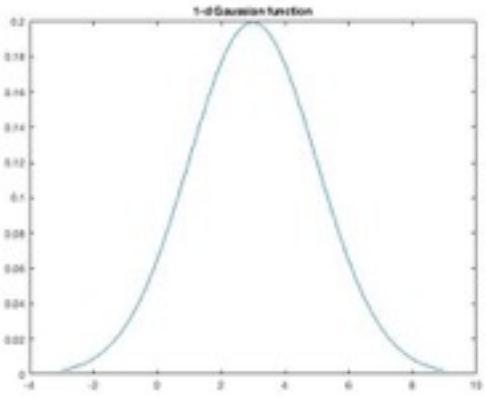
圖形識別概論Project1

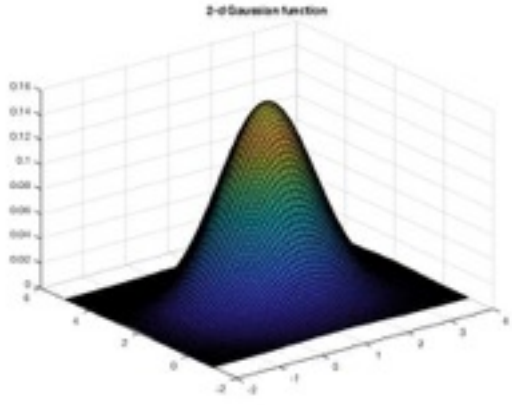
0516218軒轅照雯

一、結果（不含18、19）

1. 1-d Gaussian function

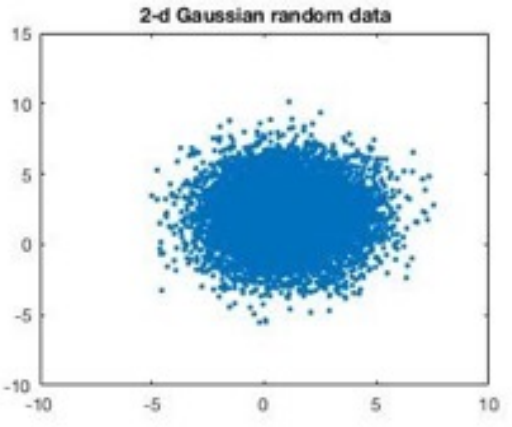


2. 2-d Gaussian function

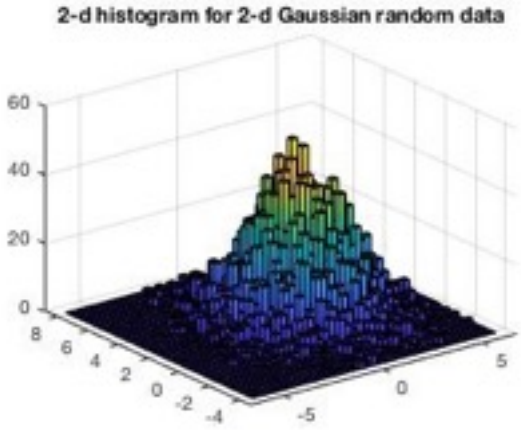


3. histogram for 1-d Gaussian random data

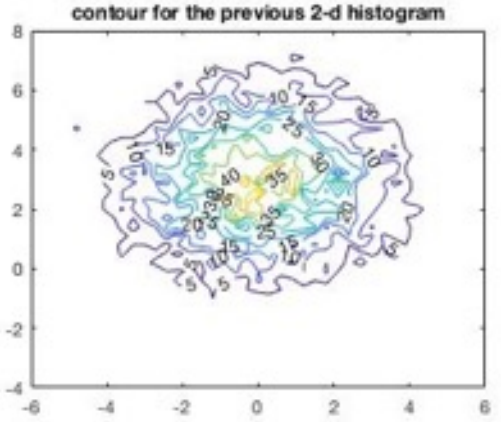
4-1. 2-d Gaussian random data



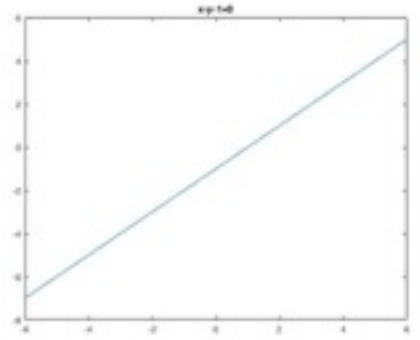
4-2. histogram for 2-d Gaussian random data



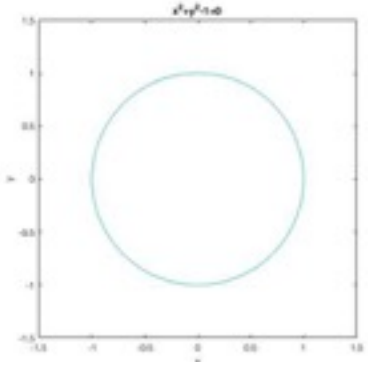
5. contour for the previous 2-d histogram



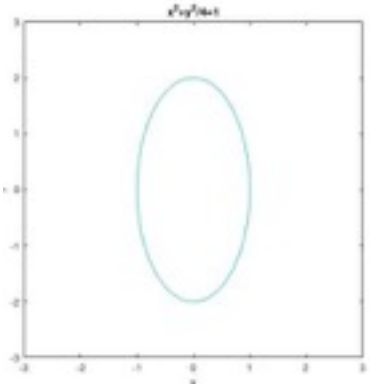
6. x-y=1



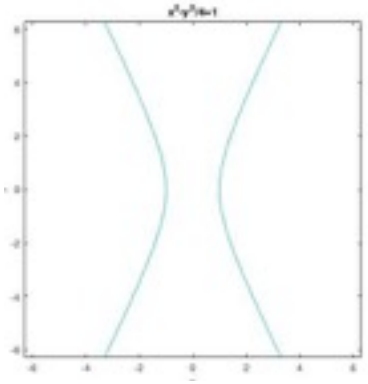
7. $x^2+y^2=1$



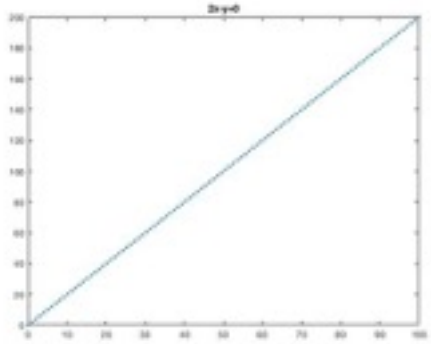
8. $x^2+y^2/4=1$



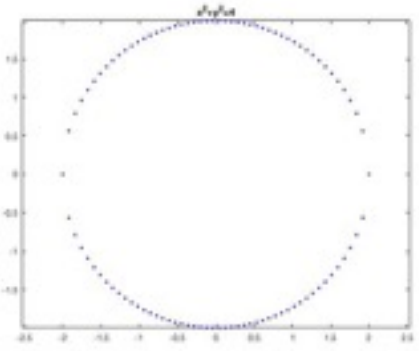
9. $x^2-y^2/4=1$



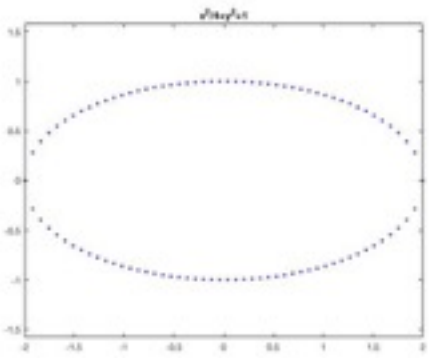
10. 2x-y=0



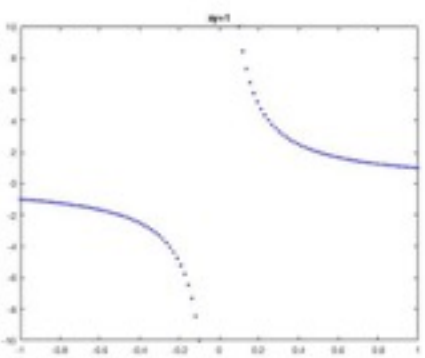
11. $x^2+y^2=4$



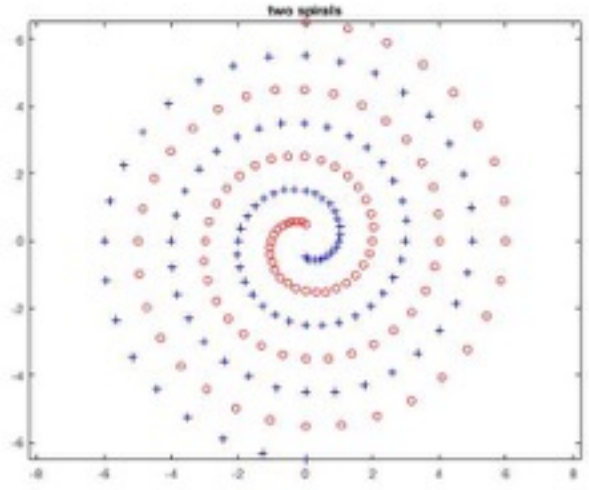
12. $x^2/4+y^2=1$



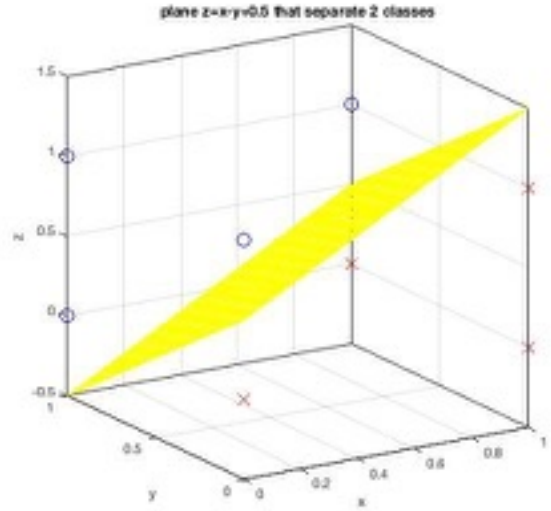
13. xy=1



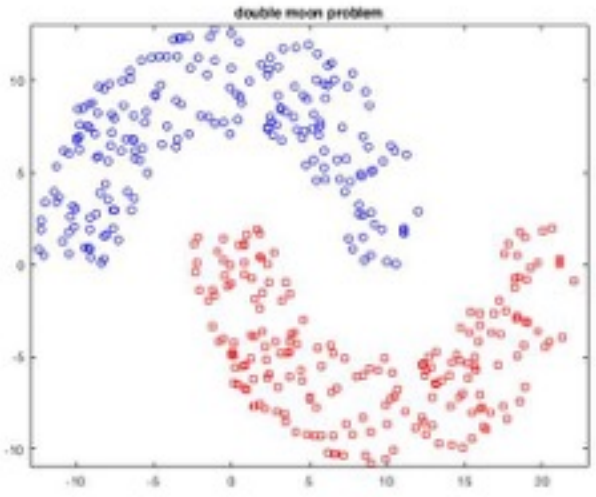
14. two spirals



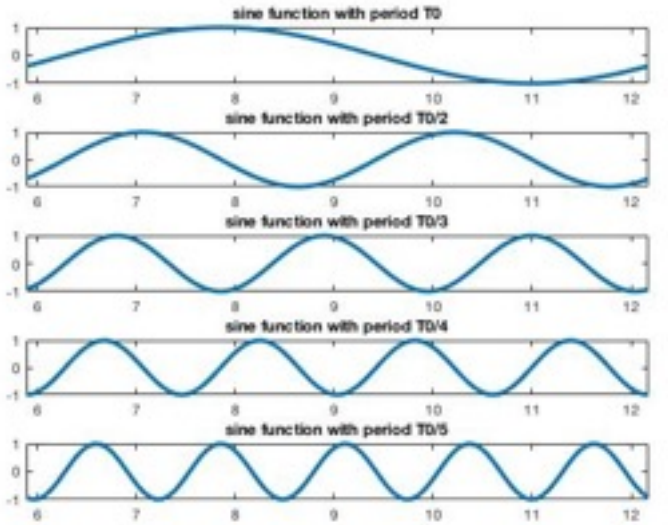
15. plan z=x-y+0.5 that separate 2 classes



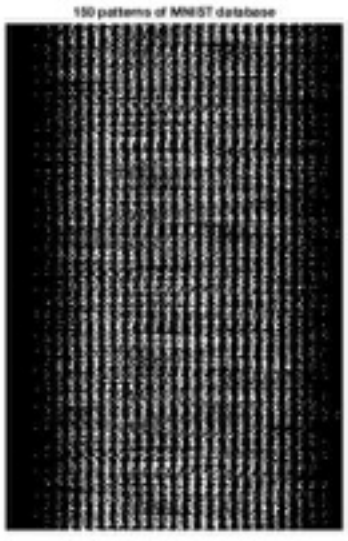
16. double moon problem



17. sine function with different periods (動畫)



20. 150 patterns of MNIST database



二、Matlab programs（不含18、19）

```
%1
m=3;
a=2;
x=linspace(m-3*a, m+3*a);
g=1/(a*((2*pi)^(1/2)))*exp((-1/2)*((x-m)/a).^2);
subplot(6, 4, 1);
plot(x, g);
title('1-d Gaussian function');

%2
mx=1;
my=2;
ax=1;
ay=1;
X=linspace(mx-3*ax, mx+3*ax);
Y=linspace(my-3*ay, my+3*ay);
[x,y] = meshgrid(X,Y);
g=1/(2*pi*ax*ay)*exp(-1/2*((x-mx).^2/ax^2+(y-my).^2/ay^2));
subplot(6, 4, 5);
surf(x,y,g);
title('2-d Gaussian function');

%3
m=0;
a=1;
x=a.*randn(100)+m;
subplot(6, 4, 9);
histogram(x);
title('1-d histogram for 1-d Gaussian random data');

%4&5
m=[1 2];
a=[3 0;0 4];
x=mvnrnd(m, a, 10000);
counts=hist3(x, 'Ctrs',{-6:0.3:6 -4:0.3:8}, ‘CDataMode','auto','FaceColor','interp');

subplot(6, 4, 13);
plot(x(:,1), x(:,2), '.');
title('2-d Gaussian random data');

subplot(6, 4, 17);
hist3(x, 'Ctrs',{-6:0.3:6 -4:0.3:8}, 'CDataMode','auto','FaceColor','interp');
title('2-d histogram for 2-d Gaussian random data');

subplot(6, 4, 21);
contour(-6:0.3:6, -4:0.3:8, counts, 'ShowText', 'on');
title('contour for the previous 2-d histogram');

%6
```

```
x=linspace(-6, 6);
y=x-1;
subplot(6, 4, 2);
plot(x, y);
axis tight;
title('x-y-1=0');

%7
subplot(6, 4, 6);
ezplot('x^2+y^2=1', [-1.5, 1.5]);
axis equal;
title('x^2+y^2-1=0');

%8
subplot(6, 4, 10);
ezplot('x^2+y^2/4=1', [-3, 3]);
axis equal;
title('x^2+y^2/4=1');

%9
subplot(6, 4, 14);
ezplot('x^2-y^2/4=1');
axis equal;
title('x^2-y^2/4=1');

%10
x=linspace(0,100, 100);
y=2*x;
subplot(6, 4, 18);
plot(x, y, '.');
title('2x-y=0');

%11
x=linspace(-2,2 , 50);
y1=sqrt(4-x.^2);
y2=-sqrt(4-x.^2);
subplot(6, 4, 22);
hold on;
box on;
plot(x, y1, 'b.');
plot(x, y2, 'b.');
axis equal;
title('x^2+y^2=4');
hold off;

%12
x=linspace(-2,2 , 50);
y1=sqrt(1-x.^2/4);
y2=-sqrt(1-x.^2/4);
subplot(6, 4, 3);
hold on;
box on;
```

```
plot(x, y1, 'b.');
plot(x, y2, 'b.');
axis equal;
title('x^2/4+y^2=1');
hold off;

%13
x1=linspace(-1,-0.1, 50);
x2=linspace(0.1,1, 50);
y1=1./x1;
y2=1./x2;
subplot(6, 4, 7);
hold on;
box on;
plot(x1, y1, 'b.');
plot(x2, y2, 'b.');
axis([-1 1 -10 10]);
title('xy=1');
hold off;

%14
i=0:96;
r=6.5.*(104-i)./104;
q=pi/16.*i;
x = r.*sin(q);
y = r.*cos(q);
subplot(6, 4, 11);
plot(x, y, 'ro');
axis equal
hold on;
x = -r.*sin(q);
y = -r.*cos(q);
plot(x, y, 'b+');
title('two spirals');


%15
x=linspace(0, 1);
y=linspace(0, 1);
z = @(x,y)(x-y+0.5);
subplot(6, 4, 15);
s=fsurf(z, [0, 1], 'y', 'edgecolor', 'y');
alpha(0.3);
axis square;
xlabel('x');
ylabel('y');
zlabel('z');
title('plane z=x-y+0.5 that separate 2 classes');
box on;
hold on;
plot3(0, 1, 1, 'bo', 'MarkerSize', 10);
plot3(0, 0, 0, 'rx', 'MarkerSize', 10);
```

```
plot3(1, 0, 0, 'rx', 'MarkerSize', 10);
plot3(1, 0, 1, 'rx', 'MarkerSize', 10);
plot3(0, 0, 1, 'bo', 'MarkerSize', 10);
plot3(1, 1, 0, 'rx', 'MarkerSize', 10);
plot3(1, 1, 1, 'bo', 'MarkerSize', 10);
plot3(0, 1, 0, 'bo', 'MarkerSize', 10);
hold off;

%16
w=6;
r=10;
d=-2;
ts=200;
ts1=10*ts;
done=0;
tmp1=[];

while ~done
    tmp=[2*(r+w/2)*(rand(ts1,1)-0.5) (r+w/2)*rand(ts1,1)];
    tmp(:,3)=sqrt(tmp(:,1).*tmp(:,1)+tmp(:,2).*tmp(:,2));
    idx=find([tmp(:,3)>r-w/2] & [tmp(:,3)<r+w/2]);
    tmp1=[tmp1;tmp(idx,1:2)];
    if length(idx)>= ts
        done=1;
    end
end

data=[tmp1(1:ts,:) zeros(ts,1);
    [tmp1(1:ts,1)+r -tmp1(1:ts,2)-d ones(ts,1)]];
subplot(6, 4, 19);
plot(data(1:ts,1),data(1:ts,2),'bo',data(ts+1:end,1),data(ts+1:end,2),'rs');
title(['double moon problem']),
axis([-r-w/2 2*r+w/2 -r-w/2-d r+w/2]);

%17
x = 0:pi/50:2*pi;
t0=2*pi;
subplot(6, 4, 4);
h1=plot(x,sin(x*2*pi/(t0)),'linewidth',3);
title('sine function with period T0');
axis([-inf inf -1 1])

subplot(6, 4, 8);
h2=plot(x,sin(x*2*pi/(t0/2)),'linewidth',3);
title('sine function with period T0/2');
axis([-inf inf -1 1])

subplot(6, 4, 12);
h3=plot(x,sin(x*2*pi/(t0/3)),'linewidth',3);
title('sine function with period T0/3');
axis([-inf inf -1 1])
```

```
subplot(6, 4, 16);
h4=plot(x,sin(x*2*pi/(t0/4)),'linewidth',3);
title('sine function with period T0/4');
axis([-inf inf -1 1])

subplot(6, 4, 20);
h5=plot(x,sin(x*2*pi/(t0/5)),'linewidth',3);
title('sine function with period T0/5');
axis([-inf inf -1 1])

dx=5*pi/360;

while x<6*pi
x=x+dx;
set(h1,'xdata',x,'ydata',sin(x*2*pi/(t0)));
set(h2,'xdata',x,'ydata',sin(x*2*pi/(t0/2)));
set(h3,'xdata',x,'ydata',sin(x*2*pi/(t0/3)));
set(h4,'xdata',x,'ydata',sin(x*2*pi/(t0/4)));
set(h5,'xdata',x,'ydata',sin(x*2*pi/(t0/5)));
drawnow
end

%20
filename = '/Users/Winnie/Downloads/三上/圖形識別/hw/hw1/Proj#1_軒轅照雯
_PR_2018_Fall/t10k-images.idx3-ubyte';
fp=fopen(filename,'r');
magic = fread(fp, 1, 'int32', 0, 'ieee-be');
numImages = fread(fp, 1, 'int32', 0, 'ieee-be');
rows = fread(fp, 1, 'int32', 0, 'ieee-be');
cols = fread(fp, 1, 'int32', 0, 'ieee-be');
test_x = zeros(150,rows*cols);
for i = 1:150
        temp = fread(fp,(rows*cols), 'uchar');
        test_x(i,:) = temp;
end
test=reshape(test_x, 15*rows, 10*cols);
subplot(6, 4, 23);
imshow(test);
title('150 patterns of MNIST database');
```

（註：第20題filename的部分因為我的電腦必須打詳細的位置，如果在別的地方跑的話可能要做更改。另外，第20題輸出的圖會在第17題動畫跑完之後才會出現。）

三、分析

18. uniform random number generator

(a)

```
rng(SEED, 'v5uniform');
URN=rand(RANDX, 1);
```

(b)
EXURN=lower_bound+(upper_bound-lower_bound)*rand(RANDX, 1);

19.Gaussian (normal) random number generator

(a)
rng(SEED, 'v5normal');
GRN=randn(RANDX, 1);
or
GRN=normrnd(0, 1, [RANDX, 1]);

(b)standard deviation(σ), mean(m)
GRN2=randn(RANDX, 1)*σ +m;
or
GRN2=normrnd(m, σ , [RANDX, 1]);

(1) For both of the random number generator, there first steps are the same.
Use rng() to specify the type of the random number generator
-SEED: seeds the random number generator using it so that rand, randi, randn produce a predictable sequence of numbers

(2)
18.(a)rand(RANDX, 1): returns an RANDX by 1 array of uniformly distributed random numbers in the interval (0,1)

19.(a)randn(RANDX, 1) / normrnd(0, 1, [RANDX, 1]): returns an RANDX by 1 array from the standard normal distribution (mean=0, standard deviation=1)

(3)
18.(a)Since rand() returns the random numbers in the interval(0, 1)(unit length), to extend the values between a lower bound and an upper bound, we just need to times rand() by the length of the new interval(upper bound-lower bound) and add the lower bound, then we'll get the uniformly distributed random numbers in the interval (lower bound, upper bound).

19.(a)normrnd() generates a random number from the normal distribution with parameters mean and standard deviation; since randn() generates the standard normal distribution, we can also generate a normal distribution with mean m and standard deviation σ by σ x randn()+m, which scales the normal distribution and move the mean from 0 to m.

參考資料：
https://www.mathworks.com/help/matlab/ref/rng.html
https://www.mathworks.com/help/matlab/ref/rand.html
https://www.mathworks.com/help/stats/normrnd.html