This is the main LiveScript to test out and understand the basic working of a GAN.

Creating input data of real examples :

```
 X_real = [1.0 0.0 0.0 1.0;
         0.9 0.1 0.2 0.8;
         0.8 0.1 0.2 0.9;
         0.9 0.2 0.1 0.8;
         0.8 0.2 0.1 0.9;
         0.85 0.15 0.15 0.85;
         0.95 0.05 0.05 0.95;
         1 0.2 0.1 1;
         1 0.1 0.2 1;
         0.9 0 0 0.9;
         0.99 0.2 0.2 0.99]
```

```
X_real = 11×4
    1.0000         0         0    1.0000
    0.9000    0.1000    0.2000    0.8000
    0.8000    0.1000    0.2000    0.9000
    0.9000    0.2000    0.1000    0.8000
    0.8000    0.2000    0.1000    0.9000
    0.8500    0.1500    0.1500    0.8500
    0.9500    0.0500    0.0500    0.9500
    1.0000    0.2000    0.1000    1.0000
    1.0000    0.1000    0.2000    1.0000
    0.9000         0         0    0.9000
     ⋮
```

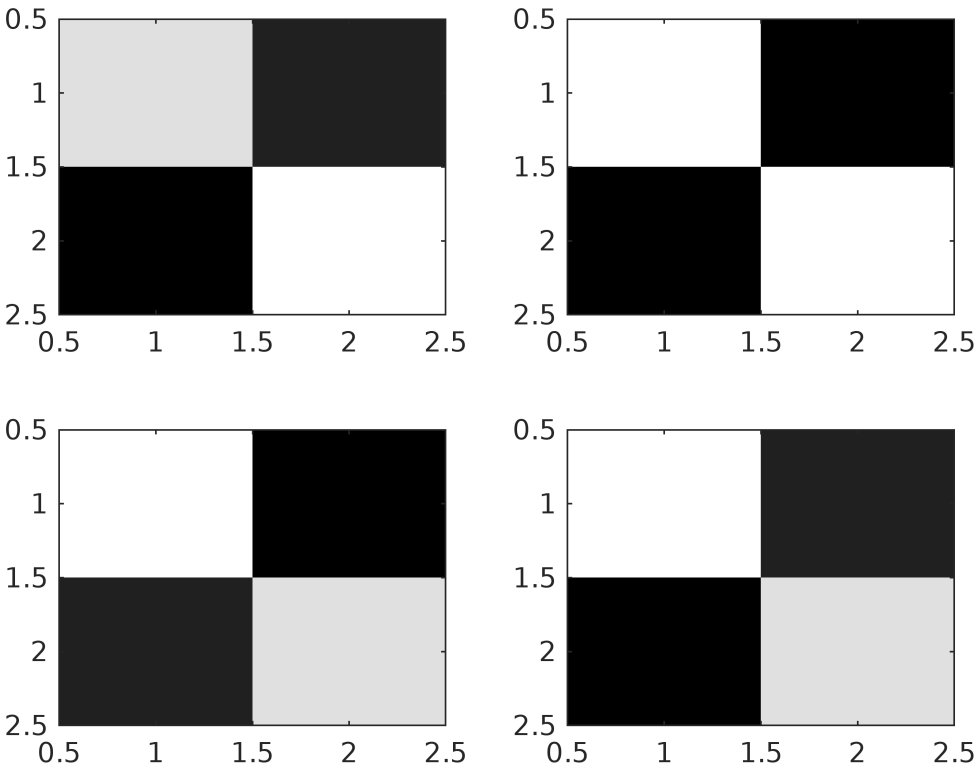
```
% X_real = [1.0 0.0 0.0 0 1.0 0 0 0 1;
%          0.9 0.1 0.2 0 0.8 0 0 0 1;
%          0.8 0.1 0.2 0 0.9 0 0 0 1;
%          0.9 0.2 0.1 0 0.8 0 0 0 1;
%          0.8 0.2 0.1 0 0.9 0 0 0 1;
%          0.85 0.15 0.15 0 0.85 0 0 0 1;
%          0.95 0.05 0.05 0 0.95 0 0 0 1;
%          1 0.2 0.1 0 1 0 0 0 1;
%          1 0.1 0.2 0 1 0 0 0 1;
%          0.9 0 0 0 0.9 0 0 0 1;
%          0.99 0.2 0.2 0 0.99 0 0 0 1]

 perm = randperm(4);


     % X_real = [1 1 1 1; 0.99 1 1 0.99; 1 1 1 0.98; 0.98 0.98 0.98 0.98]
```

Each row of X_real is a real example, so we have training set of real images of size 5, each example in itself when reshaped to a 2*2 array represents a 2*2 pixel image.

```
viewSample(X_real(perm,:),2,2)
```



view the first 4 row examples of X_real in a 2X2 subplot

Below I create the feedforward for Generator Network from one unit of noise as input and randomly initiated parameters

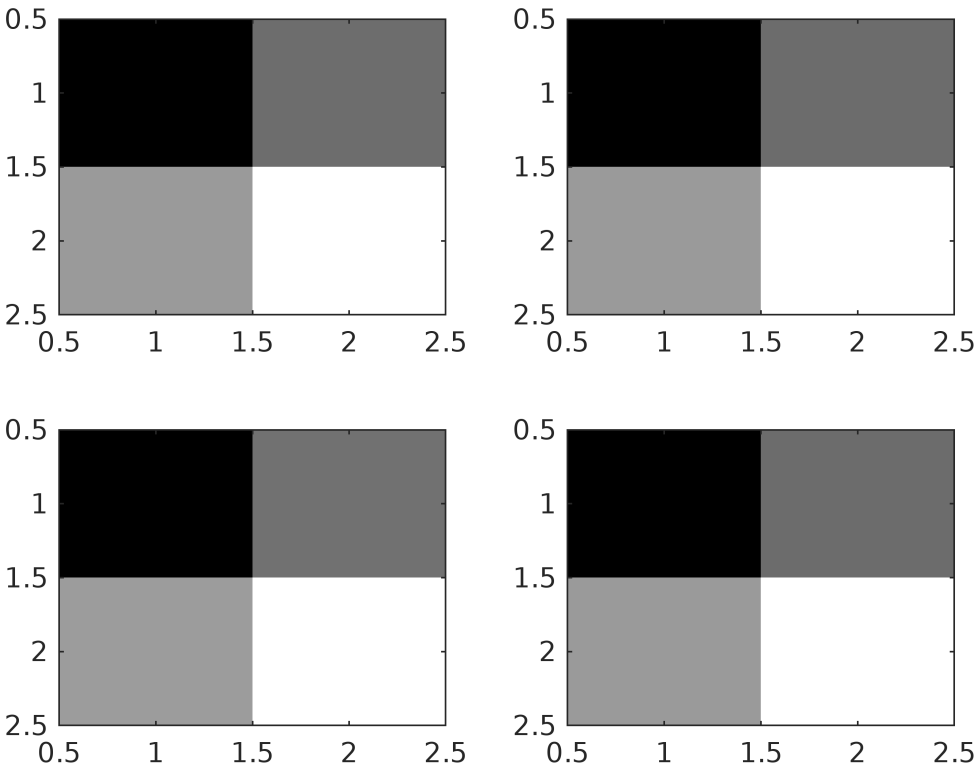
```
rng('default');
m_gen = 100; %no. of training examples for generator network

noise = rand(m_gen,1); %10 random noise examples


initial_genTheta1 = rand(3,2); %random_parameter_initialisation
initial_genTheta2 = rand(4,4);
%genTheta1 = 5000*ones(3,2);
%genTheta2 =5000*ones(4,4);
initial_genParams = [initial_genTheta1(:)' initial_genTheta2(:)'];

fake = genForward(initial_genParams,1,4,3,noise);

viewSample(fake,2,2);
```


0.5
1
1.5
2
2.5
0.5
1
1.5
2
2.5
0.5
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2.5
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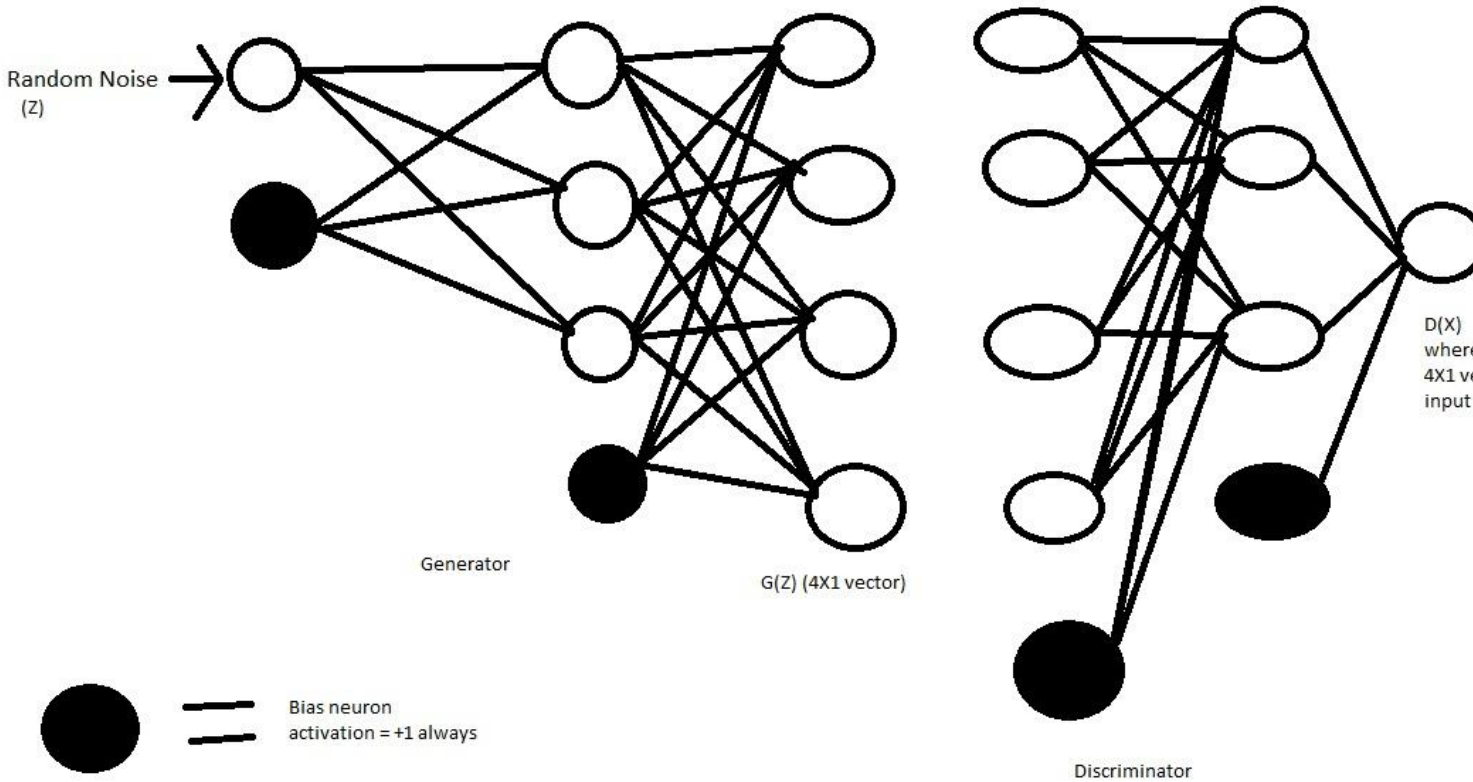
2.5



Above image is a rough representation of the architecture of the networks I've used for this illustration, simple MLPs with one hidden layer, the filled circles are bias units

and Now we write the code for Discriminator feedforward for real examples with randomly initialised parameters

```
m_real = size(X_real,1);


rng('default');
initial_theta_real1 = rand(3,5);
initial_theta_real2 = rand(1,4);
%theta_real1 = [5 -5 -5 -5 -5; -5 5 -5 -5 -5; -5 -5 5 -5 -5];
%theta_real2 = [5 -5 -5 5];
initial_discParams = [initial_theta_real1(:)' initial_theta_real2(:)'];

h = discForward(initial_discParams,4,3,X_real)
```

```
h = 11×1
    0.8731
    0.8741
    0.8750
    0.8743
    0.8752
```

```
    0.8747
    0.8736
    0.8792
    0.8790
    0.8697
     ⋮
     ⋮
```

```
[discCost,discGrad] = discLoss(initial_discParams,initial_genParams,3,3,4,1,X_real,nois
```

```
discCost = 2.3991
discGrad = 19×1
    0.0226
    0.1140
    0.0864
    0.0231
    0.0812
    0.0577
    0.0217
    0.1011
    0.0828
    0.0268
     ⋮
     ⋮
```

```
% costf = @(p)discLoss(p,initial_genParams,3,3,4,X_real,noise);
% numgrad = computeNumericalGradient(costf,initial_discParams)
% %[genCost,genGrad] = genLoss(discParams,genParams,3,3,4,noise)
```

```
checkDiscGradients(1)
```

```
  Column 1

    0.0011
    0.0002
   -0.0009
   -0.0014
   -0.0086
   -0.0079
    0.0126
    0.0108
   -0.0009
    0.0005
   -0.0091
   -0.0103
    0.0102
    0.0108
    0.0015
    0.0502
    0.0337
    0.0277
    0.0193

  Column 2

    0.0011
```

```
    0.0002
   -0.0009
   -0.0014
   -0.0086
   -0.0079
    0.0126
    0.0108
   -0.0009
    0.0005
   -0.0091
   -0.0103
    0.0102
    0.0108
    0.0015
    0.0502
    0.0337
    0.0277
    0.0193

The above two columns you get should be very similar.
(Left-Your Numerical Gradient, Right-Analytical Gradient)

If your backpropagation implementation is correct, then
the relative difference will be small (less than 1e-9).

Relative Difference: 3.02927e-10
```

```
checkGenGradients(1)
```

```
  Column 1

   -0.0000
    0.0000
   -0.0000
   -0.0151
   -0.0192
   -0.0056
    0.0002
   -0.0001
    0.0001
   -0.0000
   -0.0191
   -0.0057
    0.0132
    0.0198
    0.0083
   -0.0109
   -0.0200
   -0.0107
    0.0085
    0.0197
    0.0130
   -0.0058

  Column 2

   -0.0000
    0.0000
   -0.0000
   -0.0151
   -0.0192
   -0.0056
    0.0002
```

```
   -0.0001
    0.0001
   -0.0000
   -0.0191
   -0.0056
    0.0132
    0.0198
    0.0083
   -0.0109
   -0.0200
   -0.0107
    0.0085
    0.0198
    0.0130
   -0.0058

The above two columns you get should be very similar.
(Left-Your Numerical Gradient, Right-Analytical Gradient)

If your backpropagation implementation is correct, then
the relative difference will be small (less than 1e-9).

Relative Difference: 0.000177782
```

```
discObj = @(p)discLoss(p,initial_genParams,3,3,4,1,X_real,noise,0);
genObj = @(p)genLoss(discParams,p,3,3,4,1,noise,0);
discOptions = optimset('MaxIter', 5);
genOptions = optimset('MaxIter',1);
%lambdaDisc=10;
%lambdaGen = 1;
discParams = initial_discParams;
genParams = initial_genParams;
for i=1:500
    [discParams,~] = fminunc(discObj,discParams,discOptions);
    [genParams,~] = fminunc(genObj,genParams,genOptions);
end
```

```
Solver stopped prematurely.

fminunc stopped because it exceeded the iteration limit,
options.MaxIterations = 5.000000e+00.
Local minimum found.

Optimization completed because the size of the gradient is less than
the value of the optimality tolerance.

<stopping criteria details>
Solver stopped prematurely.

fminunc stopped because it exceeded the iteration limit,
options.MaxIterations = 5.000000e+00.
Initial point is a local minimum.

Optimization completed because the size of the gradient at the initial point
is less than the value of the optimality tolerance.

<stopping criteria details>
Solver stopped prematurely.
```

```
fminunc stopped because it exceeded the iteration limit,
options.MaxIterations = 5.000000e+00.
Initial point is a local minimum.

Optimization completed because the size of the gradient at the initial point
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fminunc stopped because it exceeded the iteration limit,
options.MaxIterations = 5.000000e+00.
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Optimization completed because the size of the gradient at the initial point
is less than the value of the optimality tolerance.

<stopping criteria details>
Solver stopped prematurely.

fminunc stopped because it exceeded the iteration limit,
options.MaxIterations = 5.000000e+00.
Initial point is a local minimum.

Optimization completed because the size of the gradient at the initial point
is less than the value of the optimality tolerance.

<stopping criteria details>
Local minimum found.

Optimization completed because the size of the gradient is less than
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fake = genForward(genParams,1,4,3,noise);

viewSample(fake(perm,:),2,2);
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