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**
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  inflating: dataset/Training/rats/images (81).jpeg
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```

```
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               inflating: dataset/Training/rats/images (99).jpeg
              inflating: dataset/Training/rats/images - 2019-05-
23T115933.485.jpeg
                   \n",
              inflating: dataset/Training/rats/images - 2019-05-
23T115940.497.jpeg \n",
              inflating: dataset/Training/rats/images - 2019-05-
23T120017.550.jpeg \n",
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                                                            \n"
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                                                            \n",
               inflating: dataset/Training/rats/Z (11).jpeg
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              inflating: dataset/Training/rats/Z (2).jpeg
                                                            \n",
              inflating: dataset/Training/rats/Z (3).jpeg
                                                            \n",
              inflating: dataset/Training/rats/Z (4).jpeg
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                                                             \n'',
                                                             \n",
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              inflating: dataset/Training/rats/Z.jpeg \n"
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        "\n",
        "!unzip '/content/Animal Dataset.zip'"
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        "It is a technique used to increase the images with some
modification on original image. By doing this we can overcome
overfitting."
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      "metadata": {
```

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        "# Data augmentation on training variable\n",
        "train datagen = ImageDataGenerator(rescale=1./255,\n",
                                             zoom range=0.2,\n",
        "
                                             horizontal flip=True)"
      ],
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     "execution count": 3,
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      "source": [
       "# Data augmentation on testing variable\n",
        "test datagen = ImageDataGenerator(rescale=1./255)"
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        "# Data augmentation on training data\n",
        "\n",
        "xtrain =
train datagen.flow from directory('/content/dataset/Training',\n",
target size=(64,64),\n",
class mode='categorical', \n",
                                                      batch size=100)"
      ],
```

```
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      },
      "execution count": 5,
      "outputs": [
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"name": "stdout",
          "text": [
            "Found 1238 images belonging to 4 classes.\n"
        }
      ]
    },
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        "\n",
        "xtest =
test datagen.flow from directory('/content/dataset/Testing',\n",
target_size=(64,64), n",
class mode='categorical', \n",
                                                     batch size=100)"
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          "text": [
            "Found 326 images belonging to 4 classes.\n"
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        }
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       "# CNN model training"
      "metadata": {
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```

```
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       "# Importing req. lib.\n",
        "\n",
        "from tensorflow.keras.models import Sequential\n",
        "from tensorflow.keras.layers import Convolution2D, MaxPooling2D,
Flatten, Dense"
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        "\n",
        "model = Sequential() # Initializing sequential model\n",
"model.add(Convolution2D(32,(3,3),activation='relu',input shape=(64,64,3)
)) # convolution layer\n",
        "model.add(MaxPooling2D(pool size=(2, 2))) # Max pooling
layer\n",
        "model.add(Flatten()) # Flatten layer\n",
        "model.add(Dense(300,activation='relu')) # Hidden layer 1\n",
        "model.add(Dense(150,activation='relu')) # Hidden layer 2\n",
        "model.add(Dense(4,activation='softmax')) # Output layer"
      ],
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      "outputs": []
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      "source": [
        "# Compiling the model\n",
        "\n",
"model.compile(optimizer='adam',loss='categorical crossentropy',metrics=[
'accuracy'])"
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      "execution count": 10,
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      "cell type": "code",
      "source": [
        "# Train model\n",
        "model.fit generator(xtrain, \n",
```

```
"
                          steps per epoch=len(xtrain), \n",
                          epochs=10, \n",
       **
                          validation_data=xtest, \n",
                          validation steps=len(xtest))"
     ],
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packages/ipykernel launcher.py:7: UserWarning: `Model.fit generator` is
deprecated and will be removed in a future version. Please use
`Model.fit`, which supports generators.\n",
           " import sys\n"
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           "Epoch 1/10\n",
           loss: 1.8822 - accuracy: 0.2908 - val loss: 1.2656 - val accuracy:
0.3558\n'',
           "Epoch 2/10\n",
           "13/13 [=========== ] - 6s 493ms/step -
loss: 1.2039 - accuracy: 0.4661 - val loss: 1.0490 - val accuracy:
0.6319\n",
           "Epoch 3/10\n",
           "13/13 [=========== ] - 6s 473ms/step -
loss: 1.0134 - accuracy: 0.5969 - val loss: 0.9052 - val accuracy:
0.6135\n",
           "Epoch 4/10\n",
           "13/13 [=========== ] - 6s 471ms/step -
loss: 0.8838 - accuracy: 0.6470 - val loss: 0.7871 - val accuracy:
0.6442 \n'',
           "Epoch 5/10\n",
           loss: 0.7732 - accuracy: 0.6963 - val loss: 0.6946 - val accuracy:
0.7423\n'',
           "Epoch 6/10\n",
           "13/13 [=========== ] - 6s 467ms/step -
loss: 0.6976 - accuracy: 0.7229 - val loss: 0.6000 - val accuracy:
0.7669\n",
           "Epoch 7/10\n",
           "13/13 [============ ] - 6s 470ms/step -
loss: 0.6408 - accuracy: 0.7585 - val loss: 0.4942 - val accuracy:
0.8405\n'',
           "Epoch 8/10\n",
```

```
loss: 0.5708 - accuracy: 0.7779 - val loss: 0.5511 - val accuracy:
0.7945\n'',
           "Epoch 9/10\n",
           "13/13 [=========== ] - 6s 466ms/step -
loss: 0.5394 - accuracy: 0.7981 - val loss: 0.5997 - val accuracy:
0.8006\n",
           "Epoch 10/10\n",
           "13/13 [============ ] - 6s 459ms/step -
loss: 0.5215 - accuracy: 0.7948 - val loss: 0.4270 - val accuracy:
0.8620\n"
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           ]
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         "metadata": {},
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       "# Save model\n",
       "\n",
       "model.save('animal.h5')"
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     "source": [
       "from tensorflow.keras.preprocessing import image\n",
       "import numpy as np"
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     "metadata": {
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     "execution count": 17,
     "outputs": []
```

```
},
      "cell type": "code",
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        "# Testing 1\n",
        "\n",
        "imq =
image.load img('/content/dataset/Testing/elephants/photo 1552055570 5c41e
f975579.jpeg',target size=(64,64)) # Reading image\n",
        "x = image.img to array(img) # Converting image into array\n",
        "x = np.expand dims(x,axis=0) # expanding Dimensions\n",
        "pred = np.argmax(model.predict(x)) # Predicting the higher
probablity index\n",
        "op = ['bears','crows','elephants','rats'] # Creating list\n",
        "op[pred] # List indexing with output"
      ],
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              "type": "string"
          },
          "metadata": {},
          "execution count": 24
      ]
    },
      "cell type": "code",
      "source": [
        "# Testing 2\n",
        "\n",
        "img =
image.load img('/content/dataset/Testing/bears/m10.jpeg',target size=(64,
64)) # Reading image\n",
        "x = image.img to array(img) # Converting image into arrayn",
        "x = np.expand dims(x,axis=0) # expanding Dimensions\n",
        "pred = np.argmax(model.predict(x)) # Predicting the higher
probablity index\n",
        "op = ['bears','crows','elephants','rats'] # Creating list\n",
        "op[pred] # List indexing with output"
      "metadata": {
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```

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          "execution count": 25
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        "# Testing 3\n",
        "\n",
        "img = image.load img('/content/dataset/Testing/crows/Z1
(65).jpg', target size=(64,64)) # Reading image\n",
        "x = image.img to array(img) # Converting image into array\n",
        "x = np.expand dims(x,axis=0) # expanding Dimensions n",
        "pred = np.argmax(model.predict(x)) # Predicting the higher
probablity indexn",
        "op = ['bears','crows','elephants','rats'] # Creating list\n",
        "op[pred] # List indexing with output"
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          "metadata": {},
```

```
"execution count": 26
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      ]
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      "source": [
        "# Testing 4\n",
        "\n",
        "img = image.load img('/content/dataset/Testing/rats/images
(55).jpeg', target_size=(6\overline{4}, 64)) # Reading image\n",
        "x = image.img_to_array(img) # Converting image into array\n",
        "x = np.expand dims(x,axis=0) # expanding Dimensionsn",
        "pred = np.argmax(model.predict(x)) # Predicting the higher
probablity index\n",
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        "op[pred] # List indexing with output"
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```

```
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          "metadata": {},
          "execution count": 22
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      "source": [
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      }
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ReduceLROnPlateau"
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      "metadata": {
        "id": "31wUmUyxk7Zf"
      "execution count": 29,
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                                     patience=5) \n",
        "\n",
        "lr = ReduceLROnPlateau(monitor='val_accuaracy', \n",
                                  factor=0.5, n,
        **
                                 min lr=0.00001) \n'',
        "callback = [early stop,lr]"
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        "# Train model\n",
        "\n",
        "model.fit_generator(xtrain,\n",
                              steps per epoch=len(xtrain), \n",
        "
                              epochs=10\overline{0}, \n",
```

```
"
                         callbacks=callback, \n",
                         validation_data=xtest, \n",
       "
                         validation steps=len(xtest))"
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packages/ipykernel_launcher.py:8: UserWarning: `Model.fit_generator` is
deprecated and will be removed in a future version. Please use
`Model.fit`, which supports generators.\n",
          " \n"
         ]
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          "13/13 [============ ] - ETA: Os - loss:
0.5002 - accuracy: 0.8174"
        1
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metric `val accuaracy` which is not available. Available metrics are:
loss, accuracy, val loss, val accuracy, lr\n"
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503ms/step - loss: 0.5002 - accuracy: 0.8174 - val_loss: 0.3022 - val_accuracy: 0.8988 - lr: 0.0010\n",
          "Epoch 2/100\n",
          "13/13 [============ ] - ETA: Os - loss:
0.4280 - accuracy: 0.8409"
        ]
       },
       {
```

```
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metric `val accuaracy` which is not available. Available metrics are:
loss, accuracy, val loss, val accuracy, lr\n"
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458ms/step - loss: 0.4280 - accuracy: 0.8409 - val loss: 0.4246 -
val accuracy: 0.8466 - lr: 0.0010\n",
        "Epoch 3/100\n",
        "13/13 [=========== ] - ETA: Os - loss:
0.4018 - accuracy: 0.8522"
       1
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metric `val accuaracy` which is not available. Available metrics are:
loss, accuracy, val loss, val accuracy, lr\n"
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       "name": "stdout",
       "text": [
469ms/step - loss: 0.4018 - accuracy: 0.8522 - val loss: 0.3677 -
val accuracy: 0.8773 - lr: 0.0010\n",
        "Epoch 4/100\n",
        0.3703 - accuracy: 0.8675"
       1
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metric `val_accuaracy` which is not available. Available metrics are:
loss, accuracy, val loss, val accuracy, lr\n"
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```

```
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472ms/step - loss: 0.3703 - accuracy: 0.8675 - val loss: 0.2848 -
val accuracy: 0.8681 - lr: 0.0010\n",
       "Epoch 5/100\n",
       0.3317 - accuracy: 0.8821"
      ]
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       "WARNING: tensorflow: Learning rate reduction is conditioned on
metric `val_accuaracy` which is not available. Available metrics are:
loss, accuracy, val loss, val accuracy, lr\n"
      1
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      "name": "stdout",
      "text": [
472ms/step - loss: 0.3317 - accuracy: 0.8821 - val loss: 0.2316 -
val accuracy: 0.9110 - lr: 0.0010\n",
       "Epoch 6/100\n",
       "13/13 [============== ] - ETA: Os - loss:
0.2919 - accuracy: 0.8982"
      1
     },
      "output type": "stream",
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      "text": [
       "WARNING: tensorflow: Learning rate reduction is conditioned on
metric `val_accuaracy` which is not available. Available metrics are:
loss, accuracy, val loss, val accuracy, lr\n"
      1
     },
      "output type": "stream",
      "name": "stdout",
      "text": [
463ms/step - loss: 0.2919 - accuracy: 0.8982 - val loss: 0.2037 -
val accuracy: 0.9141 - lr: 0.0010\n",
       "Epoch 7/100\n",
```

```
0.2653 - accuracy: 0.9168"
      ]
     },
      "output type": "stream",
      "name": "stderr",
      "text": [
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metric `val_accuaracy` which is not available. Available metrics are:
loss, accuracy, val loss, val accuracy, lr\n"
      1
     },
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      "name": "stdout",
      "text": [
472ms/step - loss: 0.2653 - accuracy: 0.9168 - val loss: 0.3426 -
val accuracy: 0.8681 - lr: 0.0010\n",
       "Epoch 8/100\n",
       0.2562 - accuracy: 0.9087"
      ]
     },
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      "text": [
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metric `val_accuaracy` which is not available. Available metrics are:
loss, accuracy, val loss, val accuracy, lr\n"
      1
     },
      "output type": "stream",
      "name": "stdout",
      "text": [
470ms/step - loss: 0.2562 - accuracy: 0.9087 - val loss: 0.1796 -
val accuracy: 0.9264 - lr: 0.0010\n",
       "Epoch 9/100\n",
       0.2512 - accuracy: 0.9192"
      ]
     },
      "output_type": "stream",
      "name": "stderr",
      "text": [
```

```
"WARNING: tensorflow: Learning rate reduction is conditioned on
metric `val_accuaracy` which is not available. Available metrics are:
loss, accuracy, val loss, val accuracy, lr\n"
       ]
     },
      {
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       "name": "stdout",
       "text": [
489ms/step - loss: 0.2512 - accuracy: 0.9192 - val loss: 0.2118 -
val accuracy: 0.9080 - lr: 0.0010\n",
        "Epoch 10/100\n",
        "13/13 [============= ] - ETA: Os - loss:
0.2113 - accuracy: 0.9386"
       ]
     },
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metric `val_accuaracy` which is not available. Available metrics are:
loss, accuracy, val loss, val accuracy, lr\n"
       1
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       "name": "stdout",
       "text": [
470ms/step - loss: 0.2113 - accuracy: 0.9386 - val loss: 0.2592 -
val accuracy: 0.9141 - lr: 0.0010\n",
        "Epoch 11/100\n",
        0.1966 - accuracy: 0.9443"
       1
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       "name": "stderr",
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metric `val accuaracy` which is not available. Available metrics are:
loss, accuracy, val loss, val accuracy, lr\n"
     },
       "output_type": "stream",
       "name": "stdout",
       "text": [
```

```
458ms/step - loss: 0.1966 - accuracy: 0.9443 - val loss: 0.1606 -
val accuracy: 0.9387 - lr: 0.0010\n",
       "Epoch 12/100 \n",
       0.1956 - accuracy: 0.9297"
      ]
    },
      "output type": "stream",
      "name": "stderr",
      "text": [
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metric `val_accuaracy` which is not available. Available metrics are:
loss, accuracy, val loss, val accuracy, lr\n"
      1
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      "text": [
454ms/step - loss: 0.1956 - accuracy: 0.9297 - val loss: 0.1876 -
val accuracy: 0.9325 - lr: 0.0010\n",
       "Epoch 13/100\n",
       "13/13 [============= ] - ETA: Os - loss:
0.2050 - accuracy: 0.9330"
      ]
     },
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       "WARNING: tensorflow: Learning rate reduction is conditioned on
metric `val accuaracy` which is not available. Available metrics are:
loss, accuracy, val loss, val accuracy, lr\n"
     },
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      "name": "stdout",
      "text": [
467ms/step - loss: 0.2050 - accuracy: 0.9330 - val loss: 0.1395 -
val accuracy: 0.9356 - lr: 0.0010\n",
       "Epoch 14/100\n",
       "13/13 [======
                   ========= ] - ETA: Os - loss:
0.1471 - accuracy: 0.9548"
      1
```

```
},
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metric `val accuaracy` which is not available. Available metrics are:
loss, accuracy, val loss, val accuracy, lr\n"
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      {
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       "text": [
456ms/step - loss: 0.1471 - accuracy: 0.9548 - val_loss: 0.1050 -
val accuracy: 0.9601 - lr: 0.0010\n",
        "Epoch 15/100\n",
        0.1326 - accuracy: 0.9564"
       ]
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"name": "stderr",
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metric `val accuaracy` which is not available. Available metrics are:
loss, accuracy, val loss, val accuracy, lr\n"
       ]
      },
       "output type": "stream",
       "name": "stdout",
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478ms/step - loss: 0.1326 - accuracy: 0.9564 - val loss: 0.0418 -
val accuracy: 0.9969 - lr: 0.0010\n",
        "Epoch 16/100\n",
        "13/13 [============ ] - ETA: 0s - loss:
0.1432 - accuracy: 0.9556"
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      },
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       "name": "stderr",
       "text": [
        "WARNING: tensorflow: Learning rate reduction is conditioned on
metric `val_accuaracy` which is not available. Available metrics are:
loss, accuracy, val loss, val accuracy, lr\n"
       ]
      },
```

```
"output type": "stream",
      "name": "stdout",
      "text": [
459ms/step - loss: 0.1432 - accuracy: 0.9556 - val loss: 0.1110 -
val accuracy: 0.9724 - lr: 0.0010\n",
       "Epoch 17/100\n",
       "13/13 [============== ] - ETA: 0s - loss:
0.1214 - accuracy: 0.9669"
     ]
     },
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metric `val accuaracy` which is not available. Available metrics are:
loss, accuracy, val loss, val accuracy, lr\n"
      1
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      "text": [
472ms/step - loss: 0.1214 - accuracy: 0.9669 - val loss: 0.0772 -
val accuracy: 0.9785 - lr: 0.0010\n",
       "Epoch 18/100\n",
       0.0967 - accuracy: 0.9750"
     ]
     },
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      "text": [
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metric `val_accuaracy` which is not available. Available metrics are:
loss, accuracy, val loss, val accuracy, lr\n"
      ]
     } ,
      "output type": "stream",
      "name": "stdout",
      "text": [
455ms/step - loss: 0.0967 - accuracy: 0.9750 - val loss: 0.0904 -
val_accuracy: 0.9693 - 1r: 0.0010\n",
```

```
"Epoch 19/100\n",
        "13/13 [======== ] - ETA: Os - loss:
0.1162 - accuracy: 0.9637"
      ]
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       "name": "stderr",
       "text": [
        "WARNING: tensorflow: Learning rate reduction is conditioned on
metric `val_accuaracy` which is not available. Available metrics are:
loss, accuracy, val loss, val accuracy, lr\n"
     },
     {
       "output type": "stream",
       "name": "stdout",
       "text": [
511ms/step - loss: 0.1162 - accuracy: 0.9637 - val loss: 0.0409 -
val accuracy: 0.9908 - lr: 0.0010\n",
        "Epoch 20/100\n",
        0.0937 - accuracy: 0.9717"
       1
     },
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       "name": "stderr",
       "text": [
        "WARNING:tensorflow:Learning rate reduction is conditioned on
metric `val_accuaracy` which is not available. Available metrics are:
loss, accuracy, val loss, val accuracy, lr\n"
       1
     },
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       "output type": "stream",
       "name": "stdout",
       "text": [
468ms/step - loss: 0.0937 - accuracy: 0.9717 - val loss: 0.0448 -
val accuracy: 0.9877 - lr: 0.0010\n"
       ]
     },
       "output type": "execute result",
       "data": {
        "text/plain": [
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       },
       "metadata": {},
```

```
"execution count": 33
      ]
    },
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      "source": [
        "# Testing 4\n",
        "\n",
        "img = image.load img('/content/dataset/Testing/rats/images
(55).jpeg', target size=(64,64)) # Reading image\n",
        "x = image.img_to_array(img) # Converting image into array\n",
        "x = np.expand dims(x,axis=0) \# expanding Dimensions\n",
        "pred = np.argmax(model.predict(x)) # Predicting the higher
probablity index\n",
        "op = ['bears','crows','elephants','rats'] # Creating list\n",
        "op[pred] # List indexing with output"
      "metadata": {
        "colab": {
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          "height": 35
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        "outputId": "e9a9e1bf-3869-4f45-ff62-16b0e87f305a"
      "execution count": 34,
      "outputs": [
        {
          "output type": "execute result",
          "data": {
            "text/plain": [
              "'rats'"
            "application/vnd.google.colaboratory.intrinsic+json": {
              "type": "string"
          },
          "metadata": {},
          "execution count": 34
        }
      ]
    },
      "cell type": "code",
      "source": [
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        "\n",
        "img =
image.load_img('/content/42ny6cwj8t_Polar_bear_on_ice_in_Svalbard_Norway_
WW294883.jpg', target size=(64,64)) # Reading image\n",
        "x = image.img to array(img) # Converting image into arrayn",
        "x = np.expand dims(x,axis=0) # expanding Dimensions n",
        "pred = np.argmax(model.predict(x)) # Predicting the higher
probablity indexn",
        "op = ['bears','crows','elephants','rats'] # Creating list\n",
        "op[pred] # List indexing with output"
      ],
```

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"metadata": {
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        "id": "sXFwDodEpKt ",
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          "output type": "execute result",
          "data": {
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              "'rats'"
            "application/vnd.google.colaboratory.intrinsic+json": {
              "type": "string"
          },
          "metadata": {},
          "execution count": 35
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    },
      "cell type": "code",
      "source": [
        "# Testing google image\n",
        "\n",
        "img = image.load img('/content/images.jpg',target size=(64,64))
# Reading image\n",
        "x = image.img to array(img) # Converting image into arrayn",
        "x = np.expand dims(x,axis=0) # expanding Dimensions\n",
        "pred = np.argmax(model.predict(x)) # Predicting the higher
probablity index\n",
        "op = ['bears','crows','elephants','rats'] # Creating list\n",
        "op[pred] # List indexing with output"
      "metadata": {
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              "'elephants'"
            "application/vnd.google.colaboratory.intrinsic+json": {
              "type": "string"
```

```
},
          "metadata": {},
          "execution count": 36
        }
      ]
    },
      "cell type": "code",
      "source": [
        "# Testing google image\n",
        "img = image.load img('/content/01-rat-friends-
nationalgeographic 1162144 16x9.jpg',target size=(64,64)) # Reading
image\n",
        "x = image.img to array(img) # Converting image into arrayn",
        "x = np.expand dims(x,axis=0) # expanding Dimensionsn",
        "pred = np.argmax(model.predict(x)) # Predicting the higher
probablity index\n",
        "op = ['bears', 'crows', 'elephants', 'rats'] # Creating list\n",
        "op[pred] # List indexing with output"
      ],
      "metadata": {
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        "outputId": "6ba32030-eef4-494d-a6b1-39a4cc3b616d"
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            "application/vnd.google.colaboratory.intrinsic+json": {
              "type": "string"
            }
          },
          "metadata": {},
          "execution count": 37
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    },
      "cell type": "code",
      "source": [
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        "\n",
        "img = image.load img('/content/photo-1599921778557-
082147629542.jpg',target size=(64,64)) # Reading image\n",
        "x = image.img to array(img) # Converting image into array\n",
        "x = np.expand dims(x,axis=0) # expanding Dimensions\n",
        "pred = np.argmax(model.predict(x)) # Predicting the higher
probablity index\n",
        "op = ['bears','crows','elephants','rats'] # Creating list\n",
```

```
"op[pred] # List indexing with output"
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        "outputId": "82169dcb-2bcf-440b-b3ef-bcf9a47966d9"
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      "execution_count": 38,
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          "data": {
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             "'elephants'"
            "application/vnd.google.colaboratory.intrinsic+json": {
              "type": "string"
          },
          "metadata": {},
          "execution_count": 38
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      "metadata": {
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     "execution_count": null,
      "outputs": []
   }
 ]
}
```