```matlab
%%linear transformation
function demoGD()
x=rand(400,2);
z(:,1) = 2*x(:,1)+x(:,2)-1;
z(:,2)=x(:,1)-x(:,2)+1;
a=gradient_descent(x,z)


function a=gradient_descent(x,y)
max_loop=2000;
[N,d]=size(x);
X=[x ones(N,1)];
a=rand(2,d+1);
hc=0; c=0.1;e=y-X*a';
E=100; loop=1;
while ~hc
 G=[mean(X.*(e(:,1)*ones(1,d+1))); mean(X.*(e(:,2)*ones(1,d+1)))];
 a_new=a-c*G;
 y_hat=X*a_new';
 e_new=y_hat-y;
 E_new=sum(mean(e_new.^2));
 if mod(loop,100)==0
 fprintf('loop %d mse %f\n',loop,E_new);
 end
 if E_new < E & loop < max_loop
 a=a_new;e=e_new;
 E=E_new;
 else
 hc=1;
 end
 loop=loop+1;
end
```

```matlab
%%nonlinear transformation
function demoGD2()
x=rand(400,2);
z(:,1) =tanh( 2*x(:,1)+x(:,2)-1);
z(:,2)= tanh(x(:,1)-x(:,2)+0.5);
a=gradient_descent(x,z)



function a=gradient_descent(x,y)
max_loop=2000;
[N,d]=size(x);
X=[x ones(N,1)];
a=rand(2,d+1);
hc=0; c=0.2;e=y-tanh(X*a');
E=100; loop=1;
while ~hc
 dy=1-tanh(X*a').^2;
 G=[mean(X.*(dy(:,1)*ones(1,d+1)).*(e(:,1)*ones(1,d+1)))];
 G=[G; mean(X.*(dy(:,2)*ones(1,d+1)).*(e(:,2)*ones(1,d+1)))];
 a_new=a-c*G;
 y_hat=tanh(X*a_new');
 e_new=y_hat-y;
 E_new=sum(mean(e_new.^2));
 if mod(loop,100)==0
 fprintf('loop %d mse %f\n',loop,E_new);
 end
 if E_new < E & loop < max_loop
 a=a_new;e=e_new;
 E=E_new;
 else
 hc=1;
 end
 loop=loop+1;
end
```