Model: "model\_1"

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Layer (type) Output Shape Param # Connected to

==================================================================================================

input\_2 (InputLayer) [(None, 224, 224, 3) 0

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block1\_conv1 (Conv2D) (None, 111, 111, 32) 864 input\_2[0][0]

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block1\_conv1\_bn (BatchNormaliza (None, 111, 111, 32) 128 block1\_conv1[0][0]

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block1\_conv1\_act (Activation) (None, 111, 111, 32) 0 block1\_conv1\_bn[0][0]

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block1\_conv2 (Conv2D) (None, 109, 109, 64) 18432 block1\_conv1\_act[0][0]

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block1\_conv2\_bn (BatchNormaliza (None, 109, 109, 64) 256 block1\_conv2[0][0]

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block1\_conv2\_act (Activation) (None, 109, 109, 64) 0 block1\_conv2\_bn[0][0]

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block2\_sepconv1 (SeparableConv2 (None, 109, 109, 128 8768 block1\_conv2\_act[0][0]

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block2\_sepconv1\_bn (BatchNormal (None, 109, 109, 128 512 block2\_sepconv1[0][0]

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block2\_sepconv2\_act (Activation (None, 109, 109, 128 0 block2\_sepconv1\_bn[0][0]

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block2\_sepconv2 (SeparableConv2 (None, 109, 109, 128 17536 block2\_sepconv2\_act[0][0]

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block2\_sepconv2\_bn (BatchNormal (None, 109, 109, 128 512 block2\_sepconv2[0][0]

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conv2d\_4 (Conv2D) (None, 55, 55, 128) 8192 block1\_conv2\_act[0][0]

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block2\_pool (MaxPooling2D) (None, 55, 55, 128) 0 block2\_sepconv2\_bn[0][0]

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batch\_normalization\_4 (BatchNor (None, 55, 55, 128) 512 conv2d\_4[0][0]

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add\_12 (Add) (None, 55, 55, 128) 0 block2\_pool[0][0]

batch\_normalization\_4[0][0]

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block3\_sepconv1\_act (Activation (None, 55, 55, 128) 0 add\_12[0][0]

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block3\_sepconv1 (SeparableConv2 (None, 55, 55, 256) 33920 block3\_sepconv1\_act[0][0]

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block3\_sepconv1\_bn (BatchNormal (None, 55, 55, 256) 1024 block3\_sepconv1[0][0]

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block3\_sepconv2\_act (Activation (None, 55, 55, 256) 0 block3\_sepconv1\_bn[0][0]

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block3\_sepconv2 (SeparableConv2 (None, 55, 55, 256) 67840 block3\_sepconv2\_act[0][0]

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block3\_sepconv2\_bn (BatchNormal (None, 55, 55, 256) 1024 block3\_sepconv2[0][0]

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conv2d\_5 (Conv2D) (None, 28, 28, 256) 32768 add\_12[0][0]

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block3\_pool (MaxPooling2D) (None, 28, 28, 256) 0 block3\_sepconv2\_bn[0][0]

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batch\_normalization\_5 (BatchNor (None, 28, 28, 256) 1024 conv2d\_5[0][0]

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add\_13 (Add) (None, 28, 28, 256) 0 block3\_pool[0][0]

batch\_normalization\_5[0][0]

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block4\_sepconv1\_act (Activation (None, 28, 28, 256) 0 add\_13[0][0]

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block4\_sepconv1 (SeparableConv2 (None, 28, 28, 728) 188672 block4\_sepconv1\_act[0][0]

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block4\_sepconv1\_bn (BatchNormal (None, 28, 28, 728) 2912 block4\_sepconv1[0][0]

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block4\_sepconv2\_act (Activation (None, 28, 28, 728) 0 block4\_sepconv1\_bn[0][0]

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block4\_sepconv2 (SeparableConv2 (None, 28, 28, 728) 536536 block4\_sepconv2\_act[0][0]

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block4\_sepconv2\_bn (BatchNormal (None, 28, 28, 728) 2912 block4\_sepconv2[0][0]

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conv2d\_6 (Conv2D) (None, 14, 14, 728) 186368 add\_13[0][0]

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block4\_pool (MaxPooling2D) (None, 14, 14, 728) 0 block4\_sepconv2\_bn[0][0]

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batch\_normalization\_6 (BatchNor (None, 14, 14, 728) 2912 conv2d\_6[0][0]

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add\_14 (Add) (None, 14, 14, 728) 0 block4\_pool[0][0]

batch\_normalization\_6[0][0]

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block5\_sepconv1\_act (Activation (None, 14, 14, 728) 0 add\_14[0][0]

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block5\_sepconv1 (SeparableConv2 (None, 14, 14, 728) 536536 block5\_sepconv1\_act[0][0]

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block5\_sepconv1\_bn (BatchNormal (None, 14, 14, 728) 2912 block5\_sepconv1[0][0]

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block5\_sepconv2\_act (Activation (None, 14, 14, 728) 0 block5\_sepconv1\_bn[0][0]

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block5\_sepconv2 (SeparableConv2 (None, 14, 14, 728) 536536 block5\_sepconv2\_act[0][0]

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block5\_sepconv2\_bn (BatchNormal (None, 14, 14, 728) 2912 block5\_sepconv2[0][0]

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block5\_sepconv3\_act (Activation (None, 14, 14, 728) 0 block5\_sepconv2\_bn[0][0]

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block5\_sepconv3 (SeparableConv2 (None, 14, 14, 728) 536536 block5\_sepconv3\_act[0][0]

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block5\_sepconv3\_bn (BatchNormal (None, 14, 14, 728) 2912 block5\_sepconv3[0][0]

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add\_15 (Add) (None, 14, 14, 728) 0 block5\_sepconv3\_bn[0][0]

add\_14[0][0]

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block6\_sepconv1\_act (Activation (None, 14, 14, 728) 0 add\_15[0][0]

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block6\_sepconv1 (SeparableConv2 (None, 14, 14, 728) 536536 block6\_sepconv1\_act[0][0]

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block6\_sepconv1\_bn (BatchNormal (None, 14, 14, 728) 2912 block6\_sepconv1[0][0]

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block6\_sepconv2\_act (Activation (None, 14, 14, 728) 0 block6\_sepconv1\_bn[0][0]

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block6\_sepconv2 (SeparableConv2 (None, 14, 14, 728) 536536 block6\_sepconv2\_act[0][0]

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block6\_sepconv2\_bn (BatchNormal (None, 14, 14, 728) 2912 block6\_sepconv2[0][0]

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block6\_sepconv3\_act (Activation (None, 14, 14, 728) 0 block6\_sepconv2\_bn[0][0]

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block6\_sepconv3 (SeparableConv2 (None, 14, 14, 728) 536536 block6\_sepconv3\_act[0][0]

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block6\_sepconv3\_bn (BatchNormal (None, 14, 14, 728) 2912 block6\_sepconv3[0][0]

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add\_16 (Add) (None, 14, 14, 728) 0 block6\_sepconv3\_bn[0][0]

add\_15[0][0]

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block7\_sepconv1\_act (Activation (None, 14, 14, 728) 0 add\_16[0][0]

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block7\_sepconv1 (SeparableConv2 (None, 14, 14, 728) 536536 block7\_sepconv1\_act[0][0]

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block7\_sepconv1\_bn (BatchNormal (None, 14, 14, 728) 2912 block7\_sepconv1[0][0]

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block7\_sepconv2\_act (Activation (None, 14, 14, 728) 0 block7\_sepconv1\_bn[0][0]

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block7\_sepconv2 (SeparableConv2 (None, 14, 14, 728) 536536 block7\_sepconv2\_act[0][0]

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block7\_sepconv2\_bn (BatchNormal (None, 14, 14, 728) 2912 block7\_sepconv2[0][0]

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block7\_sepconv3\_act (Activation (None, 14, 14, 728) 0 block7\_sepconv2\_bn[0][0]

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block7\_sepconv3 (SeparableConv2 (None, 14, 14, 728) 536536 block7\_sepconv3\_act[0][0]

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block7\_sepconv3\_bn (BatchNormal (None, 14, 14, 728) 2912 block7\_sepconv3[0][0]

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add\_17 (Add) (None, 14, 14, 728) 0 block7\_sepconv3\_bn[0][0]

add\_16[0][0]

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block8\_sepconv1\_act (Activation (None, 14, 14, 728) 0 add\_17[0][0]

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block8\_sepconv1 (SeparableConv2 (None, 14, 14, 728) 536536 block8\_sepconv1\_act[0][0]

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block8\_sepconv1\_bn (BatchNormal (None, 14, 14, 728) 2912 block8\_sepconv1[0][0]

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block8\_sepconv2\_act (Activation (None, 14, 14, 728) 0 block8\_sepconv1\_bn[0][0]

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block8\_sepconv2 (SeparableConv2 (None, 14, 14, 728) 536536 block8\_sepconv2\_act[0][0]

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block8\_sepconv2\_bn (BatchNormal (None, 14, 14, 728) 2912 block8\_sepconv2[0][0]

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block8\_sepconv3\_act (Activation (None, 14, 14, 728) 0 block8\_sepconv2\_bn[0][0]

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block8\_sepconv3 (SeparableConv2 (None, 14, 14, 728) 536536 block8\_sepconv3\_act[0][0]

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block8\_sepconv3\_bn (BatchNormal (None, 14, 14, 728) 2912 block8\_sepconv3[0][0]

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add\_18 (Add) (None, 14, 14, 728) 0 block8\_sepconv3\_bn[0][0]

add\_17[0][0]

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block9\_sepconv1\_act (Activation (None, 14, 14, 728) 0 add\_18[0][0]

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block9\_sepconv1 (SeparableConv2 (None, 14, 14, 728) 536536 block9\_sepconv1\_act[0][0]

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block9\_sepconv1\_bn (BatchNormal (None, 14, 14, 728) 2912 block9\_sepconv1[0][0]

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block9\_sepconv2\_act (Activation (None, 14, 14, 728) 0 block9\_sepconv1\_bn[0][0]

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block9\_sepconv2 (SeparableConv2 (None, 14, 14, 728) 536536 block9\_sepconv2\_act[0][0]

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block9\_sepconv2\_bn (BatchNormal (None, 14, 14, 728) 2912 block9\_sepconv2[0][0]

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block9\_sepconv3\_act (Activation (None, 14, 14, 728) 0 block9\_sepconv2\_bn[0][0]

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block9\_sepconv3 (SeparableConv2 (None, 14, 14, 728) 536536 block9\_sepconv3\_act[0][0]

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block9\_sepconv3\_bn (BatchNormal (None, 14, 14, 728) 2912 block9\_sepconv3[0][0]

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add\_19 (Add) (None, 14, 14, 728) 0 block9\_sepconv3\_bn[0][0]

add\_18[0][0]

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block10\_sepconv1\_act (Activatio (None, 14, 14, 728) 0 add\_19[0][0]

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block10\_sepconv1 (SeparableConv (None, 14, 14, 728) 536536 block10\_sepconv1\_act[0][0]

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block10\_sepconv1\_bn (BatchNorma (None, 14, 14, 728) 2912 block10\_sepconv1[0][0]

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block10\_sepconv2\_act (Activatio (None, 14, 14, 728) 0 block10\_sepconv1\_bn[0][0]

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block10\_sepconv2 (SeparableConv (None, 14, 14, 728) 536536 block10\_sepconv2\_act[0][0]

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block10\_sepconv2\_bn (BatchNorma (None, 14, 14, 728) 2912 block10\_sepconv2[0][0]

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block10\_sepconv3\_act (Activatio (None, 14, 14, 728) 0 block10\_sepconv2\_bn[0][0]

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block10\_sepconv3 (SeparableConv (None, 14, 14, 728) 536536 block10\_sepconv3\_act[0][0]

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block10\_sepconv3\_bn (BatchNorma (None, 14, 14, 728) 2912 block10\_sepconv3[0][0]

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add\_20 (Add) (None, 14, 14, 728) 0 block10\_sepconv3\_bn[0][0]

add\_19[0][0]

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block11\_sepconv1\_act (Activatio (None, 14, 14, 728) 0 add\_20[0][0]

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block11\_sepconv1 (SeparableConv (None, 14, 14, 728) 536536 block11\_sepconv1\_act[0][0]

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block11\_sepconv1\_bn (BatchNorma (None, 14, 14, 728) 2912 block11\_sepconv1[0][0]

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block11\_sepconv2\_act (Activatio (None, 14, 14, 728) 0 block11\_sepconv1\_bn[0][0]

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block11\_sepconv2 (SeparableConv (None, 14, 14, 728) 536536 block11\_sepconv2\_act[0][0]

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block11\_sepconv2\_bn (BatchNorma (None, 14, 14, 728) 2912 block11\_sepconv2[0][0]

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block11\_sepconv3\_act (Activatio (None, 14, 14, 728) 0 block11\_sepconv2\_bn[0][0]

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block11\_sepconv3 (SeparableConv (None, 14, 14, 728) 536536 block11\_sepconv3\_act[0][0]

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block11\_sepconv3\_bn (BatchNorma (None, 14, 14, 728) 2912 block11\_sepconv3[0][0]

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add\_21 (Add) (None, 14, 14, 728) 0 block11\_sepconv3\_bn[0][0]

add\_20[0][0]

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block12\_sepconv1\_act (Activatio (None, 14, 14, 728) 0 add\_21[0][0]

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block12\_sepconv1 (SeparableConv (None, 14, 14, 728) 536536 block12\_sepconv1\_act[0][0]

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block12\_sepconv1\_bn (BatchNorma (None, 14, 14, 728) 2912 block12\_sepconv1[0][0]

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block12\_sepconv2\_act (Activatio (None, 14, 14, 728) 0 block12\_sepconv1\_bn[0][0]

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block12\_sepconv2 (SeparableConv (None, 14, 14, 728) 536536 block12\_sepconv2\_act[0][0]

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block12\_sepconv2\_bn (BatchNorma (None, 14, 14, 728) 2912 block12\_sepconv2[0][0]

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block12\_sepconv3\_act (Activatio (None, 14, 14, 728) 0 block12\_sepconv2\_bn[0][0]

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block12\_sepconv3 (SeparableConv (None, 14, 14, 728) 536536 block12\_sepconv3\_act[0][0]

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block12\_sepconv3\_bn (BatchNorma (None, 14, 14, 728) 2912 block12\_sepconv3[0][0]

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add\_22 (Add) (None, 14, 14, 728) 0 block12\_sepconv3\_bn[0][0]

add\_21[0][0]

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block13\_sepconv1\_act (Activatio (None, 14, 14, 728) 0 add\_22[0][0]

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block13\_sepconv1 (SeparableConv (None, 14, 14, 728) 536536 block13\_sepconv1\_act[0][0]

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block13\_sepconv1\_bn (BatchNorma (None, 14, 14, 728) 2912 block13\_sepconv1[0][0]

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block13\_sepconv2\_act (Activatio (None, 14, 14, 728) 0 block13\_sepconv1\_bn[0][0]

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block13\_sepconv2 (SeparableConv (None, 14, 14, 1024) 752024 block13\_sepconv2\_act[0][0]

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block13\_sepconv2\_bn (BatchNorma (None, 14, 14, 1024) 4096 block13\_sepconv2[0][0]

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conv2d\_7 (Conv2D) (None, 7, 7, 1024) 745472 add\_22[0][0]

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block13\_pool (MaxPooling2D) (None, 7, 7, 1024) 0 block13\_sepconv2\_bn[0][0]

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batch\_normalization\_7 (BatchNor (None, 7, 7, 1024) 4096 conv2d\_7[0][0]

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add\_23 (Add) (None, 7, 7, 1024) 0 block13\_pool[0][0]

batch\_normalization\_7[0][0]

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block14\_sepconv1 (SeparableConv (None, 7, 7, 1536) 1582080 add\_23[0][0]

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block14\_sepconv1\_bn (BatchNorma (None, 7, 7, 1536) 6144 block14\_sepconv1[0][0]

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block14\_sepconv1\_act (Activatio (None, 7, 7, 1536) 0 block14\_sepconv1\_bn[0][0]

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block14\_sepconv2 (SeparableConv (None, 7, 7, 2048) 3159552 block14\_sepconv1\_act[0][0]

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block14\_sepconv2\_bn (BatchNorma (None, 7, 7, 2048) 8192 block14\_sepconv2[0][0]

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block14\_sepconv2\_act (Activatio (None, 7, 7, 2048) 0 block14\_sepconv2\_bn[0][0]

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flatten\_1 (Flatten) (None, 100352) 0 block14\_sepconv2\_act[0][0]

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dense\_2 (Dense) (None, 6) 602118 flatten\_1[0][0]

==================================================================================================

Total params: 21,463,598

Trainable params: 602,118

Non-trainable params: 20,861,480

Found 899 images belonging to 6 classes.

Found 222 images belonging to 6 classes.

/usr/local/lib/python3.7/dist-packages/tensorflow/python/keras/engine/training.py:1940: UserWarning: `Model.fit\_generator` is deprecated and will be removed in a future version. Please use `Model.fit`, which supports generators.

warnings.warn('`Model.fit\_generator` is deprecated and '

Epoch 1/20

8/8 [==============================] - 169s 21s/step - loss: 7.6472 - accuracy: 0.4494 - val\_loss: 6.9009 - val\_accuracy: 0.4865

/usr/local/lib/python3.7/dist-packages/tensorflow/python/keras/utils/generic\_utils.py:497: CustomMaskWarning: Custom mask layers require a config and must override get\_config. When loading, the custom mask layer must be passed to the custom\_objects argument.

category=CustomMaskWarning)

Epoch 2/20

8/8 [==============================] - 147s 21s/step - loss: 3.0807 - accuracy: 0.6574 - val\_loss: 3.3820 - val\_accuracy: 0.6441

Epoch 3/20

8/8 [==============================] - 146s 21s/step - loss: 2.1598 - accuracy: 0.7653 - val\_loss: 1.6860 - val\_accuracy: 0.7793

Epoch 4/20

8/8 [==============================] - 149s 19s/step - loss: 0.7960 - accuracy: 0.8676 - val\_loss: 1.2006 - val\_accuracy: 0.7883

Epoch 5/20

8/8 [==============================] - 149s 21s/step - loss: 0.5077 - accuracy: 0.9032 - val\_loss: 0.7417 - val\_accuracy: 0.8649

Epoch 6/20

8/8 [==============================] - 146s 19s/step - loss: 0.2736 - accuracy: 0.9399 - val\_loss: 0.7396 - val\_accuracy: 0.8739

Epoch 7/20

8/8 [==============================] - 147s 19s/step - loss: 0.1609 - accuracy: 0.9644 - val\_loss: 0.5943 - val\_accuracy: 0.8919

Epoch 8/20

8/8 [==============================] - 152s 19s/step - loss: 0.1248 - accuracy: 0.9744 - val\_loss: 0.4746 - val\_accuracy: 0.8919

Epoch 9/20

8/8 [==============================] - 149s 21s/step - loss: 0.0766 - accuracy: 0.9755 - val\_loss: 0.4221 - val\_accuracy: 0.9054

Epoch 10/20

8/8 [==============================] - 146s 18s/step - loss: 0.0297 - accuracy: 0.9867 - val\_loss: 0.3892 - val\_accuracy: 0.9144

Epoch 11/20

8/8 [==============================] - 154s 20s/step - loss: 0.0287 - accuracy: 0.9889 - val\_loss: 0.3747 - val\_accuracy: 0.9234

Epoch 12/20

8/8 [==============================] - 148s 18s/step - loss: 0.0129 - accuracy: 0.9956 - val\_loss: 0.3239 - val\_accuracy: 0.9369

Epoch 13/20

8/8 [==============================] - 163s 21s/step - loss: 0.0095 - accuracy: 0.9967 - val\_loss: 0.3015 - val\_accuracy: 0.9369

Epoch 14/20

8/8 [==============================] - 165s 21s/step - loss: 0.0091 - accuracy: 0.9978 - val\_loss: 0.3346 - val\_accuracy: 0.9324

Epoch 15/20

8/8 [==============================] - 156s 20s/step - loss: 0.0062 - accuracy: 0.9989 - val\_loss: 0.2876 - val\_accuracy: 0.9414

Epoch 16/20

8/8 [==============================] - 152s 19s/step - loss: 0.0040 - accuracy: 1.0000 - val\_loss: 0.3013 - val\_accuracy: 0.9505

Epoch 17/20

8/8 [==============================] - 149s 19s/step - loss: 0.0030 - accuracy: 1.0000 - val\_loss: 0.3015 - val\_accuracy: 0.9505

Epoch 18/20

8/8 [==============================] - 155s 20s/step - loss: 0.0016 - accuracy: 1.0000 - val\_loss: 0.2903 - val\_accuracy: 0.9505

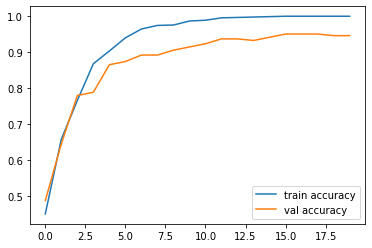
Epoch 19/20

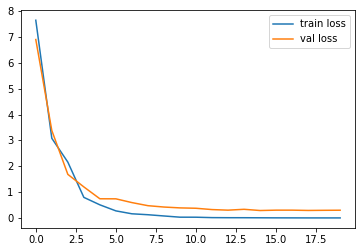
8/8 [==============================] - 148s 19s/step - loss: 0.0014 - accuracy: 1.0000 - val\_loss: 0.2958 - val\_accuracy: 0.9459

Epoch 20/20

8/8 [==============================] - 147s 19s/step - loss: 0.0014 - accuracy: 1.0000 - val\_loss: 0.2991 - val\_accuracy: 0.9459

Time: 3574.137933254242





[[149 0 0 0 0 0]

[ 10 140 0 0 0 0]

[ 1 2 147 0 0 0]

[ 0 0 0 150 0 0]

[ 2 0 0 0 148 0]

[ 0 0 0 0 0 150]]

Accuracy: 0.983315

Error rate: 0.016685

classification\_report

precision recall f1-score support

0 0.92 1.00 0.96 149

1 0.99 0.93 0.96 150

2 1.00 0.98 0.99 150

3 1.00 1.00 1.00 150

4 1.00 0.99 0.99 150

5 1.00 1.00 1.00 150

accuracy 0.98 899

macro avg 0.98 0.98 0.98 899

weighted avg 0.98 0.98 0.98 899

Cohens kappa: 0.979978