Algorithm sL-BFGS-TR on Fashion

os = 500 // |J| = 1000

l = 20 //

epoch = 10 //

Load Data

Train and Test (images): 4D double

Train and Test (label): categorical

```
clear
clc
close all
rng default


[XTrain, yTrain, XTest, yTest] = loadData_FashionMnist;
```

```
Read MNIST image data...
Number of images in the dataset:  60000 ...
Each image is of 28 by 28 pixels...
The image data is read to a matrix of dimensions:     28 by   28...
End of reading image data.

Read MNIST label data...
Number of labels in the dataset:  60000 ...
The label data is read to a matrix of dimensions:  60000 by  1...
End of reading label data.

Read MNIST image data...
Number of images in the dataset:  10000 ...
Each image is of 28 by 28 pixels...
The image data is read to a matrix of dimensions:     28 by   28...
End of reading image data.

Read MNIST label data...
Number of labels in the dataset:  10000 ...
The label data is read to a matrix of dimensions:  10000 by  1...
End of reading label data.
```

```
classes                     = categories(yTrain);
numClasses                  = numel(classes);       % 10
input_image_size            = [28 28 1];
num_of_Train_Images         = size(XTrain, 4);
num_of_Test_Images          = size(XTest, 4);
```

One-hot label

```
% One-hot labels:

YTrain = zeros(numClasses, num_of_Train_Images, 'single');
for c  = 2:10
    YTrain( c-1, yTrain == classes(c)) = 1;
end
YTrain( 10, yTrain == classes(1)) = 1;


% One-hot labels:

YTest = zeros(numClasses, num_of_Test_Images, 'single');
for c = 2:10
    YTest( c-1, yTest == classes(c) ) = 1;
end
YTest( 10, yTest == classes(1) ) = 1;
```

Convert Test set from 4D double to 4D / single / dlArray / gpuArray

Since Test set is 10000, we can do here.

```
executionEnvironment = "auto";

XTest   = dlarray(single(XTest),'SSCB');
if (executionEnvironment == "auto" && canUseGPU) || executionEnvironment == "gpu"
    XTest = gpuArray(XTest);
end
```

Architecture of Network

```
lgraph = layerGraph();

tempLayers = [

imageInputLayer(input_image_size, 'Name', 'imageinput', 'Normalization','zscore',...
'Mean', mean(XTrain,4), 'StandardDeviation', std(XTrain, 0, 4))
convolution2dLayer([3 3],16,"Name","conv_1","Padding",[1 1 1 1])
reluLayer("Name","relu_1")];
lgraph = addLayers(lgraph,tempLayers);

% B1:

tempLayers = [
    convolution2dLayer([3 3],16,"Name","conv_2","Padding",[1 1 1 1])
    reluLayer("Name","relu_2")
    convolution2dLayer([3 3],16,"Name","conv_3","Padding",[1 1 1 1])];
lgraph = addLayers(lgraph,tempLayers);
```

```
tempLayers = [
    additionLayer(2,"Name","addition_1")
    reluLayer("Name","relu_3")];
lgraph = addLayers(lgraph,tempLayers);


% B2:

tempLayers = [
    convolution2dLayer([3 3],16,"Name","conv_4","Padding",[1 1 1 1])
    reluLayer("Name","relu_4")
    convolution2dLayer([3 3],16,"Name","conv_5","Padding",[1 1 1 1])];
lgraph = addLayers(lgraph,tempLayers);

tempLayers = [
    additionLayer(2,"Name","addition_2")
    reluLayer("Name","relu_5")];
lgraph = addLayers(lgraph,tempLayers);


% B3:

tempLayers = [
    convolution2dLayer([3 3],16,"Name","conv_6","Padding",[1 1 1 1])
    reluLayer("Name","relu_6")
    convolution2dLayer([3 3],16,"Name","conv_7","Padding",[1 1 1 1])];
lgraph = addLayers(lgraph,tempLayers);

tempLayers = [
    additionLayer(2,"Name","addition_3")
    reluLayer("Name","relu_7")];
lgraph = addLayers(lgraph,tempLayers);

%==========================================================
%B1:

tempLayers = [
    convolution2dLayer([3 3],32,"Name","conv_8","Padding",[1 1 1 1],"Stride",[2 2])
    reluLayer("Name","relu_8")
    convolution2dLayer([3 3],32,"Name","conv_9","Padding",[1 1 1 1])];
lgraph = addLayers(lgraph,tempLayers);

tempLayers = [
    convolution2dLayer([1 1],32,"Name","conv_10","Stride",[2 2])];
lgraph = addLayers(lgraph,tempLayers);

tempLayers = [
    additionLayer(2,"Name","addition_4")
    reluLayer("Name","relu_9")];
lgraph = addLayers(lgraph,tempLayers);


% B2:
```

```
tempLayers = [
    convolution2dLayer([3 3],32,"Name","conv_11","Padding",[1 1 1 1])

    reluLayer("Name","relu_10")
    convolution2dLayer([3 3],32,"Name","conv_12","Padding",[1 1 1 1])];
lgraph = addLayers(lgraph,tempLayers);

tempLayers = [
    additionLayer(2,"Name","addition_5")
    reluLayer("Name","relu_11")];
lgraph = addLayers(lgraph,tempLayers);


% B3:

tempLayers = [
    convolution2dLayer([3 3],32,"Name","conv_13","Padding",[1 1 1 1])
    reluLayer("Name","relu_12")
    convolution2dLayer([3 3],32,"Name","conv_14","Padding",[1 1 1 1])];
lgraph = addLayers(lgraph,tempLayers);

tempLayers = [
    additionLayer(2,"Name","addition_6")
    reluLayer("Name","relu_13")];
lgraph = addLayers(lgraph,tempLayers);

%==========================================================

% B1:

tempLayers = [
    convolution2dLayer([3 3],64,"Name","conv_15","Padding",[1 1 1 1],"Stride",[2 2])

    reluLayer("Name","relu_14")
    convolution2dLayer([3 3],64,"Name","conv_16","Padding",[1 1 1 1])];
lgraph = addLayers(lgraph,tempLayers);


tempLayers = [
    convolution2dLayer([1 1],64,"Name","conv_17","Stride",[2 2])];
lgraph = addLayers(lgraph,tempLayers);



tempLayers = [
    additionLayer(2,"Name","addition_7")
    reluLayer("Name","relu_15")];
lgraph = addLayers(lgraph,tempLayers);

% B2:
```

```
tempLayers = [
    convolution2dLayer([3 3],64,"Name","conv_18","Padding",[1 1 1 1])
    reluLayer("Name","relu_16")
    convolution2dLayer([3 3],64,"Name","conv_19","Padding",[1 1 1 1])];
lgraph = addLayers(lgraph,tempLayers);

tempLayers = [
    additionLayer(2,"Name","addition_8")
    reluLayer("Name","relu_17")];
lgraph = addLayers(lgraph,tempLayers);


% B3:

tempLayers = [
    convolution2dLayer([3 3],64,"Name","conv_20","Padding",[1 1 1 1])
    reluLayer("Name","relu_18")
    convolution2dLayer([3 3],64,"Name","conv_21","Padding",[1 1 1 1])];
lgraph = addLayers(lgraph,tempLayers);

tempLayers = [
    additionLayer(2,"Name","addition_9")
    reluLayer("Name","relu_19")
    globalAveragePooling2dLayer("Name","gapool")
    fullyConnectedLayer(10,"Name","fc")
    softmaxLayer("Name","softmax")];
lgraph = addLayers(lgraph,tempLayers);

% clean up helper variable
clear tempLayers;

lgraph = connectLayers(lgraph,"relu_1","conv_2");
lgraph = connectLayers(lgraph,"relu_1","addition_1/in2");
lgraph = connectLayers(lgraph,"conv_3","addition_1/in1");


lgraph = connectLayers(lgraph,"relu_3","conv_4");
lgraph = connectLayers(lgraph,"relu_3","addition_2/in2");
lgraph = connectLayers(lgraph,"conv_5","addition_2/in1");


lgraph = connectLayers(lgraph,"relu_5","conv_6");
lgraph = connectLayers(lgraph,"relu_5","addition_3/in2");
lgraph = connectLayers(lgraph,"conv_7","addition_3/in1");


lgraph = connectLayers(lgraph,"relu_7","conv_8");
lgraph = connectLayers(lgraph,"relu_7","conv_10");
lgraph = connectLayers(lgraph,"conv_10","addition_4/in2");
lgraph = connectLayers(lgraph,"conv_9","addition_4/in1");


lgraph = connectLayers(lgraph,"relu_9","conv_11");
lgraph = connectLayers(lgraph,"relu_9","addition_5/in2");
```

```
lgraph = connectLayers(lgraph,"conv_12","addition_5/in1");


lgraph = connectLayers(lgraph,"relu_11","conv_13");
lgraph = connectLayers(lgraph,"relu_11","addition_6/in2");
lgraph = connectLayers(lgraph,"conv_14","addition_6/in1");


lgraph = connectLayers(lgraph,"relu_13","conv_17");
lgraph = connectLayers(lgraph,"relu_13","conv_15");
lgraph = connectLayers(lgraph,"conv_16","addition_7/in1");
lgraph = connectLayers(lgraph,"conv_17","addition_7/in2");


lgraph = connectLayers(lgraph,"relu_15","conv_18");
lgraph = connectLayers(lgraph,"relu_15","addition_8/in2");
lgraph = connectLayers(lgraph,"conv_19","addition_8/in1");


lgraph = connectLayers(lgraph,"relu_17","conv_20");
lgraph = connectLayers(lgraph,"relu_17","addition_9/in2");
lgraph = connectLayers(lgraph,"conv_21","addition_9/in1");
```

Creat Network and Initialize

```
dlNet  = dlnetwork(lgraph);

dlNet.Layers
```

```
ans =
  53×1 Layer array with layers:

     1   'imageinput'   Image Input             28×28×1 images with 'zscore' normalization
     2   'conv_1'       Convolution             16 3×3×1 convolutions with stride [1  1] and padding [1  1  1  1]
     3   'relu_1'       ReLU                    ReLU
     4   'conv_2'       Convolution             16 3×3×16 convolutions with stride [1  1] and padding [1  1  1  1]
     5   'relu_2'       ReLU                    ReLU
     6   'conv_3'       Convolution             16 3×3×16 convolutions with stride [1  1] and padding [1  1  1  1]
     7   'addition_1'   Addition                Element-wise addition of 2 inputs
     8   'relu_3'       ReLU                    ReLU
     9   'conv_4'       Convolution             16 3×3×16 convolutions with stride [1  1] and padding [1  1  1  1]
    10   'relu_4'       ReLU                    ReLU
    11   'conv_5'       Convolution             16 3×3×16 convolutions with stride [1  1] and padding [1  1  1  1]
    12   'addition_2'   Addition                Element-wise addition of 2 inputs
    13   'relu_5'       ReLU                    ReLU
    14   'conv_6'       Convolution             16 3×3×16 convolutions with stride [1  1] and padding [1  1  1  1]
    15   'relu_6'       ReLU                    ReLU
    16   'conv_7'       Convolution             16 3×3×16 convolutions with stride [1  1] and padding [1  1  1  1]
    17   'addition_3'   Addition                Element-wise addition of 2 inputs
    18   'relu_7'       ReLU                    ReLU
    19   'conv_8'       Convolution             32 3×3×16 convolutions with stride [2  2] and padding [1  1  1  1]
    20   'relu_8'       ReLU                    ReLU
    21   'conv_9'       Convolution             32 3×3×32 convolutions with stride [1  1] and padding [1  1  1  1]
    22   'conv_10'      Convolution             32 1×1×16 convolutions with stride [2  2] and padding [0  0  0  0]
    23   'addition_4'   Addition                Element-wise addition of 2 inputs
    24   'relu_9'       ReLU                    ReLU
```

```
25   'conv_11'      Convolution              32 3×3×32 convolutions with stride [1  1] and padding [1  1  1  1]
26   'relu_10'      ReLU                     ReLU
27   'conv_12'      Convolution              32 3×3×32 convolutions with stride [1  1] and padding [1  1  1  1]
28   'addition_5'   Addition                 Element-wise addition of 2 inputs
29   'relu_11'      ReLU                     ReLU
30   'conv_13'      Convolution              32 3×3×32 convolutions with stride [1  1] and padding [1  1  1  1]
31   'relu_12'      ReLU                     ReLU
32   'conv_14'      Convolution              32 3×3×32 convolutions with stride [1  1] and padding [1  1  1  1]
33   'addition_6'   Addition                 Element-wise addition of 2 inputs
34   'relu_13'      ReLU                     ReLU
35   'conv_15'      Convolution              64 3×3×32 convolutions with stride [2  2] and padding [1  1  1  1]
36   'relu_14'      ReLU                     ReLU
37   'conv_16'      Convolution              64 3×3×64 convolutions with stride [1  1] and padding [1  1  1  1]
38   'conv_17'      Convolution              64 1×1×32 convolutions with stride [2  2] and padding [0  0  0  0]
39   'addition_7'   Addition                 Element-wise addition of 2 inputs
40   'relu_15'      ReLU                     ReLU
41   'conv_18'      Convolution              64 3×3×64 convolutions with stride [1  1] and padding [1  1  1  1]
42   'relu_16'      ReLU                     ReLU
43   'conv_19'      Convolution              64 3×3×64 convolutions with stride [1  1] and padding [1  1  1  1]
44   'addition_8'   Addition                 Element-wise addition of 2 inputs
45   'relu_17'      ReLU                     ReLU
46   'conv_20'      Convolution              64 3×3×64 convolutions with stride [1  1] and padding [1  1  1  1]
47   'relu_18'      ReLU                     ReLU
48   'conv_21'      Convolution              64 3×3×64 convolutions with stride [1  1] and padding [1  1  1  1]
49   'addition_9'   Addition                 Element-wise addition of 2 inputs
50   'relu_19'      ReLU                     ReLU
51   'gapool'       Global Average Pooling   Global average pooling
52   'fc'           Fully Connected          10 fully connected layer
53   'softmax'      Softmax                  softmax
```

```
dlNet.Learnables
```

```
ans = 44×3 table
```

	Layer	Parameter	Value
1	"conv_1"	"Weights"	3×3×1×16 ...
2	"conv_1"	"Bias"	1×1×16 ...
3	"conv_2"	"Weights"	3×3×16×16 ...
4	"conv_2"	"Bias"	1×1×16 ...
5	"conv_3"	"Weights"	3×3×16×16 ...
6	"conv_3"	"Bias"	1×1×16 ...
7	"conv_4"	"Weights"	3×3×16×16 ...
8	"conv_4"	"Bias"	1×1×16 ...
9	"conv_5"	"Weights"	3×3×16×16 ...
10	"conv_5"	"Bias"	1×1×16 ...
11	"conv_6"	"Weights"	3×3×16×16 ...
12	"conv_6"	"Bias"	1×1×16 ...
13	"conv_7"	"Weights"	3×3×16×16 ...
14	"conv_7"	"Bias"	1×1×16 ...

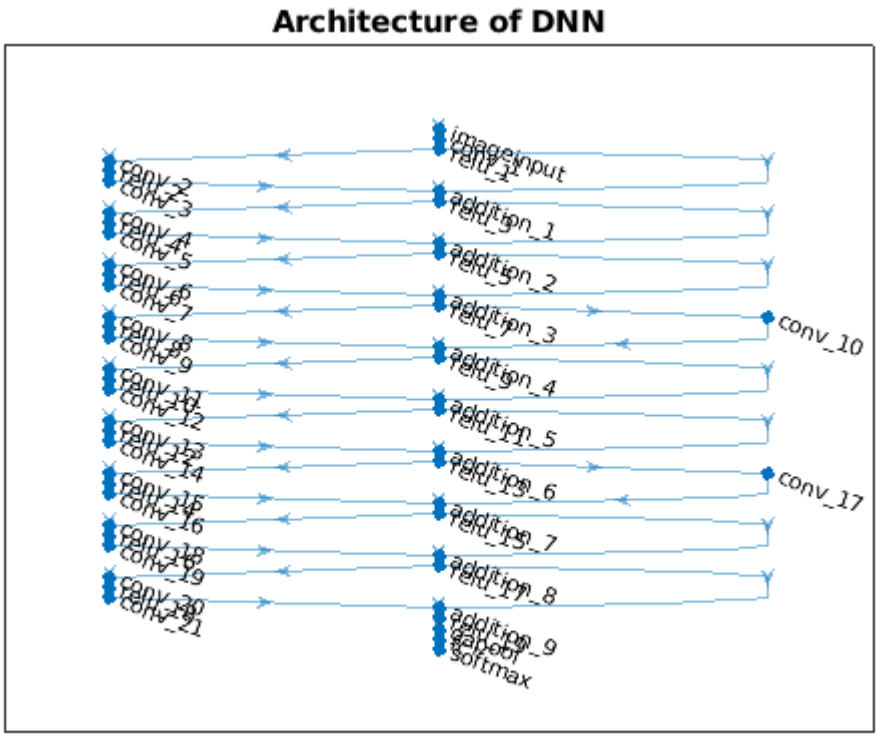
⋮

```
dlNet.State
```

```
ans =

  0×3 empty table
```

```
figure(1),
plot(lgraph),
title("Architecture of DNN")
```




```
[total, detailes] = find_num_parameters(dlNet);
fprintf('\n The number of learnable parameters: '), disp(total)
```

```
 The number of learnable parameters:       271402
```

Training Options

```
global show
show                = 0;

tol                 = 1e-5; % stopping tol
```

```
eta                 = 1e-4; % acceptance tol
S                   = [];
Y                   = [];
delta               = 1;
gamma               = 1;

skip_number         = 0;
```

```
k                   = 0;                                % counter of iteration
j                   = 1;

numEpochs           = 10;
lim_m               = 20;

bs_H                = 1000;                                % size of batch for Hessian approxi
Nb_H                = floor( num_of_Train_Images /bs_H );   % number of batches for Hessian app

bs                  = 1000;                             % size of batch
Nb                  = floor( num_of_Train_Images /bs ); % number of batches


Jac                 = zeros(total, Nb);                 % storage matrix of reduced memory Jac
N                   = zeros(Nb, bs);                    % storage matrix of indeces of batches

Jac_H               = zeros(total, Nb_H);                 % storage matrix of reduced memory Ja
N_H                 = zeros(Nb_H, bs_H);                  % storage matrix of indeces of batche
```

Train Network

Convert to SSCB and gpuArray in multi-batch formation

```
fprintf("\n=====================================================================\n")
```

```
=====================================================================
```

```
fprintf("Start Training...")
```

```
Start Training...
```

```
fprintf("\n=====================================================================\n"), start = ti
```

```
=====================================================================
```

```
t0 = tic;

idx      = randperm(num_of_Train_Images);
idx_H    = randperm(num_of_Train_Images);

fprintf('time0: %d \n', toc(t0))
```

```
time0: 4.103100e-02
```

```
fprintf("\n Computing first Jacobian for gradient and avarage...\n"), time_Nb_grads = tic;
```

```
 Computing first Jacobian for gradient and avarage...
```

```
for iter = 1: Nb
    N(iter, :)                    = idx((iter-1)*bs + 1 : iter*bs);
    X_batch                       = XTrain(:,:,:, N(iter, :) );
    dlX_batch                     = dlarray(single( X_batch ),'SSCB');
    Y_batch                       = YTrain(:, N(iter, :));
    [loss_batch, grad_batch]      = dlfeval(@model_Forward_Backward, dlNet, dlX_batch, Y_batch)

    g_batch                       = layeredVec_2_vec( grad_batch.Value );
    Jac(:,iter)                   = g_batch;
    g_bar                         = mean(Jac,2);
end
fprintf("\n Time: %d \n", toc(time_Nb_grads))
```

```
 Time: 1.861882e+02
```

```
fprintf("\n Computing first Jacobian for Hessian and avarage...\n"), time_Nb_Hess = tic;
```

```
 Computing first Jacobian for Hessian and avarage...
```

```
for iter = 1: Nb_H
    N_H(iter, :)                    = idx((iter-1)*bs_H + 1 : iter*bs_H);
    X_batch_H                       = XTrain(:,:,:, N_H(iter, :) );
    dlX_batch_H                     = dlarray(single( X_batch_H ),'SSCB');
    Y_batch_H                       = YTrain(:, N_H(iter, :));
    [loss_batch_H, grad_batch_H]    = dlfeval(@model_Forward_Backward, dlNet, dlX_batch_H, Y_

    g_batch_H                      = layeredVec_2_vec( grad_batch_H.Value );
    Jac_H(:,iter)                  = g_batch;
    g_bar_H                        = mean(Jac_H,2);
end
fprintf("\n Time: %d \n", toc(time_Nb_Hess))
```

```
 Time: 1.825272e+02
```

```
%----------------------------> Main loops
for epoch = 1:numEpochs
    fprintf("\n =============> Shuffeling of batches for gradient ...\n")

    idx_Nb   = randperm(Nb);
    idx_Nb_H = randperm(Nb_H);

    for iter = 1: Nb

        fprintf('\n =============> Iteration k : %d \n', k)

        t1 = tic;
```

```
batch_iter                      = idx_Nb(iter);
X_batch                         = XTrain(:,:,:, N(batch_iter,:));
dlX_batch                       = dlarray(single(X_batch),'SSCB');
Y_batch                         = YTrain(:, N(batch_iter,:));

[loss, grad, acc]               = dlfeval(@model_Forward_Backward, dlNet, dlX_batch, Y_ba

f                               = double(gather(extractdata( loss )));
g                               = layeredVec_2_vec( grad.Value );

%----------------------------> SAGA Computation

aux                             = g - Jac(:, batch_iter);
g_saga                          = g_bar + aux;
g_bar                           = g_bar + aux/Nb;
Jac(:, batch_iter)              = g;

fprintf('time1: %d \n', toc(t1))
%----------------------------> Exit condition:

llg_sagall                      = norm(g_saga);

if llg_sagall < tol || acc >= 100
    fprintf('\n ====> Training Stopped! \n')
end

%----------------------------> Solve: TR subproblem
t2 = tic;

if k == 0 || size(S,2) == 0
    p                   = -delta*(g_saga/llg_sagall);
    llpll               = norm(p);
    Bp                  = gamma*p;                % B0*p
    Q_p                 = p'*(g_saga + 0.5*Bp);  % Q(p) = p'*g_saga + 1/2 p'*B0*p

else

    p                   = TRsubproblem_solver_OBS(delta, gamma, g_saga, Psi, Minv);
    llpll               = norm(p);
    Bp                  = gamma*p + Psi*(Minv\(Psi'*p));        % Bk*p
    Q_p                 = p'*(g_saga + 0.5*Bp);                 % Q(p) = p'*g * 1/2 p'*
end

fprintf('time2: %d \n', toc(t2))
%----------------------------> Trial parameter
t3 = tic;

dlDir           = vec_2_layeredVec(dlNet, p);    % p (vector direction) ==> dlDir (dl
dlNet_trial     = update_dlNet(dlNet, dlDir);    % dlNet_trial = dlNet + dlDir

fprintf('time3: %d \n', toc(t3))
%----------------------------> Computation at trial parameter
```

```
t4 = tic;

loss_t          = dlfeval(@ model_Forward_Backward, dlNet_trial, dlX_batch, Y_batch);
f_t             = double(gather(extractdata( loss_t )));

fprintf('time4: %d \n', toc(t4))
%----------------------------> Compute: Rho

rho             = ( f_t - f ) / Q_p;

%----------------------------> Decoupeling
%-- Sampling
t5 = tic;

batch_iter_H                    = idx_Nb_H(iter);

X_batch_H                       = XTrain(:,:,:, N_H( batch_iter_H,:) );
dlX_batch_H                     = dlarray(single(X_batch_H),'SSCB');
Y_batch_H                       = YTrain(:, N_H(batch_iter_H,:) );



[loss_H_trial, grad_H_trial]   = dlfeval(@model_Forward_Backward, dlNet_trial, dlX_batc
[loss_H,       grad_H]         = dlfeval(@model_Forward_Backward, dlNet,       dlX_batc

g_H_trial                       = layeredVec_2_vec( grad_H_trial.Value );
g_H                             = layeredVec_2_vec( grad_H.Value );


%----------------------------> SAGA Computation

aux_H                          = g_H - Jac_H(:, batch_iter_H);
g_H_saga                       = g_bar_H + aux_H;
g_bar_H                        = g_bar_H + aux_H / Nb_H;
Jac_H(:, batch_iter)           = g_H_saga;

fprintf('time5: %d \n', toc(t5))

%-- s,y:

t6 = tic;

s                           = p;
y                           = g_H_trial - g_H;
y                           = y + (1/Nb_H - 1)*aux_H;



%----------------------------> Update: Acceptance Step

if rho > eta
    dlNet       = dlNet_trial;
else
    skip_number = skip_number + 1;
```

```
    end


    %-----------------------------> Evaluate Network


    dlNet_optimal   = dlNet;

    YPred           = predict(dlNet_optimal, XTest);
    loss_test       = crossentropy(YPred, YTest);
    f_test          = double(gather(extractdata(loss_test)));
    [~,idx_pred]    = max( (extractdata(YPred)), [], 1 );
    [~,idx_true]    = max(YTest, [], 1);
    acc_test        = mean(idx_pred == idx_true)*100;


    %-----------------------------> Update: TR Radius

    if rho > 0.75
        if norm(p)<= 0.8*delta
            delta_new = delta;
        else
            delta_new = 2*delta;
        end
    elseif (0.1 <= rho && rho <= 0.75)
        delta_new = delta;
    else
        delta_new = 0.5*delta;
    end
    delta  = delta_new;


    %-----------------------------> Update Bk = gamma*I + psi*M*Psi

    % -- updating condition:

    sty    = s'*y;
    if sty > 1e-2*llpll^2

        %-- S, Y:
        S = [S, s];
        Y = [Y, y];

        if ( size(S,2) > lim_m )
            S  = S(:, 2:end);
            Y  = Y(:, 2:end);
        end

        if size(S,2) == 0,  warning('S is empty!'), end
        while ( size(S, 2) > 0 )
            %-- gamma, Minv, Psi:
            SY      = S'*Y;
            SS      = S'*S;
```

```
                Lt = tril(SY,-1)';
                LD = tril(SY);
                LDLt    = LD +  Lt;

                eig_val       = eig(LDLt,SS);
                lambdaHat_min = min(eig_val);

                if lambdaHat_min > 0
                    gamma = max( 0.5*lambdaHat_min, 1);
                else
                    gamma = max( 1, (y'*y)/sty );  %%% add new command
                end


                minv{1,1} = -gamma*SS;
                minv{1,2} = -Lt';
                minv{2,1} = -Lt;
                minv{2,2} = diag(diag(SY));


                Minv      = cell2mat(minv);
                Psi       = [gamma*S, Y];


                if  size(Psi,2) == rank(Psi) && rank(Minv)==size(Minv,2) %if  min(eig(Psi'*Psi)
                    break
                else
                    fprintf('\n Psi is NOT full column rank! or M is Not invertable!\n')
                    S  = S(:, 2:end);
                    Y  = Y(:, 2:end);
                end
            end % while
        end % condition

        fprintf('time6: %d \n', toc(t6))


        Time_(k+1,1)    = toc(start);
        F_(k+1, 1)      = f;
        Acc_(k+1, 1)    = acc;
        F_t(k+1, 1)     = f_test;
        Acc_t(k+1, 1)   = acc_test;
        llGll(k+1, 1)   = llg_sagall;
        Delta(k+1,1)    = delta;
        Rho(k+1, 1)     = rho;


        k = k + 1;
    end

end % epoch
```

```
==============> Shuffeling of batches for gradient ...
```

```
 =============> Iteration k : 0
time1: 3.086634e+00
time2: 4.065000e-03
time3: 4.805400e-01
time4: 1.097873e+00
time5: 4.999656e+00
time6: 1.179440e+01
 =============> Iteration k : 1
time1: 3.181318e+00
time2: 9.204100e-02
time3: 5.451100e-01
time4: 1.122966e+00
time5: 5.353807e+00
 Psi is NOT full column rank! or M is Not invertable!
time6: 1.199284e+01
 =============> Iteration k : 2
time1: 2.850676e+00
time2: 6.276400e-02
time3: 5.326130e-01
time4: 1.087670e+00
time5: 5.104824e+00
time6: 1.193864e+01
 =============> Iteration k : 3
time1: 2.928788e+00
time2: 2.117100e-02
time3: 5.900930e-01
time4: 1.084170e+00
time5: 5.501449e+00
time6: 1.256655e+01
 =============> Iteration k : 4
time1: 2.960072e+00
time2: 4.120500e-02
time3: 5.330900e-01
time4: 7.078280e-01
time5: 5.848555e+00
time6: 1.151560e+01
 =============> Iteration k : 5
time1: 2.855258e+00
time2: 6.309100e-02
time3: 4.873280e-01
time4: 7.502750e-01
time5: 6.005892e+00
time6: 1.174592e+01
 =============> Iteration k : 6
time1: 2.788984e+00
time2: 8.709200e-02
time3: 4.860560e-01
time4: 9.487760e-01
time5: 6.258394e+00
time6: 1.214443e+01
 =============> Iteration k : 7
time1: 2.606112e+00
time2: 9.454400e-02
time3: 7.558390e-01
time4: 1.066573e+00
time5: 6.797655e+00
time6: 1.138270e+01
 =============> Iteration k : 8
time1: 2.336506e+00
time2: 1.562720e-01
time3: 5.194170e-01
time4: 1.094936e+00
time5: 6.205918e+00
time6: 1.142928e+01
```

```
 =============> Iteration k : 9
time1: 2.336691e+00
time2: 1.190850e-01
time3: 5.149430e-01
time4: 1.090567e+00
time5: 6.690371e+00
time6: 1.137344e+01
 =============> Iteration k : 10
time1: 2.371218e+00
time2: 1.798620e-01
time3: 5.903870e-01
time4: 1.105120e+00
time5: 6.715535e+00
time6: 1.074881e+01
 =============> Iteration k : 11
time1: 2.784530e+00
time2: 2.471640e-01
time3: 6.913110e-01
time4: 1.170072e+00
time5: 6.529575e+00
time6: 1.074338e+01
 =============> Iteration k : 12
time1: 2.885375e+00
time2: 4.006760e-01
time3: 7.949130e-01
time4: 1.209619e+00
time5: 6.594948e+00
time6: 1.047113e+01
 =============> Iteration k : 13
time1: 3.124779e+00
time2: 3.995640e-01
time3: 8.718020e-01
time4: 1.283523e+00
time5: 6.836532e+00
time6: 1.115530e+01
 =============> Iteration k : 14
time1: 3.297263e+00
time2: 7.272310e-01
time3: 9.527070e-01
time4: 1.656300e+00
time5: 7.799115e+00
time6: 1.579220e+01
 =============> Iteration k : 15
time1: 4.507114e+00
time2: 6.044220e-01
time3: 8.857180e-01
time4: 1.800864e+00
time5: 8.995641e+00
time6: 1.620857e+01
 =============> Iteration k : 16
time1: 4.558664e+00
time2: 9.873190e-01
time3: 9.498060e-01
time4: 1.790612e+00
time5: 8.768474e+00
time6: 1.598975e+01
 =============> Iteration k : 17
time1: 4.813350e+00
time2: 7.764500e-01
time3: 1.075187e+00
time4: 1.646033e+00
time5: 8.404611e+00
time6: 1.774350e+01
 =============> Iteration k : 18
```

```
time1: 4.218064e+00
time2: 1.008746e+00
time3: 7.350460e-01
time4: 1.718526e+00
time5: 8.285142e+00
time6: 1.702218e+01
 ==============> Iteration k : 19
time1: 4.257973e+00
time2: 4.965150e-01
time3: 9.254230e-01
time4: 1.669788e+00
time5: 8.320166e+00
time6: 1.757057e+01
 ==============> Iteration k : 20
time1: 4.385500e+00
time2: 6.974920e-01
time3: 7.815840e-01
time4: 1.506374e+00
time5: 9.083823e+00
time6: 1.733802e+01
 ==============> Iteration k : 21
time1: 4.046941e+00
time2: 7.253690e-01
time3: 9.105060e-01
time4: 1.762117e+00
time5: 7.915108e+00
time6: 1.798153e+01
 ==============> Iteration k : 22
time1: 4.314943e+00
time2: 6.280130e-01
time3: 5.906720e-01
time4: 1.828182e+00
time5: 8.577204e+00
time6: 1.755004e+01
 ==============> Iteration k : 23
time1: 3.866115e+00
time2: 9.899980e-01
time3: 8.779740e-01
time4: 1.213100e+00
time5: 9.009240e+00
time6: 1.743402e+01
 ==============> Iteration k : 24
time1: 3.928195e+00
time2: 9.550520e-01
time3: 8.913380e-01
time4: 1.926906e+00
time5: 9.582075e+00
time6: 1.620999e+01
 ==============> Iteration k : 25
time1: 4.652433e+00
time2: 1.019819e+00
time3: 1.195562e+00
time4: 2.068188e+00
time5: 9.805530e+00
time6: 1.630086e+01
 ==============> Iteration k : 26
time1: 4.877628e+00
time2: 1.216766e+00
time3: 9.673280e-01
time4: 1.887851e+00
time5: 9.435744e+00
time6: 1.648944e+01
 ==============> Iteration k : 27
time1: 4.574398e+00
```

```
time2: 9.217030e-01
time3: 1.385539e+00
time4: 1.748224e+00
time5: 8.202835e+00
time6: 1.662859e+01
 =============> Iteration k : 28
time1: 4.791169e+00
time2: 1.167064e+00
time3: 1.106834e+00
time4: 1.695765e+00
time5: 7.491552e+00
time6: 1.805239e+01
 =============> Iteration k : 29
time1: 4.422385e+00
time2: 7.083600e-01
time3: 1.184115e+00
time4: 1.707728e+00
time5: 7.852411e+00
time6: 1.831653e+01
 =============> Iteration k : 30
time1: 4.223339e+00
time2: 4.468220e-01
time3: 8.094130e-01
time4: 1.675428e+00
time5: 9.079867e+00
time6: 1.680210e+01
 =============> Iteration k : 31
time1: 3.204340e+00
time2: 8.682810e-01
time3: 8.369160e-01
time4: 1.871345e+00
time5: 9.320148e+00
time6: 1.611049e+01
 =============> Iteration k : 32
time1: 4.112444e+00
time2: 7.896520e-01
time3: 1.112465e+00
time4: 2.082444e+00
time5: 9.579591e+00
time6: 1.518379e+01
 =============> Iteration k : 33
time1: 4.473443e+00
time2: 1.021748e+00
time3: 1.214048e+00
time4: 1.909575e+00
time5: 9.383919e+00
time6: 1.519920e+01
 =============> Iteration k : 34
time1: 4.790459e+00
time2: 1.122554e+00
time3: 1.072370e+00
time4: 1.845175e+00
time5: 9.005549e+00
time6: 1.612177e+01
 =============> Iteration k : 35
time1: 5.175094e+00
time2: 1.140798e+00
time3: 9.721190e-01
time4: 1.879379e+00
time5: 8.396230e+00
time6: 1.609106e+01
 =============> Iteration k : 36
time1: 4.780727e+00
time2: 8.367290e-01
```

```
time3: 1.093775e+00
time4: 2.059234e+00
time5: 8.438307e+00
time6: 1.665853e+01
 ==============> Iteration k : 37
time1: 4.600573e+00
time2: 9.792700e-01
time3: 1.021108e+00
time4: 1.403854e+00
time5: 7.643076e+00
time6: 1.861665e+01
 ==============> Iteration k : 38
time1: 4.434316e+00
time2: 6.104740e-01
time3: 1.019859e+00
time4: 1.783661e+00
time5: 7.404706e+00
time6: 1.800136e+01
 ==============> Iteration k : 39
time1: 4.301391e+00
time2: 7.976180e-01
time3: 9.119410e-01
time4: 1.390467e+00
time5: 7.860199e+00
time6: 1.818225e+01
 ==============> Iteration k : 40
time1: 4.071538e+00
time2: 5.316080e-01
time3: 7.505630e-01
time4: 1.501346e+00
time5: 9.333269e+00
time6: 1.726273e+01
 ==============> Iteration k : 41
time1: 3.627444e+00
time2: 8.581370e-01
time3: 8.864220e-01
time4: 1.824565e+00
time5: 9.166651e+00
time6: 1.609988e+01
 ==============> Iteration k : 42
time1: 3.802912e+00
time2: 1.006654e+00
time3: 1.202220e+00
time4: 1.801200e+00
time5: 9.472607e+00
time6: 1.619034e+01
 ==============> Iteration k : 43
time1: 4.291086e+00
time2: 8.694710e-01
time3: 1.048647e+00
time4: 2.066235e+00
time5: 9.607456e+00
time6: 1.558607e+01
 ==============> Iteration k : 44
time1: 4.710607e+00
time2: 1.568994e+00
time3: 9.842990e-01
time4: 2.024183e+00
time5: 8.870765e+00
time6: 1.650802e+01
 ==============> Iteration k : 45
time1: 4.790167e+00
time2: 1.218228e+00
time3: 1.311967e+00
```

```
time4: 2.089404e+00
time5: 8.732661e+00
time6: 1.625043e+01
 =============> Iteration k : 46
time1: 4.569496e+00
time2: 1.098775e+00
time3: 9.982130e-01
time4: 1.974322e+00
time5: 8.114058e+00
time6: 1.730825e+01
 =============> Iteration k : 47
time1: 4.777531e+00
time2: 9.603250e-01
time3: 1.118030e+00
time4: 1.827676e+00
time5: 7.789355e+00
time6: 1.765813e+01
 =============> Iteration k : 48
time1: 4.368322e+00
time2: 7.986060e-01
time3: 1.245841e+00
time4: 1.531621e+00
time5: 7.903467e+00
time6: 1.768477e+01
 =============> Iteration k : 49
time1: 4.496183e+00
time2: 6.591930e-01
time3: 9.512260e-01
time4: 1.353265e+00
time5: 8.309119e+00
time6: 1.818195e+01
 =============> Iteration k : 50
time1: 4.069132e+00
time2: 5.174460e-01
time3: 1.002787e+00
time4: 1.613050e+00
time5: 8.740538e+00
time6: 1.712349e+01
 =============> Iteration k : 51
time1: 3.893932e+00
time2: 8.094420e-01
time3: 5.770920e-01
time4: 1.641087e+00
time5: 9.209327e+00
time6: 1.700853e+01
 =============> Iteration k : 52
time1: 4.045754e+00
time2: 7.448470e-01
time3: 8.936980e-01
time4: 1.818409e+00
time5: 9.369456e+00
time6: 1.611896e+01
 =============> Iteration k : 53
time1: 4.116750e+00
time2: 6.932350e-01
time3: 1.085013e+00
time4: 2.089001e+00
time5: 9.494809e+00
time6: 1.560469e+01
 =============> Iteration k : 54
time1: 4.873844e+00
time2: 1.437913e+00
time3: 1.049156e+00
time4: 1.817166e+00
```

```
time5: 9.209477e+00
time6: 1.506532e+01
 =============> Iteration k : 55
time1: 4.879500e+00
time2: 7.771450e-01
time3: 1.137068e+00
time4: 2.078988e+00
time5: 9.289941e+00
time6: 1.530912e+01
 =============> Iteration k : 56
time1: 4.753031e+00
time2: 9.364750e-01
time3: 1.094270e+00
time4: 1.857446e+00
time5: 8.490950e+00
time6: 1.640443e+01
 =============> Iteration k : 57
time1: 5.018288e+00
time2: 9.579470e-01
time3: 1.203699e+00
time4: 1.740096e+00
time5: 8.239559e+00
time6: 1.688564e+01
 =============> Iteration k : 58
time1: 4.492175e+00
time2: 8.940690e-01
time3: 1.200595e+00
time4: 1.602320e+00
time5: 8.367650e+00
time6: 1.661922e+01
 =============> Iteration k : 59
time1: 4.406551e+00
time2: 7.589980e-01
time3: 1.070561e+00
time4: 1.632474e+00
time5: 8.759497e+00
time6: 1.691266e+01
 =============> Shuffeling of batches for gradient ...
 =============> Iteration k : 60
time1: 3.971323e+00
time2: 9.069930e-01
time3: 7.101710e-01
time4: 1.770611e+00
time5: 8.495879e+00
time6: 1.710556e+01
 =============> Iteration k : 61
time1: 4.372963e+00
time2: 7.241850e-01
time3: 8.658920e-01
time4: 1.727792e+00
time5: 8.964710e+00
time6: 1.580040e+01
 =============> Iteration k : 62
time1: 4.373534e+00
time2: 9.127290e-01
time3: 1.021617e+00
time4: 1.825072e+00
time5: 8.822846e+00
time6: 1.655567e+01
 =============> Iteration k : 63
time1: 4.435367e+00
time2: 9.563050e-01
time3: 7.921220e-01
time4: 1.701341e+00
```

```
time5: 8.995501e+00
time6: 1.653776e+01
 =============> Iteration k : 64
time1: 4.447210e+00
time2: 8.836790e-01
time3: 1.072684e+00
time4: 1.929535e+00
time5: 9.425983e+00
time6: 1.668715e+01
 =============> Iteration k : 65
time1: 4.433094e+00
time2: 8.543790e-01
time3: 1.001659e+00
time4: 1.964753e+00
time5: 8.665605e+00
time6: 1.612656e+01
 =============> Iteration k : 66
time1: 4.555184e+00
time2: 8.002180e-01
time3: 1.094620e+00
time4: 1.711903e+00
time5: 8.573400e+00
time6: 1.689592e+01
 =============> Iteration k : 67
time1: 4.515342e+00
time2: 7.774340e-01
time3: 1.168113e+00
time4: 1.705772e+00
time5: 8.479664e+00
time6: 1.623176e+01
 =============> Iteration k : 68
time1: 4.483163e+00
time2: 1.069752e+00
time3: 1.007196e+00
time4: 2.119371e+00
time5: 8.557546e+00
time6: 1.711911e+01
 =============> Iteration k : 69
time1: 4.552658e+00
time2: 1.008894e+00
time3: 8.834430e-01
time4: 1.901107e+00
time5: 8.529363e+00
time6: 1.586841e+01
 =============> Iteration k : 70
time1: 4.562945e+00
time2: 8.234080e-01
time3: 9.113590e-01
time4: 1.690114e+00
time5: 8.678681e+00
time6: 1.701690e+01
 =============> Iteration k : 71
time1: 4.566477e+00
time2: 9.255020e-01
time3: 9.805730e-01
time4: 1.622707e+00
time5: 8.535829e+00
time6: 1.615824e+01
 =============> Iteration k : 72
time1: 4.396679e+00
time2: 8.099940e-01
time3: 1.083616e+00
time4: 1.738635e+00
time5: 8.531088e+00
```

```
time6: 1.652808e+01
 =============> Iteration k : 73
time1: 4.662038e+00
time2: 8.947710e-01
time3: 1.049783e+00
time4: 1.956874e+00
time5: 8.818556e+00
time6: 1.760556e+01
 =============> Iteration k : 74
time1: 4.397328e+00
time2: 1.171518e+00
time3: 9.334260e-01
time4: 1.554471e+00
time5: 8.765615e+00
time6: 1.688809e+01
 =============> Iteration k : 75
time1: 4.492468e+00
time2: 8.763990e-01
time3: 7.576170e-01
time4: 1.742877e+00
time5: 8.405141e+00
time6: 1.730271e+01
 =============> Iteration k : 76
time1: 3.956256e+00
time2: 1.048565e+00
time3: 7.511980e-01
time4: 1.715922e+00
time5: 8.687691e+00
time6: 1.699442e+01
 =============> Iteration k : 77
time1: 3.923831e+00
time2: 6.538430e-01
time3: 9.727230e-01
time4: 1.818053e+00
time5: 9.062437e+00
time6: 1.679866e+01
 =============> Iteration k : 78
time1: 4.394570e+00
time2: 7.730780e-01
time3: 9.159620e-01
time4: 1.666568e+00
time5: 9.533607e+00
time6: 1.526953e+01
 =============> Iteration k : 79
time1: 4.321352e+00
time2: 7.498110e-01
time3: 1.002570e+00
time4: 1.784307e+00
time5: 9.244348e+00
time6: 1.597651e+01
 =============> Iteration k : 80
time1: 3.913274e+00
time2: 9.384020e-01
time3: 1.056497e+00
time4: 1.743159e+00
time5: 9.477356e+00
time6: 1.538417e+01
 =============> Iteration k : 81
time1: 4.191266e+00
time2: 8.803720e-01
time3: 1.057436e+00
time4: 1.884650e+00
time5: 8.992823e+00
time6: 1.563613e+01
```

```
 =============> Iteration k : 82
time1: 4.681271e+00
time2: 1.225705e+00
time3: 1.277724e+00
time4: 1.803425e+00
time5: 9.106880e+00
time6: 1.617319e+01
 =============> Iteration k : 83
time1: 4.889961e+00
time2: 8.650160e-01
time3: 1.120629e+00
time4: 2.093217e+00
time5: 8.919040e+00
time6: 1.686443e+01
 =============> Iteration k : 84
time1: 5.078350e+00
time2: 8.230550e-01
time3: 1.002524e+00
time4: 1.591968e+00
time5: 8.165343e+00
time6: 1.669642e+01
 =============> Iteration k : 85
time1: 4.896726e+00
time2: 9.923860e-01
time3: 8.979140e-01
time4: 1.898115e+00
time5: 7.808329e+00
time6: 1.809339e+01
 =============> Iteration k : 86
time1: 2.891906e+00
time2: 3.066110e-01
time3: 6.420550e-01
time4: 1.059355e+00
time5: 6.098778e+00
time6: 1.074285e+01
 =============> Iteration k : 87
time1: 1.625719e+00
time2: 3.649720e-01
time3: 4.587410e-01
time4: 6.946100e-01
time5: 3.202940e+00
time6: 7.400246e+00
 =============> Iteration k : 88
time1: 1.546583e+00
time2: 3.703700e-01
time3: 4.647880e-01
time4: 6.088830e-01
time5: 3.179753e+00
time6: 7.200280e+00
 =============> Iteration k : 89
time1: 1.535640e+00
time2: 2.587260e-01
time3: 4.430720e-01
time4: 6.118720e-01
time5: 3.099136e+00
time6: 7.371272e+00
 =============> Iteration k : 90
time1: 1.597685e+00
time2: 2.755960e-01
time3: 4.553340e-01
time4: 6.127560e-01
time5: 3.136122e+00
time6: 7.115706e+00
 =============> Iteration k : 91
```

```
time1: 1.593881e+00
time2: 3.113090e-01
time3: 4.581190e-01
time4: 6.470490e-01
time5: 3.128435e+00
time6: 7.287020e+00
 ==============> Iteration k : 92
time1: 1.605630e+00
time2: 2.649720e-01
time3: 4.343520e-01
time4: 6.028530e-01
time5: 3.129700e+00
time6: 7.340972e+00
 ==============> Iteration k : 93
time1: 1.592015e+00
time2: 6.014050e-01
time3: 6.238800e-01
time4: 1.053115e+00
time5: 4.915042e+00
time6: 1.257935e+01
 ==============> Iteration k : 94
time1: 2.930800e+00
time2: 4.714430e-01
time3: 5.973830e-01
time4: 1.097184e+00
time5: 5.367794e+00
time6: 1.261112e+01
 ==============> Iteration k : 95
time1: 2.717859e+00
time2: 4.072940e-01
time3: 5.965240e-01
time4: 1.120036e+00
time5: 5.101210e+00
time6: 1.317086e+01
 ==============> Iteration k : 96
time1: 3.619865e+00
time2: 6.820050e-01
time3: 8.869870e-01
time4: 1.407771e+00
time5: 7.872751e+00
time6: 1.780576e+01
 ==============> Iteration k : 97
time1: 4.318954e+00
time2: 6.482670e-01
time3: 6.105610e-01
time4: 1.322055e+00
time5: 9.542753e+00
time6: 1.751590e+01
 ==============> Iteration k : 98
time1: 3.794104e+00
time2: 5.466170e-01
time3: 7.782460e-01
time4: 1.759615e+00
time5: 9.729731e+00
time6: 1.667157e+01
 ==============> Iteration k : 99
time1: 3.910811e+00
time2: 7.114840e-01
time3: 9.108800e-01
time4: 1.753329e+00
time5: 1.021651e+01
time6: 1.576778e+01
 ==============> Iteration k : 100
time1: 4.308097e+00
```

```
time2: 7.815540e-01
time3: 1.081949e+00
time4: 1.846682e+00
time5: 9.752881e+00
time6: 1.499197e+01
 ==============> Iteration k : 101
time1: 4.003882e+00
time2: 6.941980e-01
time3: 1.225276e+00
time4: 2.015503e+00
time5: 9.624463e+00
time6: 1.589558e+01
 ==============> Iteration k : 102
time1: 4.390282e+00
time2: 9.082040e-01
time3: 1.027741e+00
time4: 1.909566e+00
time5: 9.312721e+00
time6: 1.581842e+01
 ==============> Iteration k : 103
time1: 4.887496e+00
time2: 8.740710e-01
time3: 1.114725e+00
time4: 1.998546e+00
time5: 9.491583e+00
time6: 1.630328e+01
 ==============> Iteration k : 104
time1: 4.771707e+00
time2: 1.118601e+00
time3: 1.093171e+00
time4: 1.682121e+00
time5: 8.582785e+00
time6: 1.639930e+01
 ==============> Iteration k : 105
time1: 5.184886e+00
time2: 9.168680e-01
time3: 9.192200e-01
time4: 1.952767e+00
time5: 8.008568e+00
time6: 1.597650e+01
 ==============> Iteration k : 106
time1: 4.719080e+00
time2: 8.658690e-01
time3: 9.948780e-01
time4: 1.723749e+00
time5: 8.406628e+00
time6: 1.747662e+01
 ==============> Iteration k : 107
time1: 4.788386e+00
time2: 9.037310e-01
time3: 9.951190e-01
time4: 1.289096e+00
time5: 8.790847e+00
time6: 1.750221e+01
 ==============> Iteration k : 108
time1: 3.983435e+00
time2: 7.879630e-01
time3: 1.090476e+00
time4: 1.598966e+00
time5: 8.997769e+00
time6: 1.600435e+01
 ==============> Iteration k : 109
time1: 3.991797e+00
time2: 8.654030e-01
```

```
time3: 9.366440e-01
time4: 1.481570e+00
time5: 9.378071e+00
time6: 1.699508e+01
 ==============> Iteration k : 110
time1: 4.218644e+00
time2: 7.035340e-01
time3: 1.044092e+00
time4: 1.825597e+00
time5: 8.186982e+00
time6: 1.691553e+01
 ==============> Iteration k : 111
time1: 4.543395e+00
time2: 8.965000e-01
time3: 1.222482e+00
time4: 1.792706e+00
time5: 8.891011e+00
time6: 1.697924e+01
 ==============> Iteration k : 112
time1: 4.486928e+00
time2: 1.135930e+00
time3: 8.795080e-01
time4: 1.561668e+00
time5: 9.065029e+00
time6: 1.673698e+01
 ==============> Iteration k : 113
time1: 4.360155e+00
time2: 7.506350e-01
time3: 1.024822e+00
time4: 1.932132e+00
time5: 9.071922e+00
time6: 1.690452e+01
 ==============> Iteration k : 114
time1: 4.123742e+00
time2: 8.136530e-01
time3: 1.100670e+00
time4: 1.832486e+00
time5: 9.268948e+00
time6: 1.672020e+01
 ==============> Iteration k : 115
time1: 4.129417e+00
time2: 1.100021e+00
time3: 1.003983e+00
time4: 2.012841e+00
time5: 8.979933e+00
time6: 1.682196e+01
 ==============> Iteration k : 116
time1: 4.355438e+00
time2: 9.015320e-01
time3: 9.804940e-01
time4: 1.793215e+00
time5: 8.324927e+00
time6: 1.750020e+01
 ==============> Iteration k : 117
time1: 4.495703e+00
time2: 7.042420e-01
time3: 1.054740e+00
time4: 1.892502e+00
time5: 8.632040e+00
time6: 1.712245e+01
 ==============> Iteration k : 118
time1: 4.595864e+00
time2: 9.669970e-01
time3: 7.744260e-01
```

```
time4: 1.239826e+00
time5: 9.298886e+00
time6: 1.711008e+01
 =============> Iteration k : 119
time1: 4.540910e+00
time2: 7.560260e-01
time3: 1.006325e+00
time4: 1.816917e+00
time5: 9.179895e+00
time6: 1.647177e+01
 =============> Shuffeling of batches for gradient ...
 =============> Iteration k : 120
time1: 4.015326e+00
time2: 8.996990e-01
time3: 1.091041e+00
time4: 1.865179e+00
time5: 8.821819e+00
time6: 1.706129e+01
 =============> Iteration k : 121
time1: 4.610795e+00
time2: 1.103457e+00
time3: 1.248625e+00
time4: 1.994017e+00
time5: 9.503023e+00
time6: 1.789512e+01
 =============> Iteration k : 122
time1: 4.295281e+00
time2: 1.267719e+00
time3: 9.312840e-01
time4: 1.980019e+00
time5: 9.101200e+00
time6: 2.056264e+01
 =============> Iteration k : 123
time1: 6.331435e+00
time2: 1.433152e+00
time3: 1.117893e+00
time4: 2.346945e+00
time5: 1.192715e+01
time6: 2.214735e+01
 =============> Iteration k : 124
time1: 7.017868e+00
time2: 8.180040e-01
time3: 1.379775e+00
time4: 2.532082e+00
time5: 1.174549e+01
time6: 2.241699e+01
 =============> Iteration k : 125
time1: 5.311946e+00
time2: 1.287899e+00
time3: 1.461785e+00
time4: 1.996081e+00
time5: 1.191698e+01
time6: 2.179922e+01
 =============> Iteration k : 126
time1: 6.004348e+00
time2: 1.012803e+00
time3: 1.209844e+00
time4: 2.680645e+00
time5: 1.210328e+01
time6: 2.201583e+01
 =============> Iteration k : 127
time1: 5.677816e+00
time2: 1.611452e+00
time3: 1.495273e+00
```

```
time4: 2.511373e+00
time5: 1.281079e+01
time6: 2.189212e+01
 =============> Iteration k : 128
time1: 6.372593e+00
time2: 1.331298e+00
time3: 1.738252e+00
time4: 2.772603e+00
time5: 1.153172e+01
time6: 2.102451e+01
 =============> Iteration k : 129
time1: 6.956924e+00
time2: 1.335036e+00
time3: 1.856073e+00
time4: 2.554345e+00
time5: 1.282157e+01
time6: 2.177062e+01
 =============> Iteration k : 130
time1: 6.063820e+00
time2: 1.511414e+00
time3: 1.297691e+00
time4: 2.418785e+00
time5: 1.139652e+01
time6: 2.266730e+01
 =============> Iteration k : 131
time1: 5.985595e+00
time2: 1.434907e+00
time3: 1.140698e+00
time4: 2.398268e+00
time5: 1.100841e+01
time6: 2.271094e+01
 =============> Iteration k : 132
time1: 5.893910e+00
time2: 1.076717e+00
time3: 1.217373e+00
time4: 2.470166e+00
time5: 1.162946e+01
time6: 2.246567e+01
 =============> Iteration k : 133
time1: 5.905839e+00
time2: 1.610516e+00
time3: 9.945250e-01
time4: 1.799148e+00
time5: 1.341054e+01
time6: 2.291465e+01
 =============> Iteration k : 134
time1: 5.156167e+00
time2: 1.286205e+00
time3: 1.197308e+00
time4: 2.403452e+00
time5: 1.203096e+01
time6: 2.248014e+01
 =============> Iteration k : 135
time1: 5.724297e+00
time2: 1.303341e+00
time3: 1.479671e+00
time4: 2.317730e+00
time5: 1.322363e+01
time6: 2.201422e+01
 =============> Iteration k : 136
time1: 6.786697e+00
time2: 9.237900e-01
time3: 1.407965e+00
time4: 2.344452e+00
```

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time5: 1.337534e+01
time6: 1.986664e+01
 =============> Iteration k : 137
time1: 6.126121e+00
time2: 1.694525e+00
time3: 1.304470e+00
time4: 2.981427e+00
time5: 1.327483e+01
time6: 2.012588e+01
 =============> Iteration k : 138
time1: 6.846076e+00
time2: 1.304020e+00
time3: 1.299519e+00
time4: 3.008523e+00
time5: 1.216988e+01
time6: 2.043407e+01
 =============> Iteration k : 139
time1: 6.194656e+00
time2: 1.309131e+00
time3: 1.206903e+00
time4: 2.585458e+00
time5: 1.107707e+01
time6: 2.318785e+01
 =============> Iteration k : 140
time1: 6.405391e+00
time2: 1.486866e+00
time3: 1.199646e+00
time4: 2.476480e+00
time5: 1.009037e+01
time6: 2.412894e+01
 =============> Iteration k : 141
time1: 6.523468e+00
time2: 1.286802e+00
time3: 1.151009e+00
time4: 2.156011e+00
time5: 1.074167e+01
time6: 2.257544e+01
 =============> Iteration k : 142
time1: 5.808595e+00
time2: 1.213339e+00
time3: 8.398850e-01
time4: 2.253407e+00
time5: 1.216917e+01
time6: 2.240092e+01
 =============> Iteration k : 143
time1: 5.582337e+00
time2: 1.117853e+00
time3: 1.252029e+00
time4: 2.818920e+00
time5: 1.369805e+01
time6: 2.112244e+01
 =============> Iteration k : 144
time1: 6.157695e+00
time2: 1.331472e+00
time3: 1.762697e+00
time4: 2.285033e+00
time5: 1.250473e+01
time6: 2.120515e+01
 =============> Iteration k : 145
time1: 6.745228e+00
time2: 1.722276e+00
time3: 1.291213e+00
time4: 2.579065e+00
time5: 1.142853e+01
```

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time6: 2.063481e+01
 =============> Iteration k : 146
time1: 6.665157e+00
time2: 1.586836e+00
time3: 2.089191e+00
time4: 2.601889e+00
time5: 1.136956e+01
time6: 2.180256e+01
 =============> Iteration k : 147
time1: 6.878911e+00
time2: 1.320934e+00
time3: 1.368517e+00
time4: 2.222504e+00
time5: 1.257899e+01
time6: 2.156659e+01
 =============> Iteration k : 148
time1: 5.442820e+00
time2: 1.612562e+00
time3: 1.112356e+00
time4: 2.615769e+00
time5: 1.258309e+01
time6: 2.370415e+01
 =============> Iteration k : 149
time1: 6.090731e+00
time2: 1.426203e+00
time3: 1.610390e+00
time4: 2.342647e+00
time5: 1.182045e+01
time6: 2.229799e+01
 =============> Iteration k : 150
time1: 5.985426e+00
time2: 9.784480e-01
time3: 1.122813e+00
time4: 2.172863e+00
time5: 1.203883e+01
time6: 2.314017e+01
 =============> Iteration k : 151
time1: 5.718507e+00
time2: 1.597508e+00
time3: 1.409365e+00
time4: 2.396814e+00
time5: 1.270660e+01
time6: 2.282308e+01
 =============> Iteration k : 152
time1: 6.482000e+00
time2: 8.160820e-01
time3: 1.185316e+00
time4: 2.399705e+00
time5: 1.186307e+01
time6: 2.071695e+01
 =============> Iteration k : 153
time1: 5.618524e+00
time2: 1.806081e+00
time3: 1.704293e+00
time4: 2.492429e+00
time5: 1.269295e+01
time6: 2.149428e+01
 =============> Iteration k : 154
time1: 6.136254e+00
time2: 1.291368e+00
time3: 1.406088e+00
time4: 2.514568e+00
time5: 1.219069e+01
time6: 2.157352e+01
```

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 =============> Iteration k : 155
time1: 5.693767e+00
time2: 1.427604e+00
time3: 1.295038e+00
time4: 2.561836e+00
time5: 1.251840e+01
time6: 2.139199e+01
 =============> Iteration k : 156
time1: 5.969504e+00
time2: 1.112779e+00
time3: 1.192583e+00
time4: 2.598115e+00
time5: 1.169378e+01
time6: 2.228040e+01
 =============> Iteration k : 157
time1: 6.047116e+00
time2: 1.986446e+00
time3: 1.104598e+00
time4: 2.493050e+00
time5: 1.247791e+01
time6: 2.282847e+01
 =============> Iteration k : 158
time1: 5.993717e+00
time2: 1.871009e+00
time3: 1.333927e+00
time4: 1.915114e+00
time5: 1.131707e+01
time6: 2.210931e+01
 =============> Iteration k : 159
time1: 5.437814e+00
time2: 1.673405e+00
time3: 1.275060e+00
time4: 2.418162e+00
time5: 1.159451e+01
time6: 2.201535e+01
 =============> Iteration k : 160
time1: 5.572417e+00
time2: 1.302521e+00
time3: 1.296434e+00
time4: 2.201776e+00
time5: 1.206948e+01
time6: 2.199798e+01
 =============> Iteration k : 161
time1: 6.109330e+00
time2: 1.739481e+00
time3: 1.096273e+00
time4: 2.752868e+00
time5: 1.272705e+01
time6: 2.209706e+01
 =============> Iteration k : 162
time1: 5.698061e+00
time2: 1.401813e+00
time3: 1.100624e+00
time4: 2.801954e+00
time5: 1.220861e+01
time6: 2.129726e+01
 =============> Iteration k : 163
time1: 6.086309e+00
time2: 1.497076e+00
time3: 1.193500e+00
time4: 2.678501e+00
time5: 1.279644e+01
time6: 2.199784e+01
 =============> Iteration k : 164
```

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time1: 6.755079e+00
time2: 1.711803e+00
time3: 1.667417e+00
time4: 2.124872e+00
time5: 1.269595e+01
time6: 2.319307e+01
 ==============> Iteration k : 165
time1: 6.373452e+00
time2: 1.217143e+00
time3: 1.185940e+00
time4: 2.305686e+00
time5: 1.188812e+01
time6: 2.250388e+01
 ==============> Iteration k : 166
time1: 6.498399e+00
time2: 1.428993e+00
time3: 1.387851e+00
time4: 2.316752e+00
time5: 1.173738e+01
time6: 2.339486e+01
 ==============> Iteration k : 167
time1: 6.156865e+00
time2: 7.868510e-01
time3: 1.538747e+00
time4: 2.355751e+00
time5: 1.179548e+01
time6: 2.227811e+01
 ==============> Iteration k : 168
time1: 5.905181e+00
time2: 1.488735e+00
time3: 1.227021e+00
time4: 2.057973e+00
time5: 1.227788e+01
time6: 2.040104e+01
 ==============> Iteration k : 169
time1: 6.209686e+00
time2: 1.273850e+00
time3: 1.135751e+00
time4: 2.312005e+00
time5: 1.279980e+01
time6: 2.188655e+01
 ==============> Iteration k : 170
time1: 5.689329e+00
time2: 1.094576e+00
time3: 1.023139e+00
time4: 2.306544e+00
time5: 1.289316e+01
time6: 2.173209e+01
 ==============> Iteration k : 171
time1: 5.762253e+00
time2: 1.288116e+00
time3: 1.698666e+00
time4: 2.596229e+00
time5: 1.269682e+01
time6: 1.981758e+01
 ==============> Iteration k : 172
time1: 6.016854e+00
time2: 1.383346e+00
time3: 1.221245e+00
time4: 2.766273e+00
time5: 1.260620e+01
time6: 2.011589e+01
 ==============> Iteration k : 173
time1: 6.539609e+00
```

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time2: 1.752592e+00
time3: 1.331384e+00
time4: 2.705467e+00
time5: 1.173302e+01
time6: 2.138266e+01
 =============> Iteration k : 174
time1: 6.097804e+00
time2: 1.164719e+00
time3: 1.707177e+00
time4: 2.672970e+00
time5: 1.107916e+01
time6: 2.240026e+01
 =============> Iteration k : 175
time1: 6.287637e+00
time2: 1.388661e+00
time3: 1.195758e+00
time4: 2.226072e+00
time5: 1.223204e+01
time6: 2.389707e+01
 =============> Iteration k : 176
time1: 5.770743e+00
time2: 1.115481e+00
time3: 1.311398e+00
time4: 2.182441e+00
time5: 1.167813e+01
time6: 2.183336e+01
 =============> Iteration k : 177
time1: 6.298075e+00
time2: 1.625552e+00
time3: 1.115106e+00
time4: 2.479739e+00
time5: 1.220014e+01
time6: 2.189688e+01
 =============> Iteration k : 178
time1: 5.453375e+00
time2: 1.104776e+00
time3: 1.622908e+00
time4: 2.695145e+00
time5: 1.313096e+01
time6: 2.119569e+01
 =============> Iteration k : 179
time1: 5.867366e+00
time2: 2.013159e+00
time3: 1.173420e+00
time4: 2.417448e+00
time5: 1.255532e+01
time6: 2.011384e+01
 =============> Shuffeling of batches for gradient ...
 =============> Iteration k : 180
time1: 6.365214e+00
time2: 1.498521e+00
time3: 1.205870e+00
time4: 1.909844e+00
time5: 1.255810e+01
time6: 2.083633e+01
 =============> Iteration k : 181
time1: 6.703440e+00
time2: 1.313461e+00
time3: 1.678022e+00
time4: 2.308850e+00
time5: 1.178957e+01
time6: 2.069089e+01
 =============> Iteration k : 182
time1: 6.190696e+00
```

```
time2: 1.411283e+00
time3: 1.134536e+00
time4: 2.485324e+00
time5: 1.170273e+01
time6: 2.120149e+01
 =============> Iteration k : 183
time1: 5.975911e+00
time2: 1.085981e+00
time3: 1.282186e+00
time4: 2.530223e+00
time5: 1.178606e+01
time6: 2.217207e+01
 =============> Iteration k : 184
time1: 6.610754e+00
time2: 1.219473e+00
time3: 1.273163e+00
time4: 2.391419e+00
time5: 1.153083e+01
time6: 2.096149e+01
 =============> Iteration k : 185
time1: 5.399790e+00
time2: 1.502181e+00
time3: 1.158924e+00
time4: 2.453742e+00
time5: 1.267172e+01
time6: 2.054131e+01
 =============> Iteration k : 186
time1: 6.387636e+00
time2: 1.263551e+00
time3: 1.201476e+00
time4: 2.399859e+00
time5: 1.179579e+01
time6: 2.199783e+01
 =============> Iteration k : 187
time1: 6.416225e+00
time2: 1.249993e+00
time3: 1.615543e+00
time4: 2.215181e+00
time5: 1.157341e+01
time6: 2.089505e+01
 =============> Iteration k : 188
time1: 6.299244e+00
time2: 1.366976e+00
time3: 1.405974e+00
time4: 2.304477e+00
time5: 1.217214e+01
time6: 2.158029e+01
 =============> Iteration k : 189
time1: 6.471730e+00
time2: 1.598293e+00
time3: 1.406419e+00
time4: 2.619968e+00
time5: 1.124238e+01
time6: 1.936821e+01
 =============> Iteration k : 190
time1: 6.114468e+00
time2: 1.392245e+00
time3: 1.889143e+00
time4: 2.612561e+00
time5: 1.225147e+01
time6: 2.284597e+01
 =============> Iteration k : 191
time1: 6.227795e+00
time2: 1.084259e+00
```

```
time3: 1.516214e+00
time4: 2.394495e+00
time5: 1.209858e+01
time6: 2.169273e+01
 ==============> Iteration k : 192
time1: 5.906886e+00
time2: 1.307585e+00
time3: 1.191122e+00
time4: 2.394022e+00
time5: 1.126682e+01
time6: 2.321918e+01
 ==============> Iteration k : 193
time1: 6.490487e+00
time2: 7.192900e-01
time3: 1.310468e+00
time4: 1.670333e+00
time5: 1.141920e+01
time6: 2.240942e+01
 ==============> Iteration k : 194
time1: 5.526711e+00
time2: 9.846070e-01
time3: 1.317542e+00
time4: 1.878941e+00
time5: 1.251226e+01
time6: 2.255603e+01
 ==============> Iteration k : 195
time1: 4.932274e+00
time2: 1.311225e+00
time3: 1.109926e+00
time4: 2.112435e+00
time5: 1.306722e+01
time6: 2.188563e+01
 ==============> Iteration k : 196
time1: 5.405907e+00
time2: 1.881265e+00
time3: 1.104201e+00
time4: 2.604904e+00
time5: 1.354947e+01
time6: 1.939157e+01
 ==============> Iteration k : 197
time1: 5.759453e+00
time2: 1.685390e+00
time3: 1.386150e+00
time4: 2.787322e+00
time5: 1.268610e+01
time6: 1.952739e+01
 ==============> Iteration k : 198
time1: 6.674935e+00
time2: 2.072600e+00
time3: 1.691815e+00
time4: 2.592740e+00
time5: 1.248441e+01
time6: 1.901848e+01
 ==============> Iteration k : 199
time1: 6.592713e+00
time2: 1.567397e+00
time3: 1.107404e+00
time4: 2.477247e+00
time5: 1.253600e+01
time6: 2.015837e+01
 ==============> Iteration k : 200
time1: 6.377956e+00
time2: 1.281601e+00
time3: 1.226229e+00
```

```
time4: 2.484802e+00
time5: 1.246944e+01
time6: 2.150838e+01
 =============> Iteration k : 201
time1: 6.453870e+00
time2: 1.206667e+00
time3: 1.128413e+00
time4: 2.656049e+00
time5: 1.159093e+01
time6: 2.272940e+01
 =============> Iteration k : 202
time1: 6.611518e+00
time2: 1.572904e+00
time3: 1.186502e+00
time4: 2.308216e+00
time5: 1.067696e+01
time6: 2.482730e+01
 =============> Iteration k : 203
time1: 5.769769e+00
time2: 1.220586e+00
time3: 9.173800e-01
time4: 2.325541e+00
time5: 1.099430e+01
time6: 2.320065e+01
 =============> Iteration k : 204
time1: 5.645548e+00
time2: 1.163847e+00
time3: 8.240080e-01
time4: 2.107055e+00
time5: 1.387502e+01
time6: 2.187941e+01
 =============> Iteration k : 205
time1: 4.511747e+00
time2: 1.274671e+00
time3: 1.090261e+00
time4: 2.696833e+00
time5: 1.283193e+01
time6: 2.029118e+01
 =============> Iteration k : 206
time1: 5.434373e+00
time2: 1.514367e+00
time3: 1.282528e+00
time4: 2.796765e+00
time5: 1.281004e+01
time6: 2.148414e+01
 =============> Iteration k : 207
time1: 6.397979e+00
time2: 1.698745e+00
time3: 1.245226e+00
time4: 2.731704e+00
time5: 1.279925e+01
time6: 2.176451e+01
 =============> Iteration k : 208
time1: 7.031667e+00
time2: 1.664569e+00
time3: 1.384987e+00
time4: 2.624328e+00
time5: 1.175765e+01
time6: 2.069913e+01
 =============> Iteration k : 209
time1: 5.898751e+00
time2: 1.418344e+00
time3: 1.454400e+00
time4: 2.453130e+00
```

```
time5: 1.104494e+01
time6: 2.136947e+01
 =============> Iteration k : 210
time1: 6.286971e+00
time2: 1.196539e+00
time3: 1.197476e+00
time4: 2.672714e+00
time5: 1.123485e+01
time6: 2.328251e+01
 =============> Iteration k : 211
time1: 6.293146e+00
time2: 1.466097e+00
time3: 1.624209e+00
time4: 1.673487e+00
time5: 1.192496e+01
time6: 2.269016e+01
 =============> Iteration k : 212
time1: 5.748816e+00
time2: 6.442790e-01
time3: 1.226326e+00
time4: 2.301570e+00
time5: 1.306007e+01
time6: 2.148966e+01
 =============> Iteration k : 213
time1: 4.985948e+00
time2: 1.003257e+00
time3: 1.206011e+00
time4: 2.485520e+00
time5: 1.200229e+01
time6: 2.231527e+01
 =============> Iteration k : 214
time1: 5.640641e+00
time2: 1.410719e+00
time3: 1.195140e+00
time4: 2.288182e+00
time5: 1.164090e+01
time6: 2.071088e+01
 =============> Iteration k : 215
time1: 6.404222e+00
time2: 1.505211e+00
time3: 1.398196e+00
time4: 2.278992e+00
time5: 1.280310e+01
time6: 2.030912e+01
 =============> Iteration k : 216
time1: 6.004062e+00
time2: 1.201199e+00
time3: 1.788680e+00
time4: 2.520485e+00
time5: 1.326868e+01
time6: 2.168965e+01
 =============> Iteration k : 217
time1: 5.413425e+00
time2: 1.166550e+00
time3: 1.738246e+00
time4: 2.852815e+00
time5: 1.229479e+01
time6: 2.082329e+01
 =============> Iteration k : 218
time1: 6.051023e+00
time2: 1.014074e+00
time3: 1.296279e+00
time4: 2.457802e+00
time5: 1.170975e+01
```

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time6: 2.259266e+01
 =============> Iteration k : 219
time1: 6.173063e+00
time2: 1.227910e+00
time3: 1.349577e+00
time4: 2.009476e+00
time5: 1.170173e+01
time6: 2.308615e+01
 =============> Iteration k : 220
time1: 6.323651e+00
time2: 1.026393e+00
time3: 1.312785e+00
time4: 2.285350e+00
time5: 1.331215e+01
time6: 2.207505e+01
 =============> Iteration k : 221
time1: 6.881625e+00
time2: 1.282462e+00
time3: 1.443430e+00
time4: 2.320822e+00
time5: 1.251346e+01
time6: 2.168565e+01
 =============> Iteration k : 222
time1: 5.589182e+00
time2: 1.649779e+00
time3: 1.663919e+00
time4: 2.519384e+00
time5: 1.193639e+01
time6: 2.104016e+01
 =============> Iteration k : 223
time1: 6.710999e+00
time2: 1.319184e+00
time3: 1.207991e+00
time4: 2.585850e+00
time5: 1.228877e+01
time6: 2.052491e+01
 =============> Iteration k : 224
time1: 6.574842e+00
time2: 1.308393e+00
time3: 2.367859e+00
time4: 2.690891e+00
time5: 1.201169e+01
time6: 2.056886e+01
 =============> Iteration k : 225
time1: 6.305626e+00
time2: 1.426871e+00
time3: 1.175323e+00
time4: 2.401851e+00
time5: 1.148574e+01
time6: 2.259310e+01
 =============> Iteration k : 226
time1: 5.899425e+00
time2: 1.050879e+00
time3: 1.362086e+00
time4: 2.525590e+00
time5: 1.225568e+01
time6: 2.152196e+01
 =============> Iteration k : 227
time1: 6.255746e+00
time2: 1.019340e+00
time3: 1.177428e+00
time4: 2.287543e+00
time5: 1.119021e+01
time6: 2.203701e+01
```

```
 =============> Iteration k : 228
time1: 6.113832e+00
time2: 9.422300e-01
time3: 1.484456e+00
time4: 2.363914e+00
time5: 1.209307e+01
time6: 2.313645e+01
 =============> Iteration k : 229
time1: 5.327551e+00
time2: 1.082395e+00
time3: 1.088539e+00
time4: 2.392977e+00
time5: 1.378500e+01
time6: 2.061089e+01
 =============> Iteration k : 230
time1: 6.292849e+00
time2: 1.487669e+00
time3: 1.417080e+00
time4: 2.598548e+00
time5: 1.378680e+01
time6: 1.937360e+01
 =============> Iteration k : 231
time1: 5.898248e+00
time2: 1.420351e+00
time3: 2.271301e+00
time4: 2.712194e+00
time5: 1.285050e+01
time6: 1.950044e+01
 =============> Iteration k : 232
time1: 6.584241e+00
time2: 1.518466e+00
time3: 1.374235e+00
time4: 2.313655e+00
time5: 1.240608e+01
time6: 1.909164e+01
 =============> Iteration k : 233
time1: 6.912510e+00
time2: 1.590458e+00
time3: 1.104639e+00
time4: 2.517462e+00
time5: 1.214660e+01
time6: 2.220763e+01
 =============> Iteration k : 234
time1: 6.549293e+00
time2: 1.139181e+00
time3: 1.262840e+00
time4: 2.309963e+00
time5: 1.119473e+01
time6: 2.209678e+01
 =============> Iteration k : 235
time1: 6.789949e+00
time2: 1.425825e+00
time3: 1.277534e+00
time4: 2.366561e+00
time5: 1.040022e+01
time6: 2.371168e+01
 =============> Iteration k : 236
time1: 5.876775e+00
time2: 1.021380e+00
time3: 1.366568e+00
time4: 2.428494e+00
time5: 1.025528e+01
time6: 2.202381e+01
 =============> Iteration k : 237
```

```
time1: 5.839396e+00
time2: 1.201557e+00
time3: 9.813220e-01
time4: 2.029607e+00
time5: 1.132963e+01
time6: 2.228860e+01
 ==============> Iteration k : 238
time1: 5.128683e+00
time2: 1.170281e+00
time3: 1.112471e+00
time4: 2.003705e+00
time5: 1.208699e+01
time6: 2.112368e+01
 ==============> Iteration k : 239
time1: 4.815147e+00
time2: 1.365106e+00
time3: 1.098407e+00
time4: 2.327343e+00
time5: 1.303791e+01
time6: 2.168076e+01
 ==============> Shuffeling of batches for gradient ...
 ==============> Iteration k : 240
time1: 5.860474e+00
time2: 1.220977e+00
time3: 1.280802e+00
time4: 2.633179e+00
time5: 1.198073e+01
time6: 2.076582e+01
 ==============> Iteration k : 241
time1: 5.615403e+00
time2: 1.101877e+00
time3: 1.231678e+00
time4: 2.969803e+00
time5: 1.192619e+01
time6: 2.010263e+01
 ==============> Iteration k : 242
time1: 6.486780e+00
time2: 1.603105e+00
time3: 1.117140e+00
time4: 2.401876e+00
time5: 1.275920e+01
time6: 2.092960e+01
 ==============> Iteration k : 243
time1: 7.049895e+00
time2: 1.405856e+00
time3: 1.183236e+00
time4: 2.719079e+00
time5: 1.207985e+01
time6: 2.210572e+01
 ==============> Iteration k : 244
time1: 6.178803e+00
time2: 1.182357e+00
time3: 1.343394e+00
time4: 2.294034e+00
time5: 1.134478e+01
time6: 2.348772e+01
 ==============> Iteration k : 245
time1: 5.695349e+00
time2: 1.147613e+00
time3: 1.135048e+00
time4: 2.271224e+00
time5: 1.171368e+01
time6: 2.225803e+01
 ==============> Iteration k : 246
```

```
time1: 5.617344e+00
time2: 1.060711e+00
time3: 1.247732e+00
time4: 2.070919e+00
time5: 1.177110e+01
time6: 2.289908e+01
 ==============> Iteration k : 247
time1: 6.410838e+00
time2: 9.625380e-01
time3: 1.175819e+00
time4: 2.323908e+00
time5: 1.256938e+01
time6: 2.138781e+01
 ==============> Iteration k : 248
time1: 5.494177e+00
time2: 1.200907e+00
time3: 1.590771e+00
time4: 2.704882e+00
time5: 1.180044e+01
time6: 2.110505e+01
 ==============> Iteration k : 249
time1: 6.684890e+00
time2: 1.763924e+00
time3: 1.521499e+00
time4: 2.582824e+00
time5: 1.201186e+01
time6: 2.176530e+01
 ==============> Iteration k : 250
time1: 6.399586e+00
time2: 1.601497e+00
time3: 1.783355e+00
time4: 2.569720e+00
time5: 1.302581e+01
time6: 2.288358e+01
 ==============> Iteration k : 251
time1: 6.599311e+00
time2: 9.678970e-01
time3: 1.182295e+00
time4: 2.208340e+00
time5: 1.180645e+01
time6: 2.349951e+01
 ==============> Iteration k : 252
time1: 5.682681e+00
time2: 1.260098e+00
time3: 1.410651e+00
time4: 2.302319e+00
time5: 1.210453e+01
time6: 2.254050e+01
 ==============> Iteration k : 253
time1: 5.893032e+00
time2: 8.690840e-01
time3: 1.089909e+00
time4: 2.419649e+00
time5: 1.260110e+01
time6: 2.329908e+01
 ==============> Iteration k : 254
time1: 6.009261e+00
time2: 1.205027e+00
time3: 1.470491e+00
time4: 2.431415e+00
time5: 1.247533e+01
time6: 2.030240e+01
 ==============> Iteration k : 255
time1: 6.211145e+00
```

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time2: 1.518284e+00
time3: 1.779862e+00
time4: 2.344802e+00
time5: 1.259970e+01
time6: 2.049694e+01
 ==============> Iteration k : 256
time1: 6.620744e+00
time2: 2.120555e+00
time3: 2.205140e+00
time4: 2.616990e+00
time5: 1.200868e+01
time6: 1.957938e+01
 ==============> Iteration k : 257
time1: 6.613483e+00
time2: 1.970294e+00
time3: 1.637921e+00
time4: 2.449523e+00
time5: 1.113504e+01
time6: 2.099903e+01
 ==============> Iteration k : 258
time1: 6.385818e+00
time2: 1.217609e+00
time3: 1.508995e+00
time4: 2.354629e+00
time5: 1.093654e+01
time6: 2.207396e+01
 ==============> Iteration k : 259
time1: 6.411158e+00
time2: 1.829719e+00
time3: 1.186867e+00
time4: 2.185275e+00
time5: 1.088490e+01
time6: 2.450545e+01
 ==============> Iteration k : 260
time1: 5.966787e+00
time2: 1.296052e+00
time3: 9.450600e-01
time4: 1.696185e+00
time5: 1.214373e+01
time6: 2.362814e+01
 ==============> Iteration k : 261
time1: 5.421072e+00
time2: 1.234574e+00
time3: 1.118537e+00
time4: 1.895730e+00
time5: 1.476218e+01
time6: 2.057446e+01
 ==============> Iteration k : 262
time1: 5.321167e+00
time2: 9.030030e-01
time3: 1.358349e+00
time4: 2.531916e+00
time5: 1.309439e+01
time6: 2.187827e+01
 ==============> Iteration k : 263
time1: 5.981344e+00
time2: 1.482422e+00
time3: 1.225858e+00
time4: 2.789854e+00
time5: 1.309951e+01
time6: 2.021103e+01
 ==============> Iteration k : 264
time1: 6.558509e+00
time2: 2.067737e+00
```

```
time3: 2.012314e+00
time4: 2.792788e+00
time5: 1.159276e+01
time6: 2.050762e+01
 ==============> Iteration k : 265
time1: 7.109283e+00
time2: 1.632646e+00
time3: 1.590006e+00
time4: 2.768614e+00
time5: 1.142714e+01
time6: 2.320871e+01
 ==============> Iteration k : 266
time1: 5.899743e+00
time2: 1.490331e+00
time3: 1.314887e+00
time4: 2.720460e+00
time5: 1.094943e+01
time6: 2.187029e+01
 ==============> Iteration k : 267
time1: 7.197441e+00
time2: 1.433816e+00
time3: 1.360101e+00
time4: 2.237153e+00
time5: 1.107582e+01
time6: 2.218762e+01
 ==============> Iteration k : 268
time1: 6.289107e+00
time2: 9.941240e-01
time3: 1.029009e+00
time4: 2.345316e+00
time5: 1.119582e+01
time6: 2.219401e+01
 ==============> Iteration k : 269
time1: 5.349204e+00
time2: 1.228504e+00
time3: 1.205114e+00
time4: 2.055905e+00
time5: 1.259801e+01
time6: 2.232978e+01
 ==============> Iteration k : 270
time1: 5.337848e+00
time2: 1.241202e+00
time3: 1.521851e+00
time4: 2.291821e+00
time5: 1.218696e+01
time6: 2.079859e+01
 ==============> Iteration k : 271
time1: 5.566134e+00
time2: 1.496804e+00
time3: 1.108515e+00
time4: 2.708030e+00
time5: 1.248395e+01
time6: 2.196498e+01
 ==============> Iteration k : 272
time1: 5.832042e+00
time2: 1.442221e+00
time3: 1.266799e+00
time4: 2.499510e+00
time5: 1.281971e+01
time6: 2.058446e+01
 ==============> Iteration k : 273
time1: 5.561942e+00
time2: 1.483184e+00
time3: 1.707837e+00
```

```
time4: 2.413807e+00
time5: 1.178418e+01
time6: 2.206543e+01
 =============> Iteration k : 274
time1: 6.030258e+00
time2: 1.592138e+00
time3: 1.487359e+00
time4: 2.423658e+00
time5: 1.196322e+01
time6: 2.200882e+01
 =============> Iteration k : 275
time1: 5.790130e+00
time2: 1.491920e+00
time3: 1.113384e+00
time4: 2.496001e+00
time5: 1.160840e+01
time6: 2.154265e+01
 =============> Iteration k : 276
time1: 6.512959e+00
time2: 1.177939e+00
time3: 1.088942e+00
time4: 2.223069e+00
time5: 1.192571e+01
time6: 2.144019e+01
 =============> Iteration k : 277
time1: 6.109929e+00
time2: 9.208290e-01
time3: 1.005271e+00
time4: 2.346769e+00
time5: 1.218796e+01
time6: 2.141008e+01
 =============> Iteration k : 278
time1: 5.810803e+00
time2: 1.391685e+00
time3: 1.432155e+00
time4: 2.799756e+00
time5: 1.303171e+01
time6: 2.084328e+01
 =============> Iteration k : 279
time1: 7.288711e+00
time2: 1.692304e+00
time3: 1.517530e+00
time4: 2.804783e+00
time5: 1.172407e+01
time6: 1.967377e+01
 =============> Iteration k : 280
time1: 6.507613e+00
time2: 1.663475e+00
time3: 2.034686e+00
time4: 2.963944e+00
time5: 1.219538e+01
time6: 1.933716e+01
 =============> Iteration k : 281
time1: 7.158267e+00
time2: 1.393983e+00
time3: 1.098358e+00
time4: 2.195086e+00
time5: 1.166332e+01
time6: 2.060979e+01
 =============> Iteration k : 282
time1: 6.894026e+00
time2: 1.572349e+00
time3: 1.908140e+00
time4: 2.706459e+00
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time5: 1.096915e+01
time6: 2.301844e+01
 =============> Iteration k : 283
time1: 5.975179e+00
time2: 1.304044e+00
time3: 1.175879e+00
time4: 2.501021e+00
time5: 1.081711e+01
time6: 2.388388e+01
 =============> Iteration k : 284
time1: 6.267737e+00
time2: 1.231076e+00
time3: 7.882290e-01
time4: 1.911798e+00
time5: 1.211284e+01
time6: 2.196551e+01
 =============> Iteration k : 285
time1: 5.076787e+00
time2: 1.307787e+00
time3: 9.273520e-01
time4: 2.398456e+00
time5: 1.354632e+01
time6: 2.202186e+01
 =============> Iteration k : 286
time1: 4.685889e+00
time2: 1.365350e+00
time3: 1.414400e+00
time4: 2.318456e+00
time5: 1.282981e+01
time6: 2.050015e+01
 =============> Iteration k : 287
time1: 6.374399e+00
time2: 1.374922e+00
time3: 1.524207e+00
time4: 2.376506e+00
time5: 1.292105e+01
time6: 1.979596e+01
 =============> Iteration k : 288
time1: 6.032817e+00
time2: 1.755164e+00
time3: 1.389779e+00
time4: 2.798111e+00
time5: 1.293135e+01
time6: 2.085265e+01
 =============> Iteration k : 289
time1: 6.491748e+00
time2: 1.774640e+00
time3: 1.034918e+00
time4: 2.275324e+00
time5: 1.199267e+01
time6: 2.161583e+01
 =============> Iteration k : 290
time1: 5.735257e+00
time2: 1.409836e+00
time3: 1.179425e+00
time4: 2.497627e+00
time5: 1.139791e+01
time6: 2.103043e+01
 =============> Iteration k : 291
time1: 6.077250e+00
time2: 1.676529e+00
time3: 1.529591e+00
time4: 2.814111e+00
time5: 1.079158e+01
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time6: 2.268802e+01
 =============> Iteration k : 292
time1: 5.916071e+00
time2: 8.727900e-01
time3: 1.104530e+00
time4: 2.203922e+00
time5: 1.099376e+01
time6: 2.186149e+01
 =============> Iteration k : 293
time1: 5.928442e+00
time2: 1.234983e+00
time3: 1.314779e+00
time4: 1.931853e+00
time5: 1.111126e+01
time6: 2.139825e+01
 =============> Iteration k : 294
time1: 5.834990e+00
time2: 9.707490e-01
time3: 1.510861e+00
time4: 1.875552e+00
time5: 1.142841e+01
time6: 2.296272e+01
 =============> Iteration k : 295
time1: 5.822957e+00
time2: 7.944250e-01
time3: 1.375390e+00
time4: 2.408475e+00
time5: 1.289565e+01
time6: 2.068305e+01
 =============> Iteration k : 296
time1: 5.588475e+00
time2: 1.169829e+00
time3: 1.298216e+00
time4: 2.087018e+00
time5: 1.264338e+01
time6: 2.069110e+01
 =============> Iteration k : 297
time1: 6.276562e+00
time2: 1.315293e+00
time3: 1.208783e+00
time4: 2.811791e+00
time5: 1.265101e+01
time6: 2.172329e+01
 =============> Iteration k : 298
time1: 5.871891e+00
time2: 1.318359e+00
time3: 1.489045e+00
time4: 2.575302e+00
time5: 1.270904e+01
time6: 2.091274e+01
 =============> Iteration k : 299
time1: 6.570780e+00
time2: 1.275242e+00
time3: 1.304087e+00
time4: 2.516920e+00
time5: 1.138389e+01
time6: 2.110981e+01
 =============> Shuffeling of batches for gradient ...
 =============> Iteration k : 300
time1: 5.961427e+00
time2: 1.584320e+00
time3: 1.302006e+00
time4: 2.511430e+00
time5: 1.180373e+01
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time6: 2.169036e+01
 =============> Iteration k : 301
time1: 6.801905e+00
time2: 1.306273e+00
time3: 1.787807e+00
time4: 2.612064e+00
time5: 1.199832e+01
time6: 2.139172e+01
 =============> Iteration k : 302
time1: 6.262396e+00
time2: 9.882620e-01
time3: 1.643634e+00
time4: 2.485792e+00
time5: 1.254912e+01
time6: 2.250210e+01
 =============> Iteration k : 303
time1: 6.214112e+00
time2: 1.367523e+00
time3: 2.166396e+00
time4: 2.518256e+00
time5: 1.299241e+01
time6: 2.220499e+01
 =============> Iteration k : 304
time1: 5.938556e+00
time2: 9.788210e-01
time3: 1.361183e+00
time4: 2.299130e+00
time5: 1.188919e+01
time6: 2.197627e+01
 =============> Iteration k : 305
time1: 5.414452e+00
time2: 1.271751e+00
time3: 1.183845e+00
time4: 2.689575e+00
time5: 1.302562e+01
time6: 2.134223e+01
 =============> Iteration k : 306
time1: 5.714959e+00
time2: 1.310688e+00
time3: 1.203504e+00
time4: 2.526672e+00
time5: 1.178135e+01
time6: 2.230067e+01
 =============> Iteration k : 307
time1: 6.388752e+00
time2: 1.407309e+00
time3: 1.287915e+00
time4: 2.272044e+00
time5: 1.182175e+01
time6: 2.185048e+01
 =============> Iteration k : 308
time1: 6.620828e+00
time2: 8.951810e-01
time3: 1.002957e+00
time4: 1.880957e+00
time5: 1.280849e+01
time6: 2.267986e+01
 =============> Iteration k : 309
time1: 5.657962e+00
time2: 1.113420e+00
time3: 1.895947e+00
time4: 2.415175e+00
time5: 1.299076e+01
time6: 2.189084e+01
```

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 =============> Iteration k : 310
time1: 5.282190e+00
time2: 1.171367e+00
time3: 1.219479e+00
time4: 2.390844e+00
time5: 1.238287e+01
time6: 2.140026e+01
 =============> Iteration k : 311
time1: 5.860451e+00
time2: 1.516892e+00
time3: 1.282447e+00
time4: 2.828430e+00
time5: 1.280591e+01
time6: 2.002832e+01
 =============> Iteration k : 312
time1: 6.873621e+00
time2: 1.469810e+00
time3: 1.414102e+00
time4: 2.301643e+00
time5: 1.247362e+01
time6: 2.108708e+01
 =============> Iteration k : 313
time1: 5.828458e+00
time2: 1.046045e+00
time3: 1.196840e+00
time4: 2.576396e+00
time5: 1.188741e+01
time6: 2.241239e+01
 =============> Iteration k : 314
time1: 5.878572e+00
time2: 1.269403e+00
time3: 1.312699e+00
time4: 2.320540e+00
time5: 1.209794e+01
time6: 2.059289e+01
 =============> Iteration k : 315
time1: 6.284939e+00
time2: 1.314451e+00
time3: 1.483985e+00
time4: 2.590666e+00
time5: 1.180053e+01
time6: 2.101381e+01
 =============> Iteration k : 316
time1: 6.134852e+00
time2: 1.105044e+00
time3: 1.290419e+00
time4: 2.396535e+00
time5: 1.089109e+01
time6: 2.044217e+01
 =============> Iteration k : 317
time1: 5.889200e+00
time2: 1.452994e+00
time3: 1.405460e+00
time4: 2.191295e+00
time5: 1.222349e+01
time6: 2.186938e+01
 =============> Iteration k : 318
time1: 5.826346e+00
time2: 1.536856e+00
time3: 1.432087e+00
time4: 2.797796e+00
time5: 1.210362e+01
time6: 2.316031e+01
 =============> Iteration k : 319
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time1: 5.681706e+00
time2: 1.296532e+00
time3: 1.309626e+00
time4: 2.686868e+00
time5: 1.198567e+01
time6: 2.219894e+01
 ==============> Iteration k : 320
time1: 6.025317e+00
time2: 1.253225e+00
time3: 1.199234e+00
time4: 1.821797e+00
time5: 1.249750e+01
time6: 2.130003e+01
 ==============> Iteration k : 321
time1: 5.871248e+00
time2: 1.193134e+00
time3: 1.281120e+00
time4: 2.488930e+00
time5: 1.162176e+01
time6: 2.276853e+01
 ==============> Iteration k : 322
time1: 5.895419e+00
time2: 1.225803e+00
time3: 1.298505e+00
time4: 2.205391e+00
time5: 1.250928e+01
time6: 2.110958e+01
 ==============> Iteration k : 323
time1: 5.093128e+00
time2: 1.080073e+00
time3: 1.402882e+00
time4: 2.378662e+00
time5: 1.239903e+01
time6: 2.358838e+01
 ==============> Iteration k : 324
time1: 5.904557e+00
time2: 1.191814e+00
time3: 1.162669e+00
time4: 2.441828e+00
time5: 1.256245e+01
time6: 2.172041e+01
 ==============> Iteration k : 325
time1: 5.874009e+00
time2: 1.809485e+00
time3: 1.215636e+00
time4: 2.901179e+00
time5: 1.345370e+01
time6: 2.151798e+01
 ==============> Iteration k : 326
time1: 6.696912e+00
time2: 1.481197e+00
time3: 1.776318e+00
time4: 2.914346e+00
time5: 1.150626e+01
time6: 2.040052e+01
 ==============> Iteration k : 327
time1: 6.439114e+00
time2: 1.602509e+00
time3: 1.084663e+00
time4: 2.775353e+00
time5: 1.201439e+01
time6: 2.108040e+01
 ==============> Iteration k : 328
time1: 6.011117e+00
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time2: 1.531679e+00
time3: 1.087105e+00
time4: 2.314597e+00
time5: 1.147875e+01
time6: 2.161626e+01
 =============> Iteration k : 329
time1: 6.730003e+00
time2: 1.205971e+00
time3: 1.220244e+00
time4: 2.479731e+00
time5: 1.160445e+01
time6: 2.148000e+01
 =============> Iteration k : 330
time1: 5.929715e+00
time2: 1.852563e+00
time3: 1.265607e+00
time4: 2.375044e+00
time5: 1.178701e+01
time6: 2.232005e+01
 =============> Iteration k : 331
time1: 5.966291e+00
time2: 1.230345e+00
time3: 1.068465e+00
time4: 2.626627e+00
time5: 1.190002e+01
time6: 2.232040e+01
 =============> Iteration k : 332
time1: 5.901713e+00
time2: 9.355730e-01
time3: 1.099348e+00
time4: 2.864816e+00
time5: 1.253334e+01
time6: 2.185893e+01
 =============> Iteration k : 333
time1: 6.312046e+00
time2: 1.149776e+00
time3: 1.089789e+00
time4: 2.601457e+00
time5: 1.334290e+01
time6: 2.165634e+01
 =============> Iteration k : 334
time1: 6.106107e+00
time2: 1.573494e+00
time3: 1.034564e+00
time4: 2.312132e+00
time5: 1.281827e+01
time6: 2.229324e+01
 =============> Iteration k : 335
time1: 5.773920e+00
time2: 1.612741e+00
time3: 1.164075e+00
time4: 2.588561e+00
time5: 1.252986e+01
time6: 2.182859e+01
 =============> Iteration k : 336
time1: 6.391396e+00
time2: 1.601779e+00
time3: 1.262628e+00
time4: 2.637213e+00
time5: 1.115106e+01
time6: 2.132123e+01
 =============> Iteration k : 337
time1: 6.015144e+00
time2: 2.022373e+00
```

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time3: 1.282617e+00
time4: 2.121976e+00
time5: 1.128861e+01
time6: 2.129580e+01
 ==============> Iteration k : 338
time1: 6.589884e+00
time2: 1.362582e+00
time3: 1.096041e+00
time4: 2.522679e+00
time5: 1.159528e+01
time6: 2.178545e+01
 ==============> Iteration k : 339
time1: 5.602403e+00
time2: 1.380330e+00
time3: 1.286354e+00
time4: 2.127994e+00
time5: 1.278383e+01
time6: 2.178954e+01
 ==============> Iteration k : 340
time1: 5.665832e+00
time2: 1.205454e+00
time3: 1.233382e+00
time4: 2.469872e+00
time5: 1.279562e+01
time6: 2.021104e+01
 ==============> Iteration k : 341
time1: 5.985298e+00
time2: 1.592960e+00
time3: 1.324450e+00
time4: 2.674295e+00
time5: 1.198297e+01
time6: 2.080899e+01
 ==============> Iteration k : 342
time1: 6.259870e+00
time2: 1.417660e+00
time3: 1.392312e+00
time4: 2.592618e+00
time5: 1.180639e+01
time6: 2.337511e+01
 ==============> Iteration k : 343
time1: 6.093050e+00
time2: 1.119393e+00
time3: 1.585733e+00
time4: 2.695699e+00
time5: 1.205524e+01
time6: 2.171435e+01
 ==============> Iteration k : 344
time1: 6.259056e+00
time2: 9.462780e-01
time3: 9.261020e-01
time4: 1.415033e+00
time5: 9.244659e+00
time6: 1.559319e+01
 ==============> Iteration k : 345
time1: 4.688922e+00
time2: 6.928370e-01
time3: 7.985080e-01
time4: 1.727932e+00
time5: 9.000217e+00
time6: 1.726152e+01
 ==============> Iteration k : 346
time1: 4.105662e+00
time2: 1.066930e+00
time3: 7.285060e-01
```

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time4: 1.716366e+00
time5: 8.863407e+00
time6: 1.734873e+01
 =============> Iteration k : 347
time1: 3.783044e+00
time2: 7.466620e-01
time3: 9.195960e-01
time4: 1.880359e+00
time5: 8.833445e+00
time6: 1.660446e+01
 =============> Iteration k : 348
time1: 4.132062e+00
time2: 7.547010e-01
time3: 6.207580e-01
time4: 1.581420e+00
time5: 9.586649e+00
time6: 1.703518e+01
 =============> Iteration k : 349
time1: 3.860121e+00
time2: 8.895540e-01
time3: 1.015932e+00
time4: 1.914396e+00
time5: 9.577993e+00
time6: 1.480779e+01
 =============> Iteration k : 350
time1: 4.487588e+00
time2: 8.638810e-01
time3: 1.100754e+00
time4: 1.821393e+00
time5: 9.473635e+00
time6: 1.521747e+01
 =============> Iteration k : 351
time1: 4.987578e+00
time2: 1.215213e+00
time3: 9.026180e-01
time4: 1.986092e+00
time5: 9.103487e+00
time6: 1.609808e+01
 =============> Iteration k : 352
time1: 4.602207e+00
time2: 1.217256e+00
time3: 9.186050e-01
time4: 1.979856e+00
time5: 8.978418e+00
time6: 1.593166e+01
 =============> Iteration k : 353
time1: 4.548350e+00
time2: 9.134340e-01
time3: 9.991990e-01
time4: 1.869668e+00
time5: 8.510492e+00
time6: 1.612879e+01
 =============> Iteration k : 354
time1: 4.697299e+00
time2: 1.011836e+00
time3: 1.013887e+00
time4: 1.744146e+00
time5: 7.651620e+00
time6: 1.782153e+01
 =============> Iteration k : 355
time1: 4.482920e+00
time2: 6.072170e-01
time3: 1.057265e+00
time4: 1.745469e+00
```

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time5: 8.087629e+00
time6: 1.745545e+01
 =============> Iteration k : 356
time1: 4.223643e+00
time2: 7.756150e-01
time3: 5.421500e-01
time4: 1.487832e+00
time5: 8.133456e+00
time6: 1.679208e+01
 =============> Iteration k : 357
time1: 4.100888e+00
time2: 5.118430e-01
time3: 9.128700e-01
time4: 1.541377e+00
time5: 8.689971e+00
time6: 1.710401e+01
 =============> Iteration k : 358
time1: 3.952881e+00
time2: 6.466440e-01
time3: 7.839470e-01
time4: 1.659552e+00
time5: 9.414358e+00
time6: 1.601008e+01
 =============> Iteration k : 359
time1: 4.341308e+00
time2: 6.115660e-01
time3: 1.211371e+00
time4: 1.872293e+00
time5: 9.826270e+00
time6: 1.616361e+01
 =============> Shuffeling of batches for gradient ...
 =============> Iteration k : 360
time1: 4.193121e+00
time2: 9.210750e-01
time3: 1.002461e+00
time4: 1.771065e+00
time5: 9.393154e+00
time6: 1.586639e+01
 =============> Iteration k : 361
time1: 4.185521e+00
time2: 8.144060e-01
time3: 9.310090e-01
time4: 1.942585e+00
time5: 9.039943e+00
time6: 1.505549e+01
 =============> Iteration k : 362
time1: 4.608584e+00
time2: 8.619250e-01
time3: 1.053326e+00
time4: 1.727833e+00
time5: 8.607649e+00
time6: 1.670237e+01
 =============> Iteration k : 363
time1: 4.332675e+00
time2: 1.145096e+00
time3: 8.932060e-01
time4: 1.773858e+00
time5: 8.319635e+00
time6: 1.545821e+01
 =============> Iteration k : 364
time1: 4.213591e+00
time2: 9.066610e-01
time3: 1.049385e+00
time4: 1.826294e+00
```

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time5: 8.794467e+00
time6: 1.658902e+01
 =============> Iteration k : 365
time1: 4.486023e+00
time2: 8.690710e-01
time3: 8.447520e-01
time4: 1.774492e+00
time5: 8.997951e+00
time6: 1.596511e+01
 =============> Iteration k : 366
time1: 4.268459e+00
time2: 1.119290e+00
time3: 9.174240e-01
time4: 1.753765e+00
time5: 9.776493e+00
time6: 1.601208e+01
 =============> Iteration k : 367
time1: 4.001361e+00
time2: 8.659520e-01
time3: 9.979370e-01
time4: 1.938535e+00
time5: 8.864861e+00
time6: 1.550769e+01
 =============> Iteration k : 368
time1: 4.562935e+00
time2: 9.919950e-01
time3: 1.130286e+00
time4: 2.068024e+00
time5: 9.081705e+00
time6: 1.572427e+01
 =============> Iteration k : 369
time1: 4.692500e+00
time2: 9.074150e-01
time3: 1.094046e+00
time4: 1.871796e+00
time5: 8.616534e+00
time6: 1.556795e+01
 =============> Iteration k : 370
time1: 4.765321e+00
time2: 8.975450e-01
time3: 1.033332e+00
time4: 1.789580e+00
time5: 7.895751e+00
time6: 1.699279e+01
 =============> Iteration k : 371
time1: 5.063342e+00
time2: 1.086859e+00
time3: 1.110822e+00
time4: 1.631009e+00
time5: 7.848397e+00
time6: 1.751171e+01
 =============> Iteration k : 372
time1: 4.363393e+00
time2: 9.322980e-01
time3: 9.808270e-01
time4: 1.771780e+00
time5: 7.510645e+00
time6: 1.750234e+01
 =============> Iteration k : 373
time1: 4.394046e+00
time2: 8.877970e-01
time3: 7.072480e-01
time4: 8.027500e-01
time5: 8.496036e+00
```

```
time6: 1.787990e+01
 =============> Iteration k : 374
time1: 4.088231e+00
time2: 5.299960e-01
time3: 6.797190e-01
time4: 1.870884e+00
time5: 9.486286e+00
time6: 1.694090e+01
 =============> Iteration k : 375
time1: 3.375277e+00
time2: 7.739830e-01
time3: 8.287780e-01
time4: 1.774941e+00
time5: 9.707266e+00
time6: 1.597444e+01
 =============> Iteration k : 376
time1: 3.992844e+00
time2: 9.676650e-01
time3: 1.334193e+00
time4: 1.862189e+00
time5: 9.390171e+00
time6: 1.541645e+01
 =============> Iteration k : 377
time1: 4.305947e+00
time2: 1.092297e+00
time3: 1.160990e+00
time4: 1.802689e+00
time5: 9.380467e+00
time6: 1.521668e+01
 =============> Iteration k : 378
time1: 4.457840e+00
time2: 1.031592e+00
time3: 1.091295e+00
time4: 1.613706e+00
time5: 9.685287e+00
time6: 1.550400e+01
 =============> Iteration k : 379
time1: 4.604076e+00
time2: 1.193201e+00
time3: 1.033774e+00
time4: 2.171604e+00
time5: 8.079600e+00
time6: 1.660119e+01
 =============> Iteration k : 380
time1: 4.615141e+00
time2: 8.480970e-01
time3: 9.415840e-01
time4: 1.789702e+00
time5: 8.051018e+00
time6: 1.722180e+01
 =============> Iteration k : 381
time1: 4.516813e+00
time2: 7.936440e-01
time3: 9.778080e-01
time4: 1.874891e+00
time5: 8.176969e+00
time6: 1.692312e+01
 =============> Iteration k : 382
time1: 4.513093e+00
time2: 6.942470e-01
time3: 9.566550e-01
time4: 1.783577e+00
time5: 7.817093e+00
time6: 1.648732e+01
```

```
 =============> Iteration k : 383
time1: 3.922273e+00
time2: 7.991510e-01
time3: 1.000294e+00
time4: 1.833609e+00
time5: 8.891355e+00
time6: 1.540681e+01
 =============> Iteration k : 384
time1: 4.369764e+00
time2: 9.160990e-01
time3: 1.062298e+00
time4: 1.944837e+00
time5: 9.196929e+00
time6: 1.602839e+01
 =============> Iteration k : 385
time1: 4.511961e+00
time2: 8.753300e-01
time3: 1.034437e+00
time4: 1.728997e+00
time5: 8.889912e+00
time6: 1.578545e+01
 =============> Iteration k : 386
time1: 4.788262e+00
time2: 8.956100e-01
time3: 9.753730e-01
time4: 1.732944e+00
time5: 8.462165e+00
time6: 1.599229e+01
 =============> Iteration k : 387
time1: 4.820454e+00
time2: 1.037966e+00
time3: 1.126579e+00
time4: 1.878868e+00
time5: 8.503535e+00
time6: 1.791969e+01
 =============> Iteration k : 388
time1: 4.323295e+00
time2: 7.968760e-01
time3: 1.072328e+00
time4: 1.798930e+00
time5: 7.997341e+00
time6: 1.630032e+01
 =============> Iteration k : 389
time1: 4.392261e+00
time2: 6.172220e-01
time3: 9.803500e-01
time4: 1.374611e+00
time5: 7.943094e+00
time6: 1.786755e+01
 =============> Iteration k : 390
time1: 4.210735e+00
time2: 6.567220e-01
time3: 6.414380e-01
time4: 1.202494e+00
time5: 9.428098e+00
time6: 1.653389e+01
 =============> Iteration k : 391
time1: 3.413863e+00
time2: 4.914480e-01
time3: 9.632880e-01
time4: 1.608727e+00
time5: 9.858683e+00
time6: 1.639168e+01
 =============> Iteration k : 392
```

```
time1: 3.245618e+00
time2: 7.496470e-01
time3: 9.671080e-01
time4: 1.787028e+00
time5: 9.689649e+00
time6: 1.463934e+01
 ==============> Iteration k : 393
time1: 3.910276e+00
time2: 8.889440e-01
time3: 1.110061e+00
time4: 1.814233e+00
time5: 9.386232e+00
time6: 1.508077e+01
 ==============> Iteration k : 394
time1: 4.193727e+00
time2: 8.810700e-01
time3: 1.096359e+00
time4: 1.924647e+00
time5: 9.993220e+00
time6: 1.529293e+01
 ==============> Iteration k : 395
time1: 4.690883e+00
time2: 1.141670e+00
time3: 1.311333e+00
time4: 1.830936e+00
time5: 8.947738e+00
time6: 1.445236e+01
 ==============> Iteration k : 396
time1: 4.633774e+00
time2: 1.287317e+00
time3: 1.017170e+00
time4: 2.025906e+00
time5: 9.596547e+00
time6: 1.548644e+01
 ==============> Iteration k : 397
time1: 4.676033e+00
time2: 8.153240e-01
time3: 1.048989e+00
time4: 1.883716e+00
time5: 8.292663e+00
time6: 1.608128e+01
 ==============> Iteration k : 398
time1: 4.906805e+00
time2: 9.856550e-01
time3: 1.075817e+00
time4: 1.904514e+00
time5: 7.626474e+00
time6: 1.738821e+01
 ==============> Iteration k : 399
time1: 4.360731e+00
time2: 9.018360e-01
time3: 1.074181e+00
time4: 1.798370e+00
time5: 8.115170e+00
time6: 1.640514e+01
 ==============> Iteration k : 400
time1: 4.399618e+00
time2: 1.059447e+00
time3: 1.306699e+00
time4: 1.117791e+00
time5: 8.859690e+00
time6: 1.710375e+01
 ==============> Iteration k : 401
time1: 4.280662e+00
```

```
time2: 4.345170e-01
time3: 1.051071e+00
time4: 1.702943e+00
time5: 8.808710e+00
time6: 1.679939e+01
 =============> Iteration k : 402
time1: 3.778304e+00
time2: 7.256840e-01
time3: 9.767870e-01
time4: 1.977550e+00
time5: 8.526723e+00
time6: 1.688987e+01
 =============> Iteration k : 403
time1: 4.262759e+00
time2: 9.865030e-01
time3: 1.007056e+00
time4: 1.533941e+00
time5: 9.293736e+00
time6: 1.617956e+01
 =============> Iteration k : 404
time1: 4.482010e+00
time2: 6.605680e-01
time3: 1.133649e+00
time4: 1.771752e+00
time5: 9.442308e+00
time6: 1.530918e+01
 =============> Iteration k : 405
time1: 4.585437e+00
time2: 1.011174e+00
time3: 9.856080e-01
time4: 1.710574e+00
time5: 9.254529e+00
time6: 1.563283e+01
 =============> Iteration k : 406
time1: 4.247721e+00
time2: 9.888180e-01
time3: 1.110297e+00
time4: 1.927028e+00
time5: 8.846433e+00
time6: 1.670809e+01
 =============> Iteration k : 407
time1: 4.419499e+00
time2: 8.360710e-01
time3: 8.605230e-01
time4: 1.829890e+00
time5: 8.396743e+00
time6: 1.612593e+01
 =============> Iteration k : 408
time1: 4.266924e+00
time2: 1.027694e+00
time3: 1.063127e+00
time4: 1.731141e+00
time5: 8.644206e+00
time6: 1.682494e+01
 =============> Iteration k : 409
time1: 4.779327e+00
time2: 9.878530e-01
time3: 8.275080e-01
time4: 1.326094e+00
time5: 9.159266e+00
time6: 1.581475e+01
 =============> Iteration k : 410
time1: 4.132688e+00
time2: 8.827910e-01
```

```
time3: 9.319680e-01
time4: 1.902955e+00
time5: 8.869206e+00
time6: 1.630939e+01
 ==============> Iteration k : 411
time1: 4.185918e+00
time2: 9.121180e-01
time3: 9.746080e-01
time4: 1.892350e+00
time5: 8.826075e+00
time6: 1.591816e+01
 ==============> Iteration k : 412
time1: 4.568245e+00
time2: 8.206450e-01
time3: 1.087594e+00
time4: 1.707278e+00
time5: 9.285029e+00
time6: 1.529635e+01
 ==============> Iteration k : 413
time1: 4.787242e+00
time2: 1.076103e+00
time3: 1.116791e+00
time4: 1.821935e+00
time5: 8.870520e+00
time6: 1.577436e+01
 ==============> Iteration k : 414
time1: 4.792954e+00
time2: 9.970310e-01
time3: 1.096981e+00
time4: 1.503909e+00
time5: 8.598933e+00
time6: 1.667941e+01
 ==============> Iteration k : 415
time1: 4.795985e+00
time2: 8.087810e-01
time3: 1.006855e+00
time4: 1.868011e+00
time5: 7.876939e+00
time6: 1.591174e+01
 ==============> Iteration k : 416
time1: 4.699569e+00
time2: 6.861170e-01
time3: 1.195153e+00
time4: 1.776929e+00
time5: 7.689824e+00
time6: 1.640265e+01
 ==============> Iteration k : 417
time1: 4.480317e+00
time2: 7.924540e-01
time3: 1.017636e+00
time4: 1.684397e+00
time5: 7.614234e+00
time6: 1.765769e+01
 ==============> Iteration k : 418
time1: 4.222491e+00
time2: 7.656950e-01
time3: 8.924410e-01
time4: 1.399969e+00
time5: 7.979344e+00
time6: 1.661276e+01
 ==============> Iteration k : 419
time1: 4.392743e+00
time2: 5.870070e-01
time3: 5.687780e-01
```

```
time4: 1.065483e+00
time5: 8.868124e+00
time6: 1.739450e+01
 =============> Shuffeling of batches for gradient ...
 =============> Iteration k : 420
time1: 3.659835e+00
time2: 3.582990e-01
time3: 1.043014e+00
time4: 1.601898e+00
time5: 8.810738e+00
time6: 1.580302e+01
 =============> Iteration k : 421
time1: 3.187148e+00
time2: 8.855560e-01
time3: 8.762220e-01
time4: 1.709530e+00
time5: 9.240559e+00
time6: 1.602498e+01
 =============> Iteration k : 422
time1: 3.840408e+00
time2: 7.067980e-01
time3: 1.117423e+00
time4: 1.878203e+00
time5: 9.318142e+00
time6: 1.551221e+01
 =============> Iteration k : 423
time1: 3.978446e+00
time2: 9.900340e-01
time3: 1.076925e+00
time4: 1.725106e+00
time5: 9.751968e+00
time6: 1.441293e+01
 =============> Iteration k : 424
time1: 4.287287e+00
time2: 9.870850e-01
time3: 1.021348e+00
time4: 2.157837e+00
time5: 9.741560e+00
time6: 1.598774e+01
 =============> Iteration k : 425
time1: 4.967872e+00
time2: 1.099192e+00
time3: 1.224137e+00
time4: 2.074592e+00
time5: 9.184534e+00
time6: 1.520501e+01
 =============> Iteration k : 426
time1: 4.800559e+00
time2: 8.956390e-01
time3: 1.001218e+00
time4: 1.719147e+00
time5: 8.383694e+00
time6: 1.507498e+01
 =============> Iteration k : 427
time1: 5.005738e+00
time2: 1.100121e+00
time3: 1.023412e+00
time4: 1.668942e+00
time5: 8.311097e+00
time6: 1.557054e+01
 =============> Iteration k : 428
time1: 4.816554e+00
time2: 1.007408e+00
time3: 1.090905e+00
```

```
time4: 1.703407e+00
time5: 8.379853e+00
time6: 1.653863e+01
 =============> Iteration k : 429
time1: 4.482422e+00
time2: 9.614530e-01
time3: 1.037784e+00
time4: 1.495690e+00
time5: 8.176696e+00
time6: 1.669815e+01
 =============> Iteration k : 430
time1: 4.294885e+00
time2: 8.219490e-01
time3: 1.060055e+00
time4: 1.829885e+00
time5: 8.732905e+00
time6: 1.577223e+01
 =============> Iteration k : 431
time1: 4.205330e+00
time2: 9.072100e-01
time3: 1.073800e+00
time4: 1.796028e+00
time5: 8.600792e+00
time6: 1.617472e+01
 =============> Iteration k : 432
time1: 4.106812e+00
time2: 9.069760e-01
time3: 1.045782e+00
time4: 1.722343e+00
time5: 8.594403e+00
time6: 1.570264e+01
 =============> Iteration k : 433
time1: 4.515623e+00
time2: 8.892030e-01
time3: 1.237560e+00
time4: 1.695081e+00
time5: 8.487832e+00
time6: 1.625790e+01
 =============> Iteration k : 434
time1: 4.345008e+00
time2: 9.043340e-01
time3: 9.374110e-01
time4: 1.850836e+00
time5: 8.286490e+00
time6: 1.691138e+01
 =============> Iteration k : 435
time1: 4.607616e+00
time2: 7.915170e-01
time3: 1.092986e+00
time4: 1.688171e+00
time5: 8.481042e+00
time6: 1.612069e+01
 =============> Iteration k : 436
time1: 4.572564e+00
time2: 8.866240e-01
time3: 1.088943e+00
time4: 1.402556e+00
time5: 9.171768e+00
time6: 1.651485e+01
 =============> Iteration k : 437
time1: 4.474726e+00
time2: 7.046770e-01
time3: 1.006425e+00
time4: 1.853843e+00
```

```
time5: 8.753120e+00
time6: 1.678165e+01
 =============> Iteration k : 438
time1: 4.081065e+00
time2: 1.051113e+00
time3: 6.263180e-01
time4: 1.711146e+00
time5: 8.677839e+00
time6: 1.610632e+01
 =============> Iteration k : 439
time1: 3.691761e+00
time2: 9.484470e-01
time3: 9.141980e-01
time4: 1.879383e+00
time5: 8.841396e+00
time6: 1.633942e+01
 =============> Iteration k : 440
time1: 4.490052e+00
time2: 8.934200e-01
time3: 1.044907e+00
time4: 1.433546e+00
time5: 9.663954e+00
time6: 1.571820e+01
 =============> Iteration k : 441
time1: 4.633179e+00
time2: 1.015007e+00
time3: 9.803180e-01
time4: 1.815879e+00
time5: 9.502386e+00
time6: 1.588725e+01
 =============> Iteration k : 442
time1: 4.125877e+00
time2: 7.510470e-01
time3: 1.008450e+00
time4: 1.903835e+00
time5: 9.698320e+00
time6: 1.561086e+01
 =============> Iteration k : 443
time1: 4.573943e+00
time2: 9.624300e-01
time3: 1.105948e+00
time4: 1.900154e+00
time5: 8.918072e+00
time6: 1.587431e+01
 =============> Iteration k : 444
time1: 4.796489e+00
time2: 1.399441e+00
time3: 1.605363e+00
time4: 2.077555e+00
time5: 8.707121e+00
time6: 1.628663e+01
 =============> Iteration k : 445
time1: 4.566331e+00
time2: 1.094935e+00
time3: 1.222203e+00
time4: 1.503410e+00
time5: 8.062221e+00
time6: 1.571518e+01
 =============> Iteration k : 446
time1: 4.610455e+00
time2: 1.101778e+00
time3: 8.527530e-01
time4: 1.746140e+00
time5: 7.493955e+00
```

```
time6: 1.658590e+01
 =============> Iteration k : 447
time1: 4.290166e+00
time2: 7.979470e-01
time3: 1.314744e+00
time4: 1.821352e+00
time5: 7.528877e+00
time6: 1.688915e+01
 =============> Iteration k : 448
time1: 4.310535e+00
time2: 7.085200e-01
time3: 1.020593e+00
time4: 1.795409e+00
time5: 7.683529e+00
time6: 1.610894e+01
 =============> Iteration k : 449
time1: 3.758481e+00
time2: 8.924200e-01
time3: 9.766350e-01
time4: 1.305272e+00
time5: 7.934281e+00
time6: 1.718320e+01
 =============> Iteration k : 450
time1: 4.175442e+00
time2: 6.292810e-01
time3: 6.807090e-01
time4: 1.295032e+00
time5: 8.852726e+00
time6: 1.621223e+01
 =============> Iteration k : 451
time1: 3.886360e+00
time2: 7.078220e-01
time3: 6.719290e-01
time4: 1.525227e+00
time5: 9.186853e+00
time6: 1.602459e+01
 =============> Iteration k : 452
time1: 3.888089e+00
time2: 5.241780e-01
time3: 1.092862e+00
time4: 1.808252e+00
time5: 9.879929e+00
time6: 1.620016e+01
 =============> Iteration k : 453
time1: 4.204641e+00
time2: 6.431530e-01
time3: 1.076114e+00
time4: 1.800309e+00
time5: 9.494368e+00
time6: 1.491549e+01
 =============> Iteration k : 454
time1: 4.798285e+00
time2: 9.509140e-01
time3: 1.011514e+00
time4: 1.918319e+00
time5: 9.093495e+00
time6: 1.606294e+01
 =============> Iteration k : 455
time1: 4.580940e+00
time2: 9.322940e-01
time3: 1.004943e+00
time4: 1.918615e+00
time5: 9.416941e+00
time6: 1.578844e+01
```

```
 =============> Iteration k : 456
time1: 4.900941e+00
time2: 8.924490e-01
time3: 1.098436e+00
time4: 1.787048e+00
time5: 8.500662e+00
time6: 1.706006e+01
 =============> Iteration k : 457
time1: 4.719509e+00
time2: 8.595500e-01
time3: 1.206469e+00
time4: 1.825310e+00
time5: 8.276750e+00
time6: 1.702302e+01
 =============> Iteration k : 458
time1: 4.713048e+00
time2: 1.084185e+00
time3: 8.966170e-01
time4: 1.429318e+00
time5: 8.798390e+00
time6: 1.656969e+01
 =============> Iteration k : 459
time1: 4.265659e+00
time2: 8.199350e-01
time3: 1.041465e+00
time4: 1.767809e+00
time5: 9.414727e+00
time6: 1.528041e+01
 =============> Iteration k : 460
time1: 3.920399e+00
time2: 8.866620e-01
time3: 1.085035e+00
time4: 1.502745e+00
time5: 8.863111e+00
time6: 1.603863e+01
 =============> Iteration k : 461
time1: 4.340962e+00
time2: 9.397320e-01
time3: 1.170735e+00
time4: 1.585513e+00
time5: 8.679571e+00
time6: 1.619709e+01
 =============> Iteration k : 462
time1: 4.535838e+00
time2: 8.098540e-01
time3: 8.856240e-01
time4: 1.816510e+00
time5: 8.570936e+00
time6: 1.544368e+01
 =============> Iteration k : 463
time1: 4.391197e+00
time2: 7.531620e-01
time3: 1.009433e+00
time4: 1.843100e+00
time5: 8.823681e+00
time6: 1.677771e+01
 =============> Iteration k : 464
time1: 4.396146e+00
time2: 9.921830e-01
time3: 1.093891e+00
time4: 1.819679e+00
time5: 8.774000e+00
time6: 1.691796e+01
 =============> Iteration k : 465
```

```
time1: 4.553996e+00
time2: 8.826190e-01
time3: 1.155531e+00
time4: 1.406782e+00
time5: 8.104006e+00
time6: 1.691578e+01
 ==============> Iteration k : 466
time1: 4.500612e+00
time2: 6.966560e-01
time3: 6.658310e-01
time4: 1.775010e+00
time5: 9.117108e+00
time6: 1.570923e+01
 ==============> Iteration k : 467
time1: 4.219458e+00
time2: 5.026970e-01
time3: 8.401820e-01
time4: 1.155860e+00
time5: 8.931216e+00
time6: 1.705809e+01
 ==============> Iteration k : 468
time1: 3.414301e+00
time2: 8.028210e-01
time3: 9.860100e-01
time4: 1.776508e+00
time5: 9.588548e+00
time6: 1.622395e+01
 ==============> Iteration k : 469
time1: 3.177553e+00
time2: 6.740890e-01
time3: 9.100070e-01
time4: 1.788473e+00
time5: 9.882439e+00
time6: 1.553483e+01
 ==============> Iteration k : 470
time1: 4.543970e+00
time2: 1.029101e+00
time3: 1.375170e+00
time4: 2.093226e+00
time5: 9.703324e+00
time6: 1.447006e+01
 ==============> Iteration k : 471
time1: 4.613734e+00
time2: 1.215347e+00
time3: 1.050892e+00
time4: 1.753463e+00
time5: 9.155171e+00
time6: 1.427171e+01
 ==============> Iteration k : 472
time1: 4.568070e+00
time2: 1.399604e+00
time3: 1.311451e+00
time4: 2.005423e+00
time5: 9.357192e+00
time6: 1.480302e+01
 ==============> Iteration k : 473
time1: 5.221102e+00
time2: 1.056044e+00
time3: 9.885820e-01
time4: 2.000774e+00
time5: 8.617499e+00
time6: 1.607605e+01
 ==============> Iteration k : 474
time1: 4.783123e+00
```

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time2: 1.096641e+00
time3: 9.240660e-01
time4: 1.709620e+00
time5: 8.280228e+00
time6: 1.536397e+01
 =============> Iteration k : 475
time1: 4.721726e+00
time2: 1.243477e+00
time3: 1.182259e+00
time4: 1.815275e+00
time5: 8.095197e+00
time6: 1.625549e+01
 =============> Iteration k : 476
time1: 4.686798e+00
time2: 8.277970e-01
time3: 9.944670e-01
time4: 1.862691e+00
time5: 7.701198e+00
time6: 1.730056e+01
 =============> Iteration k : 477
time1: 4.405443e+00
time2: 9.564230e-01
time3: 9.536680e-01
time4: 1.094241e+00
time5: 8.361026e+00
time6: 1.713312e+01
 =============> Iteration k : 478
time1: 4.372338e+00
time2: 3.976000e-01
time3: 9.253220e-01
time4: 1.776839e+00
time5: 8.518398e+00
time6: 1.698119e+01
 =============> Iteration k : 479
time1: 3.777892e+00
time2: 5.873220e-01
time3: 1.010560e+00
time4: 1.847042e+00
time5: 9.317678e+00
time6: 1.580575e+01
 =============> Shuffeling of batches for gradient ...
 =============> Iteration k : 480
time1: 3.493423e+00
time2: 8.505490e-01
time3: 1.029749e+00
time4: 1.718821e+00
time5: 8.438022e+00
time6: 1.534795e+01
 =============> Iteration k : 481
time1: 4.267414e+00
time2: 6.842500e-01
time3: 9.930910e-01
time4: 1.589436e+00
time5: 8.588848e+00
time6: 1.612491e+01
 =============> Iteration k : 482
time1: 4.581680e+00
time2: 7.708330e-01
time3: 9.370030e-01
time4: 2.057959e+00
time5: 9.516462e+00
time6: 1.660220e+01
 =============> Iteration k : 483
time1: 4.284501e+00
```

```
time2: 9.380740e-01
time3: 9.162500e-01
time4: 1.722969e+00
time5: 9.013398e+00
time6: 1.679003e+01
 =============> Iteration k : 484
time1: 4.410512e+00
time2: 9.090480e-01
time3: 9.904110e-01
time4: 1.941166e+00
time5: 9.094043e+00
time6: 1.614728e+01
 =============> Iteration k : 485
time1: 4.539442e+00
time2: 1.037902e+00
time3: 7.959940e-01
time4: 1.799897e+00
time5: 8.955963e+00
time6: 1.673806e+01
 =============> Iteration k : 486
time1: 4.424932e+00
time2: 7.711680e-01
time3: 9.394370e-01
time4: 1.792759e+00
time5: 8.484899e+00
time6: 1.669701e+01
 =============> Iteration k : 487
time1: 4.682089e+00
time2: 8.006020e-01
time3: 8.944490e-01
time4: 1.313614e+00
time5: 8.870869e+00
time6: 1.548815e+01
 =============> Iteration k : 488
time1: 4.590772e+00
time2: 8.123160e-01
time3: 8.160920e-01
time4: 1.791176e+00
time5: 8.711802e+00
time6: 1.698218e+01
 =============> Iteration k : 489
time1: 3.891575e+00
time2: 7.432360e-01
time3: 9.717210e-01
time4: 1.610116e+00
time5: 8.475910e+00
time6: 1.626825e+01
 =============> Iteration k : 490
time1: 4.585978e+00
time2: 6.623510e-01
time3: 1.219038e+00
time4: 1.889764e+00
time5: 8.429241e+00
time6: 1.669862e+01
 =============> Iteration k : 491
time1: 4.745695e+00
time2: 8.417340e-01
time3: 1.047935e+00
time4: 1.904412e+00
time5: 8.489641e+00
time6: 1.682267e+01
 =============> Iteration k : 492
time1: 4.402172e+00
time2: 9.500460e-01
```

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time3: 1.013446e+00
time4: 1.385268e+00
time5: 8.805357e+00
time6: 1.732696e+01
 ==============> Iteration k : 493
time1: 4.607553e+00
time2: 5.171310e-01
time3: 1.069649e+00
time4: 1.732479e+00
time5: 8.345830e+00
time6: 1.691691e+01
 ==============> Iteration k : 494
time1: 3.969575e+00
time2: 8.257870e-01
time3: 8.611450e-01
time4: 1.803162e+00
time5: 8.714096e+00
time6: 1.650040e+01
 ==============> Iteration k : 495
time1: 3.992404e+00
time2: 7.619220e-01
time3: 1.096110e+00
time4: 1.503188e+00
time5: 8.878788e+00
time6: 1.614763e+01
 ==============> Iteration k : 496
time1: 4.454358e+00
time2: 6.071180e-01
time3: 1.049900e+00
time4: 1.756582e+00
time5: 9.643681e+00
time6: 1.516870e+01
 ==============> Iteration k : 497
time1: 4.331358e+00
time2: 8.478480e-01
time3: 1.197496e+00
time4: 1.690431e+00
time5: 9.293467e+00
time6: 1.572655e+01
 ==============> Iteration k : 498
time1: 4.697887e+00
time2: 1.010726e+00
time3: 1.373248e+00
time4: 1.746861e+00
time5: 9.178230e+00
time6: 1.549869e+01
 ==============> Iteration k : 499
time1: 4.974548e+00
time2: 1.209620e+00
time3: 1.075616e+00
time4: 1.987603e+00
time5: 8.912692e+00
time6: 1.579947e+01
 ==============> Iteration k : 500
time1: 4.549411e+00
time2: 1.129305e+00
time3: 1.120165e+00
time4: 1.927788e+00
time5: 7.984522e+00
time6: 1.732112e+01
 ==============> Iteration k : 501
time1: 4.678105e+00
time2: 8.074430e-01
time3: 8.745910e-01
```

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time4: 1.683703e+00
time5: 7.394924e+00
time6: 1.782157e+01
 =============> Iteration k : 502
time1: 4.388774e+00
time2: 6.179710e-01
time3: 1.074954e+00
time4: 1.703199e+00
time5: 7.500045e+00
time6: 1.695323e+01
 =============> Iteration k : 503
time1: 4.001915e+00
time2: 8.004700e-01
time3: 9.276100e-01
time4: 1.096720e+00
time5: 8.742916e+00
time6: 1.629539e+01
 =============> Iteration k : 504
time1: 4.225395e+00
time2: 6.711000e-01
time3: 7.223490e-01
time4: 1.281402e+00
time5: 8.900518e+00
time6: 1.646218e+01
 =============> Iteration k : 505
time1: 3.886961e+00
time2: 4.546580e-01
time3: 7.336850e-01
time4: 1.839881e+00
time5: 9.504474e+00
time6: 1.542290e+01
 =============> Iteration k : 506
time1: 4.079602e+00
time2: 9.145000e-01
time3: 1.174176e+00
time4: 1.989230e+00
time5: 9.613938e+00
time6: 1.567958e+01
 =============> Iteration k : 507
time1: 4.121790e+00
time2: 9.913490e-01
time3: 9.706410e-01
time4: 1.886992e+00
time5: 9.213449e+00
time6: 1.562056e+01
 =============> Iteration k : 508
time1: 4.479290e+00
time2: 9.881130e-01
time3: 1.114567e+00
time4: 1.704616e+00
time5: 8.732222e+00
time6: 1.566617e+01
 =============> Iteration k : 509
time1: 4.575128e+00
time2: 1.015877e+00
time3: 1.137314e+00
time4: 1.848154e+00
time5: 8.429138e+00
time6: 1.673610e+01
 =============> Iteration k : 510
time1: 4.827473e+00
time2: 8.581880e-01
time3: 1.035856e+00
time4: 1.804873e+00
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time5: 8.124803e+00
time6: 1.579664e+01
 =============> Iteration k : 511
time1: 4.762786e+00
time2: 6.280320e-01
time3: 1.196410e+00
time4: 1.793946e+00
time5: 8.180077e+00
time6: 1.658384e+01
 =============> Iteration k : 512
time1: 4.317270e+00
time2: 8.425950e-01
time3: 9.237510e-01
time4: 1.810914e+00
time5: 9.056767e+00
time6: 1.693070e+01
 =============> Iteration k : 513
time1: 4.165147e+00
time2: 9.023170e-01
time3: 9.082850e-01
time4: 1.702721e+00
time5: 8.811330e+00
time6: 1.664728e+01
 =============> Iteration k : 514
time1: 4.570308e+00
time2: 9.185750e-01
time3: 1.093574e+00
time4: 1.812791e+00
time5: 8.904648e+00
time6: 1.562677e+01
 =============> Iteration k : 515
time1: 4.410006e+00
time2: 8.742270e-01
time3: 9.978190e-01
time4: 1.879554e+00
time5: 8.521248e+00
time6: 1.690100e+01
 =============> Iteration k : 516
time1: 4.755437e+00
time2: 9.434040e-01
time3: 1.098070e+00
time4: 1.416863e+00
time5: 8.818592e+00
time6: 1.680731e+01
 =============> Iteration k : 517
time1: 4.695232e+00
time2: 6.947820e-01
time3: 9.828980e-01
time4: 1.411343e+00
time5: 8.265929e+00
time6: 1.691840e+01
 =============> Iteration k : 518
time1: 3.975819e+00
time2: 5.770270e-01
time3: 1.137131e+00
time4: 1.597440e+00
time5: 8.198299e+00
time6: 1.698004e+01
 =============> Iteration k : 519
time1: 3.771247e+00
time2: 8.017610e-01
time3: 9.808390e-01
time4: 1.628818e+00
time5: 8.674143e+00
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time6: 1.631575e+01
 =============> Iteration k : 520
time1: 4.251317e+00
time2: 7.937680e-01
time3: 1
time4: 1.531200e+00
time5: 9.030176e+00
time6: 1.609904e+01
 =============> Iteration k : 521
time1: 4.210290e+00
time2: 8.180290e-01
time3: 1.188920e+00
time4: 2.035739e+00
time5: 9.528593e+00
time6: 1.569950e+01
 =============> Iteration k : 522
time1: 4.861955e+00
time2: 9.965950e-01
time3: 8.922740e-01
time4: 2.028785e+00
time5: 9.566077e+00
time6: 1.580994e+01
 =============> Iteration k : 523
time1: 4.502353e+00
time2: 1.035839e+00
time3: 1.166938e+00
time4: 2.022288e+00
time5: 8.655845e+00
time6: 1.490429e+01
 =============> Iteration k : 524
time1: 4.604829e+00
time2: 1.010226e+00
time3: 1.208834e+00
time4: 1.971305e+00
time5: 8.840170e+00
time6: 1.618460e+01
 =============> Iteration k : 525
time1: 4.590721e+00
time2: 9.949600e-01
time3: 1.072279e+00
time4: 1.902861e+00
time5: 7.901632e+00
time6: 1.661950e+01
 =============> Iteration k : 526
time1: 4.697398e+00
time2: 1.104586e+00
time3: 1.029366e+00
time4: 1.681657e+00
time5: 7.519526e+00
time6: 1.775202e+01
 =============> Iteration k : 527
time1: 4.613168e+00
time2: 6.809160e-01
time3: 8.914830e-01
time4: 1.787358e+00
time5: 7.787899e+00
time6: 1.762610e+01
 =============> Iteration k : 528
time1: 4.349159e+00
time2: 8.267290e-01
time3: 5.885040e-01
time4: 1.098755e+00
time5: 8.916317e+00
time6: 1.655016e+01
```

```
 =============> Iteration k : 529
time1: 3.930306e+00
time2: 3.047610e-01
time3: 9.409670e-01
time4: 1.803208e+00
time5: 9.207781e+00
time6: 1.654255e+01
 =============> Iteration k : 530
time1: 3.437024e+00
time2: 8.297340e-01
time3: 8.870660e-01
time4: 1.865557e+00
time5: 9.716876e+00
time6: 1.549110e+01
 =============> Iteration k : 531
time1: 4.166771e+00
time2: 9.086430e-01
time3: 1.136727e+00
time4: 1.948890e+00
time5: 9.325164e+00
time6: 1.460800e+01
 =============> Iteration k : 532
time1: 4.598041e+00
time2: 8.220070e-01
time3: 1.171493e+00
time4: 2.119232e+00
time5: 9.406821e+00
time6: 1.539902e+01
 =============> Iteration k : 533
time1: 4.526929e+00
time2: 7.034470e-01
time3: 9.544690e-01
time4: 1.744044e+00
time5: 9.469483e+00
time6: 1.467370e+01
 =============> Iteration k : 534
time1: 4.679809e+00
time2: 8.392630e-01
time3: 1.124911e+00
time4: 1.766189e+00
time5: 9.176076e+00
time6: 1.487419e+01
 =============> Iteration k : 535
time1: 4.928101e+00
time2: 1.155187e+00
time3: 1.100754e+00
time4: 2.118997e+00
time5: 8.904620e+00
time6: 1.647122e+01
 =============> Iteration k : 536
time1: 4.685682e+00
time2: 6.975860e-01
time3: 1.119652e+00
time4: 1.874204e+00
time5: 8.178414e+00
time6: 1.598177e+01
 =============> Iteration k : 537
time1: 4.425387e+00
time2: 8.683210e-01
time3: 1.107620e+00
time4: 1.712206e+00
time5: 8.317930e+00
time6: 1.554143e+01
 =============> Iteration k : 538
```

```
time1: 4.641630e+00
time2: 8.023640e-01
time3: 8.244730e-01
time4: 1.713965e+00
time5: 8.637673e+00
time6: 1.658912e+01
 ==============> Iteration k : 539
time1: 4.021033e+00
time2: 9.674600e-01
time3: 8.022680e-01
time4: 1.772803e+00
time5: 8.753774e+00
time6: 1.597770e+01
 ==============> Shuffeling of batches for gradient ...
 ==============> Iteration k : 540
time1: 4.092061e+00
time2: 6.868670e-01
time3: 9.593670e-01
time4: 1.835912e+00
time5: 9.257387e+00
time6: 1.651705e+01
 ==============> Iteration k : 541
time1: 4.160059e+00
time2: 8.076010e-01
time3: 1.546372e+00
time4: 1.683620e+00
time5: 8.687303e+00
time6: 1.599543e+01
 ==============> Iteration k : 542
time1: 4.650689e+00
time2: 1.026608e+00
time3: 1.068807e+00
time4: 1.521155e+00
time5: 9.097942e+00
time6: 1.555654e+01
 ==============> Iteration k : 543
time1: 4.286445e+00
time2: 9.158610e-01
time3: 8.911930e-01
time4: 1.768435e+00
time5: 8.659992e+00
time6: 1.552882e+01
 ==============> Iteration k : 544
time1: 4.092660e+00
time2: 9.076760e-01
time3: 9.763930e-01
time4: 1.795478e+00
time5: 8.100666e+00
time6: 1.680357e+01
 ==============> Iteration k : 545
time1: 4.495337e+00
time2: 7.461620e-01
time3: 7.629680e-01
time4: 1.849926e+00
time5: 8.650086e+00
time6: 1.705891e+01
 ==============> Iteration k : 546
time1: 4.004951e+00
time2: 6.929280e-01
time3: 8.970720e-01
time4: 1.794818e+00
time5: 8.860635e+00
time6: 1.702498e+01
 ==============> Iteration k : 547
```

```
time1: 4.205996e+00
time2: 8.221120e-01
time3: 1.009854e+00
time4: 1.317188e+00
time5: 9.135004e+00
time6: 1.561434e+01
 ==============> Iteration k : 548
time1: 4.271715e+00
time2: 4.869410e-01
time3: 1.118979e+00
time4: 1.683408e+00
time5: 8.880531e+00
time6: 1.703207e+01
 ==============> Iteration k : 549
time1: 4.599427e+00
time2: 8.025160e-01
time3: 1.186890e+00
time4: 1.886805e+00
time5: 8.874912e+00
time6: 1.468100e+01
 ==============> Iteration k : 550
time1: 4.423866e+00
time2: 1.014527e+00
time3: 1.091851e+00
time4: 1.869745e+00
time5: 9.006197e+00
time6: 1.495642e+01
 ==============> Iteration k : 551
time1: 5.031472e+00
time2: 9.135370e-01
time3: 1.102545e+00
time4: 1.890499e+00
time5: 9.339947e+00
time6: 1.697580e+01
 ==============> Iteration k : 552
time1: 4.586029e+00
time2: 1.240750e+00
time3: 1.018453e+00
time4: 1.708492e+00
time5: 8.086407e+00
time6: 1.578668e+01
 ==============> Iteration k : 553
time1: 4.590527e+00
time2: 1.017007e+00
time3: 1.066173e+00
time4: 1.710498e+00
time5: 7.518467e+00
time6: 1.612683e+01
 ==============> Iteration k : 554
time1: 4.688862e+00
time2: 1.106340e+00
time3: 1.014043e+00
time4: 1.711030e+00
time5: 7.868300e+00
time6: 1.788623e+01
 ==============> Iteration k : 555
time1: 4.269918e+00
time2: 7.118100e-01
time3: 9.716160e-01
time4: 1.446628e+00
time5: 8.149524e+00
time6: 1.631932e+01
 ==============> Iteration k : 556
time1: 4.296201e+00
```

```
time2: 6.606030e-01
time3: 7.695630e-01
time4: 1.488594e+00
time5: 8.128094e+00
time6: 1.718992e+01
 ==============> Iteration k : 557
time1: 4.430489e+00
time2: 3.897260e-01
time3: 7.746960e-01
time4: 1.626703e+00
time5: 9.265789e+00
time6: 1.642741e+01
 ==============> Iteration k : 558
time1: 3.356802e+00
time2: 8.987180e-01
time3: 8.348890e-01
time4: 1.784380e+00
time5: 9.503168e+00
time6: 1.544743e+01
 ==============> Iteration k : 559
time1: 3.546617e+00
time2: 6.450270e-01
time3: 8.965750e-01
time4: 1.980202e+00
time5: 9.466476e+00
time6: 1.432466e+01
 ==============> Iteration k : 560
time1: 4.266288e+00
time2: 7.961220e-01
time3: 1.309932e+00
time4: 1.904096e+00
time5: 9.590181e+00
time6: 1.447631e+01
 ==============> Iteration k : 561
time1: 4.595286e+00
time2: 1.279400e+00
time3: 9.258740e-01
time4: 1.903580e+00
time5: 9.576223e+00
time6: 1.480269e+01
 ==============> Iteration k : 562
time1: 4.509091e+00
time2: 1.136852e+00
time3: 1.021691e+00
time4: 1.921596e+00
time5: 9.228622e+00
time6: 1.641346e+01
 ==============> Iteration k : 563
time1: 5.017122e+00
time2: 1.009332e+00
time3: 1.073303e+00
time4: 1.991223e+00
time5: 7.300905e+00
time6: 1.558438e+01
 ==============> Iteration k : 564
time1: 4.615678e+00
time2: 1.065146e+00
time3: 8.888210e-01
time4: 1.924929e+00
time5: 7.893687e+00
time6: 1.660978e+01
 ==============> Iteration k : 565
time1: 4.872119e+00
time2: 8.836320e-01
```

```
time3: 1.017273e+00
time4: 1.856924e+00
time5: 8.108479e+00
time6: 1.652151e+01
 ==============> Iteration k : 566
time1: 4.436772e+00
time2: 9.813830e-01
time3: 9.059140e-01
time4: 1.053451e+00
time5: 8.471833e+00
time6: 1.623116e+01
 ==============> Iteration k : 567
time1: 4.284927e+00
time2: 6.928070e-01
time3: 9.606670e-01
time4: 1.715193e+00
time5: 8.679523e+00
time6: 1.613935e+01
 ==============> Iteration k : 568
time1: 3.991743e+00
time2: 6.043520e-01
time3: 1.048973e+00
time4: 1.794002e+00
time5: 8.627273e+00
time6: 1.587974e+01
 ==============> Iteration k : 569
time1: 4.129938e+00
time2: 6.167220e-01
time3: 1.021398e+00
time4: 1.797634e+00
time5: 9.249004e+00
time6: 1.599402e+01
 ==============> Iteration k : 570
time1: 4.185624e+00
time2: 9.061910e-01
time3: 1.001656e+00
time4: 1.438547e+00
time5: 8.791016e+00
time6: 1.536698e+01
 ==============> Iteration k : 571
time1: 4.400379e+00
time2: 9.535790e-01
time3: 9.498190e-01
time4: 1.362648e+00
time5: 9.307871e+00
time6: 1.558748e+01
 ==============> Iteration k : 572
time1: 3.291917e+00
time2: 6.904760e-01
time3: 8.064910e-01
time4: 1.288817e+00
time5: 5.504571e+00
time6: 1.070859e+01
 ==============> Iteration k : 573
time1: 3.140904e+00
time2: 5.152140e-01
time3: 7.422160e-01
time4: 1.151467e+00
time5: 4.901680e+00
time6: 1.159156e+01
 ==============> Iteration k : 574
time1: 3.263324e+00
time2: 6.064150e-01
time3: 7.277850e-01
```

```
time4: 1.083332e+00
time5: 4.997331e+00
time6: 1.226900e+01
 =============> Iteration k : 575
time1: 2.879136e+00
time2: 4.193600e-01
time3: 6.420770e-01
time4: 8.526680e-01
time5: 5.477313e+00
time6: 1.217758e+01
 =============> Iteration k : 576
time1: 2.638035e+00
time2: 3.659970e-01
time3: 4.234140e-01
time4: 1.083680e+00
time5: 5.840637e+00
time6: 1.189633e+01
 =============> Iteration k : 577
time1: 2.293251e+00
time2: 4.728240e-01
time3: 6.162000e-01
time4: 1.089240e+00
time5: 6.345295e+00
time6: 1.101063e+01
 =============> Iteration k : 578
time1: 2.712411e+00
time2: 4.238790e-01
time3: 8.610960e-01
time4: 1.149850e+00
time5: 6.480032e+00
time6: 9.884208e+00
 =============> Iteration k : 579
time1: 2.965534e+00
time2: 6.505420e-01
time3: 8.709350e-01
time4: 1.274178e+00
time5: 6.383933e+00
time6: 1.074817e+01
 =============> Iteration k : 580
time1: 3.236155e+00
time2: 5.292360e-01
time3: 6.943010e-01
time4: 1.222885e+00
time5: 5.992119e+00
time6: 1.127517e+01
 =============> Iteration k : 581
time1: 3.303119e+00
time2: 6.498580e-01
time3: 7.251640e-01
time4: 1.277982e+00
time5: 5.611181e+00
time6: 1.118957e+01
 =============> Iteration k : 582
time1: 3.226800e+00
time2: 6.548780e-01
time3: 8.408200e-01
time4: 9.589250e-01
time5: 5.178987e+00
time6: 1.138810e+01
 =============> Iteration k : 583
time1: 3.256673e+00
time2: 5.130490e-01
time3: 5.140680e-01
time4: 1.106624e+00
```

```
time5: 4.883231e+00
time6: 1.218879e+01
 =============> Iteration k : 584
time1: 2.977661e+00
time2: 5.087930e-01
time3: 5.819750e-01
time4: 8.120980e-01
time5: 5.495615e+00
time6: 1.206924e+01
 =============> Iteration k : 585
time1: 2.646053e+00
time2: 3.371470e-01
time3: 5.428980e-01
time4: 1.089313e+00
time5: 5.973887e+00
time6: 1.126802e+01
 =============> Iteration k : 586
time1: 2.201316e+00
time2: 5.929460e-01
time3: 5.611130e-01
time4: 1.090792e+00
time5: 6.404843e+00
time6: 1.139447e+01
 =============> Iteration k : 587
time1: 2.426657e+00
time2: 4.995750e-01
time3: 5.815400e-01
time4: 1.384009e+00
time5: 6.108077e+00
time6: 1.091274e+01
 =============> Iteration k : 588
time1: 3.082241e+00
time2: 5.985620e-01
time3: 8.182690e-01
time4: 1.261130e+00
time5: 6.504730e+00
time6: 1.002888e+01
 =============> Iteration k : 589
time1: 3.140209e+00
time2: 7.117450e-01
time3: 7.121020e-01
time4: 1.184444e+00
time5: 6.058679e+00
time6: 1.102162e+01
 =============> Iteration k : 590
time1: 3.007796e+00
time2: 5.068240e-01
time3: 7.118770e-01
time4: 1.218815e+00
time5: 5.980333e+00
time6: 1.016344e+01
 =============> Iteration k : 591
time1: 3.289897e+00
time2: 5.489560e-01
time3: 7.609480e-01
time4: 1.225212e+00
time5: 5.713681e+00
time6: 1.136994e+01
 =============> Iteration k : 592
time1: 3.192444e+00
time2: 5.844020e-01
time3: 7.791370e-01
time4: 1.095626e+00
time5: 4.799143e+00
```

```
time6: 1.217516e+01
 =============> Iteration k : 593
time1: 3.236095e+00
time2: 6.103940e-01
time3: 5.869480e-01
time4: 1.098501e+00
time5: 4.997402e+00
time6: 1.264359e+01
 =============> Iteration k : 594
time1: 2.571952e+00
time2: 4.030300e-01
time3: 6.411850e-01
time4: 8.314160e-01
time5: 5.195102e+00
time6: 1.170987e+01
 =============> Iteration k : 595
time1: 2.700640e+00
time2: 5.003600e-01
time3: 5.565600e-01
time4: 5.945880e-01
time5: 5.891492e+00
time6: 1.151582e+01
 =============> Iteration k : 596
time1: 2.719176e+00
time2: 2.730680e-01
time3: 6.129920e-01
time4: 1.043582e+00
time5: 6.437605e+00
time6: 1.185886e+01
 =============> Iteration k : 597
time1: 2.380988e+00
time2: 4.300990e-01
time3: 5.721650e-01
time4: 1.225173e+00
time5: 6.486422e+00
time6: 1.028005e+01
 =============> Iteration k : 598
time1: 2.818554e+00
time2: 6.655940e-01
time3: 6.084830e-01
time4: 1.183065e+00
time5: 6.468328e+00
time6: 1.040775e+01
 =============> Iteration k : 599
time1: 3.333266e+00
time2: 5.201950e-01
time3: 8.263690e-01
time4: 1.257563e+00
time5: 6.032539e+00
time6: 1.088293e+01
```

```
fprintf("\n=====================================================================\n")
```

```
=====================================================================
```

```
fprintf("\n The end of Training.")
```

```
 The end of Training.
```

```
fprintf("\n=====================================================================\n")
```

```
=====================================================================
```

Model Gradient (Backward)

```
function [loss, gradients, acc, state] = model_Forward_Backward(dlNet, dlX, Y)

if nargout == 1

    Yhat         = forward(dlNet, dlX);
    loss         = crossentropy(Yhat, Y);

elseif nargout == 2
    Yhat         = forward(dlNet, dlX);
    loss         = crossentropy(Yhat, Y);
    gradients    = dlgradient(loss, dlNet.Learnables);

elseif nargout == 3
    Yhat         = forward(dlNet, dlX);
    loss         = crossentropy(Yhat, Y);
    gradients    = dlgradient(loss, dlNet.Learnables);
    acc          = accuracy_fun(Yhat, Y);

elseif nargout == 4
    [Yhat, state]     = forward(dlNet, dlX);
    loss              = crossentropy(Yhat, Y);
    gradients         = dlgradient(loss, dlNet.Learnables);
    acc               = accuracy_fun(Yhat, Y);
end

end


function acc = accuracy_fun(Y_pre, Y)

Y_predict    = extractdata(Y_pre);
[~,idx_pre]  = max(Y_predict,[],1);
[~,idx_true] = max(Y,[],1);
acc          = mean(idx_pre==idx_true)*100;

end
```