**Problem 1:**

1. Case 1 : H= -1, J=0:



Comment (H= -1, J=0):

Case 2 : H=0, J=0:



Comment (H= 0, J=0):

Case 3: H=1, J=0



Comment (H= 1, J=0):

1. Case 1: H=0, J=-1



Comment (H= 0, J=1):

Case 2: H=1, J=1



Comment (H= 1, J=1):

1. Case 1: H=4, J=--1



Comment (H= 4, J=-1):

Case 2: H=4, J=-2



Comment (H= 4, J=-2):

Code:

clear all; close all;

N=10;

X = sign(randn(N,N));

XX = X;

H = 4;

J = -2;

% define the neighbors

for i = 1:N

for j = 1:N

temp = [i-1,j;i+1,j;i,j-1;i,j+1];

ngh{i,j}=temp(min(temp,[],2)>= 1 & max(temp,[],2)<= N, :);

end

end

rand('seed',0);

K=9;

for k=2:K

for i=1:N

for j=1:N

sn=H;

for r=1:length(ngh{i,j})

sn = sn+ J\*X(ngh{i,j}(r,1), ngh{i,j}(r,2));

end

P1=exp(sn\*2)/(1+exp(2\*sn));

U=rand;

X(i,j)=(U<P1)-(U>P1);

end

end

XX(:,:,k)=X;

end

for k=1:K

subplot(3,3,k);

if(sum(sum(XX(:,:,k)))==N^2)

image(255\*ones(N,N));

elseif(sum(sum(XX(:,:,k)))==-N^2)

image(zeros(N,N));

else

imagesc(XX(:,:,k));

end

colormap(gray);

title(sprintf('%d-th run',k));

end

**Problem 2:**

For initial condition of X1:



For initial condition of X2:



For initial condition of X3:



For initial condition of X4:



Code:

clear all; close all;

load('hw4\_2\_data.mat');

N = 100;

X = X4;

XX = X;

H = 0;

J = 0;

%define the neighbors

for i = 1:N

for j = 1:N

temp = [i-1,j; i+1,j; i,j-1; i,j+1];

ngh{i,j} = temp(min(temp,[],2)>= 1 & max(temp,[],2)<= N, :);

end

end

rand('seed',0);

K = 5;

for k = 2:K

for i = 1:N

for j=1:N

sn = 0;

for r=1:length(ngh{i,j})

sn = sn + X(ngh{i,j}(r,1),ngh{i,j}(r,2));

end

sn=sn/length(ngh{i,j});

U =sn+sqrt(0.1)\*randn(1);

X(i,j) = U;

end

end

XX(:,:,k) = X;

end

for k=1:K

subplot(2,3,k);

if(sum(sum(XX(:,:,k)))==N^2)

image(255\*ones(N,N));

elseif(sum(sum(XX(:,:,k)))==-N^2)

image(zeros(N,N));

else

imagesc(XX(:,:,k));

end

colormap(gray);

title(sprintf('%d-th run',k));

end