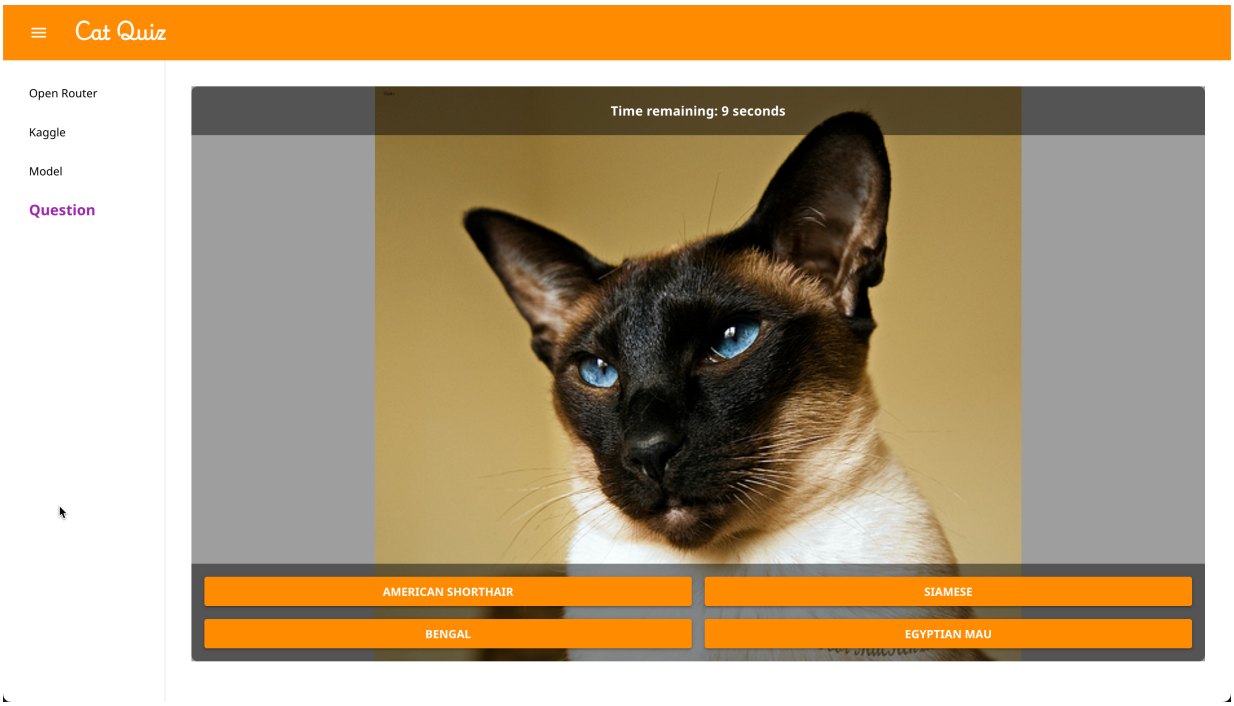
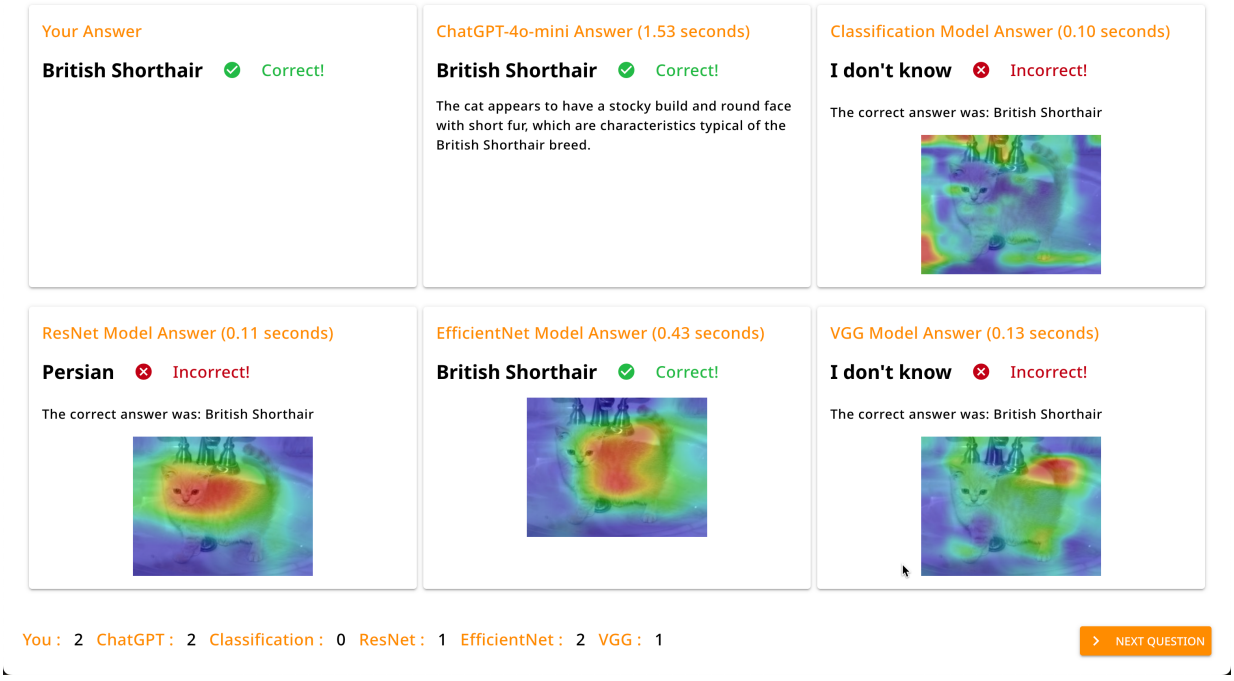
# Cat Breed Classifier

This project is to train image classifier model to classify Cat Breeds dataset images. It has frontend as web application showing Quiz which allow user to take on guessing cat breed on the images.




Then after user pick answer, it will show result comparing user's with ChatGPT-4o-mini (OpenRouter API key required) and 4 Deep Learning Models. The rationale of LLM and GradCAM has been implemented to show model interpretability.



### Data Sets

- Dataset is from Kaggle from 'Geno Cat Breed Image Collection' dataset (url: https://www.kaggle.com/datasets/shawngano/gano-cat-breed-image-collection)
- Contains 15 cat breeds with 375 photos for each breed (total 5,625 photos)
- Preprocessing step
  - Resize to 256x256
  - Random Crop to 224x224
  - Random Horizontal Flip
  - Random Rotation
  - Convert to Tensor
  - Normalize with mean and std of ImageNet

### Model Architecture

#### Custom Model (1 Model)

1. CNN Model

- 5 Convolutional Layers
- 2 Fully Connected Layers
- 1 Dropout Layer in between the two FC Layers

from src/model_train.py

[ ]:
```
import os
import time
import torch
import torch.nn as nn
import torch.optim as optim
from torch.utils.data import DataLoader, Dataset
import torchvision
import torchvision.transforms as transforms

class CatBreedClassifier(nn.Module):
    def __init__(self):
        super(CatBreedClassifier, self).__init__()
        self.conv_block = torch.nn.Sequential(
            torch.nn.Conv2d(3, 64, kernel_size=3, stride=1, padding=1),
            torch.nn.ReLU(),
            torch.nn.MaxPool2d(kernel_size=2, stride=2),  # Output: 64 x 112 x 112
            torch.nn.Conv2d(64, 128, kernel_size=3, stride=1, padding=1),
            torch.nn.ReLU(),
            torch.nn.MaxPool2d(kernel_size=2, stride=2),  # Output: 128 x 56 x 56
            torch.nn.Conv2d(128, 256, kernel_size=3, stride=1, padding=1),
            torch.nn.ReLU(),
            torch.nn.MaxPool2d(kernel_size=2, stride=2),  # Output: 256 x 28 x 28
            torch.nn.Conv2d(256, 512, kernel_size=3, stride=1, padding=1),
            torch.nn.ReLU(),
            torch.nn.MaxPool2d(kernel_size=2, stride=2),  # Output: 512 x 14 x 14
            torch.nn.Conv2d(512, 1024, kernel_size=3, stride=1, padding=1),  # Changed
 ↪from 1024 to 512
            torch.nn.ReLU(),
            torch.nn.MaxPool2d(kernel_size=2, stride=2)   # Output: 1024 x 7 x 7
```

```
        )

        # Calculate the flattened size: 512 channels * 7 * 7 = 25088
        self.fc_block = torch.nn.Sequential(
            torch.nn.Flatten(),
            torch.nn.Linear(1024 * 7 * 7, 512),  # Adjusted input size
            torch.nn.ReLU(),
            torch.nn.Dropout(0.5),
            torch.nn.Linear(512, 15),  # 15 breeds
        )


    def forward(self, x):
        x = self.conv_block(x)
        x = self.fc_block(x)
        return x
```

### Transfer Learning (3 models)

2. VGG 16 Model

[18]:
```
def get_vgg_model() -> nn.Module:
    vgg_model = torchvision.models.vgg16(weights=torchvision.models.VGG16_Weights.
 ↪IMAGENET1K_V1)
    for param in vgg_model.parameters():
        param.requires_grad = False
    vgg_model.classifier[6] = nn.Linear(vgg_model.classifier[6].in_features, 15)
    return vgg_model
```

3. ResNet 18 Model

[19]:
```
def get_resnet_model() -> nn.Module:
    res_model = torchvision.models.resnet18(weights=torchvision.models.
 ↪ResNet18_Weights.IMAGENET1K_V1)
    for param in res_model.parameters():
        param.requires_grad = False
    res_model.fc = nn.Linear(res_model.fc.in_features, 15)
    return res_model
```

4. EfficientNet B2 Model

[20]:
```
def get_efficient_net_model() -> nn.Module:
    eff_model =  torchvision.models.efficientnet_b2(weights=torchvision.models.
 ↪EfficientNet_B2_Weights.IMAGENET1K_V1)
    for param in eff_model.parameters():
        param.requires_grad = False
    eff_model.classifier[1] = nn.Linear(eff_model.classifier[1].in_features, 15)
    return eff_model
```

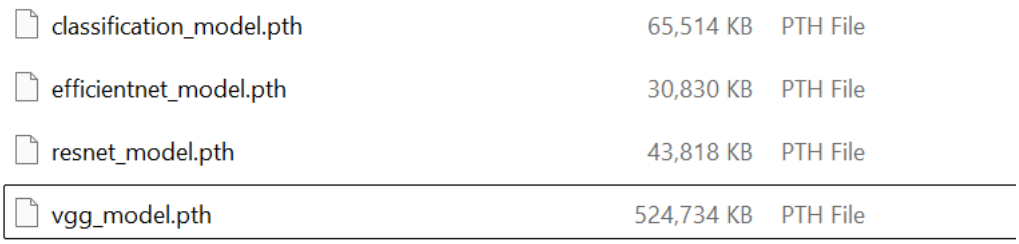
### Training

All 4 models has been trained using same hyperparamters for comparison.

- Training Batch Size: 128

- Epochs: 20 for CNN model and 10 for transfer learning models.
- Loss Function: Cross Entropy Loss
- Optimizer: SGD
  - Learning Rate: 0.01 for CNN model and 0.001 for transfer learning models.
  - Momentum: 0.9

After finish training model saved to .pth for later used for inference result on Cat Quiz program.




Below code is from `src\model_train.py` use in training all 4 models.

- CatBreedDataSet = Custom Dataset for Kaggle Cat Breed dataset
- get_cat_breed_dataset = function to create new catbreed dataset for training.

[21]:
```
class CatBreedDataset(Dataset):
    def __init__(self, image_path, class_names, transform):
        self.image_path = image_path
        self.class_names = class_names
        self.class_to_idx = {class_name: i for i, class_name in enumerate(class_names)}
        self.transform = transform
        self.image_files = []
        self.image_labels = []
        self.image_tensor = []
        for class_name in self.class_names:
            for image_file in os.listdir(os.path.join(self.image_path, class_name)):
                self.image_files.append(os.path.join(self.image_path, class_name,␣
↪image_file))
                self.image_labels.append(self.class_to_idx[class_name])
                self.image_tensor.append(self.transform(Image.open(os.path.join(self.
↪image_path, class_name, image_file)).convert('RGB')))

    def __len__(self):
        return len(self.image_files)

    def __getitem__(self, idx):
        image_tensor = self.image_tensor[idx]
        image_label = self.image_labels[idx]
        return image_tensor, image_label


def get_cat_breed_dataset(app_state, transform) -> CatBreedDataset:
    return CatBreedDataset(app_state.image_path, app_state.class_names, transform)
```

- get_transformation = function to build transformation using imagenet normalization.

[ ]:
```
def get_transformation() -> transforms.Compose:
    return transforms.Compose(
        [transforms.Resize((256, 256)),
         transforms.RandomCrop((224, 224)),
         transforms.RandomHorizontalFlip(),
         transforms.RandomRotation(10),
         transforms.ToTensor(),
         transforms.Normalize(mean=[0.485, 0.456, 0.406],
                              std=[0.229, 0.224, 0.225])]
    )
```

- train_model = function to train model and saved training accuracy/loss and validation accuracy/loss for later display.

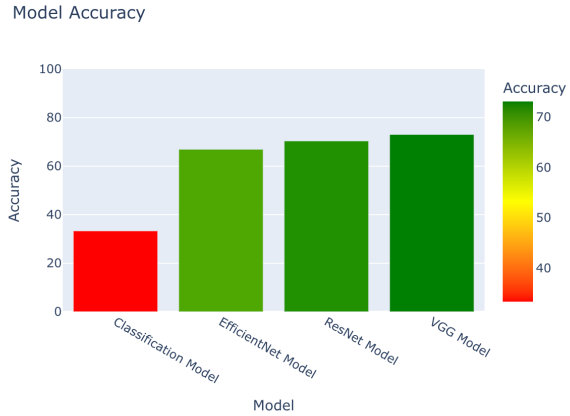
[23]:
```
def train_model(app_state,model: nn.Module, model_name: str) -> tuple[list[float],␣
↪list[float], list[float], list[float], float]:
    print(f"Training model on {app_state.device}")
    transform = get_transformation()

    print(f"Loading dataset")
    dataset = get_cat_breed_dataset(app_state, transform)

    # Split dataset into train and test sets (80% train, 20% test)
    train_size = int(0.8 * len(dataset))
    test_size = len(dataset) - train_size
    train_dataset, test_dataset = torch.utils.data.random_split(dataset, [train_size,␣
↪test_size])

    # Create data loaders for both sets
    train_loader = DataLoader(train_dataset, batch_size=128, shuffle=True,␣
↪num_workers=4)
    test_loader = DataLoader(test_dataset, batch_size=128, shuffle=False,␣
↪num_workers=4)

    print(f"Dataset split: {train_size} training samples, {test_size} test samples")

    print(f"Loading model")
    model.to(app_state.device)
    criterion = nn.CrossEntropyLoss()
    optimizer = optim.SGD(model.parameters(), lr=0.001, momentum=0.9)

    training_loss = []
    training_accuracy = []
    validation_loss = []
    validation_accuracy = []

    start_time = time.time()
    for epoch in range(5):
        model.train()

        running_loss = 0.0
```

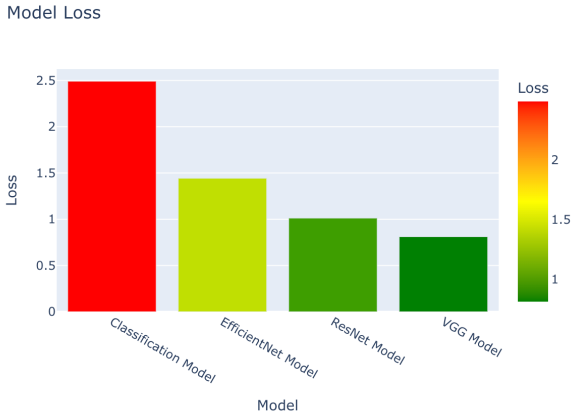
```
        correct = 0
        total = 0
        for i, data in enumerate(train_loader, 0):
            inputs, labels = data
            inputs = inputs.to(app_state.device)
            labels = labels.to(app_state.device)
            optimizer.zero_grad()

            outputs = model(inputs)
            loss = criterion(outputs, labels)
            loss.backward()
            optimizer.step()
            running_loss += loss.item()
            _, predicted = torch.max(outputs.data, 1)
            correct += (predicted == labels).sum().item()
            total += labels.size(0)

            print(f"Epoch {epoch + 1}, Batch {i + 1}, Loss: {loss.item()}")

        training_loss.append(running_loss / len(train_loader))
        training_accuracy.append(correct / total)

        model.eval()
        with torch.no_grad():
            running_loss = 0.0
            correct = 0
            total = 0
            for i, data in enumerate(test_loader, 0):
                inputs, labels = data
                inputs = inputs.to(app_state.device)
                labels = labels.to(app_state.device)
                outputs = model(inputs)
                loss = criterion(outputs, labels)
                running_loss += loss.item()
                _, predicted = torch.max(outputs.data, 1)
                total += labels.size(0)
                correct += (predicted == labels).sum().item()

            validation_loss.append(running_loss / len(test_loader))
            validation_accuracy.append(correct / total)

        print(f"Accuracy of the network on the {total} test images: {100 * correct /␣
↪total}%")
    print(f"Finished Training")
    print(f"Loss: {running_loss / len(train_loader)}")
    training_time = time.time() - start_time
    print(f"Saving model to {model_name}")
    scripted_model = torch.jit.script(model)
    torch.jit.save(scripted_model, model_name)
```

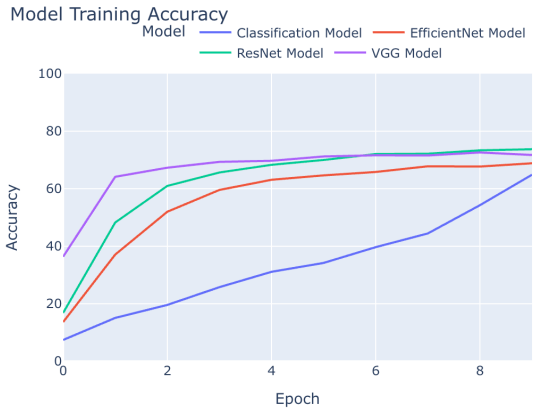
```
    return training_loss, training_accuracy, validation_loss, validation_accuracy,␣
↪training_time
```

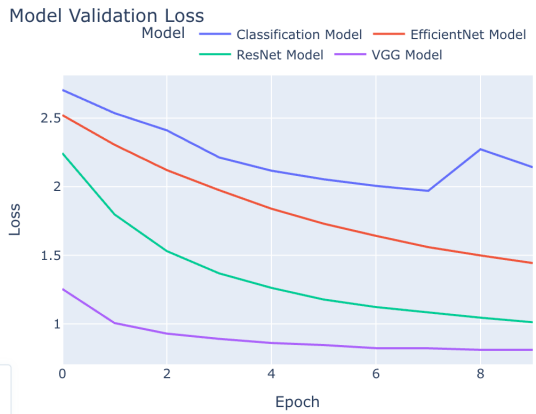
## Result and Evaluation

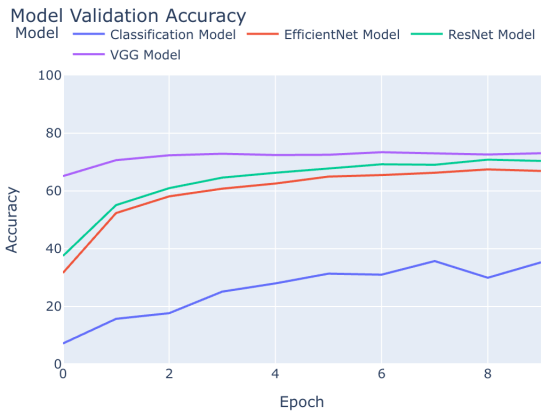
- While models were trained directly in application, both training and validation accuracy/loss will be kepted for visualization in web application later. Below chart shows training and validation accuracy/loss for each model that captured directly from web application.





### Visualization and Interpretability

- GradCAM has been implemented for each models.
  - Color will gradient from Blue(0%) -> Cyan(25%) -> Green(50%) -> Yellow(75%) -> Red(100%) impact to features that CNN layer consider.
- Code below show GradCAM implemmented on CNN Layer selection for each model from src\model_train.py

```
target_layer = None

if model_name == Models.ClassificationModel:
    # For custom CNN, use the last conv layer in conv_block
    target_layer = original_model.conv_block[-3]  # Get the last Conv2d before the final MaxPo
elif model_name == Models.ResNetModel:
    # For ResNet, use the last layer in layer4
    target_layer = original_model.layer4[-1].conv2
elif model_name == Models.EfficientNetModel:
    # For EfficientNet, use the last conv layer in features
    target_layer = original_model.features[-1][0]
elif model_name == Models.VGGModel:
    # For VGG, use the last conv layer in features
    for module in original_model.features:
        if isinstance(module, nn.Conv2d):
            target_layer = module
```

### Conclusion

- In this project, we have created a web application using Flask framework. This application uses PyTorch to train and evaluate models for different cat breeds. We have used a custom CNN, ResNet, EfficientNet, and VGG models.
- We have also implemented GradCAM to visualize the model's feature importance.
- The trained models have been saved as PyTorch models for later use.
- The application has been designed to be easily scalable and adaptable to different cat breed datasets.
- The application also provides an easy-to-use interface for users to upload images and view the model's predictions.

[2]:
```
! jupyter nbconvert --to pdf Wiwat_Pytorch_1254311.ipynb --template latex_authentic
```

```
[NbConvertApp] Converting notebook Wiwat_Pytorch_1254311.ipynb to pdf
[NbConvertApp] Writing 93209 bytes to notebook.tex
[NbConvertApp] Building PDF
[NbConvertApp] Running xelatex 3 times: ['xelatex', 'notebook.tex', '-quiet']
[NbConvertApp] CRITICAL | xelatex failed: ['xelatex', 'notebook.tex', '-quiet']
b"This is XeTeX, Version 3.141592653-2.6-0.999997 (TeX Live 2025) (preloaded
format=xelatex)\n restricted \\write18 enabled.\nentering extended
mode\n(./notebook.tex\nLaTeX2e <2024-11-01> patch level 2\nL3 programming layer
<2025-01-18>\n(/usr/local/texlive/2025/texmf-dist/tex/latex/base/article.cls\nDocument
Class: article 2024/06/29 v1.4n Standard LaTeX document
class\n(/usr/local/texlive/2025/texmf-
dist/tex/latex/base/size11.clo))\n(/usr/local/texlive/2025/texmf-
dist/tex/latex/tcolorbox/tcolorbox.sty\n(/usr/local/texlive/2025/texmf-
```

dist/tex/latex/pgf/frontendlayer/tikz.sty\n(/usr/local/texlive/2025/texmf-
dist/tex/latex/pgf/basiclayer/pgf.sty\n(/usr/local/texlive/2025/texmf-
dist/tex/latex/pgf/utilities/pgfrcs.sty\n(/usr/local/texlive/2025/texmf-
dist/tex/generic/pgf/utilities/pgfutil-common.te\nx)\n(/usr/local/texlive/2025/texmf-
dist/tex/generic/pgf/utilities/pgfutil-latex.def\n) (/usr/local/texlive/2025/texmf-
dist/tex/generic/pgf/utilities/pgfrcs.code.tex\n(/usr/local/texlive/2025/texmf-
dist/tex/generic/pgf/pgf.revision.tex)))\n(/usr/local/texlive/2025/texmf-
dist/tex/latex/pgf/basiclayer/pgfcore.sty\n(/usr/local/texlive/2025/texmf-
dist/tex/latex/graphics/graphicx.sty\n(/usr/local/texlive/2025/texmf-
dist/tex/latex/graphics/keyval.sty)\n(/usr/local/texlive/2025/texmf-
dist/tex/latex/graphics/graphics.sty\n(/usr/local/texlive/2025/texmf-
dist/tex/latex/graphics/trig.sty)\n(/usr/local/texlive/2025/texmf-
dist/tex/latex/graphics-cfg/graphics.cfg)\n(/usr/local/texlive/2025/texmf-
dist/tex/latex/graphics-def/xetex.def)))\n(/usr/local/texlive/2025/texmf-
dist/tex/latex/pgf/systemlayer/pgfsys.sty\n(/usr/local/texlive/2025/texmf-
dist/tex/generic/pgf/systemlayer/pgfsys.code.tex\n(/usr/local/texlive/2025/texmf-
dist/tex/generic/pgf/utilities/pgfkeys.code.tex\n(/usr/local/texlive/2025/texmf-dist/tex/
generic/pgf/utilities/pgfkeyslibraryfil\ntered.code.tex))\n(/usr/local/texlive/2025/texmf
-dist/tex/generic/pgf/systemlayer/pgf.cfg)\n(/usr/local/texlive/2025/texmf-
dist/tex/generic/pgf/systemlayer/pgfsys-xetex.de\nf\n(/usr/local/texlive/2025/texmf-
dist/tex/generic/pgf/systemlayer/pgfsys-dvipdfmx\n.def\n(/usr/local/texlive/2025/texmf-
dist/tex/generic/pgf/systemlayer/pgfsys-
common-p\ndf.def))))\n(/usr/local/texlive/2025/texmf-dist/tex/generic/pgf/systemlayer/pgf
syssoftpath.\ncode.tex)\n(/usr/local/texlive/2025/texmf-
dist/tex/generic/pgf/systemlayer/pgfsysprotocol.\ncode.tex))
(/usr/local/texlive/2025/texmf-
dist/tex/latex/xcolor/xcolor.sty\n(/usr/local/texlive/2025/texmf-dist/tex/latex/graphics-
cfg/color.cfg)\n(/usr/local/texlive/2025/texmf-
dist/tex/latex/graphics/mathcolor.ltx))\n(/usr/local/texlive/2025/texmf-
dist/tex/generic/pgf/basiclayer/pgfcore.code.tex\n(/usr/local/texlive/2025/texmf-
dist/tex/generic/pgf/math/pgfmath.code.tex\n(/usr/local/texlive/2025/texmf-
dist/tex/generic/pgf/math/pgfmathutil.code.tex)\n(/usr/local/texlive/2025/texmf-
dist/tex/generic/pgf/math/pgfmathparser.code.tex\n)\n(/usr/local/texlive/2025/texmf-
dist/tex/generic/pgf/math/pgfmathfunctions.code.\ntex)\n(/usr/local/texlive/2025/texmf-di
st/tex/generic/pgf/math/pgfmathfunctions.basic\n.code.tex)\n(/usr/local/texlive/2025/texm
f-dist/tex/generic/pgf/math/pgfmathfunctions.trigo\nnometric.code.tex)\n(/usr/local/texli
ve/2025/texmf-dist/tex/generic/pgf/math/pgfmathfunctions.rando\nm.code.tex)\n(/usr/local/
texlive/2025/texmf-dist/tex/generic/pgf/math/pgfmathfunctions.compa\nrison.code.tex)\n(/u
sr/local/texlive/2025/texmf-dist/tex/generic/pgf/math/pgfmathfunctions.base.\ncode.tex)\n
(/usr/local/texlive/2025/texmf-dist/tex/generic/pgf/math/pgfmathfunctions.round\n.code.te
x)\n(/usr/local/texlive/2025/texmf-dist/tex/generic/pgf/math/pgfmathfunctions.misc.\ncode
.tex)\n(/usr/local/texlive/2025/texmf-dist/tex/generic/pgf/math/pgfmathfunctions.integ\ne
rarithmetics.code.tex)\n(/usr/local/texlive/2025/texmf-
dist/tex/generic/pgf/math/pgfmathcalc.code.tex)\n(/usr/local/texlive/2025/texmf-
dist/tex/generic/pgf/math/pgfmathfloat.code.tex)\n) (/usr/local/texlive/2025/texmf-
dist/tex/generic/pgf/math/pgfint.code.tex)\n(/usr/local/texlive/2025/texmf-dist/tex/gener
ic/pgf/basiclayer/pgfcorepoints.co\nde.tex)\n(/usr/local/texlive/2025/texmf-dist/tex/gene
ric/pgf/basiclayer/pgfcorepathconst\nruct.code.tex)\n(/usr/local/texlive/2025/texmf-dist/
tex/generic/pgf/basiclayer/pgfcorepathusage\n.code.tex)\n(/usr/local/texlive/2025/texmf-d
ist/tex/generic/pgf/basiclayer/pgfcorescopes.co\nde.tex)\n(/usr/local/texlive/2025/texmf-
dist/tex/generic/pgf/basiclayer/pgfcoregraphicst\nate.code.tex)\n(/usr/local/texlive/2025
/texmf-dist/tex/generic/pgf/basiclayer/pgfcoretransform\nations.code.tex)\n(/usr/local/te

xlive/2025/texmf-
dist/tex/generic/pgf/basiclayer/pgfcorequick.cod\ne.tex)\n(/usr/local/texlive/2025/texmf-
dist/tex/generic/pgf/basiclayer/pgfcoreobjects.c\node.tex)\n(/usr/local/texlive/2025/texm
f-dist/tex/generic/pgf/basiclayer/pgfcorepathproce\nssing.code.tex)\n(/usr/local/texlive/
2025/texmf-dist/tex/generic/pgf/basiclayer/pgfcorearrows.co\nde.tex)\n(/usr/local/texlive
/2025/texmf-
dist/tex/generic/pgf/basiclayer/pgfcoreshade.cod\ne.tex)\n(/usr/local/texlive/2025/texmf-
dist/tex/generic/pgf/basiclayer/pgfcoreimage.cod\ne.tex)\n(/usr/local/texlive/2025/texmf-
dist/tex/generic/pgf/basiclayer/pgfcoreexternal.\ncode.tex)\n(/usr/local/texlive/2025/tex
mf-dist/tex/generic/pgf/basiclayer/pgfcorelayers.co\nde.tex)\n(/usr/local/texlive/2025/te
xmf-dist/tex/generic/pgf/basiclayer/pgfcoretranspare\nncy.code.tex)\n(/usr/local/texlive/
2025/texmf-dist/tex/generic/pgf/basiclayer/pgfcorepatterns.\ncode.tex)\n(/usr/local/texli
ve/2025/texmf-
dist/tex/generic/pgf/basiclayer/pgfcorerdf.code.\ntex)))\n(/usr/local/texlive/2025/texmf-
dist/tex/generic/pgf/modules/pgfmoduleshapes.cod\ne.tex)\n(/usr/local/texlive/2025/texmf-
dist/tex/generic/pgf/modules/pgfmoduleplot.code.\ntex)\n(/usr/local/texlive/2025/texmf-
dist/tex/latex/pgf/compatibility/pgfcomp-
version\n-0-65.sty)\n(/usr/local/texlive/2025/texmf-
dist/tex/latex/pgf/compatibility/pgfcomp-
version\n-1-18.sty))\n(/usr/local/texlive/2025/texmf-
dist/tex/latex/pgf/utilities/pgffor.sty\n(/usr/local/texlive/2025/texmf-
dist/tex/latex/pgf/utilities/pgfkeys.sty\n(/usr/local/texlive/2025/texmf-
dist/tex/generic/pgf/utilities/pgfkeys.code.tex)\n) (/usr/local/texlive/2025/texmf-
dist/tex/latex/pgf/math/pgfmath.sty\n(/usr/local/texlive/2025/texmf-
dist/tex/generic/pgf/math/pgfmath.code.tex))\n(/usr/local/texlive/2025/texmf-
dist/tex/generic/pgf/utilities/pgffor.code.tex))\n\n(/usr/local/texlive/2025/texmf-
dist/tex/generic/pgf/frontendlayer/tikz/tikz.cod\ne.tex\n(/usr/local/texlive/2025/texmf-d
ist/tex/generic/pgf/libraries/pgflibraryplothan\ndlers.code.tex)\n(/usr/local/texlive/202
5/texmf-
dist/tex/generic/pgf/modules/pgfmodulematrix.cod\ne.tex)\n(/usr/local/texlive/2025/texmf-
dist/tex/generic/pgf/frontendlayer/tikz/librarie\ns/tikzlibrarytopaths.code.tex)))\n(/usr
/local/texlive/2025/texmf-
dist/tex/latex/tools/verbatim.sty)\n(/usr/local/texlive/2025/texmf-
dist/tex/latex/environ/environ.sty\n(/usr/local/texlive/2025/texmf-
dist/tex/latex/trimspaces/trimspaces.sty))\n(/usr/local/texlive/2025/texmf-
dist/tex/latex/etoolbox/etoolbox.sty)\n(/usr/local/texlive/2025/texmf-
dist/tex/latex/tcolorbox/tcbbreakable.code.tex\nLibrary (tcolorbox):
'tcbbreakable.code.tex' version '6.4.1'\n(/usr/local/texlive/2025/texmf-
dist/tex/latex/pdfcol/pdfcol.sty\n(/usr/local/texlive/2025/texmf-
dist/tex/generic/ltxcmds/ltxcmds.sty)\n(/usr/local/texlive/2025/texmf-
dist/tex/generic/infwarerr/infwarerr.sty)\n(/usr/local/texlive/2025/texmf-
dist/tex/generic/iftex/iftex.sty))))\n(/usr/local/texlive/2025/texmf-
dist/tex/latex/parskip/parskip.sty\n(/usr/local/texlive/2025/texmf-
dist/tex/latex/kvoptions/kvoptions.sty\n(/usr/local/texlive/2025/texmf-
dist/tex/latex/kvsetkeys/kvsetkeys.sty)))\n(/usr/local/texlive/2025/texmf-
dist/tex/latex/caption/caption.sty\n(/usr/local/texlive/2025/texmf-
dist/tex/latex/caption/caption3.sty))\n(/usr/local/texlive/2025/texmf-
dist/tex/latex/float/float.sty)\n(/usr/local/texlive/2025/texmf-
dist/tex/latex/tools/enumerate.sty)\n(/usr/local/texlive/2025/texmf-
dist/tex/latex/geometry/geometry.sty\n(/usr/local/texlive/2025/texmf-
dist/tex/generic/iftex/ifvtex.sty))\n(/usr/local/texlive/2025/texmf-
dist/tex/latex/amsmath/amsmath.sty\nFor additional information on amsmath, use the `?'

option.\n(/usr/local/texlive/2025/texmf-
dist/tex/latex/amsmath/amstext.sty\n(/usr/local/texlive/2025/texmf-
dist/tex/latex/amsmath/amsgen.sty))\n(/usr/local/texlive/2025/texmf-
dist/tex/latex/amsmath/amsbsy.sty)\n(/usr/local/texlive/2025/texmf-
dist/tex/latex/amsmath/amsopn.sty))\n(/usr/local/texlive/2025/texmf-
dist/tex/latex/amsfonts/amssymb.sty\n(/usr/local/texlive/2025/texmf-
dist/tex/latex/amsfonts/amsfonts.sty))\n(/usr/local/texlive/2025/texmf-
dist/tex/latex/base/textcomp.sty)\n(/usr/local/texlive/2025/texmf-
dist/tex/latex/upquote/upquote.sty)\n(/usr/local/texlive/2025/texmf-
dist/tex/latex/eurosym/eurosym.sty)\n(/usr/local/texlive/2025/texmf-
dist/tex/latex/fontspec/fontspec.sty\n(/usr/local/texlive/2025/texmf-
dist/tex/latex/l3packages/xparse/xparse.sty\n(/usr/local/texlive/2025/texmf-
dist/tex/latex/l3kernel/expl3.sty\n(/usr/local/texlive/2025/texmf-
dist/tex/latex/l3backend/l3backend-xetex.def)))\n(/usr/local/texlive/2025/texmf-
dist/tex/latex/fontspec/fontspec-xetex.sty\n(/usr/local/texlive/2025/texmf-
dist/tex/latex/base/fontenc.sty)\n(/usr/local/texlive/2025/texmf-
dist/tex/latex/fontspec/fontspec.cfg)))\n(/usr/local/texlive/2025/texmf-
dist/tex/latex/unicode-math/unicode-math.sty\n(/usr/local/texlive/2025/texmf-
dist/tex/latex/unicode-math/unicode-math-xetex.s\nty\n(/usr/local/texlive/2025/texmf-
dist/tex/latex/l3packages/l3keys2e/l3keys2e.sty)\n (/usr/local/texlive/2025/texmf-
dist/tex/latex/base/fix-cm.sty\n(/usr/local/texlive/2025/texmf-
dist/tex/latex/base/ts1enc.def))\n(/usr/local/texlive/2025/texmf-dist/tex/latex/unicode-
math/unicode-math-table.t\nex))) (/usr/local/texlive/2025/texmf-
dist/tex/latex/fancyvrb/fancyvrb.sty)\n(/usr/local/texlive/2025/texmf-
dist/tex/latex/grffile/grffile.sty)\n(/usr/local/texlive/2025/texmf-
dist/tex/latex/adjustbox/adjustbox.sty\n(/usr/local/texlive/2025/texmf-
dist/tex/latex/xkeyval/xkeyval.sty\n(/usr/local/texlive/2025/texmf-
dist/tex/generic/xkeyval/xkeyval.tex\n(/usr/local/texlive/2025/texmf-
dist/tex/generic/xkeyval/xkvutils.tex)))\n(/usr/local/texlive/2025/texmf-
dist/tex/latex/adjustbox/adjcalc.sty)\n(/usr/local/texlive/2025/texmf-
dist/tex/latex/adjustbox/trimclip.sty\n(/usr/local/texlive/2025/texmf-
dist/tex/latex/collectbox/collectbox.sty)\n(/usr/local/texlive/2025/texmf-
dist/tex/latex/adjustbox/tc-xetex.def))\n(/usr/local/texlive/2025/texmf-
dist/tex/latex/ifoddpage/ifoddpage.sty)\n(/usr/local/texlive/2025/texmf-
dist/tex/latex/varwidth/varwidth.sty))\n(/usr/local/texlive/2025/texmf-
dist/tex/latex/hyperref/hyperref.sty\n(/usr/local/texlive/2025/texmf-
dist/tex/generic/kvdefinekeys/kvdefinekeys.sty)\n(/usr/local/texlive/2025/texmf-
dist/tex/generic/pdfescape/pdfescape.sty\n(/usr/local/texlive/2025/texmf-
dist/tex/generic/pdftexcmds/pdftexcmds.sty))\n(/usr/local/texlive/2025/texmf-
dist/tex/latex/hycolor/hycolor.sty)\n(/usr/local/texlive/2025/texmf-
dist/tex/latex/hyperref/nameref.sty\n(/usr/local/texlive/2025/texmf-
dist/tex/latex/refcount/refcount.sty)\n(/usr/local/texlive/2025/texmf-
dist/tex/generic/gettitlestring/gettitlestring.s\nty)) (/usr/local/texlive/2025/texmf-
dist/tex/generic/stringenc/stringenc.sty)\n(/usr/local/texlive/2025/texmf-
dist/tex/latex/hyperref/pd1enc.def)\n(/usr/local/texlive/2025/texmf-
dist/tex/generic/intcalc/intcalc.sty)\n(/usr/local/texlive/2025/texmf-
dist/tex/latex/hyperref/puenc.def)\n(/usr/local/texlive/2025/texmf-
dist/tex/latex/url/url.sty)\n(/usr/local/texlive/2025/texmf-
dist/tex/generic/bitset/bitset.sty\n(/usr/local/texlive/2025/texmf-
dist/tex/generic/bigintcalc/bigintcalc.sty))\n(/usr/local/texlive/2025/texmf-
dist/tex/latex/base/atbegshi-ltx.sty))\n(/usr/local/texlive/2025/texmf-
dist/tex/latex/hyperref/hxetex.def\n(/usr/local/texlive/2025/texmf-

```
dist/tex/latex/rerunfilecheck/rerunfilecheck.sty\n(/usr/local/texlive/2025/texmf-
dist/tex/latex/base/atveryend-ltx.sty)\n(/usr/local/texlive/2025/texmf-
dist/tex/generic/uniquecounter/uniquecounter.sty\n))) (/usr/local/texlive/2025/texmf-
dist/tex/latex/titling/titling.sty)\n(/usr/local/texlive/2025/texmf-
dist/tex/latex/tools/longtable.sty)\n(/usr/local/texlive/2025/texmf-
dist/tex/latex/booktabs/booktabs.sty)\n(/usr/local/texlive/2025/texmf-
dist/tex/latex/tools/array.sty)\n(/usr/local/texlive/2025/texmf-
dist/tex/latex/tools/calc.sty)\n(/usr/local/texlive/2025/texmf-
dist/tex/latex/enumitem/enumitem.sty)\n(/usr/local/texlive/2025/texmf-
dist/tex/generic/ulem/ulem.sty)\n(/usr/local/texlive/2025/texmf-
dist/tex/generic/soul/soul.sty\n(/usr/local/texlive/2025/texmf-
dist/tex/generic/soul/soul-ori.sty)\n(/usr/local/texlive/2025/texmf-
dist/tex/generic/etexcmds/etexcmds.sty))\n(/usr/local/texlive/2025/texmf-
dist/tex/latex/jknapltx/mathrsfs.sty)\nNo file
notebook.aux.\n(/usr/local/texlive/2025/texmf-
dist/tex/latex/caption/ltcaption.sty)\n*geometry* driver: auto-detecting\n*geometry*
detected driver: xetex\n\nPackage geometry Warning: The marginal notes overrun the
paper.\n     Add 18.41122pt and more to the right margin.\n\n*geometry* verbose mode - [
preamble ] result:\n* driver: xetex\n* paper: <default>\n* layout: <same size as
paper>\n* layoutoffset:(h,v)=(0.0pt,0.0pt)\n* modes: \n* h-part:(L,W,R)=(50.58878pt,
513.11745pt, 50.58878pt)\n* v-part:(T,H,B)=(36.135pt, 708.24622pt, 50.58878pt)\n*
\\paperwidth=614.295pt\n* \\paperheight=794.96999pt\n* \\textwidth=513.11745pt\n*
\\textheight=708.24622pt\n* \\oddsidemargin=-21.68121pt\n*
\\evensidemargin=-21.68121pt\n* \\topmargin=-73.135pt\n* \\headheight=12.0pt\n*
\\headsep=25.0pt\n* \\topskip=11.0pt\n* \\footskip=30.0pt\n* \\marginparwidth=59.0pt\n*
\\marginparsep=10.0pt\n* \\columnsep=10.0pt\n* \\skip\\footins=10.0pt plus 4.0pt minus
2.0pt\n* \\hoffset=0.0pt\n* \\voffset=0.0pt\n* \\mag=1000\n* \\@twocolumnfalse\n*
\\@twosidefalse\n* \\@mparswitchfalse\n* \\@reversemarginfalse\n* (1in=72.27pt=25.4mm,
1cm=28.453pt)\n\n\nPackage hyperref Warning: Rerun to get /PageLabels
entry.\n\n\nUnderfull \\hbox (badness 10000) in paragraph at lines 485--
489\n[]\\TU/lmr/m/n/10.95 Dataset is from Kaggle from \xe2\x80\x98Geno Cat Breed Image
Collectio\nn\xe2\x80\x99 dataset (url:\n\n[1] (/usr/local/texlive/2025/texmf-
dist/tex/latex/amsfonts/umsa.fd)\n(/usr/local/texlive/2025/texmf-
dist/tex/latex/amsfonts/umsb.fd)\n(/usr/local/texlive/2025/texmf-
dist/tex/latex/jknapltx/ursfs.fd)\n[2]\n[3]\n[4]\n[5]\n[6]\n[7]\n! Undefined control
sequence.\nl.892   model from src\\model\n                              \\_train.py\n? \n!
Emergency stop.\nl.892 \n      \nOutput written on notebook.pdf (7 pages).\nTranscript
written on notebook.log.\n"
Traceback (most recent call last):
  File "/opt/anaconda3/envs/pytorch/bin/jupyter-nbconvert", line 8, in <module>
    sys.exit(main())
             ^^^^^^
  File "/opt/anaconda3/envs/pytorch/lib/python3.12/site-
packages/jupyter_core/application.py", line 283, in launch_instance
    super().launch_instance(argv=argv, **kwargs)
  File "/opt/anaconda3/envs/pytorch/lib/python3.12/site-
packages/traitlets/config/application.py", line 1075, in launch_instance
    app.start()
  File "/opt/anaconda3/envs/pytorch/lib/python3.12/site-
packages/nbconvert/nbconvertapp.py", line 420, in start
    self.convert_notebooks()
  File "/opt/anaconda3/envs/pytorch/lib/python3.12/site-
```

```
packages/nbconvert/nbconvertapp.py", line 597, in convert_notebooks
    self.convert_single_notebook(notebook_filename)
  File "/opt/anaconda3/envs/pytorch/lib/python3.12/site-
packages/nbconvert/nbconvertapp.py", line 563, in convert_single_notebook
    output, resources = self.export_single_notebook(
                        ^^^^^^^^^^^^^^^^^^^^^^^^^^^^
  File "/opt/anaconda3/envs/pytorch/lib/python3.12/site-
packages/nbconvert/nbconvertapp.py", line 487, in export_single_notebook
    output, resources = self.exporter.from_filename(
                        ^^^^^^^^^^^^^^^^^^^^^^^^^^^^
  File "/opt/anaconda3/envs/pytorch/lib/python3.12/site-
packages/nbconvert/exporters/templateexporter.py", line 390, in from_filename
    return super().from_filename(filename, resources, **kw)  # type:ignore[return-value]
           ^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^
  File "/opt/anaconda3/envs/pytorch/lib/python3.12/site-
packages/nbconvert/exporters/exporter.py", line 201, in from_filename
    return self.from_file(f, resources=resources, **kw)
           ^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^
  File "/opt/anaconda3/envs/pytorch/lib/python3.12/site-
packages/nbconvert/exporters/templateexporter.py", line 396, in from_file
    return super().from_file(file_stream, resources, **kw)  # type:ignore[return-value]
           ^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^
  File "/opt/anaconda3/envs/pytorch/lib/python3.12/site-
packages/nbconvert/exporters/exporter.py", line 220, in from_file
    return self.from_notebook_node(
           ^^^^^^^^^^^^^^^^^^^^^^^^
  File "/opt/anaconda3/envs/pytorch/lib/python3.12/site-
packages/nbconvert/exporters/pdf.py", line 197, in from_notebook_node
    self.run_latex(tex_file)
  File "/opt/anaconda3/envs/pytorch/lib/python3.12/site-
packages/nbconvert/exporters/pdf.py", line 166, in run_latex
    return self.run_command(
           ^^^^^^^^^^^^^^^^^
  File "/opt/anaconda3/envs/pytorch/lib/python3.12/site-
packages/nbconvert/exporters/pdf.py", line 156, in run_command
    raise raise_on_failure(msg)
nbconvert.exporters.pdf.LatexFailed: PDF creating failed, captured latex output:
Failed to run "['xelatex', 'notebook.tex', '-quiet']" command:
This is XeTeX, Version 3.141592653-2.6-0.999997 (TeX Live 2025) (preloaded
format=xelatex)
 restricted \write18 enabled.
entering extended mode
(./notebook.tex
LaTeX2e <2024-11-01> patch level 2
L3 programming layer <2025-01-18>
(/usr/local/texlive/2025/texmf-dist/tex/latex/base/article.cls
Document Class: article 2024/06/29 v1.4n Standard LaTeX document class
(/usr/local/texlive/2025/texmf-dist/tex/latex/base/size11.clo))
(/usr/local/texlive/2025/texmf-dist/tex/latex/tcolorbox/tcolorbox.sty
(/usr/local/texlive/2025/texmf-dist/tex/latex/pgf/frontendlayer/tikz.sty
(/usr/local/texlive/2025/texmf-dist/tex/latex/pgf/basiclayer/pgf.sty
(/usr/local/texlive/2025/texmf-dist/tex/latex/pgf/utilities/pgfrcs.sty
```

(/usr/local/texlive/2025/texmf-dist/tex/generic/pgf/utilities/pgfutil-common.te
x)
(/usr/local/texlive/2025/texmf-dist/tex/generic/pgf/utilities/pgfutil-latex.def
) (/usr/local/texlive/2025/texmf-dist/tex/generic/pgf/utilities/pgfrcs.code.tex
(/usr/local/texlive/2025/texmf-dist/tex/generic/pgf/pgf.revision.tex)))
(/usr/local/texlive/2025/texmf-dist/tex/latex/pgf/basiclayer/pgfcore.sty
(/usr/local/texlive/2025/texmf-dist/tex/latex/graphics/graphicx.sty
(/usr/local/texlive/2025/texmf-dist/tex/latex/graphics/keyval.sty)
(/usr/local/texlive/2025/texmf-dist/tex/latex/graphics/graphics.sty
(/usr/local/texlive/2025/texmf-dist/tex/latex/graphics/trig.sty)
(/usr/local/texlive/2025/texmf-dist/tex/latex/graphics-cfg/graphics.cfg)
(/usr/local/texlive/2025/texmf-dist/tex/latex/graphics-def/xetex.def)))
(/usr/local/texlive/2025/texmf-dist/tex/latex/pgf/systemlayer/pgfsys.sty
(/usr/local/texlive/2025/texmf-dist/tex/generic/pgf/systemlayer/pgfsys.code.tex
(/usr/local/texlive/2025/texmf-dist/tex/generic/pgf/utilities/pgfkeys.code.tex
(/usr/local/texlive/2025/texmf-dist/tex/generic/pgf/utilities/pgfkeyslibraryfil
tered.code.tex))
(/usr/local/texlive/2025/texmf-dist/tex/generic/pgf/systemlayer/pgf.cfg)
(/usr/local/texlive/2025/texmf-dist/tex/generic/pgf/systemlayer/pgfsys-xetex.de
f
(/usr/local/texlive/2025/texmf-dist/tex/generic/pgf/systemlayer/pgfsys-dvipdfmx
.def
(/usr/local/texlive/2025/texmf-dist/tex/generic/pgf/systemlayer/pgfsys-common-p
df.def))))
(/usr/local/texlive/2025/texmf-dist/tex/generic/pgf/systemlayer/pgfsyssoftpath.
code.tex)
(/usr/local/texlive/2025/texmf-dist/tex/generic/pgf/systemlayer/pgfsysprotocol.
code.tex)) (/usr/local/texlive/2025/texmf-dist/tex/latex/xcolor/xcolor.sty
(/usr/local/texlive/2025/texmf-dist/tex/latex/graphics-cfg/color.cfg)
(/usr/local/texlive/2025/texmf-dist/tex/latex/graphics/mathcolor.ltx))
(/usr/local/texlive/2025/texmf-dist/tex/generic/pgf/basiclayer/pgfcore.code.tex
(/usr/local/texlive/2025/texmf-dist/tex/generic/pgf/math/pgfmath.code.tex
(/usr/local/texlive/2025/texmf-dist/tex/generic/pgf/math/pgfmathutil.code.tex)
(/usr/local/texlive/2025/texmf-dist/tex/generic/pgf/math/pgfmathparser.code.tex
)
(/usr/local/texlive/2025/texmf-dist/tex/generic/pgf/math/pgfmathfunctions.code.
tex)
(/usr/local/texlive/2025/texmf-dist/tex/generic/pgf/math/pgfmathfunctions.basic
.code.tex)
(/usr/local/texlive/2025/texmf-dist/tex/generic/pgf/math/pgfmathfunctions.trigo
nometric.code.tex)
(/usr/local/texlive/2025/texmf-dist/tex/generic/pgf/math/pgfmathfunctions.rando
m.code.tex)
(/usr/local/texlive/2025/texmf-dist/tex/generic/pgf/math/pgfmathfunctions.compa
rison.code.tex)
(/usr/local/texlive/2025/texmf-dist/tex/generic/pgf/math/pgfmathfunctions.base.
code.tex)
(/usr/local/texlive/2025/texmf-dist/tex/generic/pgf/math/pgfmathfunctions.round
.code.tex)
(/usr/local/texlive/2025/texmf-dist/tex/generic/pgf/math/pgfmathfunctions.misc.
code.tex)
(/usr/local/texlive/2025/texmf-dist/tex/generic/pgf/math/pgfmathfunctions.integ

erarithmetics.code.tex)
(/usr/local/texlive/2025/texmf-dist/tex/generic/pgf/math/pgfmathcalc.code.tex)
(/usr/local/texlive/2025/texmf-dist/tex/generic/pgf/math/pgfmathfloat.code.tex)
) (/usr/local/texlive/2025/texmf-dist/tex/generic/pgf/math/pgfint.code.tex)
(/usr/local/texlive/2025/texmf-dist/tex/generic/pgf/basiclayer/pgfcorepoints.co
de.tex)
(/usr/local/texlive/2025/texmf-dist/tex/generic/pgf/basiclayer/pgfcorepathconst
ruct.code.tex)
(/usr/local/texlive/2025/texmf-dist/tex/generic/pgf/basiclayer/pgfcorepathusage
.code.tex)
(/usr/local/texlive/2025/texmf-dist/tex/generic/pgf/basiclayer/pgfcorescopes.co
de.tex)
(/usr/local/texlive/2025/texmf-dist/tex/generic/pgf/basiclayer/pgfcoregraphicst
ate.code.tex)
(/usr/local/texlive/2025/texmf-dist/tex/generic/pgf/basiclayer/pgfcoretransform
ations.code.tex)
(/usr/local/texlive/2025/texmf-dist/tex/generic/pgf/basiclayer/pgfcorequick.cod
e.tex)
(/usr/local/texlive/2025/texmf-dist/tex/generic/pgf/basiclayer/pgfcoreobjects.c
ode.tex)
(/usr/local/texlive/2025/texmf-dist/tex/generic/pgf/basiclayer/pgfcorepathproce
ssing.code.tex)
(/usr/local/texlive/2025/texmf-dist/tex/generic/pgf/basiclayer/pgfcorearrows.co
de.tex)
(/usr/local/texlive/2025/texmf-dist/tex/generic/pgf/basiclayer/pgfcoreshade.cod
e.tex)
(/usr/local/texlive/2025/texmf-dist/tex/generic/pgf/basiclayer/pgfcoreimage.cod
e.tex)
(/usr/local/texlive/2025/texmf-dist/tex/generic/pgf/basiclayer/pgfcoreexternal.
code.tex)
(/usr/local/texlive/2025/texmf-dist/tex/generic/pgf/basiclayer/pgfcorelayers.co
de.tex)
(/usr/local/texlive/2025/texmf-dist/tex/generic/pgf/basiclayer/pgfcoretranspare
ncy.code.tex)
(/usr/local/texlive/2025/texmf-dist/tex/generic/pgf/basiclayer/pgfcorepatterns.
code.tex)
(/usr/local/texlive/2025/texmf-dist/tex/generic/pgf/basiclayer/pgfcorerdf.code.
tex)))
(/usr/local/texlive/2025/texmf-dist/tex/generic/pgf/modules/pgfmoduleshapes.cod
e.tex)
(/usr/local/texlive/2025/texmf-dist/tex/generic/pgf/modules/pgfmoduleplot.code.
tex)
(/usr/local/texlive/2025/texmf-dist/tex/latex/pgf/compatibility/pgfcomp-version
-0-65.sty)
(/usr/local/texlive/2025/texmf-dist/tex/latex/pgf/compatibility/pgfcomp-version
-1-18.sty))
(/usr/local/texlive/2025/texmf-dist/tex/latex/pgf/utilities/pgffor.sty
(/usr/local/texlive/2025/texmf-dist/tex/latex/pgf/utilities/pgfkeys.sty
(/usr/local/texlive/2025/texmf-dist/tex/generic/pgf/utilities/pgfkeys.code.tex)
) (/usr/local/texlive/2025/texmf-dist/tex/latex/pgf/math/pgfmath.sty
(/usr/local/texlive/2025/texmf-dist/tex/generic/pgf/math/pgfmath.code.tex))
(/usr/local/texlive/2025/texmf-dist/tex/generic/pgf/utilities/pgffor.code.tex))

(/usr/local/texlive/2025/texmf-dist/tex/generic/pgf/frontendlayer/tikz/tikz.cod
e.tex
(/usr/local/texlive/2025/texmf-dist/tex/generic/pgf/libraries/pgflibraryplothan
dlers.code.tex)
(/usr/local/texlive/2025/texmf-dist/tex/generic/pgf/modules/pgfmodulematrix.cod
e.tex)
(/usr/local/texlive/2025/texmf-dist/tex/generic/pgf/frontendlayer/tikz/librarie
s/tikzlibrarytopaths.code.tex)))
(/usr/local/texlive/2025/texmf-dist/tex/latex/tools/verbatim.sty)
(/usr/local/texlive/2025/texmf-dist/tex/latex/environ/environ.sty
(/usr/local/texlive/2025/texmf-dist/tex/latex/trimspaces/trimspaces.sty))
(/usr/local/texlive/2025/texmf-dist/tex/latex/etoolbox/etoolbox.sty)
(/usr/local/texlive/2025/texmf-dist/tex/latex/tcolorbox/tcbbreakable.code.tex
Library (tcolorbox): 'tcbbreakable.code.tex' version '6.4.1'
(/usr/local/texlive/2025/texmf-dist/tex/latex/pdfcol/pdfcol.sty
(/usr/local/texlive/2025/texmf-dist/tex/generic/ltxcmds/ltxcmds.sty)
(/usr/local/texlive/2025/texmf-dist/tex/generic/infwarerr/infwarerr.sty)
(/usr/local/texlive/2025/texmf-dist/tex/generic/iftex/iftex.sty))))
(/usr/local/texlive/2025/texmf-dist/tex/latex/parskip/parskip.sty
(/usr/local/texlive/2025/texmf-dist/tex/latex/kvoptions/kvoptions.sty
(/usr/local/texlive/2025/texmf-dist/tex/latex/kvsetkeys/kvsetkeys.sty)))
(/usr/local/texlive/2025/texmf-dist/tex/latex/caption/caption.sty
(/usr/local/texlive/2025/texmf-dist/tex/latex/caption/caption3.sty))
(/usr/local/texlive/2025/texmf-dist/tex/latex/float/float.sty)
(/usr/local/texlive/2025/texmf-dist/tex/latex/tools/enumerate.sty)
(/usr/local/texlive/2025/texmf-dist/tex/latex/geometry/geometry.sty
(/usr/local/texlive/2025/texmf-dist/tex/generic/iftex/ifvtex.sty))
(/usr/local/texlive/2025/texmf-dist/tex/latex/amsmath/amsmath.sty
For additional information on amsmath, use the `?' option.
(/usr/local/texlive/2025/texmf-dist/tex/latex/amsmath/amstext.sty
(/usr/local/texlive/2025/texmf-dist/tex/latex/amsmath/amsgen.sty))
(/usr/local/texlive/2025/texmf-dist/tex/latex/amsmath/amsbsy.sty)
(/usr/local/texlive/2025/texmf-dist/tex/latex/amsmath/amsopn.sty))
(/usr/local/texlive/2025/texmf-dist/tex/latex/amsfonts/amssymb.sty
(/usr/local/texlive/2025/texmf-dist/tex/latex/amsfonts/amsfonts.sty))
(/usr/local/texlive/2025/texmf-dist/tex/latex/base/textcomp.sty)
(/usr/local/texlive/2025/texmf-dist/tex/latex/upquote/upquote.sty)
(/usr/local/texlive/2025/texmf-dist/tex/latex/eurosym/eurosym.sty)
(/usr/local/texlive/2025/texmf-dist/tex/latex/fontspec/fontspec.sty
(/usr/local/texlive/2025/texmf-dist/tex/latex/l3packages/xparse/xparse.sty
(/usr/local/texlive/2025/texmf-dist/tex/latex/l3kernel/expl3.sty
(/usr/local/texlive/2025/texmf-dist/tex/latex/l3backend/l3backend-xetex.def)))
(/usr/local/texlive/2025/texmf-dist/tex/latex/fontspec/fontspec-xetex.sty
(/usr/local/texlive/2025/texmf-dist/tex/latex/base/fontenc.sty)
(/usr/local/texlive/2025/texmf-dist/tex/latex/fontspec/fontspec.cfg)))
(/usr/local/texlive/2025/texmf-dist/tex/latex/unicode-math/unicode-math.sty
(/usr/local/texlive/2025/texmf-dist/tex/latex/unicode-math/unicode-math-xetex.s
ty
(/usr/local/texlive/2025/texmf-dist/tex/latex/l3packages/l3keys2e/l3keys2e.sty)
 (/usr/local/texlive/2025/texmf-dist/tex/latex/base/fix-cm.sty
(/usr/local/texlive/2025/texmf-dist/tex/latex/base/ts1enc.def))

(/usr/local/texlive/2025/texmf-dist/tex/latex/unicode-math/unicode-math-table.t
ex))) (/usr/local/texlive/2025/texmf-dist/tex/latex/fancyvrb/fancyvrb.sty)
(/usr/local/texlive/2025/texmf-dist/tex/latex/grffile/grffile.sty)
(/usr/local/texlive/2025/texmf-dist/tex/latex/adjustbox/adjustbox.sty
(/usr/local/texlive/2025/texmf-dist/tex/latex/xkeyval/xkeyval.sty
(/usr/local/texlive/2025/texmf-dist/tex/generic/xkeyval/xkeyval.tex
(/usr/local/texlive/2025/texmf-dist/tex/generic/xkeyval/xkvutils.tex)))
(/usr/local/texlive/2025/texmf-dist/tex/latex/adjustbox/adjcalc.sty)
(/usr/local/texlive/2025/texmf-dist/tex/latex/adjustbox/trimclip.sty
(/usr/local/texlive/2025/texmf-dist/tex/latex/collectbox/collectbox.sty)
(/usr/local/texlive/2025/texmf-dist/tex/latex/adjustbox/tc-xetex.def))
(/usr/local/texlive/2025/texmf-dist/tex/latex/ifoddpage/ifoddpage.sty)
(/usr/local/texlive/2025/texmf-dist/tex/latex/varwidth/varwidth.sty))
(/usr/local/texlive/2025/texmf-dist/tex/latex/hyperref/hyperref.sty
(/usr/local/texlive/2025/texmf-dist/tex/generic/kvdefinekeys/kvdefinekeys.sty)
(/usr/local/texlive/2025/texmf-dist/tex/generic/pdfescape/pdfescape.sty
(/usr/local/texlive/2025/texmf-dist/tex/generic/pdftexcmds/pdftexcmds.sty))
(/usr/local/texlive/2025/texmf-dist/tex/latex/hycolor/hycolor.sty)
(/usr/local/texlive/2025/texmf-dist/tex/latex/hyperref/nameref.sty
(/usr/local/texlive/2025/texmf-dist/tex/latex/refcount/refcount.sty)
(/usr/local/texlive/2025/texmf-dist/tex/generic/gettitlestring/gettitlestring.s
ty)) (/usr/local/texlive/2025/texmf-dist/tex/generic/stringenc/stringenc.sty)
(/usr/local/texlive/2025/texmf-dist/tex/latex/hyperref/pd1enc.def)
(/usr/local/texlive/2025/texmf-dist/tex/generic/intcalc/intcalc.sty)
(/usr/local/texlive/2025/texmf-dist/tex/latex/hyperref/puenc.def)
(/usr/local/texlive/2025/texmf-dist/tex/latex/url/url.sty)
(/usr/local/texlive/2025/texmf-dist/tex/generic/bitset/bitset.sty
(/usr/local/texlive/2025/texmf-dist/tex/generic/bigintcalc/bigintcalc.sty))
(/usr/local/texlive/2025/texmf-dist/tex/latex/base/atbegshi-ltx.sty))
(/usr/local/texlive/2025/texmf-dist/tex/latex/hyperref/hxetex.def
(/usr/local/texlive/2025/texmf-dist/tex/latex/rerunfilecheck/rerunfilecheck.sty
(/usr/local/texlive/2025/texmf-dist/tex/latex/base/atveryend-ltx.sty)
(/usr/local/texlive/2025/texmf-dist/tex/generic/uniquecounter/uniquecounter.sty
))) (/usr/local/texlive/2025/texmf-dist/tex/latex/titling/titling.sty)
(/usr/local/texlive/2025/texmf-dist/tex/latex/tools/longtable.sty)
(/usr/local/texlive/2025/texmf-dist/tex/latex/booktabs/booktabs.sty)
(/usr/local/texlive/2025/texmf-dist/tex/latex/tools/array.sty)
(/usr/local/texlive/2025/texmf-dist/tex/latex/tools/calc.sty)
(/usr/local/texlive/2025/texmf-dist/tex/latex/enumitem/enumitem.sty)
(/usr/local/texlive/2025/texmf-dist/tex/generic/ulem/ulem.sty)
(/usr/local/texlive/2025/texmf-dist/tex/generic/soul/soul.sty
(/usr/local/texlive/2025/texmf-dist/tex/generic/soul/soul-ori.sty)
(/usr/local/texlive/2025/texmf-dist/tex/generic/etexcmds/etexcmds.sty))
(/usr/local/texlive/2025/texmf-dist/tex/latex/jknapltx/mathrsfs.sty)
No file notebook.aux.
(/usr/local/texlive/2025/texmf-dist/tex/latex/caption/ltcaption.sty)
*geometry* driver: auto-detecting
*geometry* detected driver: xetex

Package geometry Warning: The marginal notes overrun the paper.
     Add 18.41122pt and more to the right margin.

```
*geometry* verbose mode - [ preamble ] result:
* driver: xetex
* paper: <default>
* layout: <same size as paper>
* layoutoffset:(h,v)=(0.0pt,0.0pt)
* modes:
* h-part:(L,W,R)=(50.58878pt, 513.11745pt, 50.58878pt)
* v-part:(T,H,B)=(36.135pt, 708.24622pt, 50.58878pt)
* \paperwidth=614.295pt
* \paperheight=794.96999pt
* \textwidth=513.11745pt
* \textheight=708.24622pt
* \oddsidemargin=-21.68121pt
* \evensidemargin=-21.68121pt
* \topmargin=-73.135pt
* \headheight=12.0pt
* \headsep=25.0pt
* \topskip=11.0pt
* \footskip=30.0pt
* \marginparwidth=59.0pt
* \marginparsep=10.0pt
* \columnsep=10.0pt
* \skip\footins=10.0pt plus 4.0pt minus 2.0pt
* \hoffset=0.0pt
* \voffset=0.0pt
* \mag=1000
* \@twocolumnfalse
* \@twosidefalse
* \@mparswitchfalse
* \@reversemarginfalse
* (1in=72.27pt=25.4mm, 1cm=28.453pt)


Package hyperref Warning: Rerun to get /PageLabels entry.


Underfull \hbox (badness 10000) in paragraph at lines 485--489
[]\TU/lmr/m/n/10.95 Dataset is from Kaggle from ‘Geno Cat Breed Image Collectio
n’ dataset (url:

[1] (/usr/local/texlive/2025/texmf-dist/tex/latex/amsfonts/umsa.fd)
(/usr/local/texlive/2025/texmf-dist/tex/latex/amsfonts/umsb.fd)
(/usr/local/texlive/2025/texmf-dist/tex/latex/jknapltx/ursfs.fd)
[2]
[3]
[4]
[5]
[6]
[7]
! Undefined control sequence.
l.892   model from src\model
                           \_train.py
```

```
?
! Emergency stop.
l.892

Output written on notebook.pdf (7 pages).
Transcript written on notebook.log.
```