

```

clc;
close all;

fullData = readtable("Train_Aug.csv");
imageData = fullData.Name;
nImg = height(imageData)

```

```
nImg = 5420
```

```

imds = imageDatastore(imageData);

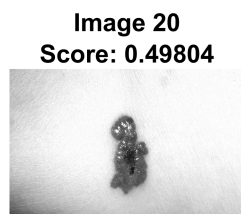
data = fullData.Value;

```

```

figure
t = tiledlayout(1,3);
idx1 = 8;
displayImageAndScores(t,readimage(imds,idx1), ...
    data(idx1),"Image "+ idx1)
idx2 = 20;
displayImageAndScores(t,readimage(imds,idx2), ...
    data(idx2),"Image "+idx2)
idx3 = 5;
displayImageAndScores(t,readimage(imds,idx3), ...
    data(idx3),"Image "+idx3)

```



```
numTrain = floor(0.80 * nImg)
```

```
numTrain = 4336
```

```
numVal = floor(0.05 * nImg)
```

```
numVal = 271
```

```
Idx = randperm(nImg);
```

```
idxTrain = Idx(1:numTrain);
```

```
idxVal = Idx(numTrain+1:numTrain+numVal);
```

```
idxTest = Idx(numTrain+numVal+1:nImg);
```

```
trainData = fullData(idxTrain,:);
```

```
valData = fullData(idxVal,:);
```

```
testData = fullData(idxTest,:);
```

```
trainDSI = fullData(idxTrain,:).Value;
```

```
valDSI = fullData(idxVal,:).Value;
```

```
testDSI = fullData(idxTest,:).Value;
```

```
% imageAugmenter = imageDataAugmenter( ...
```

```
%     'RandXTranslation',[-3 3], ...
```

```
%     'RandYTranslation',[-3 3],...
```

```
%     'RandXReflection', true, ...
```

```
%     'RandYReflection',true)
```

```
% trainds = augmentedImageDatastore([224 224],trainData,'DataAugmentation',imageAugmenter);
```

```
% valds = augmentedImageDatastore([224 224],valData,'DataAugmentation',imageAugmenter);
```

```
% testds = augmentedImageDatastore([224 224],testData,'DataAugmentation',imageAugmenter);
```

```
trainds = augmentedImageDatastore([224 224],trainData);
```

```
valds = augmentedImageDatastore([224 224],valData);
```

```
testds = augmentedImageDatastore([224 224],testData);
```

Modified EfficientNet Network Architecture with Pretrained Parameters

Script for creating the layers for a deep learning network with the following properties:

Number of layers: 289

Number of connections: 362

Pretrained parameters file: D:\NITPY PhD\Contrast_EnH_Skin_Images\Source_Codes\New_Method\params_2021_09_18__2

Run the script to create the layers in the workspace variable lgraph.

Load the Pretrained Parameters

% Give correct path to load the pre-trained parameters.

```
params = load("D:\NITPY PhD\Contrast_EnH_Skin_Images\Source_Codes\New_Method_DL\params_2021_09_09.mat");
```

Create Layer Graph

Create the layer graph variable to contain the network layers.

```
lgraph = layerGraph();
```

Add Layer Branches

Add the branches of the network to the layer graph. Each branch is a linear array of layers.

```
tempLayers = [  
    imageInputLayer([224 224 1],"Name","imageinput","Normalization","zscore")  
    convolution2dLayer([1 1],32,"Name","conv","Padding","same","Stride",[2 2])  
    batchNormalizationLayer("Name","efficientnet-b0|model|stem|tpu_batch_normalization|FusedBatchNorm2d")  
];  
lgraph = addLayers(lgraph,tempLayers);  
  
tempLayers = sigmoidLayer("Name","efficientnet-b0|model|stem|SigmoidLayer");  
lgraph = addLayers(lgraph,tempLayers);  
  
tempLayers = [  
    multiplicationLayer(2,"Name","efficientnet-b0|model|stem|MulLayer")  
    groupedConvolution2dLayer([3 3],1,32,"Name","efficientnet-b0|model|blocks_0|depthwise_conv2d")  
    batchNormalizationLayer("Name","efficientnet-b0|model|blocks_0|tpu_batch_normalization|FusedBatchNorm2d")  
];  
lgraph = addLayers(lgraph,tempLayers);  
  
tempLayers = sigmoidLayer("Name","efficientnet-b0|model|blocks_0|SigmoidLayer");  
lgraph = addLayers(lgraph,tempLayers);  
  
tempLayers = multiplicationLayer(2,"Name","efficientnet-b0|model|blocks_0|MulLayer");  
lgraph = addLayers(lgraph,tempLayers);  
  
tempLayers = [  
    globalAveragePooling2dLayer("Name","efficientnet-b0|model|blocks_0|se|GlobAvgPool")  
    convolution2dLayer([1 1],8,"Name","Conv__301","Bias",params.Conv__301.Bias,"Weights",params.Conv__301.Weights)  
];  
lgraph = addLayers(lgraph,tempLayers);  
  
tempLayers = sigmoidLayer("Name","efficientnet-b0|model|blocks_0|se|SigmoidLayer");  
lgraph = addLayers(lgraph,tempLayers);  
  
tempLayers = [  
    multiplicationLayer(2,"Name","efficientnet-b0|model|blocks_0|se|MulLayer")  
    convolution2dLayer([1 1],32,"Name","Conv__304","Bias",params.Conv__304.Bias,"Weights",params.Conv__304.Weights)  
    sigmoidLayer("Name","efficientnet-b0|model|blocks_0|se|SigmoidLayer_1");  
];  
lgraph = addLayers(lgraph,tempLayers);
```

```

tempLayers = [
    multiplicationLayer(2,"Name","efficientnet-b0|model|blocks_0|se|MulLayer_1")
    convolution2dLayer([1 1],16,"Name","efficientnet-b0|model|blocks_0|conv2d|Conv2D","Bias",params.Conv__288.Bias,"Weights",params.Conv__288.Weights);
    batchNormalizationLayer("Name","efficientnet-b0|model|blocks_0|tpu_batch_normalization_1|FusedBatchNorm");
    convolution2dLayer([1 1],96,"Name","efficientnet-b0|model|blocks_1|conv2d|Conv2D","Bias",params.Conv__289.Bias,"Weights",params.Conv__289.Weights);
    batchNormalizationLayer("Name","efficientnet-b0|model|blocks_1|tpu_batch_normalization_1|FusedBatchNorm");
lgraph = addLayers(lgraph,tempLayers);

tempLayers = sigmoidLayer("Name","efficientnet-b0|model|blocks_1|SigmoidLayer");
lgraph = addLayers(lgraph,tempLayers);

tempLayers = [
    multiplicationLayer(2,"Name","efficientnet-b0|model|blocks_1|MulLayer")
    groupedConvolution2dLayer([3 3],1,96,"Name","efficientnet-b0|model|blocks_1|depthwise_conv2d|DepthwiseConv2D","Bias",params.Conv__290.Bias,"Weights",params.Conv__290.Weights);
    batchNormalizationLayer("Name","efficientnet-b0|model|blocks_1|tpu_batch_normalization_1|FusedBatchNorm");
lgraph = addLayers(lgraph,tempLayers);

tempLayers = sigmoidLayer("Name","efficientnet-b0|model|blocks_1|SigmoidLayer_1");
lgraph = addLayers(lgraph,tempLayers);

tempLayers = multiplicationLayer(2,"Name","efficientnet-b0|model|blocks_1|MulLayer_1");
lgraph = addLayers(lgraph,tempLayers);

tempLayers = [
    globalAveragePooling2dLayer("Name","efficientnet-b0|model|blocks_1|se|GlobAvgPool")
    convolution2dLayer([1 1],4,"Name","Conv__309","Bias",params.Conv__309.Bias,"Weights",params.Conv__309.Weights);
lgraph = addLayers(lgraph,tempLayers);

tempLayers = sigmoidLayer("Name","efficientnet-b0|model|blocks_1|se|SigmoidLayer");
lgraph = addLayers(lgraph,tempLayers);

tempLayers = [
    multiplicationLayer(2,"Name","efficientnet-b0|model|blocks_1|se|MulLayer")
    convolution2dLayer([1 1],96,"Name","Conv__312","Bias",params.Conv__312.Bias,"Weights",params.Conv__312.Weights);
    sigmoidLayer("Name","efficientnet-b0|model|blocks_1|se|SigmoidLayer_1");
lgraph = addLayers(lgraph,tempLayers);

tempLayers = [
    multiplicationLayer(2,"Name","efficientnet-b0|model|blocks_1|se|MulLayer_1")
    convolution2dLayer([1 1],24,"Name","efficientnet-b0|model|blocks_1|conv2d_1|Conv2D","Bias",params.Conv__313.Bias,"Weights",params.Conv__313.Weights);
    batchNormalizationLayer("Name","efficientnet-b0|model|blocks_1|tpu_batch_normalization_2|FusedBatchNorm");
lgraph = addLayers(lgraph,tempLayers);

tempLayers = [
    convolution2dLayer([1 1],144,"Name","efficientnet-b0|model|blocks_2|conv2d|Conv2D","Bias",params.Conv__314.Bias,"Weights",params.Conv__314.Weights);
    batchNormalizationLayer("Name","efficientnet-b0|model|blocks_2|tpu_batch_normalization_2|FusedBatchNorm");
lgraph = addLayers(lgraph,tempLayers);

tempLayers = sigmoidLayer("Name","efficientnet-b0|model|blocks_2|SigmoidLayer");
lgraph = addLayers(lgraph,tempLayers);

```

```

tempLayers = [
    multiplicationLayer(2,"Name","efficientnet-b0|model|blocks_2|MulLayer")
    groupedConvolution2dLayer([3 3],1,144,"Name","efficientnet-b0|model|blocks_2|depthwise_conv")
    batchNormalizationLayer("Name","efficientnet-b0|model|blocks_2|tpu_batch_normalization_1|Fu
lgraph = addLayers(lgraph,tempLayers);

tempLayers = sigmoidLayer("Name","efficientnet-b0|model|blocks_2|SigmoidLayer_1");
lgraph = addLayers(lgraph,tempLayers);

tempLayers = multiplicationLayer(2,"Name","efficientnet-b0|model|blocks_2|MulLayer_1");
lgraph = addLayers(lgraph,tempLayers);

tempLayers = [
    globalAveragePooling2dLayer("Name","efficientnet-b0|model|blocks_2|se|GlobAvgPool")
    convolution2dLayer([1 1],6,"Name","Conv__319","Bias",params.Conv__319.Bias,"Weights",params
lgraph = addLayers(lgraph,tempLayers);

tempLayers = sigmoidLayer("Name","efficientnet-b0|model|blocks_2|se|SigmoidLayer");
lgraph = addLayers(lgraph,tempLayers);

tempLayers = [
    multiplicationLayer(2,"Name","efficientnet-b0|model|blocks_2|se|MulLayer")
    convolution2dLayer([1 1],144,"Name","Conv__322","Bias",params.Conv__322.Bias,"Weights",params
    sigmoidLayer("Name","efficientnet-b0|model|blocks_2|se|SigmoidLayer_1")];
lgraph = addLayers(lgraph,tempLayers);

tempLayers = [
    multiplicationLayer(2,"Name","efficientnet-b0|model|blocks_2|se|MulLayer_1")
    convolution2dLayer([1 1],24,"Name","efficientnet-b0|model|blocks_2|conv2d_1|Conv2D","Bias",
    batchNormalizationLayer("Name","efficientnet-b0|model|blocks_2|tpu_batch_normalization_2|Fu
lgraph = addLayers(lgraph,tempLayers);

tempLayers = [
    additionLayer(2,"Name","efficientnet-b0|model|blocks_2|Add")
    convolution2dLayer([1 1],144,"Name","efficientnet-b0|model|blocks_3|conv2d|Conv2D","Bias",p
    batchNormalizationLayer("Name","efficientnet-b0|model|blocks_3|tpu_batch_normalization|Fuse
lgraph = addLayers(lgraph,tempLayers);

tempLayers = sigmoidLayer("Name","efficientnet-b0|model|blocks_3|SigmoidLayer");
lgraph = addLayers(lgraph,tempLayers);

tempLayers = [
    multiplicationLayer(2,"Name","efficientnet-b0|model|blocks_3|MulLayer")
    groupedConvolution2dLayer([5 5],1,144,"Name","efficientnet-b0|model|blocks_3|depthwise_conv")
    batchNormalizationLayer("Name","efficientnet-b0|model|blocks_3|tpu_batch_normalization_1|Fu
lgraph = addLayers(lgraph,tempLayers);

tempLayers = sigmoidLayer("Name","efficientnet-b0|model|blocks_3|SigmoidLayer_1");
lgraph = addLayers(lgraph,tempLayers);

```

```

tempLayers = multiplicationLayer(2,"Name","efficientnet-b0|model|blocks_3|MulLayer_1");
lgraph = addLayers(lgraph,tempLayers);

tempLayers = [
    globalAveragePooling2dLayer("Name","efficientnet-b0|model|blocks_3|se|GlobAvgPool")
    convolution2dLayer([1 1],6,"Name","Conv__327","Bias",params.Conv__327.Bias,"Weights",params.Conv__327.Weights);
lgraph = addLayers(lgraph,tempLayers);

tempLayers = sigmoidLayer("Name","efficientnet-b0|model|blocks_3|se|SigmoidLayer");
lgraph = addLayers(lgraph,tempLayers);

tempLayers = [
    multiplicationLayer(2,"Name","efficientnet-b0|model|blocks_3|se|MulLayer")
    convolution2dLayer([1 1],144,"Name","Conv__330","Bias",params.Conv__330.Bias,"Weights",params.Conv__330.Weights);
    sigmoidLayer("Name","efficientnet-b0|model|blocks_3|se|SigmoidLayer_1");
lgraph = addLayers(lgraph,tempLayers);

tempLayers = [
    multiplicationLayer(2,"Name","efficientnet-b0|model|blocks_3|se|MulLayer_1")
    convolution2dLayer([1 1],40,"Name","efficientnet-b0|model|blocks_3|conv2d_1|Conv2D","Bias",params.Conv2D_1.Bias,"Weights",params.Conv2D_1.Weights);
    batchNormalizationLayer("Name","efficientnet-b0|model|blocks_3|tpu_batch_normalization_2|FusedBatchNorm2D");
lgraph = addLayers(lgraph,tempLayers);

tempLayers = [
    convolution2dLayer([1 1],240,"Name","efficientnet-b0|model|blocks_4|conv2d|Conv2D","Bias",params.Conv2D.Bias,"Weights",params.Conv2D.Weights);
    batchNormalizationLayer("Name","efficientnet-b0|model|blocks_4|tpu_batch_normalization|FusedBatchNorm2D");
lgraph = addLayers(lgraph,tempLayers);

tempLayers = sigmoidLayer("Name","efficientnet-b0|model|blocks_4|SigmoidLayer");
lgraph = addLayers(lgraph,tempLayers);

tempLayers = [
    multiplicationLayer(2,"Name","efficientnet-b0|model|blocks_4|MulLayer")
    groupedConvolution2dLayer([5 5],1,240,"Name","efficientnet-b0|model|blocks_4|depthwise_conv2d|DepthwiseConv2d","Bias",params.DepthwiseConv2d.Bias,"Weights",params.DepthwiseConv2d.Weights);
    batchNormalizationLayer("Name","efficientnet-b0|model|blocks_4|tpu_batch_normalization_1|FusedBatchNorm2D");
lgraph = addLayers(lgraph,tempLayers);

tempLayers = sigmoidLayer("Name","efficientnet-b0|model|blocks_4|SigmoidLayer_1");
lgraph = addLayers(lgraph,tempLayers);

tempLayers = multiplicationLayer(2,"Name","efficientnet-b0|model|blocks_4|MulLayer_1");
lgraph = addLayers(lgraph,tempLayers);

tempLayers = [
    globalAveragePooling2dLayer("Name","efficientnet-b0|model|blocks_4|se|GlobAvgPool")
    convolution2dLayer([1 1],10,"Name","Conv__337","Bias",params.Conv__337.Bias,"Weights",params.Conv__337.Weights);
lgraph = addLayers(lgraph,tempLayers);

tempLayers = sigmoidLayer("Name","efficientnet-b0|model|blocks_4|se|SigmoidLayer");

```

```

lgraph = addLayers(lgraph,tempLayers);

tempLayers = [
    multiplicationLayer(2,"Name","efficientnet-b0|model|blocks_4|se|MulLayer")
    convolution2dLayer([1 1],240,"Name","Conv__340","Bias",params.Conv__340.Bias,"Weights",params.Conv__340.Weights);
    sigmoidLayer("Name","efficientnet-b0|model|blocks_4|se|SigmoidLayer_1");
lgraph = addLayers(lgraph,tempLayers);

tempLayers = [
    multiplicationLayer(2,"Name","efficientnet-b0|model|blocks_4|se|MulLayer_1")
    convolution2dLayer([1 1],40,"Name","efficientnet-b0|model|blocks_4|conv2d_1|Conv2D","Bias",params.Conv__340.Bias,"Weights",params.Conv__340.Weights);
    batchNormalizationLayer("Name","efficientnet-b0|model|blocks_4|tpu_batch_normalization_2|BatchNorm");
lgraph = addLayers(lgraph,tempLayers);

tempLayers = [
    additionLayer(2,"Name","efficientnet-net-b0|model|blocks_4|Add")
    convolution2dLayer([1 1],240,"Name","efficientnet-b0|model|blocks_5|conv2d|Conv2D","Bias",params.Conv__340.Bias,"Weights",params.Conv__340.Weights);
    batchNormalizationLayer("Name","efficientnet-b0|model|blocks_5|tpu_batch_normalization|BatchNorm");
lgraph = addLayers(lgraph,tempLayers);

tempLayers = sigmoidLayer("Name","efficientnet-b0|model|blocks_5|SigmoidLayer");
lgraph = addLayers(lgraph,tempLayers);

tempLayers = [
    multiplicationLayer(2,"Name","efficientnet-b0|model|blocks_5|MulLayer")
    groupedConvolution2dLayer([3 3],1,240,"Name","efficientnet-b0|model|blocks_5|depthwise_conv2d|DepthwiseConv2D","Bias",params.Conv__340.Bias,"Weights",params.Conv__340.Weights);
    batchNormalizationLayer("Name","efficientnet-b0|model|blocks_5|tpu_batch_normalization_1|BatchNorm");
lgraph = addLayers(lgraph,tempLayers);

tempLayers = sigmoidLayer("Name","efficientnet-b0|model|blocks_5|SigmoidLayer_1");
lgraph = addLayers(lgraph,tempLayers);

tempLayers = multiplicationLayer(2,"Name","efficientnet-b0|model|blocks_5|MulLayer_1");
lgraph = addLayers(lgraph,tempLayers);

tempLayers = [
    globalAveragePooling2dLayer("Name","efficientnet-b0|model|blocks_5|se|GlobAvgPool")
    convolution2dLayer([1 1],10,"Name","Conv__345","Bias",params.Conv__345.Bias,"Weights",params.Conv__345.Weights);
lgraph = addLayers(lgraph,tempLayers);

tempLayers = sigmoidLayer("Name","efficientnet-b0|model|blocks_5|se|SigmoidLayer");
lgraph = addLayers(lgraph,tempLayers);

tempLayers = [
    multiplicationLayer(2,"Name","efficientnet-b0|model|blocks_5|se|MulLayer")
    convolution2dLayer([1 1],240,"Name","Conv__348","Bias",params.Conv__348.Bias,"Weights",params.Conv__348.Weights);
    sigmoidLayer("Name","efficientnet-b0|model|blocks_5|se|SigmoidLayer_1");
lgraph = addLayers(lgraph,tempLayers);

tempLayers = [

```



```

        multiplicationLayer(2,"Name","efficientnet-b0|model|blocks_5|se|MulLayer_1")
        convolution2dLayer([1 1],80,"Name","efficientnet-b0|model|blocks_5|conv2d_1|Conv2D","Bias",
        batchNormalizationLayer("Name","efficientnet-b0|model|blocks_5|tpu_batch_normalization_2|FusedBatchNorm2D");
lgraph = addLayers(lgraph,tempLayers);

tempLayers = [
    convolution2dLayer([1 1],480,"Name","efficientnet-b0|model|blocks_6|conv2d|Conv2D","Bias",
    batchNormalizationLayer("Name","efficientnet-b0|model|blocks_6|tpu_batch_normalization|FusedBatchNorm2D");
lgraph = addLayers(lgraph,tempLayers);

tempLayers = sigmoidLayer("Name","efficientnet-b0|model|blocks_6|SigmoidLayer");
lgraph = addLayers(lgraph,tempLayers);

tempLayers = [
    multiplicationLayer(2,"Name","efficientnet-b0|model|blocks_6|MulLayer")
    groupedConvolution2dLayer([3 3],1,480,"Name","efficientnet-b0|model|blocks_6|depthwise_conv2d|Conv2D",
    batchNormalizationLayer("Name","efficientnet-b0|model|blocks_6|tpu_batch_normalization_1|FusedBatchNorm2D");
lgraph = addLayers(lgraph,tempLayers);

tempLayers = sigmoidLayer("Name","efficientnet-b0|model|blocks_6|SigmoidLayer_1");
lgraph = addLayers(lgraph,tempLayers);

tempLayers = multiplicationLayer(2,"Name","efficientnet-b0|model|blocks_6|MulLayer_1");
lgraph = addLayers(lgraph,tempLayers);

tempLayers = [
    globalAveragePooling2dLayer("Name","efficientnet-b0|model|blocks_6|se|GlobAvgPool")
    convolution2dLayer([1 1],20,"Name","Conv__355","Bias",params.Conv__355.Bias,"Weights",params.Conv__355.Weights);
lgraph = addLayers(lgraph,tempLayers);

tempLayers = sigmoidLayer("Name","efficientnet-b0|model|blocks_6|se|SigmoidLayer");
lgraph = addLayers(lgraph,tempLayers);

tempLayers = [
    multiplicationLayer(2,"Name","efficientnet-b0|model|blocks_6|se|MulLayer")
    convolution2dLayer([1 1],480,"Name","Conv__358","Bias",params.Conv__358.Bias,"Weights",params.Conv__358.Weights);
    sigmoidLayer("Name","efficientnet-b0|model|blocks_6|se|SigmoidLayer_1");
];
lgraph = addLayers(lgraph,tempLayers);

tempLayers = [
    multiplicationLayer(2,"Name","efficientnet-b0|model|blocks_6|se|MulLayer_1")
    convolution2dLayer([1 1],80,"Name","efficientnet-b0|model|blocks_6|conv2d_1|Conv2D","Bias",
    batchNormalizationLayer("Name","efficientnet-b0|model|blocks_6|tpu_batch_normalization_2|FusedBatchNorm2D");
lgraph = addLayers(lgraph,tempLayers);

tempLayers = additionLayer(2,"Name","efficientnet-b0|model|blocks_6|Add");
lgraph = addLayers(lgraph,tempLayers);

tempLayers = [
    convolution2dLayer([1 1],480,"Name","efficientnet-b0|model|blocks_7|conv2d|Conv2D","Bias",

```



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        batchNormalizationLayer("Name","efficientnet-b0|model|blocks_7|tpu_batch_normalization|Fuse
lgraph = addLayers(lgraph,tempLayers);

tempLayers = sigmoidLayer("Name","efficientnet-b0|model|blocks_7|SigmoidLayer");
lgraph = addLayers(lgraph,tempLayers);

tempLayers = [
    multiplicationLayer(2,"Name","efficientnet-b0|model|blocks_7|MulLayer")
    groupedConvolution2dLayer([3 3],1,480,"Name","efficientnet-b0|model|blocks_7|depthwise_conv
    batchNormalizationLayer("Name","efficientnet-b0|model|blocks_7|tpu_batch_normalization_1|Fu
lgraph = addLayers(lgraph,tempLayers);

tempLayers = sigmoidLayer("Name","efficientnet-b0|model|blocks_7|SigmoidLayer_1");
lgraph = addLayers(lgraph,tempLayers);

tempLayers = multiplicationLayer(2,"Name","efficientnet-b0|model|blocks_7|MulLayer_1");
lgraph = addLayers(lgraph,tempLayers);

tempLayers = [
    globalAveragePooling2dLayer("Name","efficientnet-b0|model|blocks_7|se|GlobAvgPool")
    convolution2dLayer([1 1],20,"Name","Conv__365","Bias",params.Conv__365.Bias,"Weights",para
lgraph = addLayers(lgraph,tempLayers);

tempLayers = sigmoidLayer("Name","efficientnet-b0|model|blocks_7|se|SigmoidLayer");
lgraph = addLayers(lgraph,tempLayers);

tempLayers = [
    multiplicationLayer(2,"Name","efficientnet-b0|model|blocks_7|se|MulLayer")
    convolution2dLayer([1 1],480,"Name","Conv__368","Bias",params.Conv__368.Bias,"Weights",para
    sigmoidLayer("Name","efficientnet-b0|model|blocks_7|se|SigmoidLayer_1")];
lgraph = addLayers(lgraph,tempLayers);

tempLayers = [
    multiplicationLayer(2,"Name","efficientnet-b0|model|blocks_7|se|MulLayer_1")
    convolution2dLayer([1 1],80,"Name","efficientnet-b0|model|blocks_7|conv2d_1|Conv2D","Bias",
    batchNormalizationLayer("Name","efficientnet-b0|model|blocks_7|tpu_batch_normalization_2|Fu
lgraph = addLayers(lgraph,tempLayers);

tempLayers = [
    additionLayer(2,"Name","efficientnet-b0|model|blocks_7|Add")
    convolution2dLayer([1 1],480,"Name","efficientnet-b0|model|blocks_8|conv2d|Conv2D","Bias",p
    batchNormalizationLayer("Name","efficientnet-b0|model|blocks_8|tpu_batch_normalization|Fuse
lgraph = addLayers(lgraph,tempLayers);

tempLayers = sigmoidLayer("Name","efficientnet-b0|model|blocks_8|SigmoidLayer");
lgraph = addLayers(lgraph,tempLayers);

tempLayers = [
    multiplicationLayer(2,"Name","efficientnet-b0|model|blocks_8|MulLayer")
    groupedConvolution2dLayer([5 5],1,480,"Name","efficientnet-b0|model|blocks_8|depthwise_conv

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        batchNormalizationLayer("Name","efficientnet-b0|model|blocks_8|tpu_batch_normalization_1|FusedBatchNormV2");
lgraph = addLayers(lgraph,tempLayers);

tempLayers = sigmoidLayer("Name","efficientnet-b0|model|blocks_8|SigmoidLayer_1");
lgraph = addLayers(lgraph,tempLayers);

tempLayers = multiplicationLayer(2,"Name","efficientnet-b0|model|blocks_8|MulLayer_1");
lgraph = addLayers(lgraph,tempLayers);

tempLayers = [
    globalAveragePooling2dLayer("Name","efficientnet-b0|model|blocks_8|se|GlobAvgPool")
    convolution2dLayer([1 1],20,"Name","Conv__373","Bias",params.Conv__373.Bias,"Weights",params.Conv__373.Weights);
lgraph = addLayers(lgraph,tempLayers);

tempLayers = sigmoidLayer("Name","efficientnet-b0|model|blocks_8|se|SigmoidLayer");
lgraph = addLayers(lgraph,tempLayers);

tempLayers = [
    multiplicationLayer(2,"Name","efficientnet-b0|model|blocks_8|se|MulLayer")
    convolution2dLayer([1 1],480,"Name","Conv__376","Bias",params.Conv__376.Bias,"Weights",params.Conv__376.Weights);
    sigmoidLayer("Name","efficientnet-b0|model|blocks_8|se|SigmoidLayer_1");
lgraph = addLayers(lgraph,tempLayers);

tempLayers = [
    multiplicationLayer(2,"Name","efficientnet-b0|model|blocks_8|se|MulLayer_1")
    convolution2dLayer([1 1],112,"Name","efficientnet-b0|model|blocks_8|conv2d_1|Conv2D","Bias",params.Conv2D_1.Bias,"Weights",params.Conv2D_1.Weights);
    batchNormalizationLayer("Name","efficientnet-b0|model|blocks_8|tpu_batch_normalization_2|FusedBatchNormV2");
lgraph = addLayers(lgraph,tempLayers);

tempLayers = [
    convolution2dLayer([1 1],672,"Name","efficientnet-b0|model|blocks_9|conv2d|Conv2D","Bias",params.Conv2D.Bias,"Weights",params.Conv2D.Weights);
    batchNormalizationLayer("Name","efficientnet-b0|model|blocks_9|tpu_batch_normalization|FusedBatchNormV2");
lgraph = addLayers(lgraph,tempLayers);

tempLayers = sigmoidLayer("Name","efficientnet-b0|model|blocks_9|SigmoidLayer");
lgraph = addLayers(lgraph,tempLayers);

tempLayers = [
    multiplicationLayer(2,"Name","efficientnet-b0|model|blocks_9|MulLayer")
    groupedConvolution2dLayer([5 5],1,672,"Name","efficientnet-b0|model|blocks_9|depthwise_conv2d|DepthwiseConv2dNative","Bias",params.DepthwiseConv2dNative.Bias,"Weights",params.DepthwiseConv2dNative.Weights);
    batchNormalizationLayer("Name","efficientnet-b0|model|blocks_9|tpu_batch_normalization_1|FusedBatchNormV2");
lgraph = addLayers(lgraph,tempLayers);

tempLayers = sigmoidLayer("Name","efficientnet-b0|model|blocks_9|SigmoidLayer_1");
lgraph = addLayers(lgraph,tempLayers);

tempLayers = multiplicationLayer(2,"Name","efficientnet-b0|model|blocks_9|MulLayer_1");
lgraph = addLayers(lgraph,tempLayers);

tempLayers = [

```

```

        globalAveragePooling2dLayer("Name", "efficientnet-b0|model|blocks_9|se|GlobAvgPool")
        convolution2dLayer([1 1], 28, "Name", "Conv__383", "Bias", params.Conv__383.Bias, "Weights", params.Conv__383.Weights);
lgraph = addLayers(lgraph, tempLayers);

tempLayers = sigmoidLayer("Name", "efficientnet-b0|model|blocks_9|se|SigmoidLayer");
lgraph = addLayers(lgraph, tempLayers);

tempLayers = [
    multiplicationLayer(2, "Name", "efficientnet-b0|model|blocks_9|se|MulLayer")
    convolution2dLayer([1 1], 672, "Name", "Conv__386", "Bias", params.Conv__386.Bias, "Weights", params.Conv__386.Weights);
    sigmoidLayer("Name", "efficientnet-b0|model|blocks_9|se|SigmoidLayer_1")];
lgraph = addLayers(lgraph, tempLayers);

tempLayers = [
    multiplicationLayer(2, "Name", "efficientnet-b0|model|blocks_9|se|MulLayer_1")
    convolution2dLayer([1 1], 112, "Name", "efficientnet-b0|model|blocks_9|conv2d_1|Conv2D", "Bias", params.Conv2D__1.Bias, "Weights", params.Conv2D__1.Weights);
    batchNormalizationLayer("Name", "efficientnet-b0|model|blocks_9|tpu_batch_normalization_2|BatchNormalization");
lgraph = addLayers(lgraph, tempLayers);

tempLayers = additionLayer(2, "Name", "efficientnet-b0|model|blocks_9|Add");
lgraph = addLayers(lgraph, tempLayers);

tempLayers = [
    convolution2dLayer([1 1], 672, "Name", "efficientnet-b0|model|blocks_10|conv2d|Conv2D", "Bias", params.Conv2D__2.Bias, "Weights", params.Conv2D__2.Weights);
    batchNormalizationLayer("Name", "efficientnet-b0|model|blocks_10|tpu_batch_normalization|BatchNormalization");
lgraph = addLayers(lgraph, tempLayers);

tempLayers = sigmoidLayer("Name", "efficientnet-b0|model|blocks_10|SigmoidLayer");
lgraph = addLayers(lgraph, tempLayers);

tempLayers = [
    multiplicationLayer(2, "Name", "efficientnet-b0|model|blocks_10|MulLayer")
    groupedConvolution2dLayer([5 5], 1, 672, "Name", "efficientnet-b0|model|blocks_10|depthwise_conv2d|DepthwiseConv2D", "Bias", params.DepthwiseConv2D__1.Bias, "Weights", params.DepthwiseConv2D__1.Weights);
    batchNormalizationLayer("Name", "efficientnet-b0|model|blocks_10|tpu_batch_normalization_1|BatchNormalization");
lgraph = addLayers(lgraph, tempLayers);

tempLayers = sigmoidLayer("Name", "efficientnet-b0|model|blocks_10|SigmoidLayer_1");
lgraph = addLayers(lgraph, tempLayers);

tempLayers = multiplicationLayer(2, "Name", "efficientnet-b0|model|blocks_10|MulLayer_1");
lgraph = addLayers(lgraph, tempLayers);

tempLayers = [
    globalAveragePooling2dLayer("Name", "efficientnet-b0|model|blocks_10|se|GlobAvgPool")
    convolution2dLayer([1 1], 28, "Name", "Conv__393", "Bias", params.Conv__393.Bias, "Weights", params.Conv__393.Weights);
lgraph = addLayers(lgraph, tempLayers);

tempLayers = sigmoidLayer("Name", "efficientnet-b0|model|blocks_10|se|SigmoidLayer");
lgraph = addLayers(lgraph, tempLayers);

```

```

tempLayers = [
    multiplicationLayer(2,"Name","efficientnet-b0|model|blocks_10|se|MulLayer")
    convolution2dLayer([1 1],672,"Name","Conv__396","Bias",params.Conv__396.Bias,"Weights",params.Conv__396.Weights);
    sigmoidLayer("Name","efficientnet-b0|model|blocks_10|se|SigmoidLayer_1");
lgraph = addLayers(lgraph,tempLayers);

tempLayers = [
    multiplicationLayer(2,"Name","efficientnet-b0|model|blocks_10|se|MulLayer_1")
    convolution2dLayer([1 1],112,"Name","efficientnet-b0|model|blocks_10|conv2d_1|Conv2D","Bias",params.Conv__396.Bias,"Weights",params.Conv__396.Weights);
    batchNormalizationLayer("Name","efficientnet-b0|model|blocks_10|tpu_batch_normalization_2|BatchNormalization");
lgraph = addLayers(lgraph,tempLayers);

tempLayers = [
    additionLayer(2,"Name","efficientnet-b0|model|blocks_10|Add")
    convolution2dLayer([1 1],672,"Name","efficientnet-b0|model|blocks_11|conv2d|Conv2D","Bias",params.Conv__396.Bias,"Weights",params.Conv__396.Weights);
    batchNormalizationLayer("Name","efficientnet-b0|model|blocks_11|tpu_batch_normalization|BatchNormalization");
lgraph = addLayers(lgraph,tempLayers);

tempLayers = sigmoidLayer("Name","efficientnet-b0|model|blocks_11|SigmoidLayer");
lgraph = addLayers(lgraph,tempLayers);

tempLayers = [
    multiplicationLayer(2,"Name","efficientnet-b0|model|blocks_11|MulLayer")
    groupedConvolution2dLayer([5 5],1,672,"Name","efficientnet-b0|model|blocks_11|depthwise_conv2d|DepthwiseConv2D","Bias",params.Conv__396.Bias,"Weights",params.Conv__396.Weights);
    batchNormalizationLayer("Name","efficientnet-b0|model|blocks_11|tpu_batch_normalization_1|BatchNormalization");
lgraph = addLayers(lgraph,tempLayers);

tempLayers = sigmoidLayer("Name","efficientnet-b0|model|blocks_11|SigmoidLayer_1");
lgraph = addLayers(lgraph,tempLayers);

tempLayers = multiplicationLayer(2,"Name","efficientnet-b0|model|blocks_11|MulLayer_1");
lgraph = addLayers(lgraph,tempLayers);

tempLayers = [
    globalAveragePooling2dLayer("Name","efficientnet-b0|model|blocks_11|se|GlobAvgPool")
    convolution2dLayer([1 1],28,"Name","Conv__401","Bias",params.Conv__401.Bias,"Weights",params.Conv__401.Weights);
lgraph = addLayers(lgraph,tempLayers);

tempLayers = sigmoidLayer("Name","efficientnet-b0|model|blocks_11|se|SigmoidLayer");
lgraph = addLayers(lgraph,tempLayers);

tempLayers = [
    multiplicationLayer(2,"Name","efficientnet-b0|model|blocks_11|se|MulLayer")
    convolution2dLayer([1 1],672,"Name","Conv__404","Bias",params.Conv__404.Bias,"Weights",params.Conv__404.Weights);
    sigmoidLayer("Name","efficientnet-b0|model|blocks_11|se|SigmoidLayer_1");
lgraph = addLayers(lgraph,tempLayers);

tempLayers = [
    multiplicationLayer(2,"Name","efficientnet-b0|model|blocks_11|se|MulLayer_1")
    convolution2dLayer([1 1],192,"Name","efficientnet-b0|model|blocks_11|conv2d_1|Conv2D","Bias",params.Conv__404.Bias,"Weights",params.Conv__404.Weights);

```

```

        batchNormalizationLayer("Name","efficientnet-b0|model|blocks_11|tpu_batch_normalization_2|Fus
lgraph = addLayers(lgraph,tempLayers);

tempLayers = [
    convolution2dLayer([1 1],1152,"Name","efficientnet-b0|model|blocks_12|conv2d|Conv2D","Bias
    batchNormalizationLayer("Name","efficientnet-b0|model|blocks_12|tpu_batch_normalization|Fus
lgraph = addLayers(lgraph,tempLayers);

tempLayers = sigmoidLayer("Name","efficientnet-b0|model|blocks_12|SigmoidLayer");
lgraph = addLayers(lgraph,tempLayers);

tempLayers = [
    multiplicationLayer(2,"Name","efficientnet-b0|model|blocks_12|MulLayer")
    groupedConvolution2dLayer([5 5],1,1152,"Name","efficientnet-b0|model|blocks_12|depthwise_co
    batchNormalizationLayer("Name","efficientnet-b0|model|blocks_12|tpu_batch_normalization_1|Fus
lgraph = addLayers(lgraph,tempLayers);

tempLayers = sigmoidLayer("Name","efficientnet-b0|model|blocks_12|SigmoidLayer_1");
lgraph = addLayers(lgraph,tempLayers);

tempLayers = multiplicationLayer(2,"Name","efficientnet-b0|model|blocks_12|MulLayer_1");
lgraph = addLayers(lgraph,tempLayers);

tempLayers = [
    globalAveragePooling2dLayer("Name","efficientnet-b0|model|blocks_12|se|GlobAvgPool")
    convolution2dLayer([1 1],48,"Name","Conv__411","Bias",params.Conv__411.Bias,"Weights",param
lgraph = addLayers(lgraph,tempLayers);

tempLayers = sigmoidLayer("Name","efficientnet-b0|model|blocks_12|se|SigmoidLayer");
lgraph = addLayers(lgraph,tempLayers);

tempLayers = [
    multiplicationLayer(2,"Name","efficientnet-b0|model|blocks_12|se|MulLayer")
    convolution2dLayer([1 1],1152,"Name","Conv__414","Bias",params.Conv__414.Bias,"Weights",param
    sigmoidLayer("Name","efficientnet-b0|model|blocks_12|se|SigmoidLayer_1")];
lgraph = addLayers(lgraph,tempLayers);

tempLayers = [
    multiplicationLayer(2,"Name","efficientnet-b0|model|blocks_12|se|MulLayer_1")
    convolution2dLayer([1 1],192,"Name","efficientnet-b0|model|blocks_12|conv2d_1|Conv2D","Bias
    batchNormalizationLayer("Name","efficientnet-b0|model|blocks_12|tpu_batch_normalization_2|Fus
lgraph = addLayers(lgraph,tempLayers);

tempLayers = additionLayer(2,"Name","efficientnet-b0|model|blocks_12|Add");
lgraph = addLayers(lgraph,tempLayers);

tempLayers = [
    convolution2dLayer([1 1],1152,"Name","efficientnet-b0|model|blocks_13|conv2d|Conv2D","Bias
    batchNormalizationLayer("Name","efficientnet-b0|model|blocks_13|tpu_batch_normalization|Fus
lgraph = addLayers(lgraph,tempLayers);

```

```

tempLayers = sigmoidLayer("Name","efficientnet-b0|model|blocks_13|SigmoidLayer");
lgraph = addLayers(lgraph,tempLayers);

tempLayers = [
    multiplicationLayer(2,"Name","efficientnet-b0|model|blocks_13|MulLayer")
    groupedConvolution2dLayer([5 5],1,1152,"Name","efficientnet-b0|model|blocks_13|depthwise_co
    batchNormalizationLayer("Name","efficientnet-b0|model|blocks_13|tpu_batch_normalization_1|f
lgraph = addLayers(lgraph,tempLayers);

tempLayers = sigmoidLayer("Name","efficientnet-b0|model|blocks_13|SigmoidLayer_1");
lgraph = addLayers(lgraph,tempLayers);

tempLayers = multiplicationLayer(2,"Name","efficientnet-b0|model|blocks_13|MulLayer_1");
lgraph = addLayers(lgraph,tempLayers);

tempLayers = [
    globalAveragePooling2dLayer("Name","efficientnet-b0|model|blocks_13|se|GlobAvgPool")
    convolution2dLayer([1 1],48,"Name","Conv__421","Bias",params.Conv__421.Bias,"Weights",param
lgraph = addLayers(lgraph,tempLayers);

tempLayers = sigmoidLayer("Name","efficientnet-b0|model|blocks_13|se|SigmoidLayer");
lgraph = addLayers(lgraph,tempLayers);

tempLayers = [
    multiplicationLayer(2,"Name","efficientnet-b0|model|blocks_13|se|MulLayer")
    convolution2dLayer([1 1],1152,"Name","Conv__424","Bias",params.Conv__424.Bias,"Weights",param
    sigmoidLayer("Name","efficientnet-b0|model|blocks_13|se|SigmoidLayer_1")];
lgraph = addLayers(lgraph,tempLayers);

tempLayers = [
    multiplicationLayer(2,"Name","efficientnet-b0|model|blocks_13|se|MulLayer_1")
    convolution2dLayer([1 1],192,"Name","efficientnet-b0|model|blocks_13|conv2d_1|Conv2D","Bias
    batchNormalizationLayer("Name","efficientnet-b0|model|blocks_13|tpu_batch_normalization_2|f
lgraph = addLayers(lgraph,tempLayers);

tempLayers = additionLayer(2,"Name","efficientnet-b0|model|blocks_13|Add");
lgraph = addLayers(lgraph,tempLayers);

tempLayers = [
    convolution2dLayer([1 1],1152,"Name","efficientnet-b0|model|blocks_14|conv2d|Conv2D","Bias
    batchNormalizationLayer("Name","efficientnet-b0|model|blocks_14|tpu_batch_normalization|Fus
lgraph = addLayers(lgraph,tempLayers);

tempLayers = sigmoidLayer("Name","efficientnet-b0|model|blocks_14|SigmoidLayer");
lgraph = addLayers(lgraph,tempLayers);

tempLayers = [
    multiplicationLayer(2,"Name","efficientnet-b0|model|blocks_14|MulLayer")
    groupedConvolution2dLayer([5 5],1,1152,"Name","efficientnet-b0|model|blocks_14|depthwise_co

```



```

        batchNormalizationLayer("Name","efficientnet-b0|model|blocks_14|tpu_batch_normalization_1|K
lgraph = addLayers(lgraph,tempLayers);

tempLayers = sigmoidLayer("Name","efficientnet-b0|model|blocks_14|SigmoidLayer_1");
lgraph = addLayers(lgraph,tempLayers);

tempLayers = multiplicationLayer(2,"Name","efficientnet-b0|model|blocks_14|MulLayer_1");
lgraph = addLayers(lgraph,tempLayers);

tempLayers = [
    globalAveragePooling2dLayer("Name","efficientnet-b0|model|blocks_14|se|GlobAvgPool")
    convolution2dLayer([1 1],48,"Name","Conv__431","Bias",params.Conv__431.Bias,"Weights",para
lgraph = addLayers(lgraph,tempLayers);

tempLayers = sigmoidLayer("Name","efficientnet-b0|model|blocks_14|se|SigmoidLayer");
lgraph = addLayers(lgraph,tempLayers);

tempLayers = [
    multiplicationLayer(2,"Name","efficientnet-b0|model|blocks_14|se|MulLayer")
    convolution2dLayer([1 1],1152,"Name","Conv__434","Bias",params.Conv__434.Bias,"Weights",para
    sigmoidLayer("Name","efficientnet-b0|model|blocks_14|se|SigmoidLayer_1")];
lgraph = addLayers(lgraph,tempLayers);

tempLayers = [
    multiplicationLayer(2,"Name","efficientnet-b0|model|blocks_14|se|MulLayer_1")
    convolution2dLayer([1 1],192,"Name","efficientnet-b0|model|blocks_14|conv2d_1|Conv2D","Bias
    batchNormalizationLayer("Name","efficientnet-b0|model|blocks_14|tpu_batch_normalization_2|K
lgraph = addLayers(lgraph,tempLayers);

tempLayers = [
    additionLayer(2,"Name","efficientnet-b0|model|blocks_14|Add")
    convolution2dLayer([1 1],1152,"Name","efficientnet-b0|model|blocks_15|conv2d|Conv2D","Bias
    batchNormalizationLayer("Name","efficientnet-b0|model|blocks_15|tpu_batch_normalization|Fus
lgraph = addLayers(lgraph,tempLayers);

tempLayers = sigmoidLayer("Name","efficientnet-b0|model|blocks_15|SigmoidLayer");
lgraph = addLayers(lgraph,tempLayers);

tempLayers = [
    multiplicationLayer(2,"Name","efficientnet-b0|model|blocks_15|MulLayer")
    groupedConvolution2dLayer([3 3],1,1152,"Name","efficientnet-b0|model|blocks_15|depthwise_co
    batchNormalizationLayer("Name","efficientnet-b0|model|blocks_15|tpu_batch_normalization_1|K
lgraph = addLayers(lgraph,tempLayers);

tempLayers = sigmoidLayer("Name","efficientnet-b0|model|blocks_15|SigmoidLayer_1");
lgraph = addLayers(lgraph,tempLayers);

tempLayers = multiplicationLayer(2,"Name","efficientnet-b0|model|blocks_15|MulLayer_1");
lgraph = addLayers(lgraph,tempLayers);

```



```

tempLayers = [
    globalAveragePooling2dLayer("Name", "efficientnet-b0|model|blocks_15|se|GlobAvgPool")
    convolution2dLayer([1 1], 48, "Name", "Conv__439", "Bias", params.Conv__439.Bias, "Weights", params.Conv__439.Weights);
lgraph = addLayers(lgraph, tempLayers);

tempLayers = sigmoidLayer("Name", "efficientnet-b0|model|blocks_15|se|SigmoidLayer");
lgraph = addLayers(lgraph, tempLayers);

tempLayers = [
    multiplicationLayer(2, "Name", "efficientnet-b0|model|blocks_15|se|MulLayer")
    convolution2dLayer([1 1], 1152, "Name", "Conv__442", "Bias", params.Conv__442.Bias, "Weights", params.Conv__442.Weights);
    sigmoidLayer("Name", "efficientnet-b0|model|blocks_15|se|SigmoidLayer_1");
lgraph = addLayers(lgraph, tempLayers);

tempLayers = [
    multiplicationLayer(2, "Name", "efficientnet-b0|model|blocks_15|se|MulLayer_1")
    convolution2dLayer([1 1], 320, "Name", "efficientnet-b0|model|blocks_15|conv2d_1|Conv2D", "Bias", params.Conv2D_1.Bias, "Weights", params.Conv2D_1.Weights);
    batchNormalizationLayer("Name", "efficientnet-b0|model|blocks_15|tpu_batch_normalization_2|FusedBatchNorm_2");
    convolution2dLayer([1 1], 1280, "Name", "efficientnet-b0|model|head|conv2d|Conv2D", "Bias", params.Conv2D.Bias, "Weights", params.Conv2D.Weights);
    batchNormalizationLayer("Name", "efficientnet-b0|model|head|tpu_batch_normalization|FusedBatchNorm");
lgraph = addLayers(lgraph, tempLayers);

tempLayers = sigmoidLayer("Name", "efficientnet-b0|model|head|SigmoidLayer");
lgraph = addLayers(lgraph, tempLayers);

tempLayers = [
    multiplicationLayer(2, "Name", "efficientnet-b0|model|head|MulLayer")
    globalAveragePooling2dLayer("Name", "efficientnet-b0|model|head|global_average_pooling2d|GlobalAveragePooling2D");
    fullyConnectedLayer(1, "Name", "fc")
    regressionLayer("Name", "regressionoutput");
lgraph = addLayers(lgraph, tempLayers);

% clean up helper variable
clear tempLayers;

```

Connect Layer Branches

Connect all the branches of the network to create the network graph.

```

lgraph = connectLayers(lgraph, "efficientnet-b0|model|stem|tpu_batch_normalization|FusedBatchNorm");
lgraph = connectLayers(lgraph, "efficientnet-b0|model|stem|tpu_batch_normalization|FusedBatchNorm");
lgraph = connectLayers(lgraph, "efficientnet-b0|model|stem|SigmoidLayer", "efficientnet-b0|model|stem|SigmoidLayer");
lgraph = connectLayers(lgraph, "efficientnet-b0|model|blocks_0|tpu_batch_normalization|FusedBatchNorm");
lgraph = connectLayers(lgraph, "efficientnet-b0|model|blocks_0|tpu_batch_normalization|FusedBatchNorm");
lgraph = connectLayers(lgraph, "efficientnet-b0|model|blocks_0|SigmoidLayer", "efficientnet-b0|model|blocks_0|SigmoidLayer");
lgraph = connectLayers(lgraph, "efficientnet-b0|model|blocks_0|MulLayer", "efficientnet-b0|model|blocks_0|MulLayer");
lgraph = connectLayers(lgraph, "efficientnet-b0|model|blocks_0|MulLayer", "efficientnet-b0|model|blocks_0|MulLayer");
lgraph = connectLayers(lgraph, "Conv__301", "efficientnet-b0|model|blocks_0|se|SigmoidLayer");
lgraph = connectLayers(lgraph, "Conv__301", "efficientnet-b0|model|blocks_0|se|MulLayer/in1");
lgraph = connectLayers(lgraph, "efficientnet-b0|model|blocks_0|se|SigmoidLayer", "efficientnet-b0|model|blocks_0|se|SigmoidLayer");

```

[illegible]

[illegible]

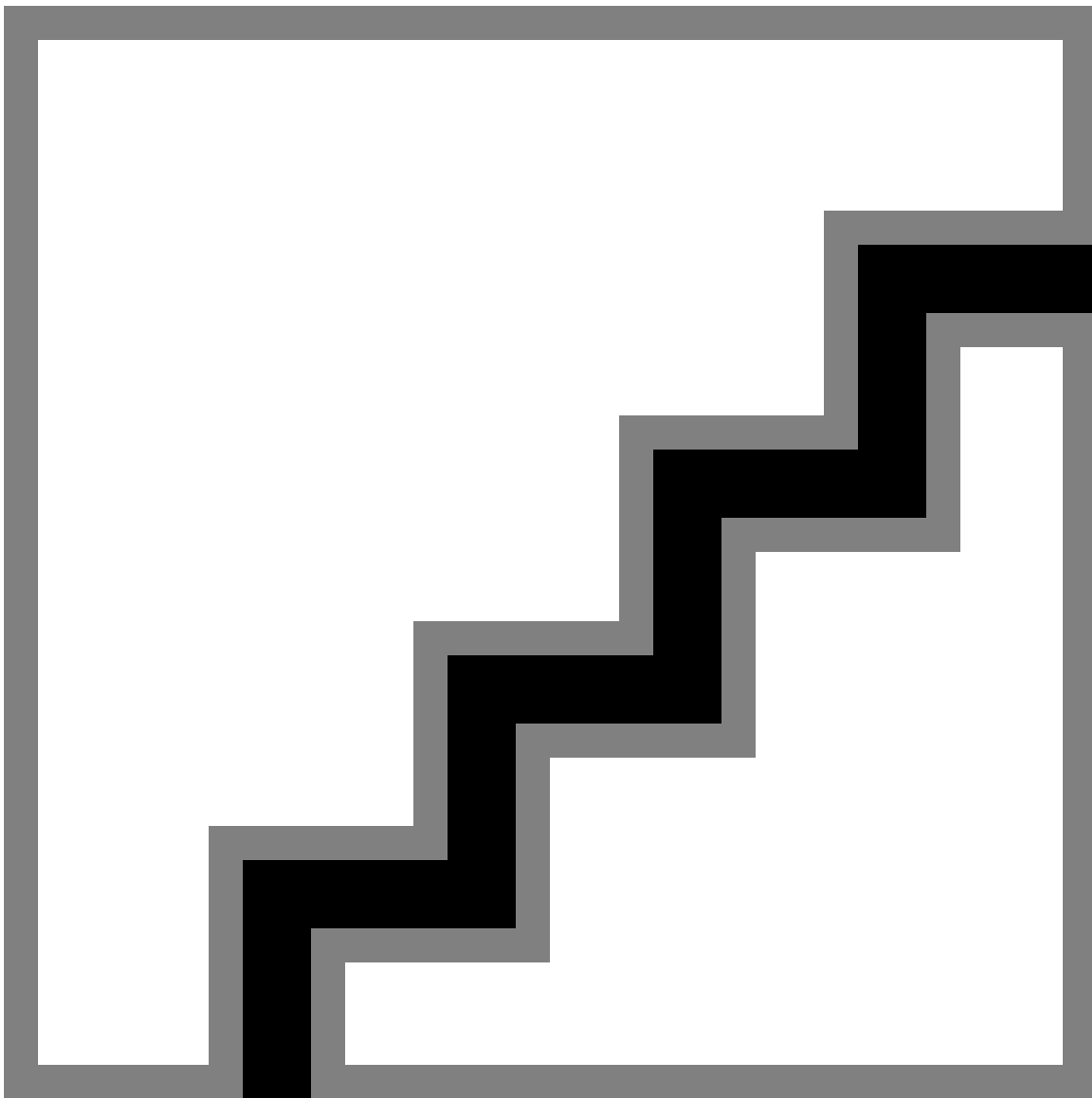
[illegible]

[illegible]

```
lgraph = connectLayers(lgraph, "efficientnet-b0|model|blocks_15|tpu_batch_normalization_1|FusedBatchNorm", "efficientnet-b0|model|blocks_15|tpu_batch_normalization_1|FusedBatchNorm");
lgraph = connectLayers(lgraph, "efficientnet-b0|model|blocks_15|SigmoidLayer_1", "efficientnet-b0|model|blocks_15|SigmoidLayer_1");
lgraph = connectLayers(lgraph, "efficientnet-b0|model|blocks_15|MulLayer_1", "efficientnet-b0|model|blocks_15|MulLayer_1");
lgraph = connectLayers(lgraph, "efficientnet-b0|model|blocks_15|MulLayer_1", "efficientnet-b0|model|blocks_15|MulLayer_1");
lgraph = connectLayers(lgraph, "Conv__439", "efficientnet-b0|model|blocks_15|se|SigmoidLayer");
lgraph = connectLayers(lgraph, "Conv__439", "efficientnet-b0|model|blocks_15|se|MulLayer/in1");
lgraph = connectLayers(lgraph, "efficientnet-b0|model|blocks_15|se|SigmoidLayer", "efficientnet-b0|model|blocks_15|se|SigmoidLayer");
lgraph = connectLayers(lgraph, "efficientnet-b0|model|blocks_15|se|SigmoidLayer_1", "efficientnet-b0|model|blocks_15|se|SigmoidLayer_1");
lgraph = connectLayers(lgraph, "efficientnet-b0|model|head|tpu_batch_normalization|FusedBatchNorm", "efficientnet-b0|model|head|tpu_batch_normalization|FusedBatchNorm");
lgraph = connectLayers(lgraph, "efficientnet-b0|model|head|tpu_batch_normalization|FusedBatchNorm", "efficientnet-b0|model|head|tpu_batch_normalization|FusedBatchNorm");
lgraph = connectLayers(lgraph, "efficientnet-b0|model|head|SigmoidLayer", "efficientnet-b0|model|head|SigmoidLayer");
```

Plot Layers

```
plot(lgraph);
```



```
% Define the parameters for the network
options=trainingOptions('sgdm',...
```

```

'InitialLearnRate', 0.03, ...
'Momentum',0.9,...
'L2Regularization',0.0005,...
'MaxEpochs',15,...
'MiniBatchSize',16,...
'VerboseFrequency',20,...
'LearnRateSchedule','piecewise',...
'ExecutionEnvironment','gpu',...
'Shuffle','every-epoch',...
"OutputNetwork", 'best-validation-loss',...
'ValidationData',{valds,valDSI}, ...
'ValidationFrequency',40, ...
'ValidationPatience',20,...
'GradientThresholdMethod','l2norm',...
'GradientThreshold',0.05);
%'Plots','training-progress',...

```

```
ccnet = trainNetwork(traininds,lgraph,options)
```

Initializing input data normalization.

Epoch	Iteration	Time Elapsed (hh:mm:ss)	Mini-batch RMSE	Validation RMSE	Mini-batch Loss	Validation Loss	Base Learning Rate
1	1	00:00:26	0.76	0.79	0.2923	0.3141	0.03
1	20	00:01:14	0.68		0.2324		0.03
1	40	00:02:06	0.29	0.36	0.0408	0.0637	0.03
1	60	00:02:50	0.33		0.0552		0.03
1	80	00:03:40	0.36	0.31	0.0645	0.0477	0.03
1	100	00:04:20	0.29		0.0410		0.03
1	120	00:05:08	0.27	0.30	0.0367	0.0440	0.03
1	140	00:05:47	0.23		0.0272		0.03
1	160	00:06:32	0.28	0.28	0.0405	0.0388	0.03
1	180	00:07:11	0.31		0.0482		0.03
1	200	00:07:55	0.29	0.27	0.0412	0.0356	0.03
1	220	00:08:34	0.28		0.0398		0.03
1	240	00:09:20	0.21	0.25	0.0229	0.0307	0.03
1	260	00:10:01	0.18		0.0162		0.03
2	280	00:10:47	0.15	0.25	0.0108	0.0309	0.03
2	300	00:11:26	0.24		0.0278		0.03
2	320	00:12:09	0.26	0.23	0.0343	0.0262	0.03
2	340	00:12:46	0.19		0.0180		0.03
2	360	00:13:30	0.18	0.23	0.0169	0.0263	0.03
2	380	00:14:07	0.23		0.0255		0.03
2	400	00:14:50	0.22	0.23	0.0249	0.0256	0.03
2	420	00:15:27	0.17		0.0147		0.03
2	440	00:16:50	0.25	0.21	0.0306	0.0221	0.03
2	460	00:18:16	0.17		0.0141		0.03
2	480	00:19:51	0.10	0.20	0.0054	0.0206	0.03
2	500	00:21:17	0.15		0.0114		0.03
2	520	00:22:49	0.14	0.20	0.0092	0.0204	0.03
2	540	00:23:29	0.17		0.0150		0.03
3	560	00:24:16	0.17	0.19	0.0146	0.0182	0.03
3	580	00:24:56	0.20		0.0207		0.03
3	600	00:25:42	0.14	0.20	0.0104	0.0194	0.03
3	620	00:26:21	0.20		0.0193		0.03
3	640	00:27:07	0.14	0.18	0.0091	0.0160	0.03
3	660	00:27:46	0.11		0.0064		0.03

3	680	00:28:33	0.11	0.18	0.0060	0.0170	0.03
3	700	00:29:13	0.08		0.0034		0.03
3	720	00:29:59	0.13	0.18	0.0086	0.0167	0.03
3	740	00:30:39	0.22		0.0237		0.03
3	760	00:31:24	0.14	0.18	0.0094	0.0162	0.03
3	780	00:32:04	0.17		0.0145		0.03
3	800	00:32:49	0.16	0.18	0.0133	0.0170	0.03
4	820	00:33:31	0.14		0.0100		0.03
4	840	00:34:18	0.15	0.18	0.0105	0.0156	0.03
4	860	00:34:59	0.10		0.0050		0.03
4	880	00:35:44	0.14	0.18	0.0093	0.0155	0.03
4	900	00:36:23	0.11		0.0065		0.03
4	920	00:37:10	0.18	0.16	0.0162	0.0131	0.03
4	940	00:37:50	0.11		0.0062		0.03
4	960	00:38:36	0.15	0.16	0.0111	0.0122	0.03
4	980	00:39:15	0.13		0.0084		0.03
4	1000	00:40:02	0.11	0.17	0.0055	0.0142	0.03
4	1020	00:40:41	0.11		0.0056		0.03
4	1040	00:41:25	0.13	0.17	0.0080	0.0148	0.03
4	1060	00:42:03	0.10		0.0047		0.03
4	1080	00:42:47	0.17	0.16	0.0141	0.0136	0.03
5	1100	00:43:27	0.09		0.0041		0.03
5	1120	00:44:09	0.11	0.16	0.0060	0.0134	0.03
5	1140	00:44:47	0.10		0.0049		0.03
5	1160	00:45:34	0.12	0.15	0.0074	0.0114	0.03
5	1180	00:46:56	0.11		0.0060		0.03
5	1200	00:48:15	0.09	0.16	0.0038	0.0121	0.03
5	1220	00:49:27	0.11		0.0062		0.03
5	1240	00:50:14	0.07	0.16	0.0022	0.0125	0.03
5	1260	00:50:53	0.11		0.0055		0.03
5	1280	00:51:36	0.12	0.15	0.0073	0.0120	0.03
5	1300	00:52:15	0.15		0.0114		0.03
5	1320	00:52:59	0.15	0.16	0.0106	0.0123	0.03
5	1340	00:53:38	0.09		0.0040		0.03
6	1360	00:54:25	0.06	0.15	0.0019	0.0108	0.03
6	1380	00:55:04	0.05		0.0014		0.03
6	1400	00:55:48	0.11	0.15	0.0061	0.0112	0.03
6	1420	00:56:26	0.10		0.0052		0.03
6	1440	00:57:11	0.09	0.15	0.0041	0.0117	0.03
6	1460	00:57:49	0.09		0.0038		0.03
6	1480	00:58:43	0.06	0.16	0.0017	0.0126	0.03
6	1500	00:59:41	0.09		0.0036		0.03
6	1520	01:00:34	0.12	0.15	0.0077	0.0108	0.03
6	1540	01:01:20	0.08		0.0034		0.03
6	1560	01:02:21	0.10	0.15	0.0050	0.0114	0.03
6	1580	01:03:17	0.14		0.0099		0.03
6	1600	01:04:11	0.14	0.15	0.0096	0.0116	0.03
6	1620	01:05:09	0.13		0.0089		0.03
7	1640	01:06:01	0.05	0.16	0.0015	0.0122	0.03
7	1660	01:06:42	0.10		0.0055		0.03
7	1680	01:07:27	0.09	0.15	0.0037	0.0119	0.03
7	1700	01:08:08	0.11		0.0063		0.03
7	1720	01:08:54	0.09	0.16	0.0036	0.0122	0.03
7	1740	01:09:35	0.16		0.0129		0.03
7	1760	01:10:23	0.11	0.16	0.0058	0.0124	0.03
7	1780	01:11:02	0.16		0.0134		0.03
7	1800	01:11:48	0.12	0.15	0.0071	0.0119	0.03
7	1820	01:12:29	0.09		0.0039		0.03
7	1840	01:13:20	0.12	0.15	0.0076	0.0107	0.03
7	1860	01:14:02	0.07		0.0025		0.03
7	1880	01:15:03	0.08	0.15	0.0035	0.0114	0.03
8	1900	01:15:51	0.07		0.0024		0.03
8	1920	01:16:43	0.12	0.14	0.0072	0.0104	0.03
8	1940	01:17:25	0.10		0.0047		0.03

8	1960	01:18:19	0.09	0.14	0.0043	0.0097	0.03
8	1980	01:19:03	0.09		0.0039		0.03
8	2000	01:19:55	0.09	0.15	0.0036	0.0108	0.03
8	2020	01:20:38	0.09		0.0041		0.03
8	2040	01:21:27	0.07	0.14	0.0025	0.0100	0.03
8	2060	01:22:07	0.06		0.0018		0.03
8	2080	01:22:54	0.06	0.14	0.0020	0.0101	0.03
8	2100	01:23:33	0.07		0.0028		0.03
8	2120	01:24:20	0.12	0.15	0.0070	0.0113	0.03
8	2140	01:25:03	0.11		0.0059		0.03
8	2160	01:25:52	0.08	0.15	0.0035	0.0111	0.03
9	2180	01:26:35	0.08		0.0029		0.03
9	2200	01:27:23	0.09	0.16	0.0045	0.0122	0.03
9	2220	01:28:04	0.10		0.0046		0.03
9	2240	01:28:52	0.13	0.15	0.0079	0.0112	0.03
9	2260	01:29:32	0.07		0.0023		0.03
9	2280	01:30:20	0.11	0.15	0.0066	0.0105	0.03
9	2300	01:31:10	0.06		0.0019		0.03
9	2320	01:32:01	0.08	0.15	0.0029	0.0105	0.03
9	2340	01:32:45	0.12		0.0070		0.03
9	2360	01:33:36	0.05	0.14	0.0013	0.0101	0.03
9	2380	01:34:17	0.06		0.0019		0.03
9	2400	01:35:06	0.11	0.15	0.0057	0.0107	0.03
9	2420	01:35:48	0.12		0.0077		0.03
10	2440	01:36:38	0.11	0.15	0.0063	0.0107	0.03
10	2460	01:37:25	0.10		0.0047		0.03
10	2480	01:38:15	0.07	0.14	0.0025	0.0096	0.03
10	2500	01:39:08	0.06		0.0019		0.03
10	2520	01:39:59	0.08	0.14	0.0028	0.0098	0.03
10	2540	01:40:41	0.09		0.0038		0.03
10	2560	01:41:35	0.05	0.14	0.0015	0.0098	0.03
10	2580	01:42:16	0.07		0.0025		0.03
10	2600	01:43:03	0.08	0.14	0.0035	0.0099	0.03
10	2620	01:43:43	0.07		0.0023		0.03
10	2640	01:44:30	0.07	0.14	0.0025	0.0100	0.03
10	2660	01:45:10	0.09		0.0039		0.03
10	2680	01:45:58	0.09	0.14	0.0038	0.0095	0.03
10	2700	01:46:39	0.08		0.0031		0.03
11	2720	01:47:28	0.07	0.14	0.0026	0.0094	0.00
11	2740	01:48:09	0.08		0.0036		0.00
11	2760	01:48:55	0.06	0.14	0.0018	0.0091	0.00
11	2780	01:49:40	0.07		0.0023		0.00
11	2800	01:50:29	0.06	0.13	0.0015	0.0089	0.00
11	2820	01:51:16	0.07		0.0021		0.00
11	2840	01:52:09	0.05	0.13	0.0011	0.0090	0.00
11	2860	01:52:56	0.07		0.0025		0.00
11	2880	01:53:41	0.08	0.14	0.0036	0.0092	0.00
11	2900	01:54:20	0.06		0.0018		0.00
11	2920	01:55:13	0.06	0.13	0.0015	0.0090	0.00
11	2940	01:55:58	0.10		0.0046		0.00
11	2960	01:56:46	0.06	0.13	0.0019	0.0080	0.00
11	2980	01:57:27	0.06		0.0020		0.00
12	3000	01:58:17	0.09	0.13	0.0042	0.0086	0.00
12	3020	01:58:56	0.10		0.0053		0.00
12	3040	01:59:54	0.06	0.13	0.0019	0.0090	0.00
12	3060	02:00:34	0.07		0.0023		0.00
12	3080	02:01:20	0.08	0.14	0.0032	0.0091	0.00
12	3100	02:02:06	0.06		0.0019		0.00
12	3120	02:02:56	0.09	0.13	0.0041	0.0079	0.00
12	3140	02:03:39	0.07		0.0025		0.00
12	3160	02:04:27	0.10	0.13	0.0051	0.0090	0.00
12	3180	02:05:09	0.07		0.0028		0.00
12	3200	02:06:06	0.06	0.14	0.0019	0.0094	0.00
12	3220	02:06:48	0.06		0.0019		0.00

12	3240	02:07:40	0.06	0.13	0.0019	0.0089	0.00
13	3260	02:08:27	0.07		0.0023		0.00
13	3280	02:09:13	0.05	0.13	0.0015	0.0089	0.00
13	3300	02:09:53	0.10		0.0051		0.00
13	3320	02:10:46	0.09	0.13	0.0042	0.0083	0.00
13	3340	02:11:28	0.05		0.0013		0.00
13	3360	02:12:15	0.06	0.14	0.0015	0.0091	0.00
13	3380	02:12:54	0.07		0.0025		0.00
13	3400	02:13:40	0.07	0.13	0.0024	0.0087	0.00
13	3420	02:14:21	0.06		0.0021		0.00
13	3440	02:15:07	0.05	0.13	0.0012	0.0085	0.00
13	3460	02:15:50	0.06		0.0016		0.00
13	3480	02:16:35	0.11	0.13	0.0056	0.0088	0.00
13	3500	02:17:18	0.06		0.0016		0.00
13	3520	02:18:06	0.03	0.14	0.0006	0.0097	0.00
14	3540	02:18:48	0.08		0.0033		0.00
14	3560	02:19:35	0.03	0.13	0.0006	0.0084	0.00
14	3580	02:20:17	0.06		0.0019		0.00
14	3600	02:21:03	0.05	0.13	0.0015	0.0091	0.00
14	3620	02:21:49	0.05		0.0012		0.00
14	3640	02:22:37	0.05	0.14	0.0013	0.0095	0.00
14	3660	02:23:20	0.08		0.0031		0.00
14	3680	02:24:13	0.07	0.13	0.0028	0.0089	0.00
14	3700	02:24:57	0.12		0.0074		0.00
14	3720	02:25:48	0.09	0.13	0.0040	0.0086	0.00
14	3740	02:26:33	0.06		0.0018		0.00
14	3760	02:27:22	0.06	0.13	0.0015	0.0087	0.00
14	3780	02:28:05	0.08		0.0032		0.00
15	3800	02:28:54	0.09	0.13	0.0037	0.0080	0.00
15	3820	02:29:32	0.10		0.0046		0.00
15	3840	02:30:14	0.08	0.13	0.0033	0.0089	0.00
15	3860	02:30:51	0.09		0.0044		0.00
15	3880	02:31:35	0.07	0.13	0.0024	0.0087	0.00
15	3900	02:32:12	0.07		0.0026		0.00
15	3920	02:32:55	0.07	0.13	0.0025	0.0083	0.00

Training finished: Met validation criterion.

ccnet =

DAGNetwork with properties:

Layers: [289x1 nnet.cnn.layer.Layer]

Connections: [362x2 table]

InputNames: {'imageinput'}

OutputNames: {'regressionoutput'}

```
Train_Predicted = abs(predict(ccnet,trainds));
```

```
Test_Predicted = abs(predict(ccnet,testds));
```

```
Train_Pred_mae = errperf(trainDSI,Train_Predicted,'mae')
```

```
Train_Pred_mae = single
```

```
0.0419
```

```
Test_Pred_mae = errperf(testDSI,Test_Predicted,'mae')
```

```
Test_Pred_mae = single
```

```
0.0768
```

```
Train_Pred_rmse = errperf(trainDSI,Train_Predicted,'rmse')
```

```
Train_Pred_rmse = single
```

```
0.0578
```

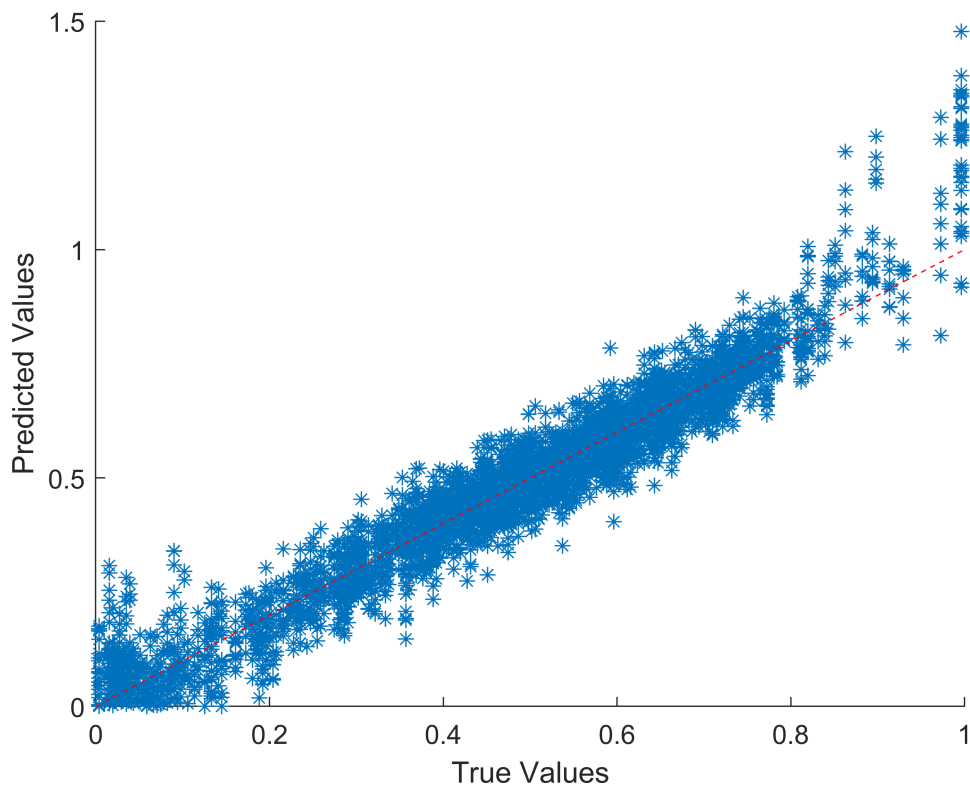
```
Test_Pred_rmse = errperf(testDSI,Test_Predicted,'rmse')
```

```
Test_Pred_rmse = single
```

```
0.1082
```

```
figure
scatter(trainDSI,Train_Predicted,'*')
xlabel("True Values")
ylabel("Predicted Values")

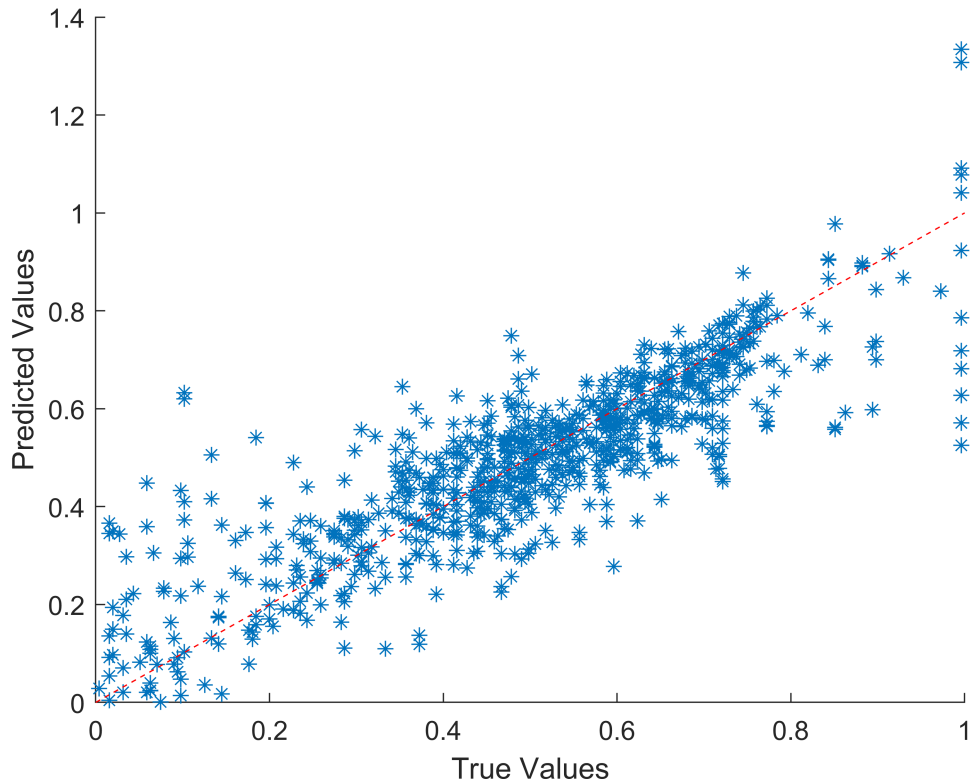
hold on
plot([0 1], [0 1],'r--')
```



```
figure
scatter(testDSI,Test_Predicted,'*')
xlabel("True Values")
ylabel("Predicted Values")

hold on
```

```
plot([0 1], [0 1], 'r--')
```



GradCAM Analysis

```
% mytestds = imresize(imread("08_Orig.jpg"),[224 224]);
```

```
% My_Test_Predicted = abs(predict(ccnet,mytestds))
```

```
% %mytestDSI = testData(30,:).DSI  
% mytestDSI = 0.12508
```

```
% featureLayer = 'activation_49_relu';  
% reductionLayer = 'fc';
```

```
% reductionFcn = @(x)x;
```

```
% scoreMap = gradCAM(ccnet,mytestds,reductionFcn, ...  
%     'ReductionLayer',reductionLayer, ...  
%     'FeatureLayer',featureLayer);
```

```

% ax(1) = subplot(1,2,1);
% imshow(mytestds)
% title("True IQ = " + mytestDSI + '\newline Pred IQ = ' + My_Test_Predicted)
% colormap(ax(1),'gray')
%
% ax(2) = subplot(1,2,2);
% imshow(mytestds)
% hold on
% imagesc(scoreMap,'AlphaData',1)
% colormap(ax(2),'jet')
% title("GradCAM")
% hold off

```

```

OrigtestData = readtable("Test.csv");
imagetestData = OrigtestData.Name;
ntestImg = height(imagetestData)

```

```

ntestImg = 48

```

```

Origtestimds= imageDatastore(imagetestData);

OrigtestSC = OrigtestData.Value ;

```

```

Origtestds = augmentedImageDatastore([224 224],OrigtestData);
Origtest_SC_Predicted = abs(predict(ccnet,Origtestds));

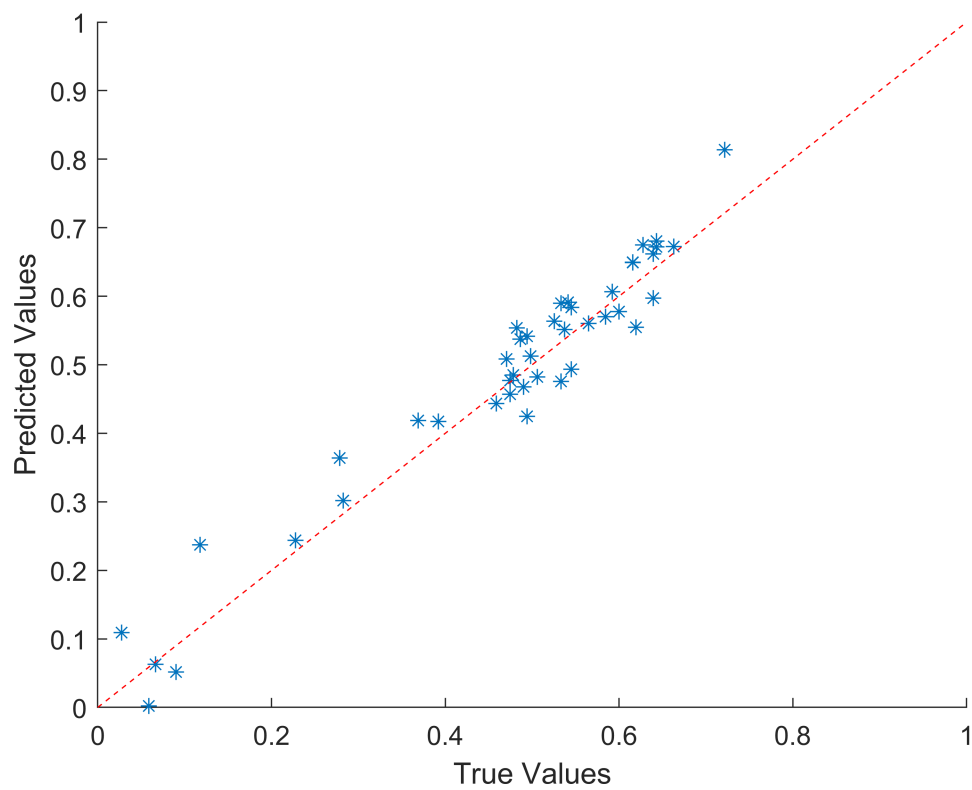
```

```

figure
scatter(OrigtestSC,Origtest_SC_Predicted,'*')
xlabel("True Values")
ylabel("Predicted Values")

hold on
plot([0 1], [0 1], 'r--')

```



```
Origtest_Pred_mae = errperf(OrigtestSC,Origtest_SC_Predicted,'mae')
```

```
Origtest_Pred_mae = single
```

```
0.0380
```

```
Origtest_Pred_rmse = errperf(OrigtestSC,Origtest_SC_Predicted,'rmse')
```

```
Origtest_Pred_rmse = single
```

```
0.0459
```

```
T= table(imagetestData,Origtest_SC_Predicted);  
%writetable(T,'EfficientNet_15epoch_Test1_25.02.23.xls');
```

```
errperf(trainDSI,Train_Predicted,'mape')
```

```
ans = single
```

```
31.4140
```