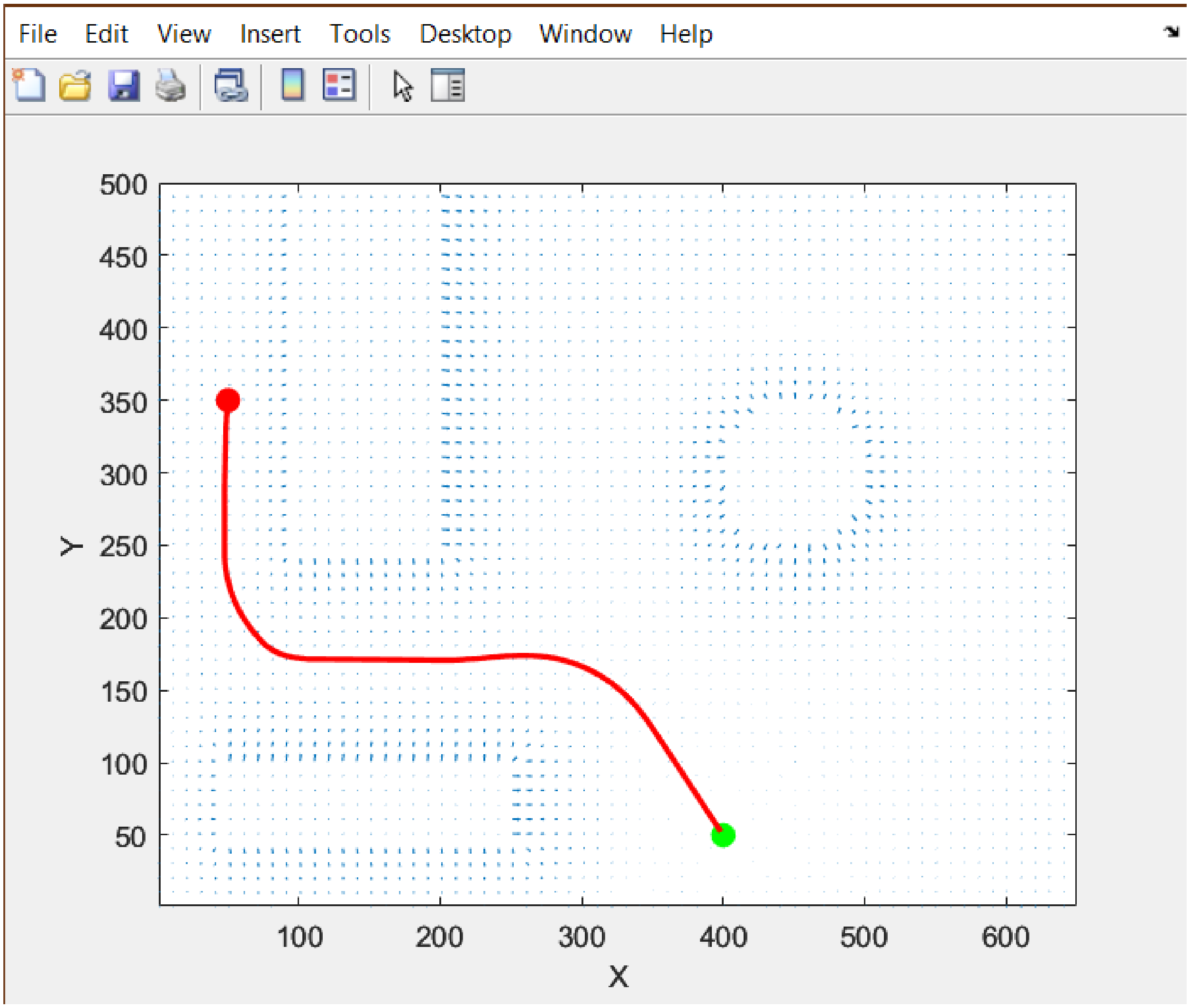
3)

```
nu = 800;
zita = 1/650;
```



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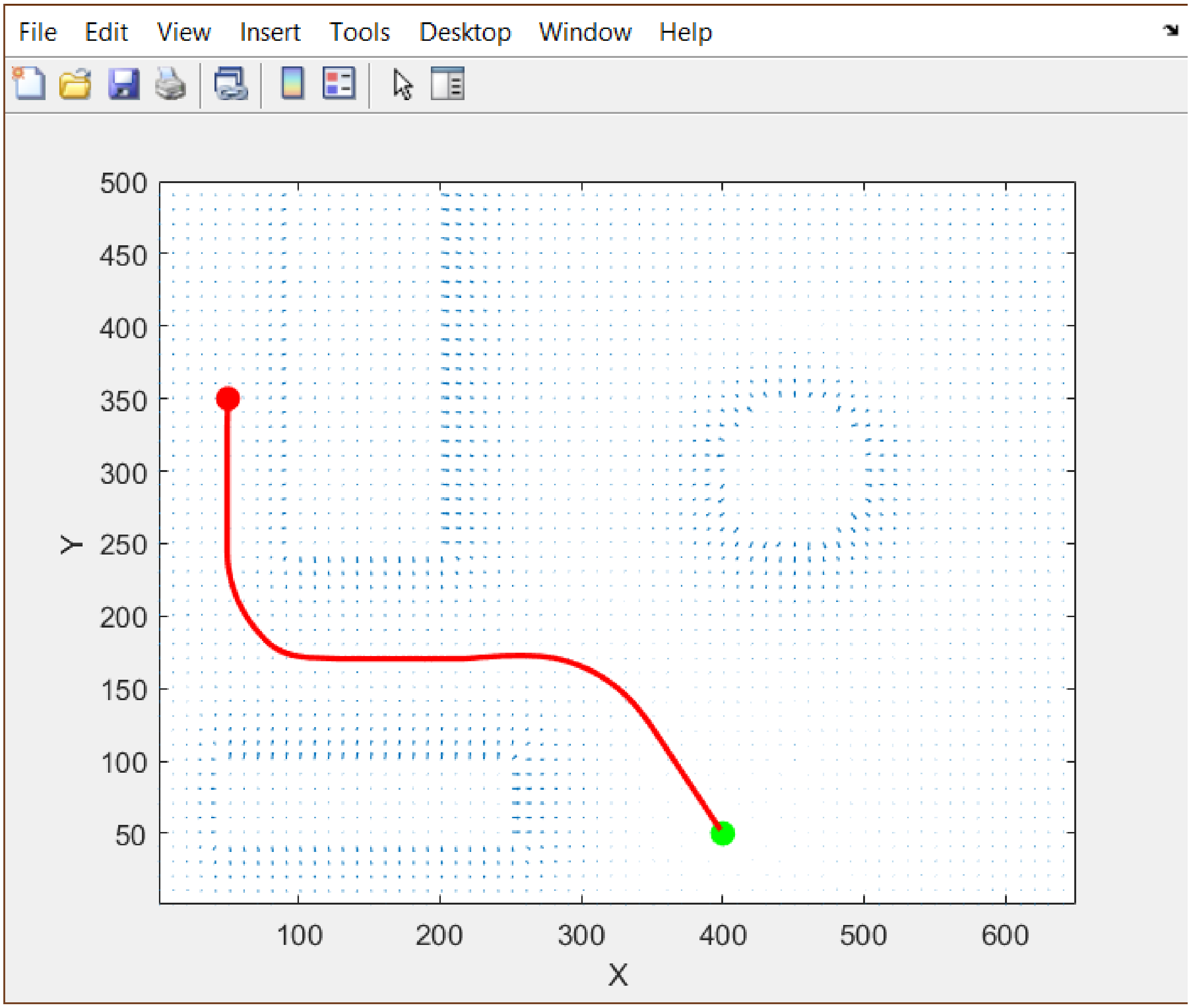
4)

```
nu = 300;
zita = 1/650;
```



4th path is best

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5. Submit the full program. Show several figures (4-5) that show the work space with obstacles with start and goal points. Final paths from initial point to goal points.

```
% Install Image Processing Toolbox
function mainFunction()
% Generate 2 random integers between 50 and 350
random_numbers = randi([50, 350], 1, 2);
random_numbers2 = randi([50, 350], 1, 2);
%start=random_numbers;
%goal=random_numbers2;
start = [100, 175];
goal = [600, 100];
%% Generating a rectangular workspace
col = 650;
row = 500;
x = repmat(1:col, row, 1);
y = repmat((1:row)', 1, col);
%%
% b=8;a=6;c=3;
% d = b^2 - 4*a*c;
% if d < 0
% elseif d == 0
%     root = -b / (2*a);
% else
%     root1 = (-b + sqrt(d)) / (2*a);
%     root2 = (-b - sqrt(d)) / (2*a);
% end
%% Generate some obstacle
obs = false(row, col);
obs (250:end, 100:200) = true;
obs (50:100, 50:250) = true;
t = ((x - 450).^2 + (y - 300).^2) < 50^2;
obs(t) = true;
% Create a masked image with the obstacle color
%% Compute distance transform
d = bwdist(obs);
% Rescale and transform distances
d1 = (d/100) + 1;d0 = 2;nu = 1000;
%% Display repulsive potential
repul = nu*((1./d1 - 1/d0).^2);
repul (d1 > d0) = 0;
figure;
m = mesh (repul);
m.FaceLighting = 'phong';
axis equal;
title ('Repulsive Potential');
%% Compute attractive force
```

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```
zita = 1/1000;
attr = zita * ( (x - goal(1)).^2 + (y - goal(2)).^2 );
figure;
m = mesh (attr);
m.FaceLighting = 'phong';
axis equal;
title ('Attractive Potential');
%% Display 2D configuration space
figure;
imshow(~obs);
hold on;
plot (goal(1), goal(2), 'r.', 'MarkerSize', 25);
plot (start(1), start(2), 'g.', 'MarkerSize', 25);
hold off;
axis ([0 col 0 row]);
axis xy;
axis on;
xlabel ('x');
ylabel ('y');
legend('Goal', 'Start')
title ('Rectangualar Workspace');
%% Combine terms
Total = attr + repul;
figure;
m = mesh (Total);
m.FaceLighting = 'phong';
axis equal;
title ('Total Potential');
%% Plan route
route = Grad_planner (Total, start, goal, 1000);
%% Plot the energy surface
figure;
m = mesh (Total);
axis equal;
%% quiver plot
[gx, gy] = gradient (-Total);
skip = 10;
figure;
xidx = 1:skip:col;
yidx = 1:skip:row;
quiver (x(yidx,xidx), y(yidx,xidx), gx(yidx,xidx), gy(yidx,xidx), 0.4);
axis ([1 col 1 row]);
hold on;
ps = plot(start(1), start(2), 'r.', 'MarkerSize', 30);
pg = plot(goal(1), goal(2), 'g.', 'MarkerSize', 30);
p3 = plot (route(:,1), route(:,2), 'r', 'LineWidth', 2);
xlabel('X')
ylabel('Y')
%function
```

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```
function route = Grad_planner (f, start_coords, end_coords, max_its)
[gx, gy] = gradient (-f);
route = start_coords;
for i=1:max_its
    current_point = route(end,:);
    if sum( abs(current_point-end_coords) ) < 5.0
        break
    end
    ix = round( current_point(2) ); % X and Y axis are swaped
    iy = round( current_point(1) );
    w = 10;
    vx = mean( mean( gx(ix-w/2:ix+w/2, iy-w/2:iy+w/2) ) );
    vy = mean( mean( gy(ix-w/2:ix+w/2, iy-w/2:iy+w/2) ) );
    dt = 1 / norm([vx, vy]);
    np = current_point + dt*[vx, vy];
    route = vertcat(route, np);
end
end
end
```

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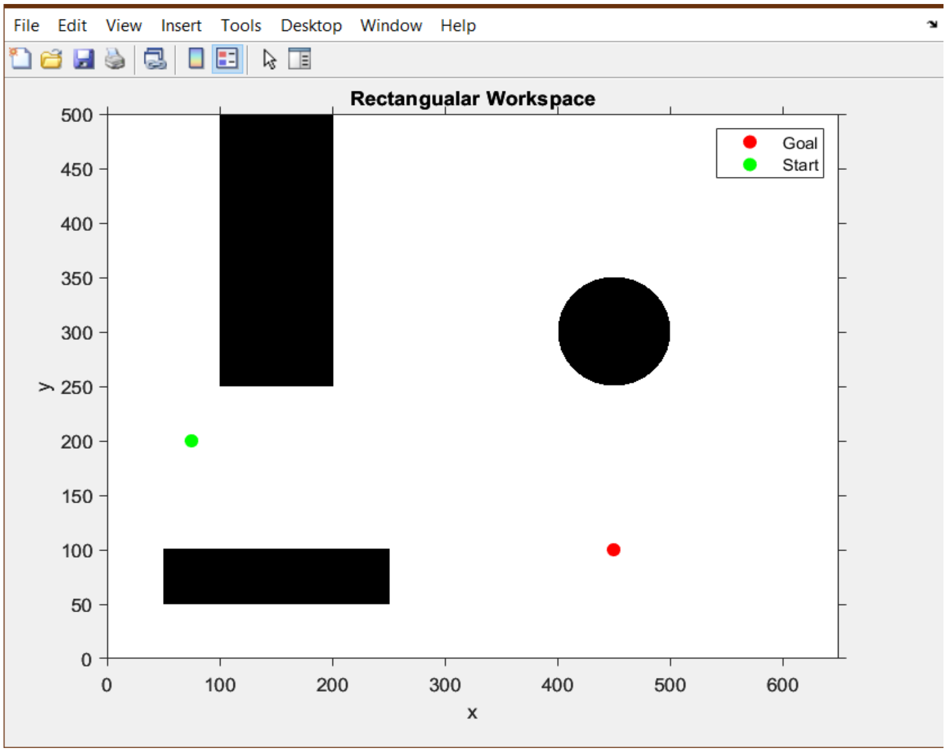

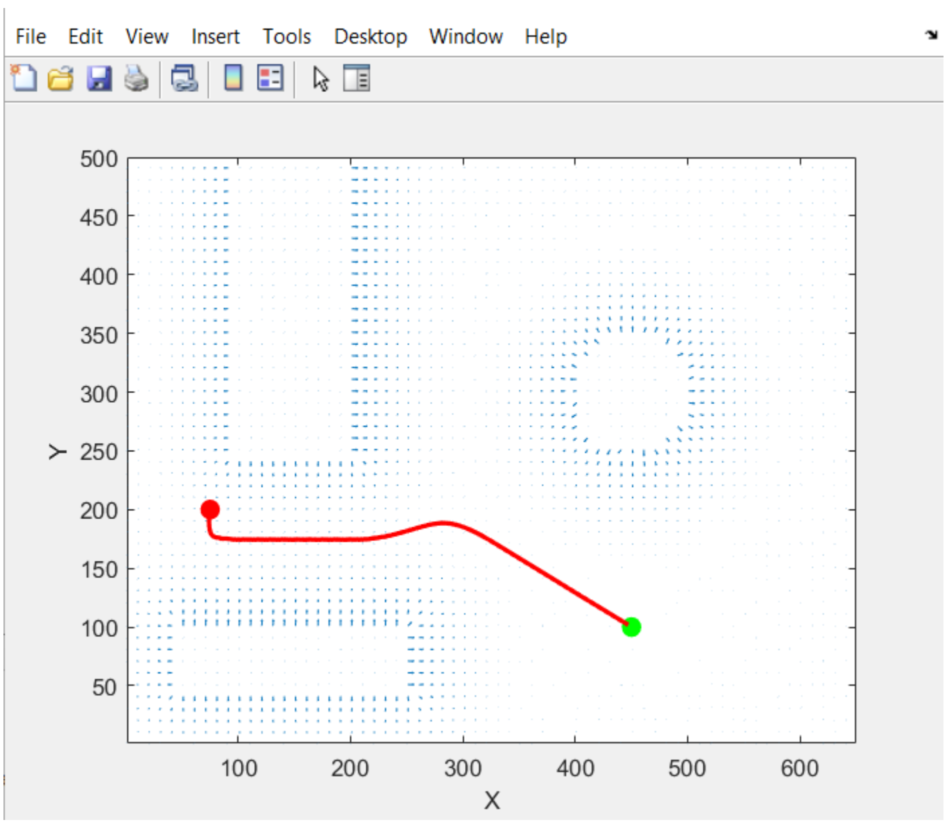

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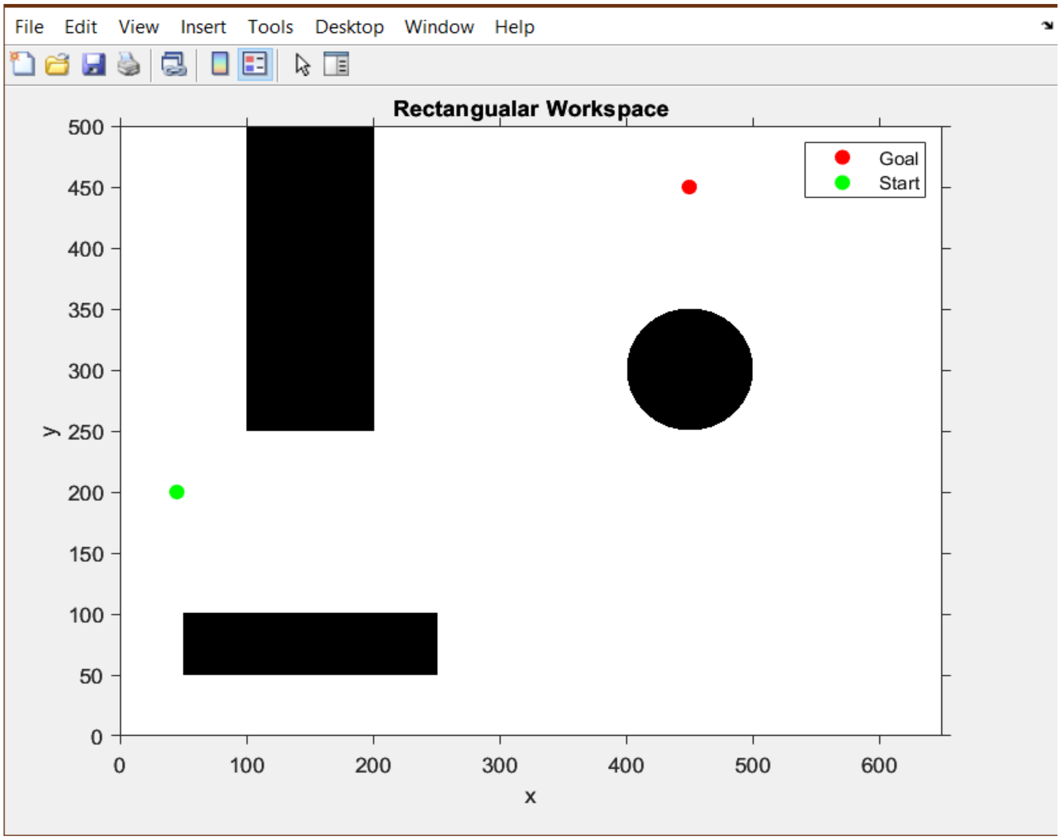

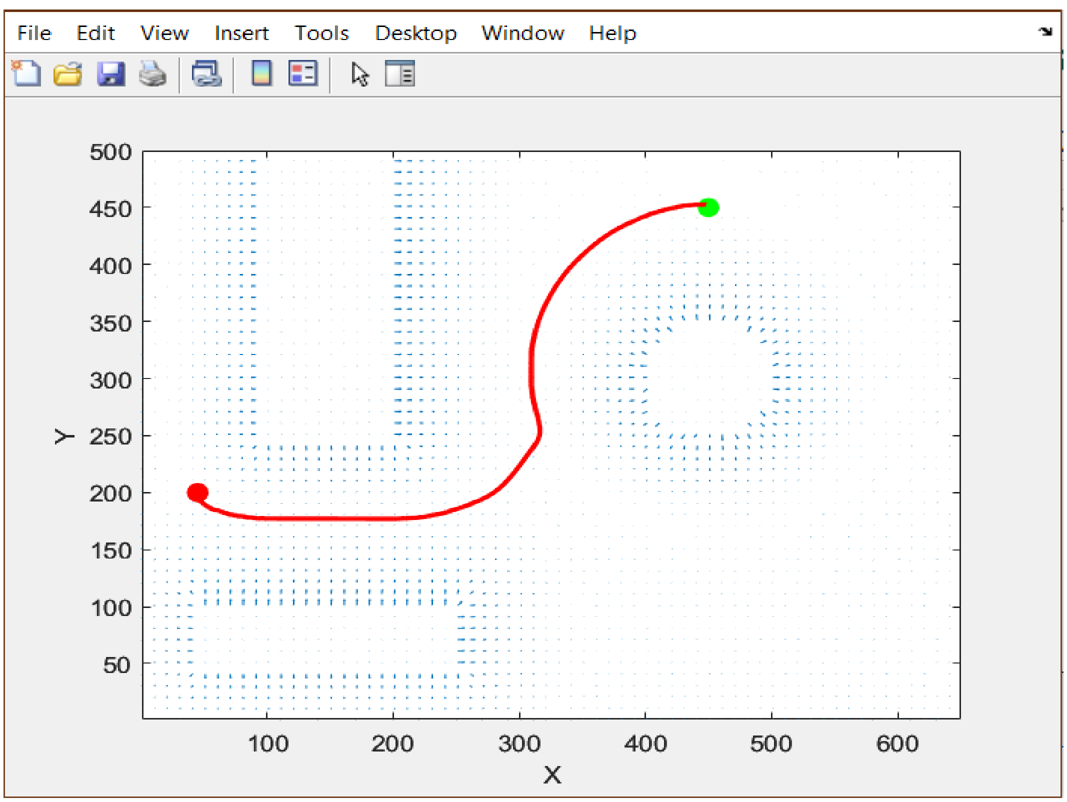

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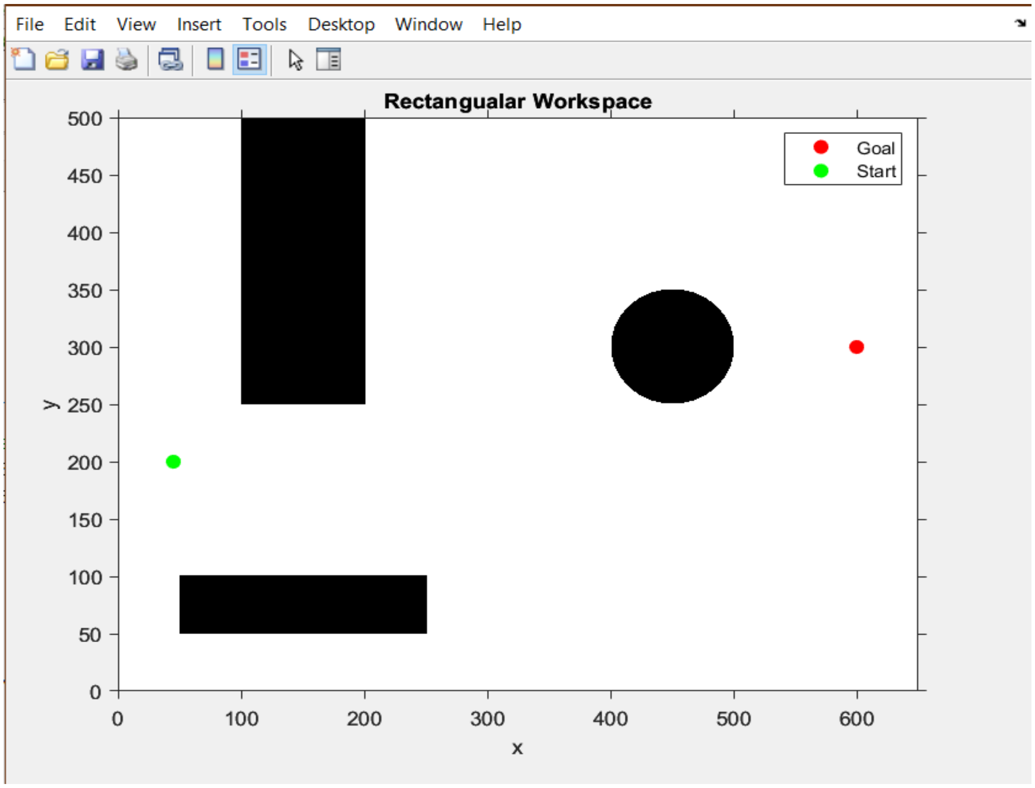

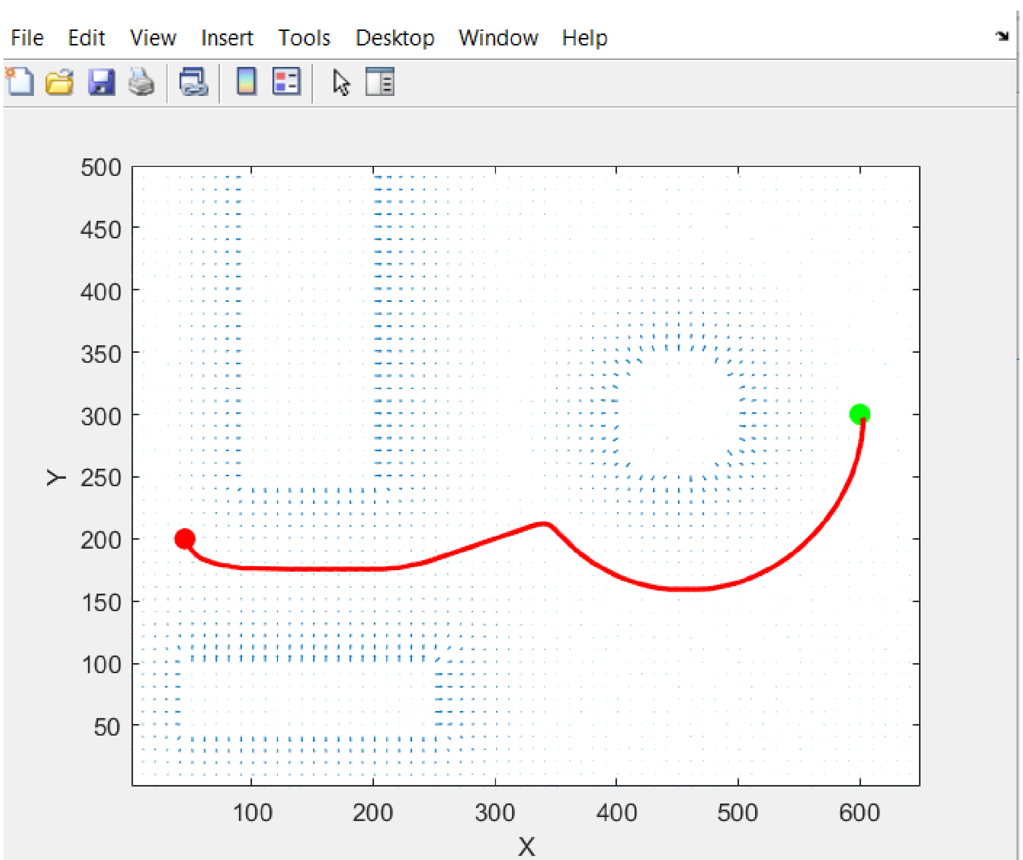

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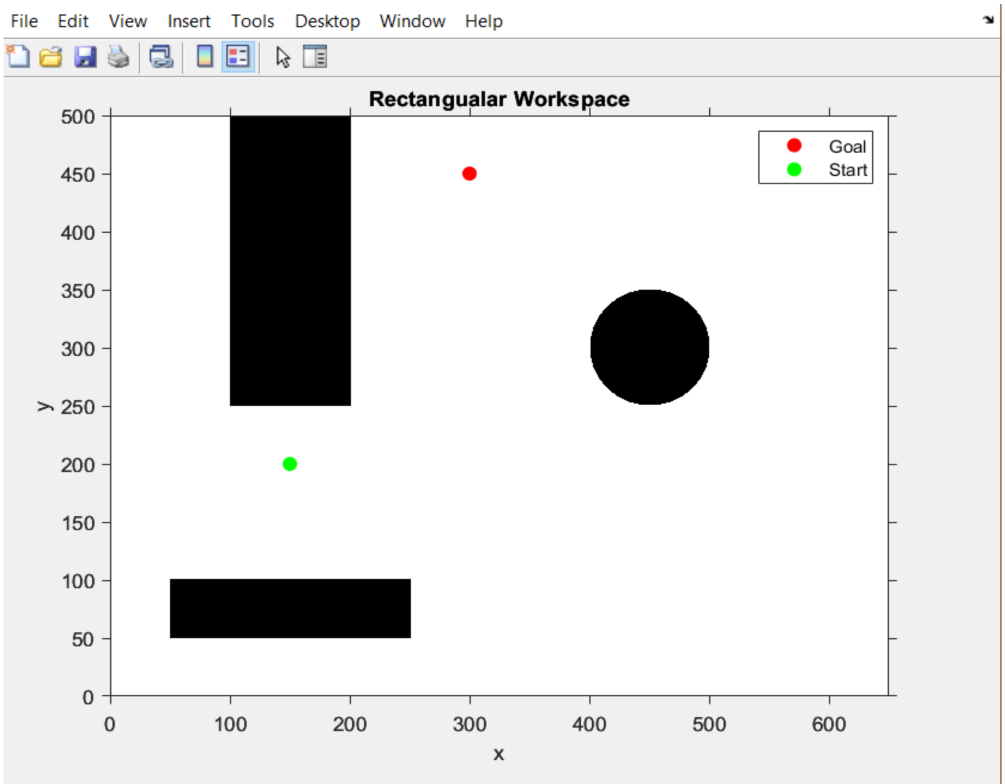

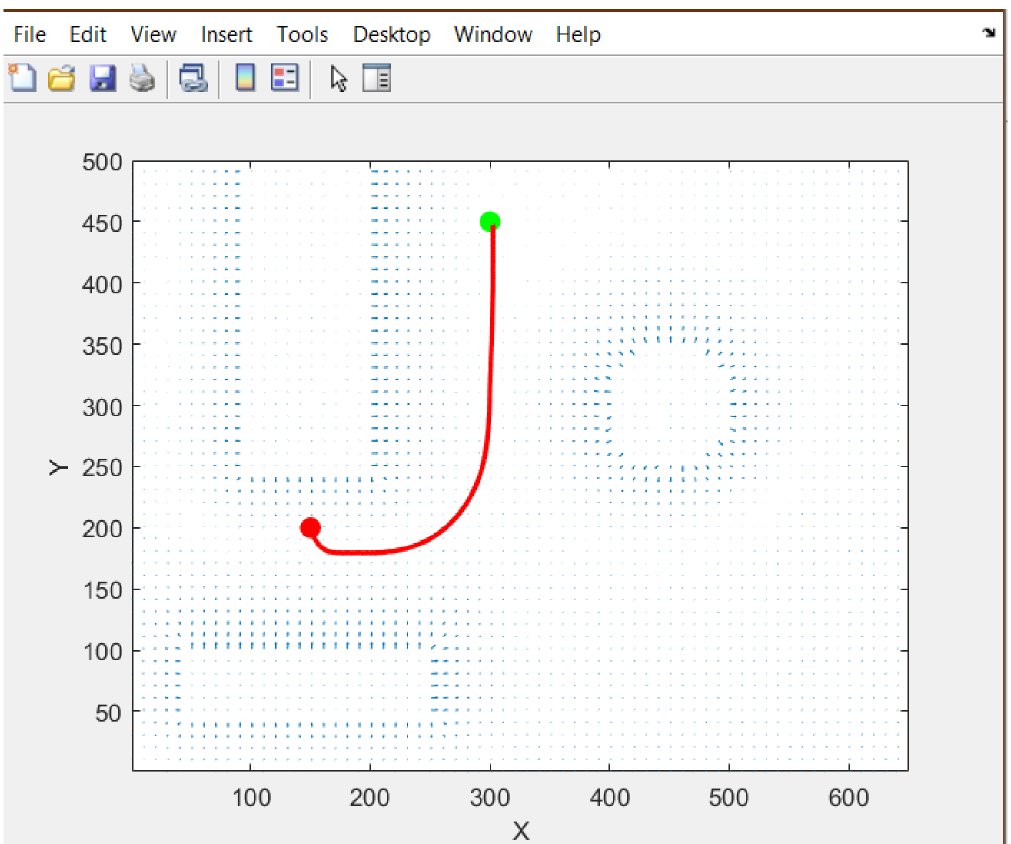

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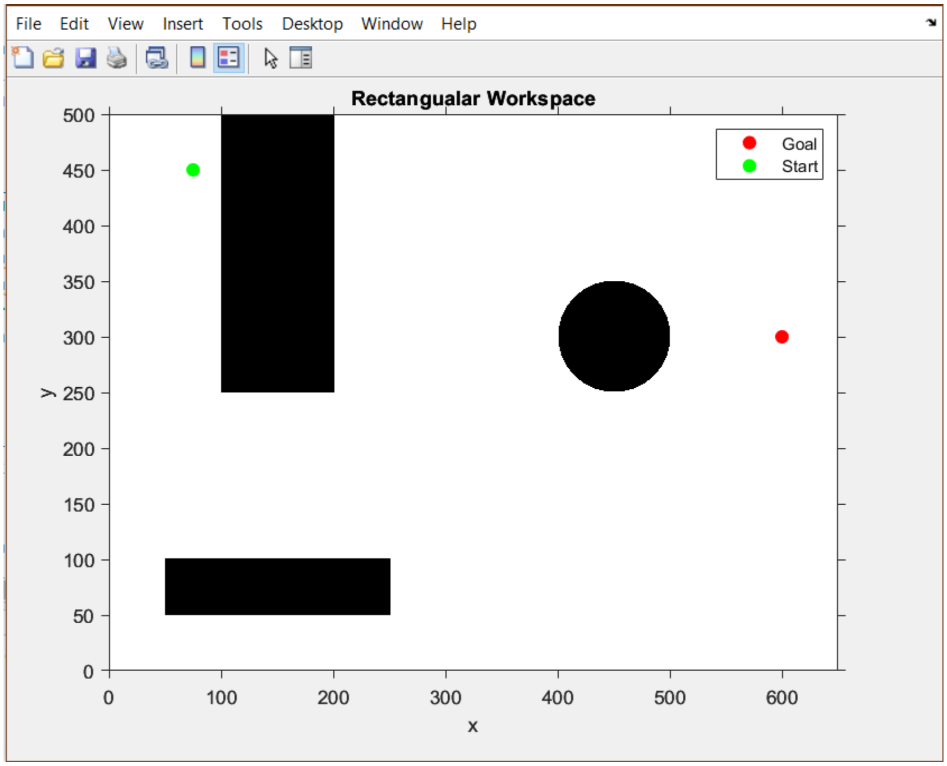
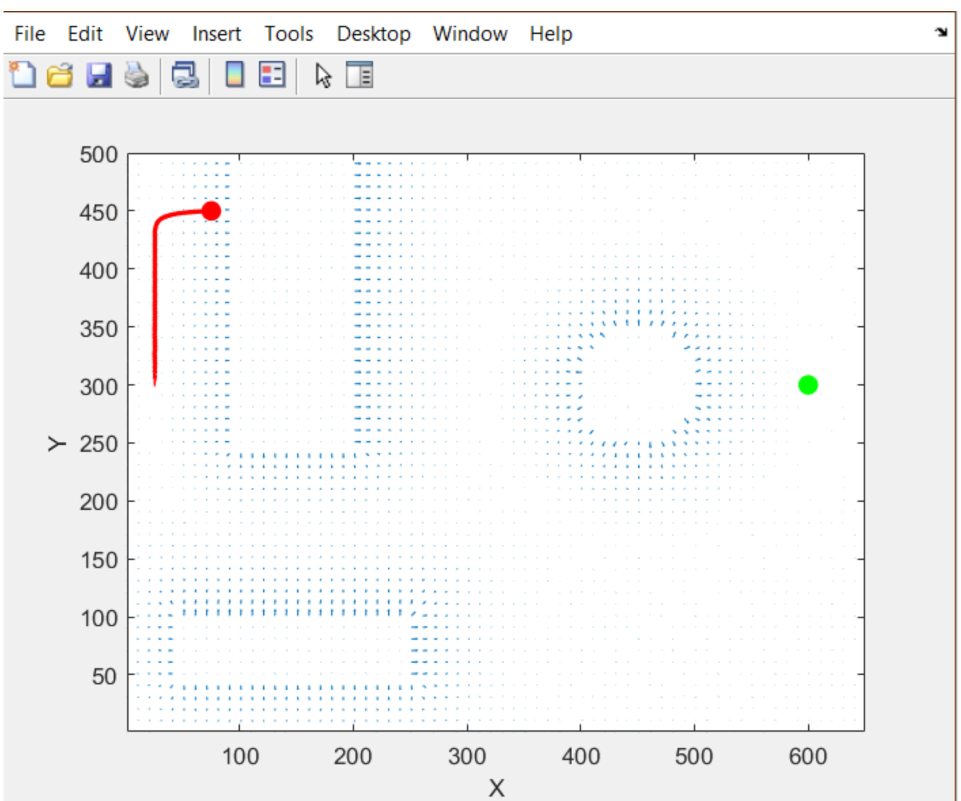
6. One result shows failed cases , with suitable object position or shapes.





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Explain why it is failing

It is stuck at a point where the gradient is zero, which indicates that the point has equal amounts of attractive and repulsive potential, which cancel each other out, and is therefore failing.

For passing this case we can adjust the value of attractive and repulsive constants