

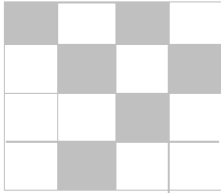
GRAY COLOR IMAGES

In matlab environment image means matrix. For example a 2x2 matrix $A = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$ means,



1 white
0 black

In a similar way



$$A = \begin{bmatrix} 0 & 1 & 0 & 0 \\ 1 & 0 & 1 & 0 \\ 1 & 1 & 0 & 1 \\ 1 & 0 & 1 & 1 \end{bmatrix}$$

Write the following command in MATLAB and see the results

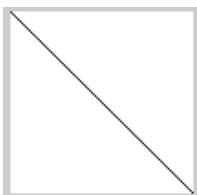
```
>> aa=[ 1 0 1; 0 1 0; 1 0 1]; imshow(aa)
>> aa=[ ones(5,5) zeros(5,5); zeros(5,5) ones(5,5); ]
>> imshow(aa)
```

```
>> aa=[ ones(5,5) zeros(5,5) ones(5,5);
      zeros(5,5) ones(5,5) zeros(5,5);
      ones(5,5) zeros(5,5) ones(5,5); ]
>> imshow(aa)
```

Examples:

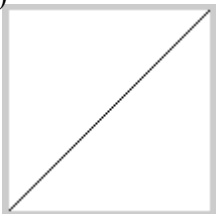
```
>> aa=ones(100,100); aa(50:50,:)=0; imshow(aa)
>> aa=ones(100,100); aa(:,50:50)=0; imshow(aa)
>> aa=ones(100,100); aa(50:60,:)=0; imshow(aa)
>> aa=ones(100,100); aa(:,40:60)=0; imshow(aa)
```

Example 511 : Assume the image size 100x100 pixel.



```
>> aa=ones(100,100);
>> for kk=1:100, aa(kk,kk)=0; end; imshow(aa);
```

Ex-513)



```
aa=ones(100,100);
for kk=1:100, aa(100-kk+1,kk)=0; end; imshow(aa);
```

Ex-514)



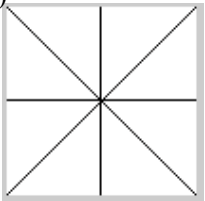
```
aa=ones(100,100);
for kk=1:100, aa(kk,kk)=0; end;
for kk=1:100, aa(100-kk+1,kk)=0; end; imshow(aa);
```

Ex-515)



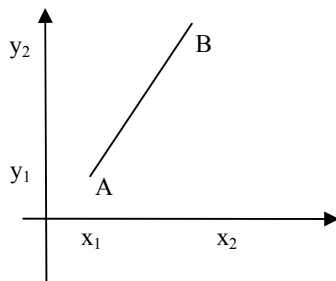
```
aa=ones(100,100);
for kk=1:100, aa(kk,kk)=0; end;
for kk=1:100, aa(100-kk+1,kk)=0; end;
aa(50:50,:)=0; imshow(aa);
```

Ex-516)



```
aa=ones(100,100);
for kk=1:100, aa(kk,kk)=0; end;
for kk=1:100, aa(100-kk+1,kk)=0; end;
aa(50:50,:)=0; aa(:,50:50)=0; imshow(aa);
```

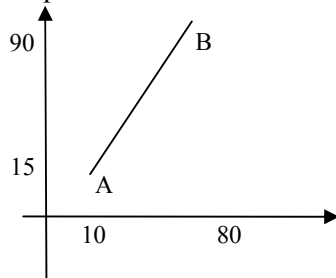
Drawing a line from point A(x1,y1) to point B(x2,y2)



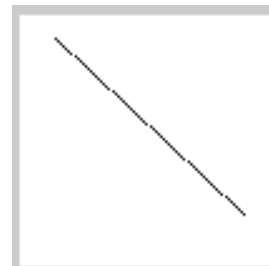
$$\text{Line equation } \frac{y - y_1}{y_1 - y_2} = \frac{x - x_1}{x_1 - x_2}$$

$$y = (y_1 - y_2) \frac{x - x_1}{x_1 - x_2} + y_1$$

Example 531 Draw a line from A to B. A(10,15) B(80,90), x1=10, x2=80, y1=15, y2=90



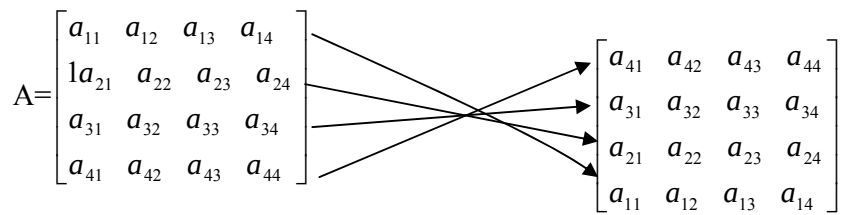
```
x1=10, x2=80, y1=15, y2=90
aa=ones(100,100);
for kk=x1:x2,
    xx(kk)=kk;
    yy(kk)=(y1-y2)*(kk-x1)/(x1-x2) + y1;
    yy(kk)=round(yy(kk))
    aa(yy(kk),xx(kk))=0;
end;
imshow(aa);
```



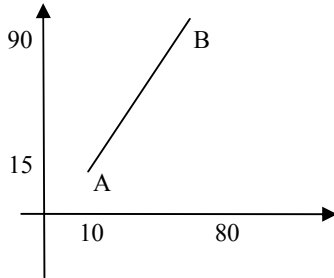
MATLAB RESULT

The reason is direction of y coordinate is in the **opposite direction** in MATLAB.

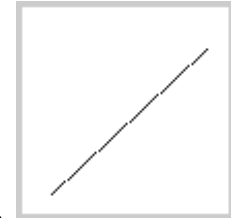
Solution: Change the rows of the aa matrix as follows



Example 533 Draw a line from A to B. A(10,15) B(80,90), $x_1=10$, $x_2=80$, $y_1=15$, $y_2=90$



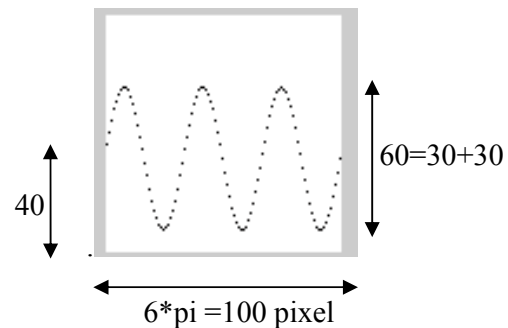
```
aa=ones(100,100);
x1=10, x2=80, y1=15, y2=90
for kk=x1:x2,
    xx(kk)=kk;
    yy(kk)=(y1-y2)*(kk-x1)/(x1-x2) + y1;
    yy(kk)=round(yy(kk))
    aa(yy(kk),xx(kk))=0;
end;
for kk=1:100, anew(kk,:)=aa(100-kk+1,:);
end;
imshow(anew);
```



MATLAB RESULT

Example 541 Draw $y=\sin(x)$

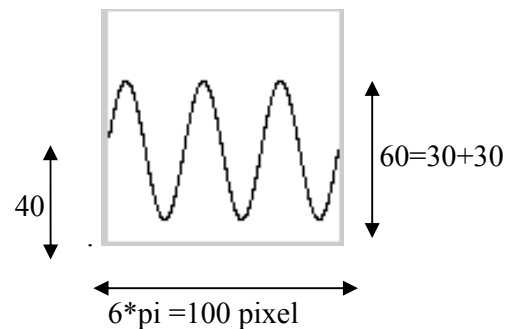
```
aa=ones(100,100);
for kk=1:100,
    xx(kk)=kk;
    yy(kk)=40+30*sin(kk*6*pi/100);
    yy(kk)=round(yy(kk))
    aa(yy(kk),xx(kk))=0;
end;
for kk=1:100, anew(kk,:)=aa(100-kk+1,:);
end;
imshow(anew);
```



We have drawn $y(x)=40+30 \sin(6\pi x)$

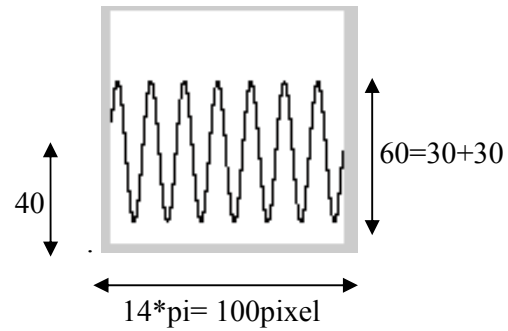
Example 543 Draw $y=\sin(x)$. include more points. Be careful about indexes.

```
aa=ones(100,100);
for kk=1:0.1:100,
    rkk=round(kk)
    xx(rkk)=round(kk);
    yy(rkk)=40+30*sin(kk*6*pi/100);
    yy(rkk)=round(yy(rkk))
    aa(yy(rkk),xx(rkk))=0;
end;
for kk=1:100, anew(kk,:)=aa(100-kk+1,:);
end;
imshow(anew);
```



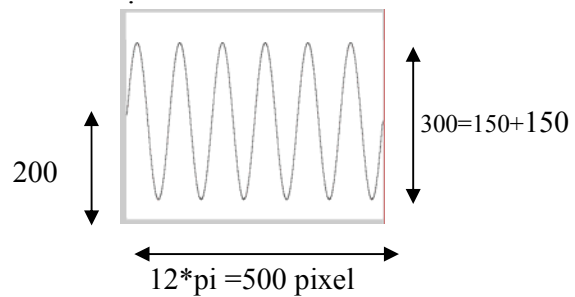
Example 545 Draw $y=\sin(x)$. include more periods. Be careful about indexes.

```
aa=ones(100,100);
for kk=1:0.01:100,
    rkk=round(kk)
    xx(rkk)=round(kk);
    yy(rkk)=40+30*sin(kk*14*pi/100);
    yy(rkk)=round(yy(rkk))
    aa(yy(rkk),xx(rkk))=0;
end;
for kk=1:100, anew(kk,:)=aa(100-kk+1,:);
end;
imshow(anew);
```



Example 547 Draw $y=\sin(x)$. increase resolution

```
NN=500
aa=ones(NN,NN);
for kk=1:0.002:NN,
    rkk=round(kk);
    xx(rkk)=round(kk);
    yy(rkk)=200+150*sin(kk*12*pi/NN);
    yy(rkk)=round(yy(rkk));
    aa(yy(rkk),xx(rkk))=0;
end;
for kk=1:NN, anew(kk,:)=aa(NN-kk+1,:);
end;
imshow(anew);
```



551 write a function to draw a line from A(x1,y1) to B(x2,y2).

Solution: Use (example 533)

```
%*****
```

```
function [anew]=line_equ(aa,x1,y1,x2,y2)
for kk=x1:x2,
    xx(kk)=kk;
    yy(kk)=(y1-y2)*(kk-x1)/(x1-x2) + y1;
    yy(kk)=round(yy(kk));
    aa(yy(kk),xx(kk))=0;
end;
anew=aa;
```

```
%****To call the function
```

```
aa=ones(100,100);
x1=10, x2=80, y1=15, y2=90
a2=line_equ(aa,x1,y1,x2,y2);
anew=a2;
for kk=1:100, anew(kk,:)=a2(100-kk+1,:); end;
imshow(anew);
```

553, draw different lines using line_eq function.

555 The corrected line_eq function are below.

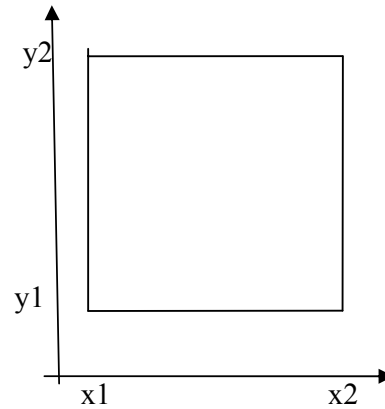
```
function [anew]=line_eq(aa,x1,y1,x2,y2)
    if x1>x2, xq=x1; x1=x2; x2=xq; end;
    if y1>y2, yq=y1; y1=y2; y2=yq; end;
    if abs(x1-x2)<0.0000000001,
        disp('zero slope');
        aa(y1:y2,x1)=0;
        anew=aa;
        return;
    end;

    for kk=x1:x2,
        xx(kk)=kk;
        yy(kk)=(y1-y2)*(kk-x1)/(x1-x2) + y1;
        yy(kk)=round(yy(kk));
        aa(yy(kk),xx(kk))=0;
    end;
    anew=aa;
```

559, draw the following rectangle using line_eq function.

```
aa=ones(100,100);
x1=60, y1=50; x2=90; y2=80
aa=line_eq(aa,x1,y1,x2,y1);
aa=line_eq(aa,x2,y1,x2,y2);
aa=line_eq(aa,x2,y2,x1,y2);
aa=line_eq(aa,x1,y2,x1,y1);
anew=aa;

for kk=1:100, anew(kk,:)=aa(100-kk+1,:); end;
imshow(anew);
```



561)Write a function to draw a rectangle.

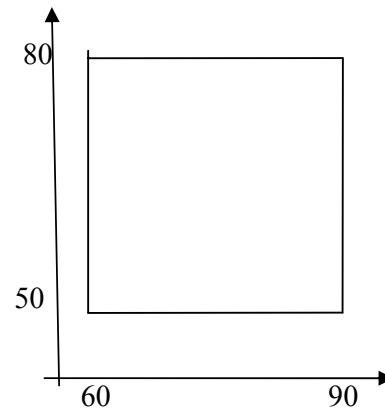
```
function anew=rect_draw(aa,x1,y1,x2,y2);
aa=line_eq(aa,x1,y1,x2,y1);
aa=line_eq(aa,x2,y1,x2,y2);
aa=line_eq(aa,x2,y2,x1,y2);
aa=line_eq(aa,x1,y2,x1,y1);
anew=aa;
```

563)Draw the following rectangle using rect_draw function

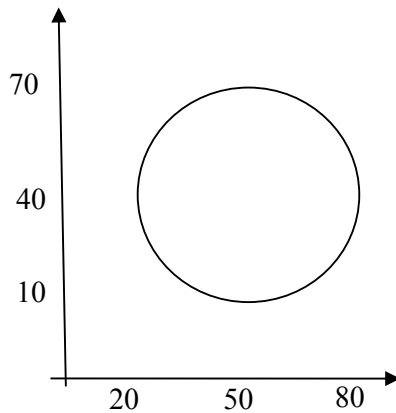
```

aa=ones(100,100);
aa=rect_draw(aa,60,50,90,80);
anew=aa;
for kk=1:100, anew(kk,:)=aa(100-kk+1,:); end;
imshow(anew);

```



571) Draw the following circle



```

aa=ones(100,100);
rr=30; x1=50; y1=40;
for kk=20:80,
    xx(kk)=kk;
    yqq=sqrt(rr^2-(kk-x1)^2);
    yupper(kk)=round(yqq+y1);
    ylower(kk)=round(-yqq+y1);
    aa(yupper(kk),xx(kk))=0;
    aa(ylower(kk),xx(kk))=0;
end;
anew=aa;
for kk=1:100, anew(kk,:)=aa(100-kk+1,:); end;
imshow(anew);

```

$$(x-x1)^2 + (y-y1)^2 = r^2$$

$$y = \sqrt{r^2 - (x - x1)^2} + y1$$

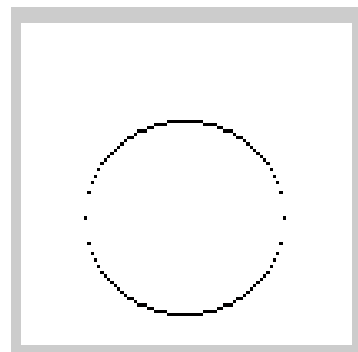
$$yupper = y = \sqrt{r^2 - (x - x1)^2} + y1 \quad ylower = -\sqrt{r^2 - (x - x1)^2} + y1$$

573) Draw the above circle

```

aa=ones(100,100);
rr=30; x1=50; y1=40;
for kk=20:80,
    xx(kk)=kk;
    yqq=sqrt(rr^2-(kk-x1)^2);
    yupper(kk)=round(yqq+y1);
    ylower(kk)=round(-yqq+y1);
    aa(yupper(kk),xx(kk))=0;
    aa(ylower(kk),xx(kk))=0;
end;
anew=aa;
for kk=1:100, anew(kk,:)=aa(100-kk+1,:); end;
imshow(anew);

```



573) Draw the above circle. Increase the resolution

```
aa=ones(100,100);
rr=30; x1=50; y1=40;
for kk=20:0.05:80,
    rkk=round(kk);
    xx(rkk)=rkk;
    yqq=sqrt(rr^2-(kk-x1)^2 );
    yupper(rkk)=round( yqq+y1 );
    ylower(rkk)=round(-yqq+y1 );
    aa(yupper(rkk),xx(rkk))=0;
    aa(ylower(rkk),xx(rkk))=0;
end;
anew=aa;
for kk=1:100, anew(kk,:)=aa(100-kk+1,:); end;
imshow(anew);
```

