

```
[xTrain, tTrain, xValid, tValid, xTest, tTest] = LoadCIFAR(3);
imshow(xTrain(:,:,1,25081))
labelCount = length(tTrain)
layers = [
    imageInputLayer([32 32 3])
    fullyConnectedLayer(50)
    reluLayer
    fullyConnectedLayer(50)
    reluLayer
    fullyConnectedLayer(10)
    softmaxLayer
    classificationLayer
];
```

```
options = trainingOptions(...
    'sgdm',...
    'Momentum',0.9,...
    'MaxEpochs',400,...
    'MiniBatchSize',8192,...
    'InitialLearnRate',0.001,...
    'Shuffle','every-epoch',...
    'ValidationPatience',3,...
    'ValidationFrequency',30,...
    'ValidationData',{xValid,tValid},...
    'Plots','Training-Progress');
```

```
net = trainNetwork(xTrain,tTrain,layers,options);
```

```
%Epochs: 210, Classification Error: 0.5128
```

```
%
```

```
[xTrain, tTrain, xValid, tValid, xTest, tTest] = LoadCIFAR(3);
labelCount = length(tTrain)
layers = [
    imageInputLayer([32 32 3])
    fullyConnectedLayer(50)
    reluLayer
    fullyConnectedLayer(50)
    reluLayer
    fullyConnectedLayer(50)
    reluLayer

    fullyConnectedLayer(10)
    softmaxLayer
    classificationLayer
];
```

```
options = trainingOptions(...
    'sgdm',...
    'Momentum',0.9,...
    'MaxEpochs',400,...
    'MiniBatchSize',8192,...
    'InitialLearnRate',0.003,...
    'Shuffle','every-epoch',...
    'ValidationPatience',3,...
    'ValidationFrequency',30,...
    'ValidationData',{xValid,tValid},...
    'Plots','Training-Progress');
```

```
net = trainNetwork(xTrain,tTrain,layers,options);
```

```
outputs = net.classify(xTest);
classification_error(outputs,tTest);
```

```

61 %158, 0.5237
62 [xTrain, tTrain, xValid, tValid, xTest, tTest] = LoadCIFAR(3);
63 %imshow(xTrain(:,:, :, 25081))
64 labelCount = length(tTrain)
65 layers = [
66     imageInputLayer([32 32 3])
67     fullyConnectedLayer(50)
68     reluLayer
69     fullyConnectedLayer(50)
70     reluLayer
71     fullyConnectedLayer(10)
72     softmaxLayer
73     classificationLayer
74 ];
75
76 options = trainingOptions(...
77 'sgdm',...
78 'Momentum',0.9,...
79 'MaxEpochs',400,...
80 'MiniBatchSize',8192,...
81 'InitialLearnRate',0.001,...
82 'Shuffle','every-epoch',...
83 'ValidationPatience',3,...
84 'ValidationFrequency',30,...
85 'ValidationData',{xValid,tValid},...
86 'Plots','Training-Progress',...
87 'L2Regularization',0.2);
88
89 net = trainNetwork(xTrain,tTrain,layers,options);
90
91 %Epochs: 375, Classification Error: 0.4924
92
93 [xTrain, tTrain, xValid, tValid, xTest, tTest] = LoadCIFAR(4);
94 %imshow(xTrain(:,:, :, 25081))
95 labelCount = length(tTrain)
96 layers = [
97     imageInputLayer([32 32 3])
98     convolution2dLayer(5,20,'Padding',1, 'Stride',1)
99     reluLayer
100    maxPooling2dLayer(2,'Padding',0,'Stride',2)
101    fullyConnectedLayer(50)
102    reluLayer
103    fullyConnectedLayer(10)
104    reluLayer
105    softmaxLayer
106    classificationLayer
107 ];
108
109 options = trainingOptions(...
110 'sgdm',...
111 'Momentum',0.9,...
112 'MaxEpochs',120,...
113 'MiniBatchSize',8192,...
114 'InitialLearnRate',0.001,...
115 'Shuffle','every-epoch',...
116 'ValidationData',{xValid,tValid},...
117 'ValidationPatience',3,...
118 'ValidationFrequency',30,...
119 'Plots','Training-Progress');
120

```

```
121 net = trainNetwork(xTrain,tTrain,layers,options);
122
123 %Epochs: 120
124 %tTrain: 0.3365
125 %tValid: 0.3980
126 %tTest: 0.3925
127
128 [xTrain, tTrain, xValid, tValid, xTest, tTest] = LoadCIFAR(4);
129 %imshow(xTrain(:,:,1,25081))
130 labelCount = length(tTrain)
131 layers = [
132     imageInputLayer([32 32 3])
133     convolution2dLayer(3,20,'Padding',1, 'Stride',1)
134     batchNormalizationLayer
135     reluLayer
136     maxPooling2dLayer(2,'Padding',0,'Stride',2)
137     convolution2dLayer(3,30,'Padding',1, 'Stride',1)
138     batchNormalizationLayer
139     reluLayer
140     maxPooling2dLayer(2,'Padding',0,'Stride',2)
141     convolution2dLayer(3,50,'Padding',1, 'Stride',1)
142     batchNormalizationLayer
143     reluLayer
144     fullyConnectedLayer(10)
145     softmaxLayer
146     classificationLayer
147 ];
148
149 options = trainingOptions(...
150 'sgdm',...
151 'Momentum',0.9,...
152 'MaxEpochs',120,...
153 'MiniBatchSize',8192,...
154 'InitialLearnRate',0.001,...
155 'Shuffle','every-epoch',...
156 'ValidationData',{xValid,tValid},...
157 'ValidationPatience',3,...
158 'ValidationFrequency',30,...
159 'Plots','Training-Progress');
160
161 net = trainNetwork(xTrain,tTrain,layers,options);
162
163 %Epochs: 120
164 %tTrain: 0.2698
165 %tValid: 0.3069
166 %tTest: 0.3043
```

