Homework 3

Problem 1 Solution

unraveled

Trying to draw the picture

```matlab
t=linspace(0, 10*pi,5000);
x=sin(t.*cos(t));
y=cos(t.*sin(t));
z=-t;
plot3(x,y,z,'k.','MarkerSize',2);
set(gcf,'position',[100,100,200,600]);
set(gca,'xtick',[],'ytick',[],'ztick',[],'xcolor','w','ycolor','w','zcolor','w');
title('\it{unraveled}','FontSize',13);
```

Then the figure is as below:

unraveled

shapes

```
axis equal;
x1 = [380 540 540];
y1 = [135 0 270];
patch(x1,y1,[51/255 150/255 93/155],'Edgecolor',[51/255 150/255 93/155]);

rectangle('Position',[10 90 80 80],'Curvature',1,...
    'Edgecolor',[180 177 46]./255,'Facecolor',[180 177 46]./255);
rectangle('Position',[50 30 170 100],'Curvature',0.2,...
    'Edgecolor',[57 62 153]./255,'Facecolor',[57 62 153]./255);
rectangle('Position',[200 155 140 140],'Curvature',1,...
```

```
     'Edgecolor',[180 52 39]./255,'Facecolor',[180 52 39]./255);
rectangle('Position',[200 270 200 100],'Facecolor',[1 1 1],'Edgecolor',[1 1 1]);
rectangle('Position',[0 0 540 270],'Edgecolor',[0 0 0],'LineWidth',1);

set(gca,'xtick',[],'ytick',[],'ztick',[],'xcolor','w','ycolor','w','zcolor','w');
xlim([0 540]);
ylim([0 270]);
title('\it{shapes}')
```

The figure is as below:
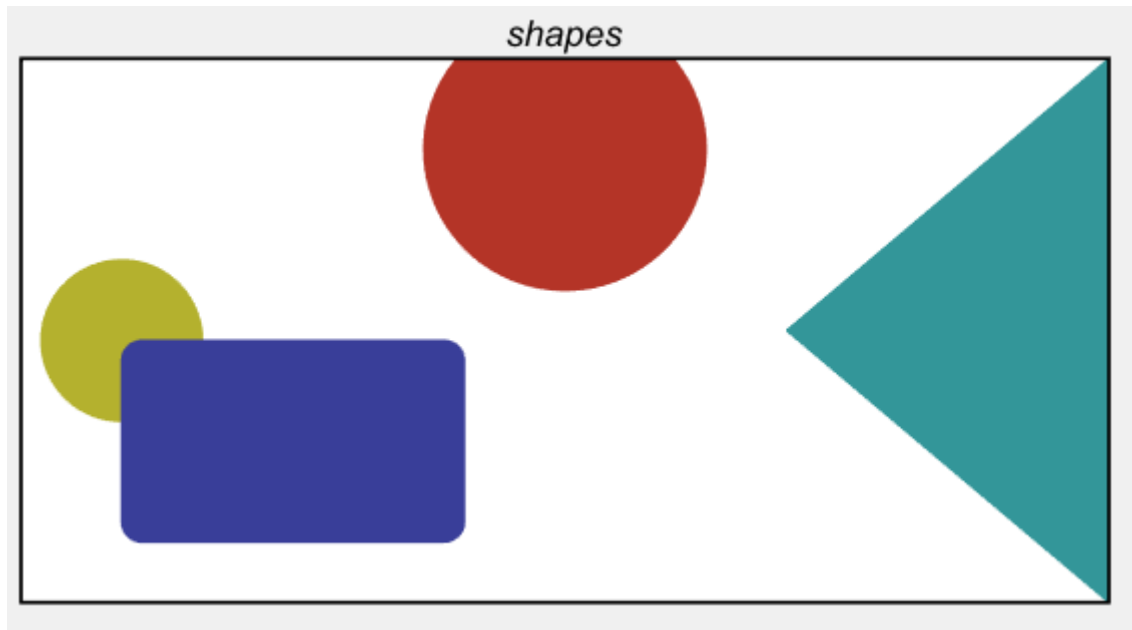
Problem 2 Solution

```
function mandelbrotPlot(N,xLims,yLims,pass)
    x = linspace(xLims(1),xLims(2),N);
    y = linspace(yLims(1),yLims(2),N);
    z = zeros(N,N);
    for k=1:pass
        z=z.^2 + x + i*y';
    end

    w = exp(-abs(z));
    contourf(x,y,w);
    set(gca,'xtick',[],'ytick',[],'ztick',
[],'xcolor','w','ycolor','w','zcolor','w');
    title(pass);
end
```
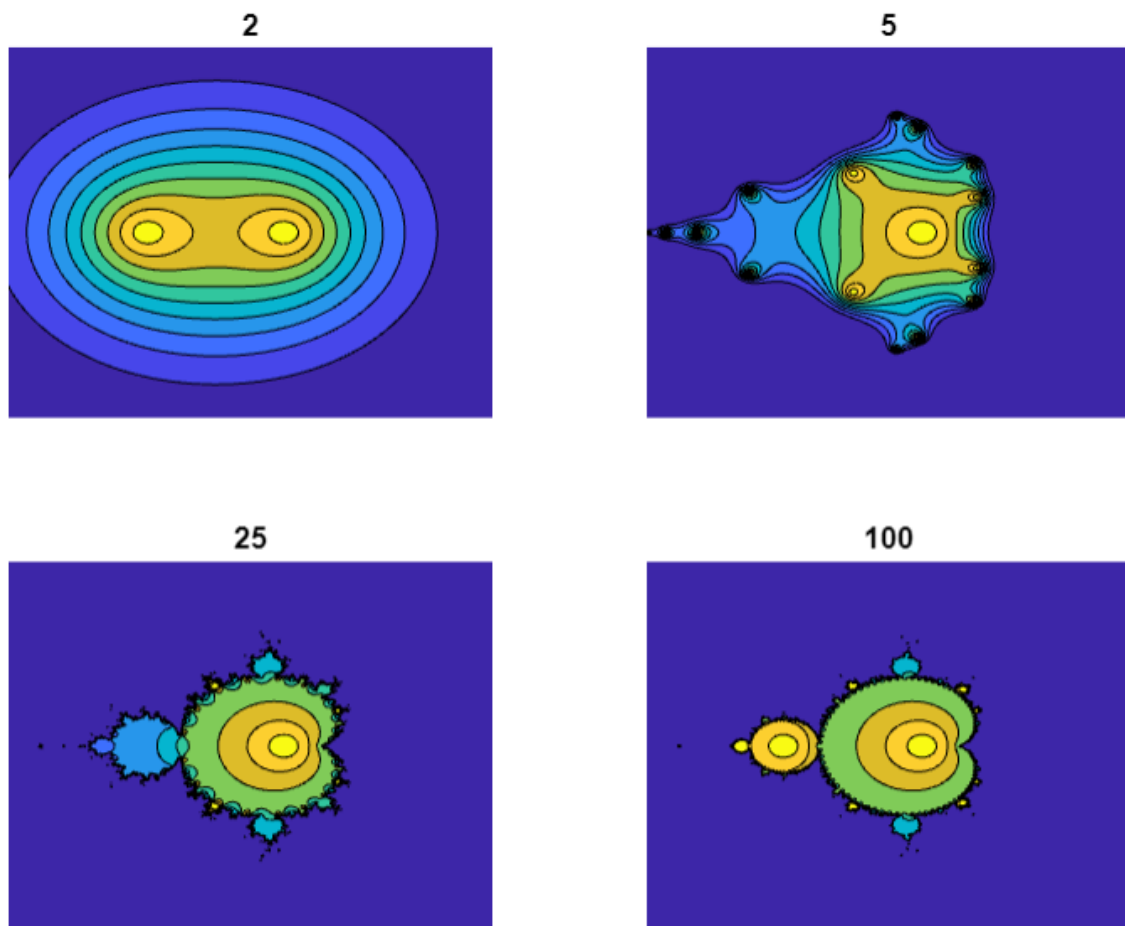
Then write to plot 4 figure:

```
subplot(2,2,1);
mandelbrotPlot(400,[-2 1.5],[-1.75 1.75],2);
```

```
subplot(2,2,2);
mandelbrotPlot(400,[-2 1.5],[-1.75 1.75],5);
subplot(2,2,3);
mandelbrotPlot(400,[-2 1.5],[-1.75 1.75],25);
subplot(2,2,4);
mandelbrotPlot(400,[-2 1.5],[-1.75 1.75],100);
```
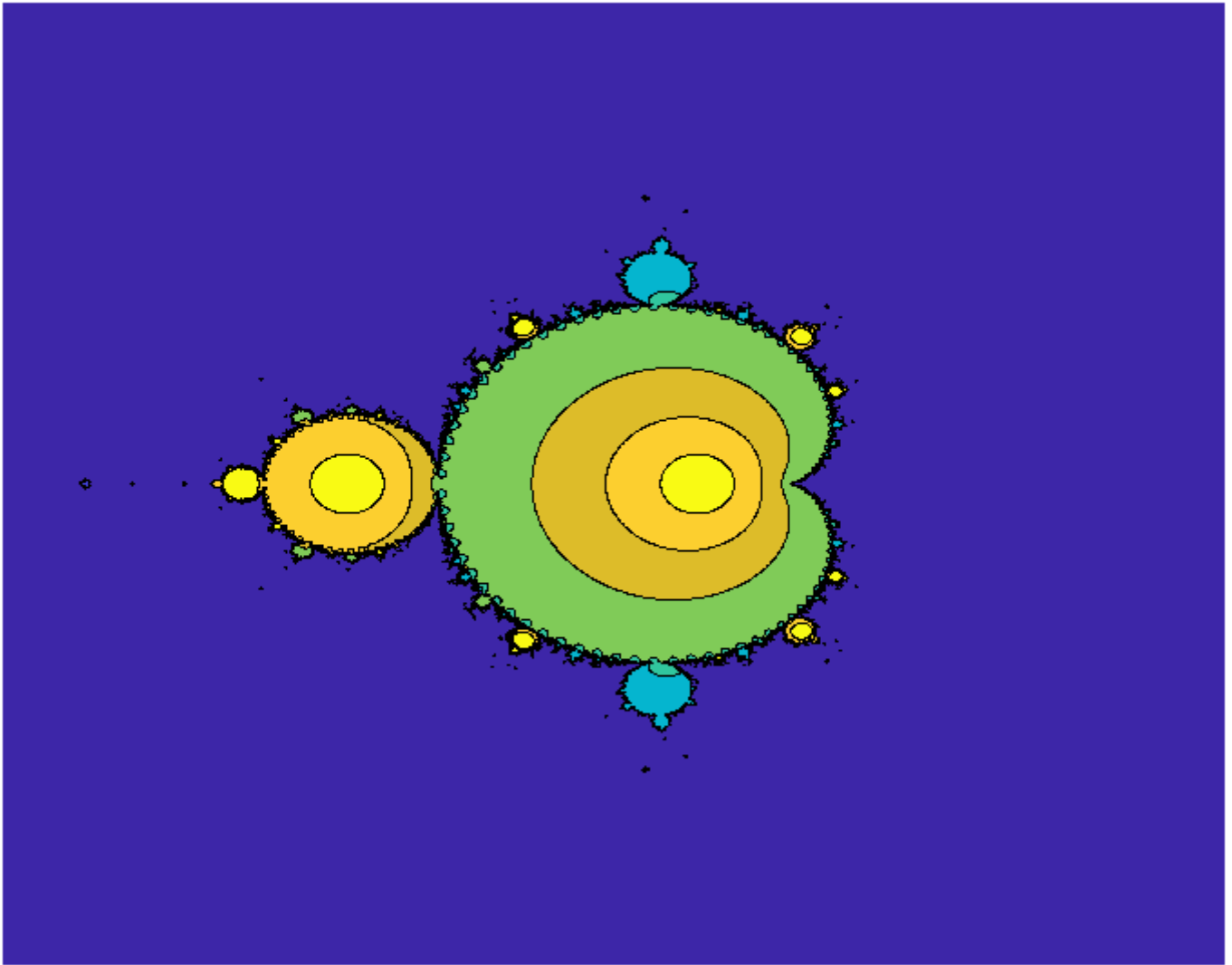
Then we got:

Then we try $N = 1000, pass = 100$

```
tic;
mandelbrotPlot(1000,[-2 1.5],[-1.75 1.75],100);
toc
```

Then we get:

100

The time it takes:

```
>> test
历时 0.361532 秒。
```

Problem 3 Solution

```matlab
function out = processScores(filename)
    data = csvread(filename);
    team = unique(data(:,1:2));
    l = length(team);

    out = zeros(l,4);
    out(:,1) = team;

    for i = 1:l
        home = data(data(:,1)==team(i),:);
        away = data(data(:,2)==team(i),:);

        out(i,2) = sum(home(:,3)>home(:,4)) + sum(away(:,4)>away(:,3));
        out(i,3) = numel(home(:,1))+numel(away(:,1)) - out(i,2);
        out(i,4) = out(i,2)/(out(i,2)+out(i,3));
```

```
        end

        out = sortrows(out,4,"descend");
    end
```

The result is:

```
ans =

     1.0000    23.0000    13.0000     0.6389
     7.0000    23.0000    13.0000     0.6389
     9.0000    21.0000    15.0000     0.5833
     8.0000    19.0000    17.0000     0.5278
     4.0000    18.0000    18.0000     0.5000
    10.0000    18.0000    18.0000     0.5000
     6.0000    17.0000    19.0000     0.4722
     3.0000    15.0000    21.0000     0.4167
     2.0000    14.0000    22.0000     0.3889
     5.0000    12.0000    24.0000     0.3333
```

Problem 4 Solution

scrambleWord

```
function out = scrambleWord(in)
    noletter = ~isletter(in);
    letter = in(isletter(in));
    scramble = letter;
    scramble(2:end-1) = letter(randperm(length(letter)-2)+1);

    out(noletter) = in(noletter);
    out(isletter(in)) = scramble;
end
```

scramble

```
function scramble(in,out)
    input = fopen(in,'r');
    output = fopen(out,'w');
    line = fgets(input);
    while(line ~= -1)
        a = strread(line,'%s');
        for i = 1:length(a)
            fprintf(output,scrambleWord(a{i}));
            fprintf(output,' ');
```
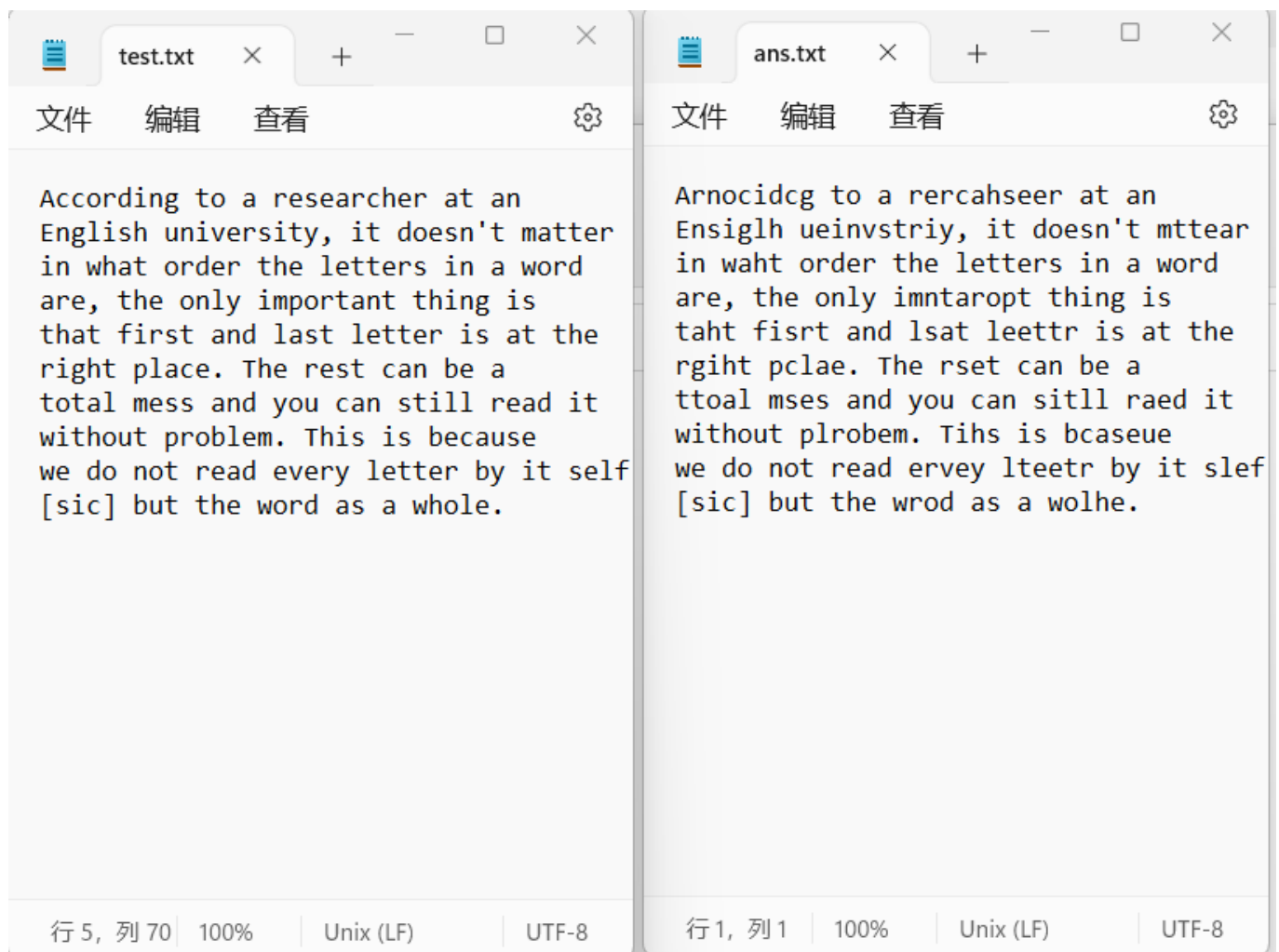
```
            end
        fprintf(output,'\n');
        line = fgets(input);
    end
    fclose(input);
    fclose(output);
end
```

result

We run as below:

```
scramble("test.txt","ans.txt");
```

The result is:

test.txt	ans.txt
文件　编辑　查看	文件　编辑　查看
According to a researcher at an English university, it doesn't matter in what order the letters in a word are, the only important thing is that first and last letter is at the right place. The rest can be a total mess and you can still read it without problem. This is because we do not read every letter by it self [sic] but the word as a whole.	Arnocidcg to a rercahseer at an Ensiglh ueinvstriy, it doesn't mttear in waht order the letters in a word are, the only imntaropt thing is taht fisrt and lsat leettr is at the rgiht pclae. The rset can be a ttoal mses and you can sitll raed it without plrobem. Tihs is bcaseue we do not read ervey lteetr by it slef [sic] but the wrod as a wolhe.
行 5, 列 70 100% Unix (LF) UTF-8	行 1, 列 1 100% Unix (LF) UTF-8

Problem 5 Solution

getCell

```
function out = getCell(in, row, col)
    edge = size(in);
```

```matlab
        out = [];

        for i = 1:length(row)
            if row(i)<1 | col(i)<1 | row(i)>edge(1) | col(i)>edge(2)
                out(end+1) = 0;
            else out(end+1) = in(row(i),col(i));
            end
        end
    end
```

countNeighbors

```matlab
function out = countNeighbors(in)
    edge = size(in);
    out = in;
    for i = 1:edge(1)
        for j = 1:edge(2)
            row = [i-1,i-1,i-1,i,i,i+1,i+1,i+1];
            col = [j-1,j,j+1,j-1,j+1,j-1,j,j+1];
            out(i,j) = sum(getCell(in,row,col));
        end
    end
end
```

updateCells
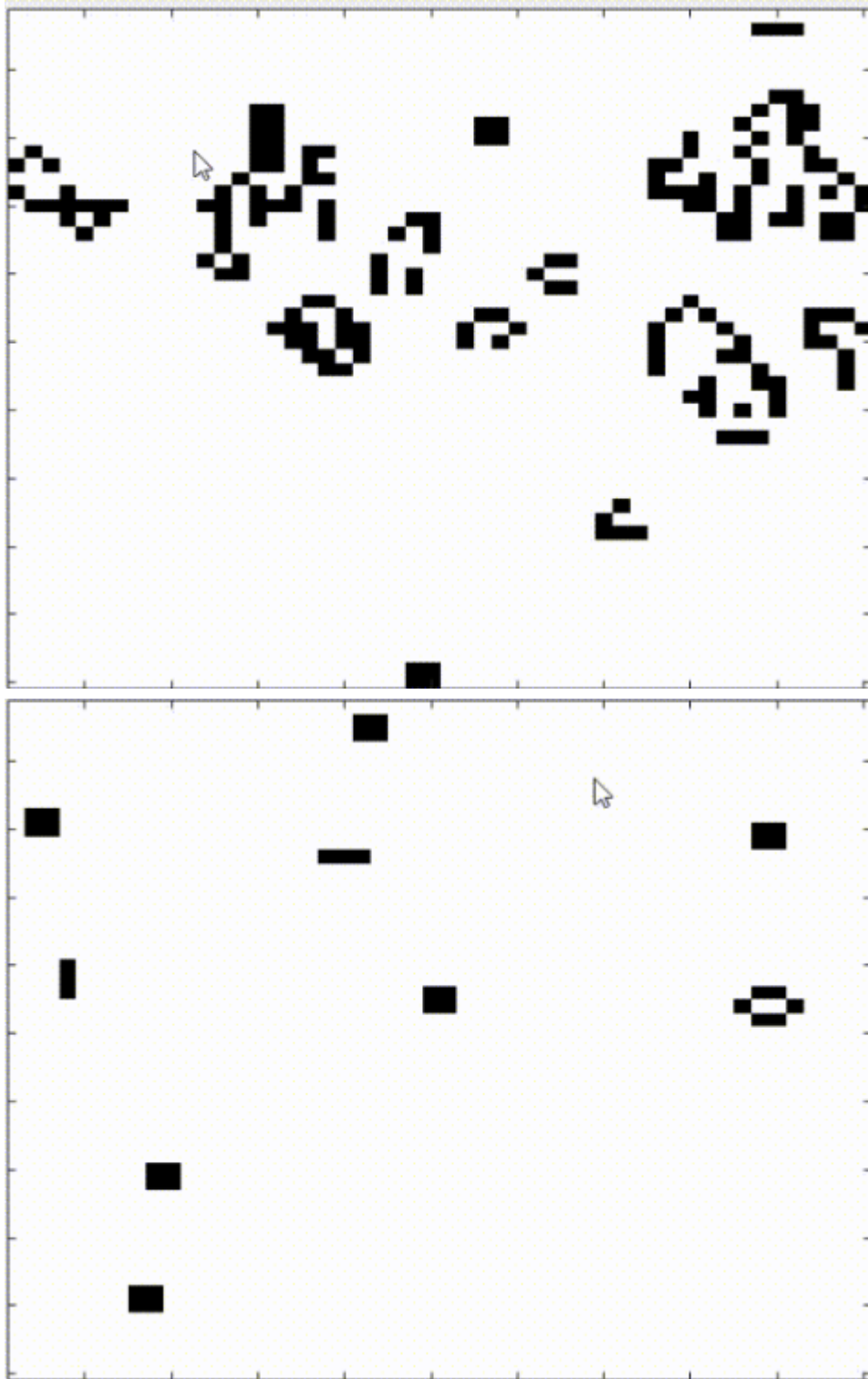
```matlab
function out = updateCells(in)
    edge = size(in);
    out = in;
    now = countNeighbors(in);

    for i = 1:edge(1)
        for j = 1:edge(2)
            if now(i,j) == 3
                out(i,j) = 1;
            else if now(i,j)<2 | now(i,j)>3
                out(i,j) = 0;
                end
            end
        end
    end
end
```

Run the LifeScript.m, because gif is not allowed in PDF, so part of the result is as below:

Problem 6 Solution

```
function plotAFMdata(H,F,I,ss,savename)
    subplot(2,2,1);
    scatter(F,I,'k.');
    xlabel('Friction(mV)');
    ylabel('Current response (V)');
    title('current as a function of friction');
    ylim([-2 8]);
    box on;
```

```matlab
    subplot(2,2,2);
    histogram(I,'FaceColor',[0,2,140]./255);
    xlabel('Current response (V)');
    ylabel('Counts');
    title('Current histogram');
    xlim([-1,7]);
    box on;

    s = size(H);
    X = linspace(1,ss,s(1));
    Y = linspace(1,ss,s(2));

    subplot(2,2,3);
    mesh(X,Y,H,F);
    colormap("jet");
    cbar = colorbar;
    cbar.Title.String = sprintf('Friction \n (mV)');
    cbar.Position = [0.5 0.1 0.01 0.3];
    xlabel('nm');
    ylabel('nm');
    zlabel('nm');
    title('Friction overlaid height','FontSize',10);
    box on;
    ax = gca;
    ax.BoxStyle = 'full';
    axis tight;
    grid off;

    subplot(2,2,4);
    mesh(X,Y,H,I);
    colormap("jet");
    cbar = colorbar;
    cbar.Title.String = sprintf('Current \n Response (mV)');
    cbar.Position = [0.93 0.1 0.01 0.3];
    xlabel('nm');
    ylabel('nm');
    zlabel('nm');
    title('Current overlaid height','FontSize',10);
    box on;
    ax = gca;
    ax.BoxStyle = 'full';
    axis tight;
    grid off;

    set(gcf, 'Position', [0, 0, 1000, 460],'color','w');
    print(gcf, '-djpeg', '-r300', savename);
    close(gcf);
end
```

Run this script:

```matlab
plotAFMdata(height,friction,current,200,"p6.jpg")
```

Then we get a photo: