Importing Required Libraries

In [1]:

```
from google.colab import drive
import zipfile
import os
import shutil
import random
import matplotlib.pyplot as plt
import seaborn as sns
from tensorflow.keras.preprocessing.image import ImageDataGenerator
from tensorflow.keras.models import Sequential
from tensorflow.keras.layers import Conv2D, MaxPooling2D, Flatten, Dense, Dropout, Bat
from tensorflow.keras.regularizers import l2
from tensorflow.keras.applications import ResNet50
from tensorflow.keras.layers import GlobalAveragePooling2D
from tensorflow.keras.models import Model
```

Loading and Extracting Dataset

In [2]:

```
drive.mount('/content/drive')

root_dir = '/content/drive/MyDrive'
dataset_zip = os.path.join(root_dir, 'cats_vs_dogs_small_dataset.zip')
extracted_dataset_dir = os.path.join(root_dir, 'cats_vs_dogs_small_dataset')
```

```
Drive already mounted at /content/drive; to attempt to forcibly remount, call drive.m
ount("/content/drive", force_remount=True).
```

In [3]:

```
'''
with zipfile.ZipFile(dataset_zip, 'r') as zip_file:
    zip_file.extractall(extracted_dataset_dir)
'''
```

Out[3]:

```
"\nwith zipfile.ZipFile(dataset_zip, 'r') as zip_file:\n    zip_file.extractall(extra
cted_dataset_dir)\n"
```

In [4]:

```
cats_dir = os.path.join(extracted_dataset_dir, 'cats_vs_dogs_small_dataset/cat')
dogs_dir = os.path.join(extracted_dataset_dir, 'cats_vs_dogs_small_dataset/dog')
```

Splitting Dataset

In [5]:

```
def organize_data_folders(base_dir, cats_images, dogs_images, num_train, num_val, num_
    train_directory = os.path.join(base_dir, 'train_set')
    validation_directory = os.path.join(base_dir, 'validation_set')
    test_directory = os.path.join(base_dir, 'test_set')

    for dir in [train_directory, validation_directory, test_directory]:
        shutil.rmtree(dir, ignore_errors=True)
        os.makedirs(os.path.join(dir, 'cat'), exist_ok=True)
        os.makedirs(os.path.join(dir, 'dog'), exist_ok=True)
    random.shuffle(cats_images)
    random.shuffle(dogs_images)

    def copy_image_files(src_folder, dest_folder, img_files):
        for file in img_files:
            shutil.copy(os.path.join(src_folder, file), os.path.join(dest_folder, file

    copy_image_files(cats_dir, os.path.join(train_directory, 'cat'), cats_images[:num_
    copy_image_files(dogs_dir, os.path.join(train_directory, 'dog'), dogs_images[:num_

    copy_image_files(cats_dir, os.path.join(validation_directory, 'cat'), cats_images[
    copy_image_files(dogs_dir, os.path.join(validation_directory, 'dog'), dogs_images[

    copy_image_files(cats_dir, os.path.join(test_directory, 'cat'), cats_images[num_tr
    copy_image_files(dogs_dir, os.path.join(test_directory, 'dog'), dogs_images[num_tr

    return train_directory, validation_directory, test_directory
```

Data Generators with Different Augmentations

In [6]:

```
def setup_data_generators(train_dir, val_dir, test_dir, img_size, batch_sz):
    train_data_gen = ImageDataGenerator(
        rescale=1./255,
        rotation_range=30,
        zoom_range=0.15,
        width_shift_range=0.1,
        height_shift_range=0.1,
        horizontal_flip=True
    )

    validation_data_gen = ImageDataGenerator(rescale=1./255)
    test_data_gen = ImageDataGenerator(rescale=1./255)

    train_gen = train_data_gen.flow_from_directory(
        train_dir,
        target_size=img_size,
        batch_size=batch_sz,
        class_mode='binary'
    )
    val_gen = validation_data_gen.flow_from_directory(
        val_dir,
        target_size=img_size,
        batch_size=batch_sz,
        class_mode='binary'
    )
    test_gen = test_data_gen.flow_from_directory(
        test_dir,
        target_size=img_size,
        batch_size=batch_sz,
        class_mode='binary'
    )
    return train_gen, val_gen, test_gen
```

Model Architecture for Scratch Model

In [7]:

```
def build_custom_scratch_model(img_size):
    model = Sequential([
        Conv2D(64, (3, 3), activation='relu', input_shape=(img_size[0], img_size[1], 3
        BatchNormalization(),
        MaxPooling2D(2, 2),
        Conv2D(128, (3, 3), activation='relu', kernel_regularizer=l2(0.001)),
        BatchNormalization(),
        MaxPooling2D(2, 2),
        Conv2D(256, (3, 3), activation='relu', kernel_regularizer=l2(0.001)),
        BatchNormalization(),
        MaxPooling2D(2, 2),
        Conv2D(512, (3, 3), activation='relu', kernel_regularizer=l2(0.001)),
        BatchNormalization(),
        MaxPooling2D(2, 2),
        Flatten(),
        Dense(1024, activation='relu', kernel_regularizer=l2(0.001)),
        Dropout(0.5),
        Dense(1, activation='sigmoid')
    ])
    model.compile(optimizer='adam', loss='binary_crossentropy', metrics=['accuracy'])
    return model
```

Improved Pretrained Model Using ResNet50

In [8]:

```
def build_resnet_model(img_size):
    base_model = ResNet50(weights='imagenet', include_top=False, input_shape=(img_size
    for layer in base_model.layers:
        layer.trainable = False

    x = GlobalAveragePooling2D()(base_model.output)
    x = Dense(1024, activation='relu')(x)
    x = Dropout(0.5)(x)
    output_layer = Dense(1, activation='sigmoid')(x)

    model = Model(inputs=base_model.input, outputs=output_layer)
    model.compile(optimizer='adam', loss='binary_crossentropy', metrics=['accuracy'])
    return model
```

Model Training and Evaluation

In [9]:

```
def train_model_and_plot(model, train_gen, val_gen, num_epochs):
    history = model.fit(train_gen, epochs=num_epochs, validation_data=val_gen)
    return history
```

In [10]:

```
def plot_enhanced_metrics(history, title_prefix):
    plt.figure(figsize=(12, 6))

    sns.set(style="whitegrid")
    # Accuracy plot
    plt.subplot(1, 2, 1)
    plt.plot(history.history['accuracy'], label='Training Accuracy', color='blue')
    plt.plot(history.history['val_accuracy'], label='Validation Accuracy', color='gree
    plt.title(f'{title_prefix} - Training vs Validation Accuracy')
    plt.xlabel('Epochs')
    plt.ylabel('Accuracy')
    plt.legend()

    # Loss plot
    plt.subplot(1, 2, 2)
    plt.plot(history.history['loss'], label='Training Loss', color='red')
    plt.plot(history.history['val_loss'], label='Validation Loss', color='purple')
    plt.title(f'{title_prefix} - Training vs Validation Loss')
    plt.xlabel('Epochs')
    plt.ylabel('Loss')
    plt.legend()

    plt.show()
```

Comparing Different Models

In [11]:

```
def compare_model_performance(sample_counts, results_dict):
    for sample_count in sample_counts:
        train_acc_scratch = results_dict[sample_count]['scratch']['history'].history['
        val_acc_scratch = results_dict[sample_count]['scratch']['history'].history['va
        train_acc_resnet = results_dict[sample_count]['resnet']['history'].history['ac
        val_acc_resnet = results_dict[sample_count]['resnet']['history'].history['val_

        # Comparison plots
        plt.figure(figsize=(10, 5))
        plt.plot(train_acc_scratch, label='Scratch Model - Training Accuracy', color='
        plt.plot(val_acc_scratch, label='Scratch Model - Validation Accuracy', color='
        plt.plot(train_acc_resnet, label='ResNet Model - Training Accuracy', color='or
        plt.plot(val_acc_resnet, label='ResNet Model - Validation Accuracy', color='da
        plt.title(f'Accuracy Comparison for {sample_count} Samples')
        plt.xlabel('Epochs')
        plt.ylabel('Accuracy')
        plt.legend()
        plt.show()
```

Finalizing Parameters and Running Models

In [12]:

```
image_dimensions = (224, 224)
batch_size_value = 32
validation_data_count = 600
testing_data_count = 600
cat_image_files = os.listdir(cats_dir)
dog_image_files = os.listdir(dogs_dir)

sample_set_sizes = [1000, 1500, 2000, 2500]
evaluation_results = {}
```

Running models for different sample sizes

In [14]:

```
for sample_size in sample_set_sizes:
    train_dir, val_dir, test_dir = organize_data_folders(extracted_dataset_dir, cat_im
    train_gen, val_gen, test_gen = setup_data_generators(train_dir, val_dir, test_dir,

    # Train scratch model
    custom_scratch_model = build_custom_scratch_model(image_dimensions)
    history_scratch_model = train_model_and_plot(custom_scratch_model, train_gen, val_

    # Train ResNet model
    resnet_model = build_resnet_model(image_dimensions)
    history_resnet_model = train_model_and_plot(resnet_model, train_gen, val_gen, num_

    # Store the results
    evaluation_results[sample_size] = {
        'scratch': {'model': custom_scratch_model, 'history': history_scratch_model},
        'resnet': {'model': resnet_model, 'history': history_resnet_model}
    }

    # Plot metrics
    plot_enhanced_metrics(history_scratch_model, f'Scratch Model for {sample_size} Sam
    plot_enhanced_metrics(history_resnet_model, f'ResNet Model for {sample_size} Sampl
```

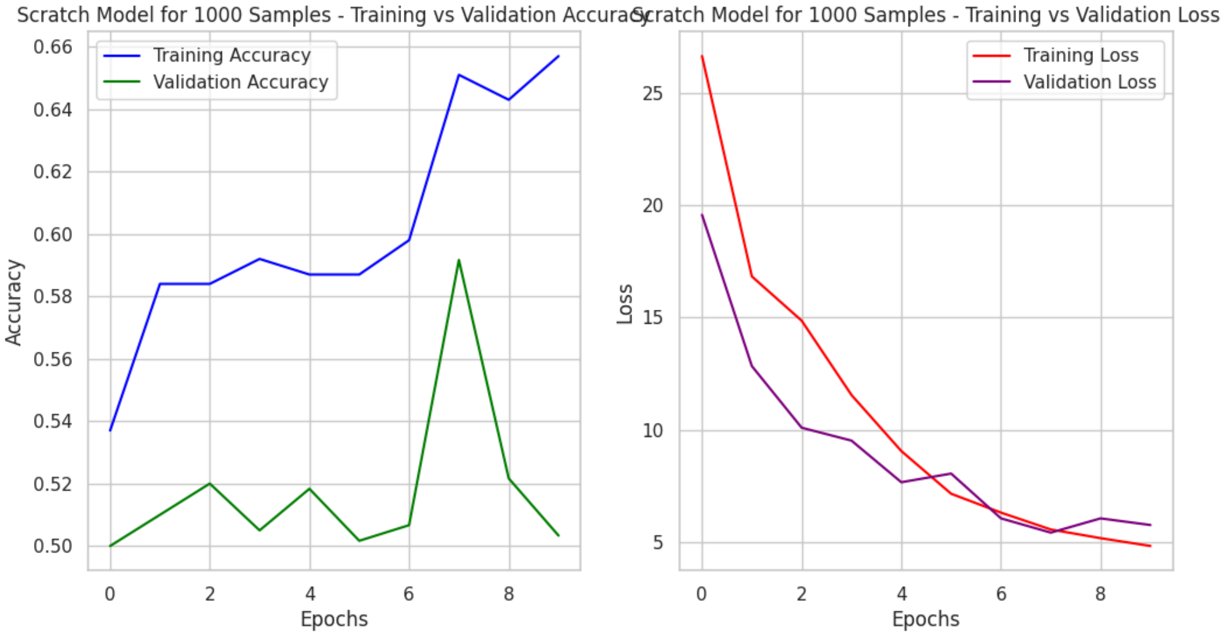
```
Found 1000 images belonging to 2 classes.
Found 600 images belonging to 2 classes.
Found 600 images belonging to 2 classes.
```

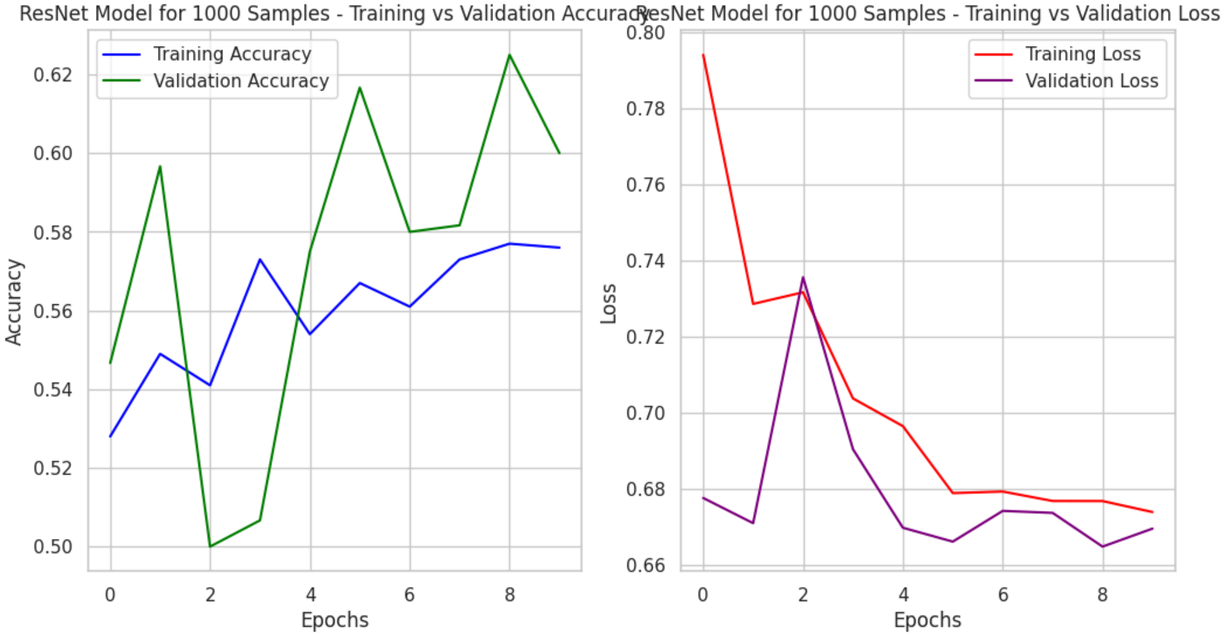
```
/usr/local/lib/python3.10/dist-packages/keras/src/layers/convolutional/base_conv.py:1
07: UserWarning: Do not pass an `input_shape`/`input_dim` argument to a layer. When u
sing Sequential models, prefer using an `Input(shape)` object as the first layer in t
he model instead.
  super().__init__(activity_regularizer=activity_regularizer, **kwargs)
```

```
Epoch 1/10
```

```
/usr/local/lib/python3.10/dist-packages/keras/src/trainers/data_adapters/py_dataset_a
dapter.py:121: UserWarning: Your `PyDataset` class should call `super().__init__(**kw
args)` in its constructor. `**kwargs` can include `workers`, `use_multiprocessing`, `
max_queue_size`. Do not pass these arguments to `fit()`, as they will be ignored.
  self._warn_if_super_not_called()
```

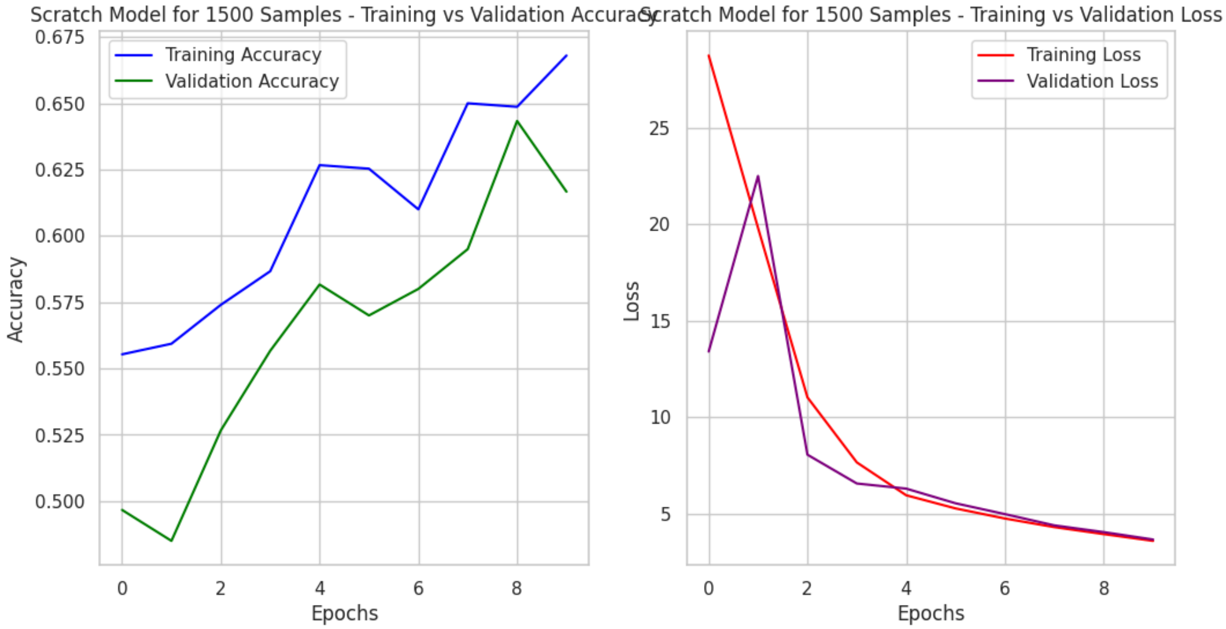
```
32/32 ━━━━━━━━━━━━━━━━━━━━ 53s 972ms/step - accuracy: 0.5395 - loss: 28.0936 - val_ac
curacy: 0.5000 - val_loss: 19.5655
Epoch 2/10
32/32 ━━━━━━━━━━━━━━━━━━━━ 54s 509ms/step - accuracy: 0.5768 - loss: 17.3044 - val_ac
curacy: 0.5100 - val_loss: 12.8325
Epoch 3/10
32/32 ━━━━━━━━━━━━━━━━━━━━ 20s 515ms/step - accuracy: 0.6167 - loss: 14.8028 - val_ac
curacy: 0.5200 - val_loss: 10.0886
Epoch 4/10
32/32 ━━━━━━━━━━━━━━━━━━━━ 21s 501ms/step - accuracy: 0.5962 - loss: 11.5466 - val_ac
curacy: 0.5050 - val_loss: 9.5143
Epoch 5/10
32/32 ━━━━━━━━━━━━━━━━━━━━ 20s 535ms/step - accuracy: 0.6025 - loss: 9.7075 - val_acc
uracy: 0.5183 - val_loss: 7.6612
Epoch 6/10
32/32 ━━━━━━━━━━━━━━━━━━━━ 23s 570ms/step - accuracy: 0.5877 - loss: 7.5025 - val_acc
uracy: 0.5017 - val_loss: 8.0466
Epoch 7/10
32/32 ━━━━━━━━━━━━━━━━━━━━ 39s 504ms/step - accuracy: 0.5680 - loss: 6.5496 - val_acc
uracy: 0.5067 - val_loss: 6.0529
Epoch 8/10
32/32 ━━━━━━━━━━━━━━━━━━━━ 41s 506ms/step - accuracy: 0.6454 - loss: 5.6995 - val_acc
uracy: 0.5917 - val_loss: 5.4177
Epoch 9/10
32/32 ━━━━━━━━━━━━━━━━━━━━ 41s 523ms/step - accuracy: 0.6633 - loss: 5.2470 - val_acc
uracy: 0.5217 - val_loss: 6.0518
Epoch 10/10
32/32 ━━━━━━━━━━━━━━━━━━━━ 20s 523ms/step - accuracy: 0.6559 - loss: 4.8820 - val_acc
uracy: 0.5033 - val_loss: 5.7566
Epoch 1/10
32/32 ━━━━━━━━━━━━━━━━━━━━ 44s 919ms/step - accuracy: 0.5429 - loss: 0.8379 - val_acc
uracy: 0.5467 - val_loss: 0.6777
Epoch 2/10
32/32 ━━━━━━━━━━━━━━━━━━━━ 22s 492ms/step - accuracy: 0.5410 - loss: 0.7339 - val_acc
uracy: 0.5967 - val_loss: 0.6711
Epoch 3/10
32/32 ━━━━━━━━━━━━━━━━━━━━ 20s 491ms/step - accuracy: 0.5452 - loss: 0.7141 - val_acc
uracy: 0.5000 - val_loss: 0.7357
Epoch 4/10
32/32 ━━━━━━━━━━━━━━━━━━━━ 19s 505ms/step - accuracy: 0.5443 - loss: 0.7235 - val_acc
uracy: 0.5067 - val_loss: 0.6905
Epoch 5/10
32/32 ━━━━━━━━━━━━━━━━━━━━ 22s 561ms/step - accuracy: 0.5343 - loss: 0.7143 - val_acc
uracy: 0.5750 - val_loss: 0.6699
Epoch 6/10
32/32 ━━━━━━━━━━━━━━━━━━━━ 19s 499ms/step - accuracy: 0.6004 - loss: 0.6704 - val_acc
uracy: 0.6167 - val_loss: 0.6663
Epoch 7/10
32/32 ━━━━━━━━━━━━━━━━━━━━ 22s 526ms/step - accuracy: 0.5331 - loss: 0.6869 - val_acc
uracy: 0.5800 - val_loss: 0.6743
Epoch 8/10
32/32 ━━━━━━━━━━━━━━━━━━━━ 19s 499ms/step - accuracy: 0.5628 - loss: 0.6782 - val_acc
uracy: 0.5817 - val_loss: 0.6738
Epoch 9/10
32/32 ━━━━━━━━━━━━━━━━━━━━ 19s 500ms/step - accuracy: 0.5636 - loss: 0.6831 - val_acc
uracy: 0.6250 - val_loss: 0.6650
Epoch 10/10
32/32 ━━━━━━━━━━━━━━━━━━━━ 21s 519ms/step - accuracy: 0.5944 - loss: 0.6719 - val_acc
uracy: 0.6000 - val_loss: 0.6697
```


Scratch Model for 1000 Samples - Training vs Validation Accuracy
Training Accuracy
Validation Accuracy
Accuracy
0.50
0.52
0.54
0.56
0.58
0.60
0.62
0.64
0.66
0
2
4
6
8
Epochs
Scratch Model for 1000 Samples - Training vs Validation Loss
Training Loss
Validation Loss
Loss
5
10
15
20
25
0
2
4
6
8
Epochs


ResNet Model for 1000 Samples - Training vs Validation Accuracy
Training Accuracy
Validation Accuracy
Accuracy
0.50
0.52
0.54
0.56
0.58
0.60
0.62
0
2
4
6
8
Epochs
ResNet Model for 1000 Samples - Training vs Validation Loss
Training Loss
Validation Loss
Loss
0.66
0.68
0.70
0.72
0.74
0.76
0.78
0.80
0
2
4
6
8
Epochs

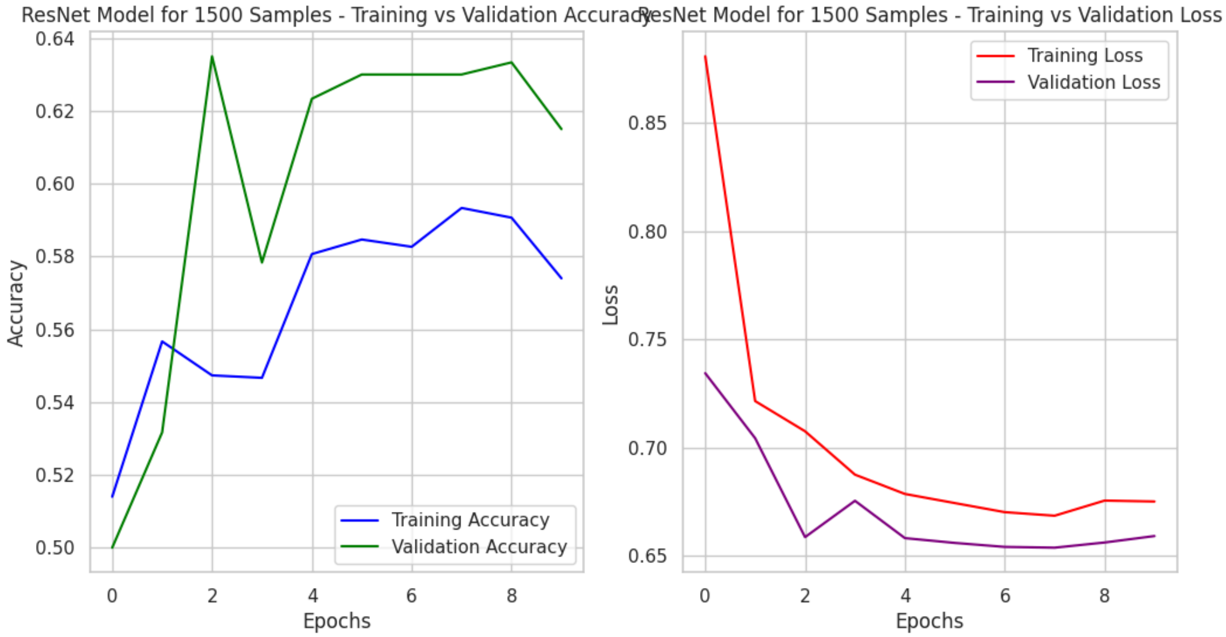
```
Found 1500 images belonging to 2 classes.
Found 600 images belonging to 2 classes.
Found 600 images belonging to 2 classes.
Epoch 1/10
47/47 ━━━━━━━━━━━━━━━━━━━━ 56s 970ms/step - accuracy: 0.5753 - loss: 26.4160 - val_ac
curacy: 0.4967 - val_loss: 13.3991
Epoch 2/10
47/47 ━━━━━━━━━━━━━━━━━━━━ 29s 559ms/step - accuracy: 0.5539 - loss: 22.6608 - val_ac
curacy: 0.4850 - val_loss: 22.4943
Epoch 3/10
47/47 ━━━━━━━━━━━━━━━━━━━━ 43s 600ms/step - accuracy: 0.5571 - loss: 12.6092 - val_ac
curacy: 0.5267 - val_loss: 8.0545
Epoch 4/10
47/47 ━━━━━━━━━━━━━━━━━━━━ 38s 543ms/step - accuracy: 0.6050 - loss: 8.2591 - val_acc
uracy: 0.5567 - val_loss: 6.5619
Epoch 5/10
47/47 ━━━━━━━━━━━━━━━━━━━━ 29s 543ms/step - accuracy: 0.6291 - loss: 6.2067 - val_acc
uracy: 0.5817 - val_loss: 6.2965
Epoch 6/10
47/47 ━━━━━━━━━━━━━━━━━━━━ 29s 543ms/step - accuracy: 0.6212 - loss: 5.4030 - val_acc
uracy: 0.5700 - val_loss: 5.5369
Epoch 7/10
47/47 ━━━━━━━━━━━━━━━━━━━━ 40s 532ms/step - accuracy: 0.6058 - loss: 4.8477 - val_acc
uracy: 0.5800 - val_loss: 4.9748
Epoch 8/10
47/47 ━━━━━━━━━━━━━━━━━━━━ 29s 532ms/step - accuracy: 0.6470 - loss: 4.3808 - val_acc
uracy: 0.5950 - val_loss: 4.3920
Epoch 9/10
47/47 ━━━━━━━━━━━━━━━━━━━━ 29s 524ms/step - accuracy: 0.6451 - loss: 4.0234 - val_acc
uracy: 0.6433 - val_loss: 4.0431
Epoch 10/10
47/47 ━━━━━━━━━━━━━━━━━━━━ 41s 522ms/step - accuracy: 0.6765 - loss: 3.6707 - val_acc
uracy: 0.6167 - val_loss: 3.6594
Epoch 1/10
47/47 ━━━━━━━━━━━━━━━━━━━━ 48s 732ms/step - accuracy: 0.4984 - loss: 0.9875 - val_acc
uracy: 0.5000 - val_loss: 0.7345
Epoch 2/10
47/47 ━━━━━━━━━━━━━━━━━━━━ 28s 523ms/step - accuracy: 0.5475 - loss: 0.7546 - val_acc
uracy: 0.5317 - val_loss: 0.7044
Epoch 3/10
47/47 ━━━━━━━━━━━━━━━━━━━━ 27s 516ms/step - accuracy: 0.5397 - loss: 0.7183 - val_acc
uracy: 0.6350 - val_loss: 0.6587
Epoch 4/10
47/47 ━━━━━━━━━━━━━━━━━━━━ 41s 524ms/step - accuracy: 0.5568 - loss: 0.6829 - val_acc
uracy: 0.5783 - val_loss: 0.6755
Epoch 5/10
47/47 ━━━━━━━━━━━━━━━━━━━━ 41s 522ms/step - accuracy: 0.5739 - loss: 0.6807 - val_acc
uracy: 0.6233 - val_loss: 0.6582
Epoch 6/10
47/47 ━━━━━━━━━━━━━━━━━━━━ 41s 527ms/step - accuracy: 0.5813 - loss: 0.6758 - val_acc
uracy: 0.6300 - val_loss: 0.6560
Epoch 7/10
47/47 ━━━━━━━━━━━━━━━━━━━━ 41s 529ms/step - accuracy: 0.5716 - loss: 0.6729 - val_acc
uracy: 0.6300 - val_loss: 0.6542
Epoch 8/10
47/47 ━━━━━━━━━━━━━━━━━━━━ 41s 531ms/step - accuracy: 0.5965 - loss: 0.6658 - val_acc
uracy: 0.6300 - val_loss: 0.6538
Epoch 9/10
47/47 ━━━━━━━━━━━━━━━━━━━━ 28s 531ms/step - accuracy: 0.5790 - loss: 0.6758 - val_acc
uracy: 0.6333 - val_loss: 0.6562
```

```
Epoch 10/10
47/47 ━━━━━━━━━━━━━━━━━━━━ 41s 526ms/step - accuracy: 0.5751 - loss: 0.6693 - val_acc
uracy: 0.6150 - val_loss: 0.6592
```



Scratch Model for 1500 Samples - Training vs Validation Accuracy

Scratch Model for 1500 Samples - Training vs Validation Loss

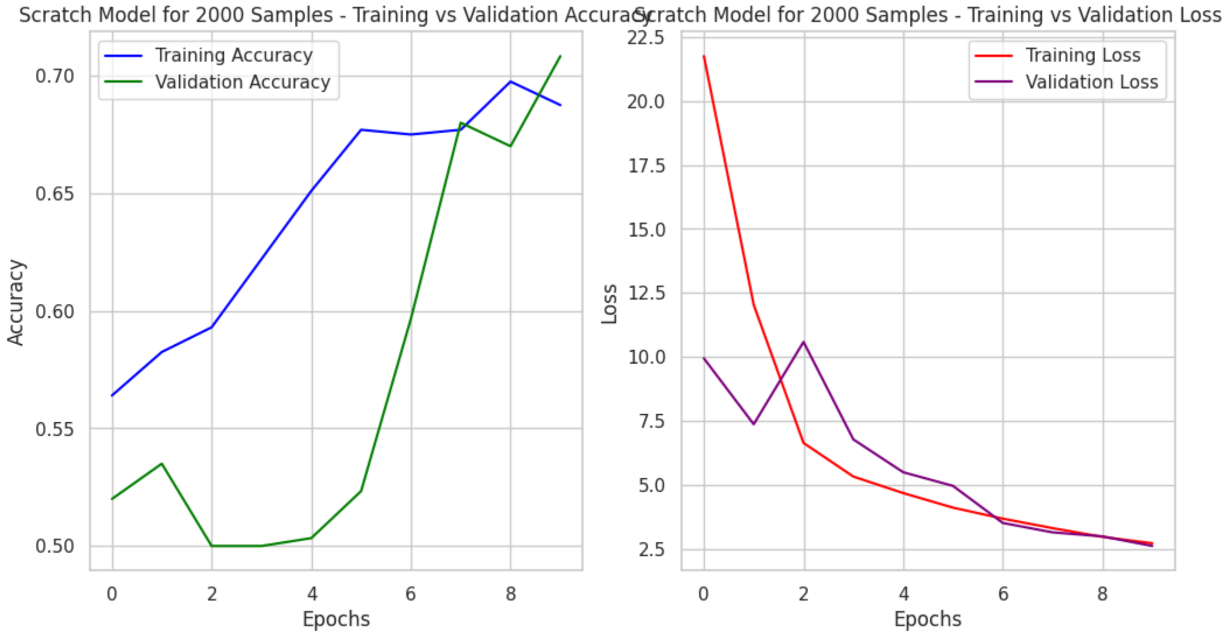


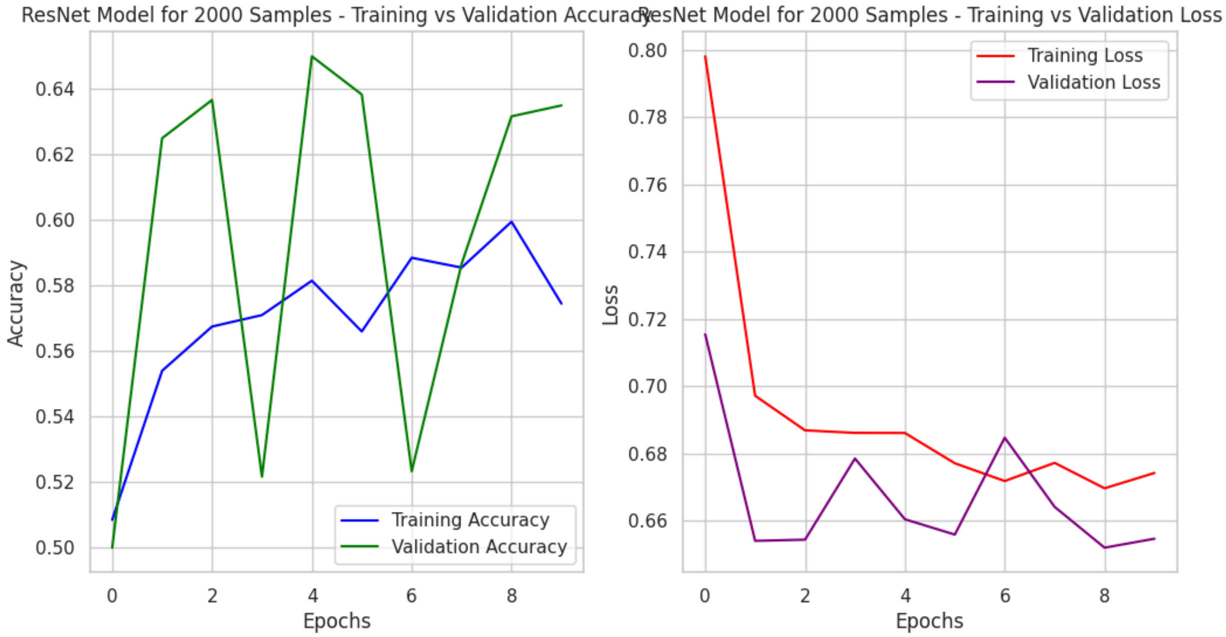
ResNet Model for 1500 Samples - Training vs Validation Accuracy

ResNet Model for 1500 Samples - Training vs Validation Loss

```
Found 2000 images belonging to 2 classes.
Found 600 images belonging to 2 classes.
Found 600 images belonging to 2 classes.
Epoch 1/10
63/63 ━━━━━━━━━━━━━━━━━━━━ 60s 788ms/step - accuracy: 0.5456 - loss: 25.4603 - val_ac
curacy: 0.5200 - val_loss: 9.9494
Epoch 2/10
63/63 ━━━━━━━━━━━━━━━━━━━━ 63s 552ms/step - accuracy: 0.5783 - loss: 14.1120 - val_ac
curacy: 0.5350 - val_loss: 7.3758
Epoch 3/10
63/63 ━━━━━━━━━━━━━━━━━━━━ 38s 554ms/step - accuracy: 0.5745 - loss: 7.2842 - val_acc
uracy: 0.5000 - val_loss: 10.5914
Epoch 4/10
63/63 ━━━━━━━━━━━━━━━━━━━━ 42s 577ms/step - accuracy: 0.6090 - loss: 5.5155 - val_acc
uracy: 0.5000 - val_loss: 6.7836
Epoch 5/10
63/63 ━━━━━━━━━━━━━━━━━━━━ 36s 530ms/step - accuracy: 0.6565 - loss: 4.8309 - val_acc
uracy: 0.5033 - val_loss: 5.5033
Epoch 6/10
63/63 ━━━━━━━━━━━━━━━━━━━━ 38s 530ms/step - accuracy: 0.6583 - loss: 4.2643 - val_acc
uracy: 0.5233 - val_loss: 4.9695
Epoch 7/10
63/63 ━━━━━━━━━━━━━━━━━━━━ 41s 536ms/step - accuracy: 0.6754 - loss: 3.7732 - val_acc
uracy: 0.5967 - val_loss: 3.5221
Epoch 8/10
63/63 ━━━━━━━━━━━━━━━━━━━━ 41s 536ms/step - accuracy: 0.6649 - loss: 3.4185 - val_acc
uracy: 0.6800 - val_loss: 3.1548
Epoch 9/10
63/63 ━━━━━━━━━━━━━━━━━━━━ 36s 525ms/step - accuracy: 0.7029 - loss: 3.0319 - val_acc
uracy: 0.6700 - val_loss: 2.9993
Epoch 10/10
63/63 ━━━━━━━━━━━━━━━━━━━━ 37s 528ms/step - accuracy: 0.7019 - loss: 2.7696 - val_acc
uracy: 0.7083 - val_loss: 2.6235
Epoch 1/10
63/63 ━━━━━━━━━━━━━━━━━━━━ 55s 661ms/step - accuracy: 0.4947 - loss: 0.8872 - val_acc
uracy: 0.5000 - val_loss: 0.7155
Epoch 2/10
63/63 ━━━━━━━━━━━━━━━━━━━━ 36s 529ms/step - accuracy: 0.5391 - loss: 0.7013 - val_acc
uracy: 0.6250 - val_loss: 0.6541
Epoch 3/10
63/63 ━━━━━━━━━━━━━━━━━━━━ 42s 547ms/step - accuracy: 0.5614 - loss: 0.6868 - val_acc
uracy: 0.6367 - val_loss: 0.6544
Epoch 4/10
63/63 ━━━━━━━━━━━━━━━━━━━━ 35s 511ms/step - accuracy: 0.5708 - loss: 0.6867 - val_acc
uracy: 0.5217 - val_loss: 0.6786
Epoch 5/10
63/63 ━━━━━━━━━━━━━━━━━━━━ 37s 527ms/step - accuracy: 0.5601 - loss: 0.6975 - val_acc
uracy: 0.6500 - val_loss: 0.6605
Epoch 6/10
63/63 ━━━━━━━━━━━━━━━━━━━━ 42s 547ms/step - accuracy: 0.5785 - loss: 0.6763 - val_acc
uracy: 0.6383 - val_loss: 0.6559
Epoch 7/10
63/63 ━━━━━━━━━━━━━━━━━━━━ 41s 548ms/step - accuracy: 0.5912 - loss: 0.6725 - val_acc
uracy: 0.5233 - val_loss: 0.6848
Epoch 8/10
63/63 ━━━━━━━━━━━━━━━━━━━━ 41s 543ms/step - accuracy: 0.5758 - loss: 0.6883 - val_acc
uracy: 0.5867 - val_loss: 0.6642
Epoch 9/10
63/63 ━━━━━━━━━━━━━━━━━━━━ 35s 512ms/step - accuracy: 0.5838 - loss: 0.6810 - val_acc
uracy: 0.6317 - val_loss: 0.6521
```

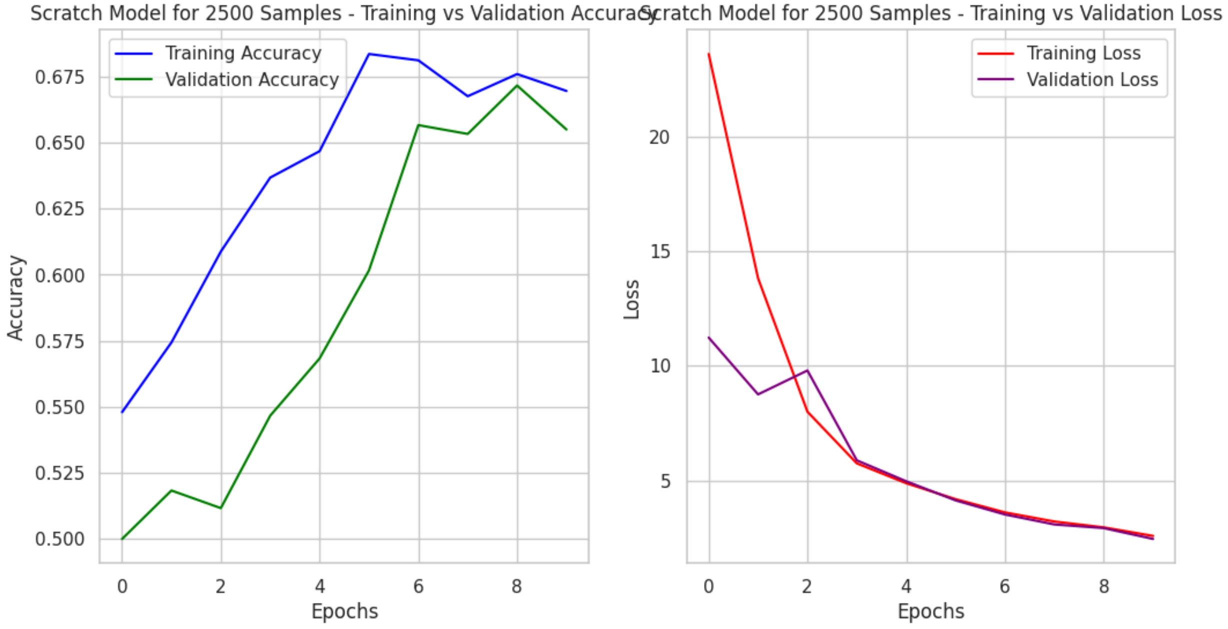
```
Epoch 10/10
63/63 ━━━━━━━━━━━━━━━━━━━━ 36s 515ms/step - accuracy: 0.5856 - loss: 0.6680 - val_acc
uracy: 0.6350 - val_loss: 0.6547
```

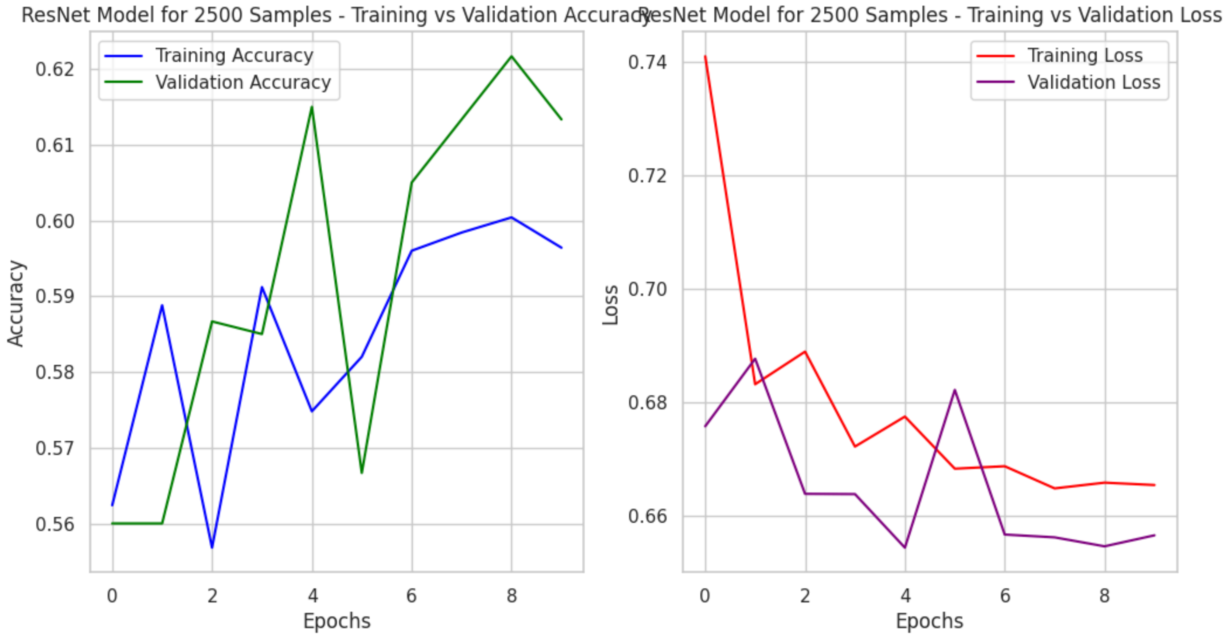




```
Found 2500 images belonging to 2 classes.
Found 600 images belonging to 2 classes.
Found 600 images belonging to 2 classes.
Epoch 1/10
79/79 ━━━━━━━━━━━━━━━━━━━━ 62s 645ms/step - accuracy: 0.5327 - loss: 26.4176 - val_ac
curacy: 0.5000 - val_loss: 11.2321
Epoch 2/10
79/79 ━━━━━━━━━━━━━━━━━━━━ 70s 549ms/step - accuracy: 0.5904 - loss: 14.9811 - val_ac
curacy: 0.5183 - val_loss: 8.7546
Epoch 3/10
79/79 ━━━━━━━━━━━━━━━━━━━━ 82s 558ms/step - accuracy: 0.6055 - loss: 8.9048 - val_acc
uracy: 0.5117 - val_loss: 9.7966
Epoch 4/10
79/79 ━━━━━━━━━━━━━━━━━━━━ 47s 547ms/step - accuracy: 0.6384 - loss: 5.9957 - val_acc
uracy: 0.5467 - val_loss: 5.8790
Epoch 5/10
79/79 ━━━━━━━━━━━━━━━━━━━━ 46s 543ms/step - accuracy: 0.6322 - loss: 5.0639 - val_acc
uracy: 0.5683 - val_loss: 4.9655
Epoch 6/10
79/79 ━━━━━━━━━━━━━━━━━━━━ 45s 536ms/step - accuracy: 0.6932 - loss: 4.3118 - val_acc
uracy: 0.6017 - val_loss: 4.1323
Epoch 7/10
79/79 ━━━━━━━━━━━━━━━━━━━━ 82s 534ms/step - accuracy: 0.6795 - loss: 3.7314 - val_acc
uracy: 0.6567 - val_loss: 3.5172
Epoch 8/10
79/79 ━━━━━━━━━━━━━━━━━━━━ 46s 524ms/step - accuracy: 0.6677 - loss: 3.2901 - val_acc
uracy: 0.6533 - val_loss: 3.0828
Epoch 9/10
79/79 ━━━━━━━━━━━━━━━━━━━━ 45s 537ms/step - accuracy: 0.6691 - loss: 3.0380 - val_acc
uracy: 0.6717 - val_loss: 2.9237
Epoch 10/10
79/79 ━━━━━━━━━━━━━━━━━━━━ 45s 535ms/step - accuracy: 0.6681 - loss: 2.6559 - val_acc
uracy: 0.6550 - val_loss: 2.4508
Epoch 1/10
79/79 ━━━━━━━━━━━━━━━━━━━━ 62s 623ms/step - accuracy: 0.5546 - loss: 0.7641 - val_acc
uracy: 0.5600 - val_loss: 0.6757
Epoch 2/10
79/79 ━━━━━━━━━━━━━━━━━━━━ 44s 507ms/step - accuracy: 0.5798 - loss: 0.6845 - val_acc
uracy: 0.5600 - val_loss: 0.6877
Epoch 3/10
79/79 ━━━━━━━━━━━━━━━━━━━━ 82s 513ms/step - accuracy: 0.5600 - loss: 0.6920 - val_acc
uracy: 0.5867 - val_loss: 0.6638
Epoch 4/10
79/79 ━━━━━━━━━━━━━━━━━━━━ 44s 517ms/step - accuracy: 0.5749 - loss: 0.6784 - val_acc
uracy: 0.5850 - val_loss: 0.6638
Epoch 5/10
79/79 ━━━━━━━━━━━━━━━━━━━━ 44s 516ms/step - accuracy: 0.5672 - loss: 0.6810 - val_acc
uracy: 0.6150 - val_loss: 0.6544
Epoch 6/10
79/79 ━━━━━━━━━━━━━━━━━━━━ 44s 518ms/step - accuracy: 0.5855 - loss: 0.6673 - val_acc
uracy: 0.5667 - val_loss: 0.6822
Epoch 7/10
79/79 ━━━━━━━━━━━━━━━━━━━━ 45s 524ms/step - accuracy: 0.5895 - loss: 0.6724 - val_acc
uracy: 0.6050 - val_loss: 0.6567
Epoch 8/10
79/79 ━━━━━━━━━━━━━━━━━━━━ 83s 527ms/step - accuracy: 0.5906 - loss: 0.6689 - val_acc
uracy: 0.6133 - val_loss: 0.6562
Epoch 9/10
79/79 ━━━━━━━━━━━━━━━━━━━━ 80s 511ms/step - accuracy: 0.5940 - loss: 0.6680 - val_acc
uracy: 0.6217 - val_loss: 0.6546
```

```
Epoch 10/10
79/79 ━━━━━━━━━━━━━━━━━━━━ 82s 513ms/step - accuracy: 0.5949 - loss: 0.6644 - val_acc
uracy: 0.6133 - val_loss: 0.6565
```

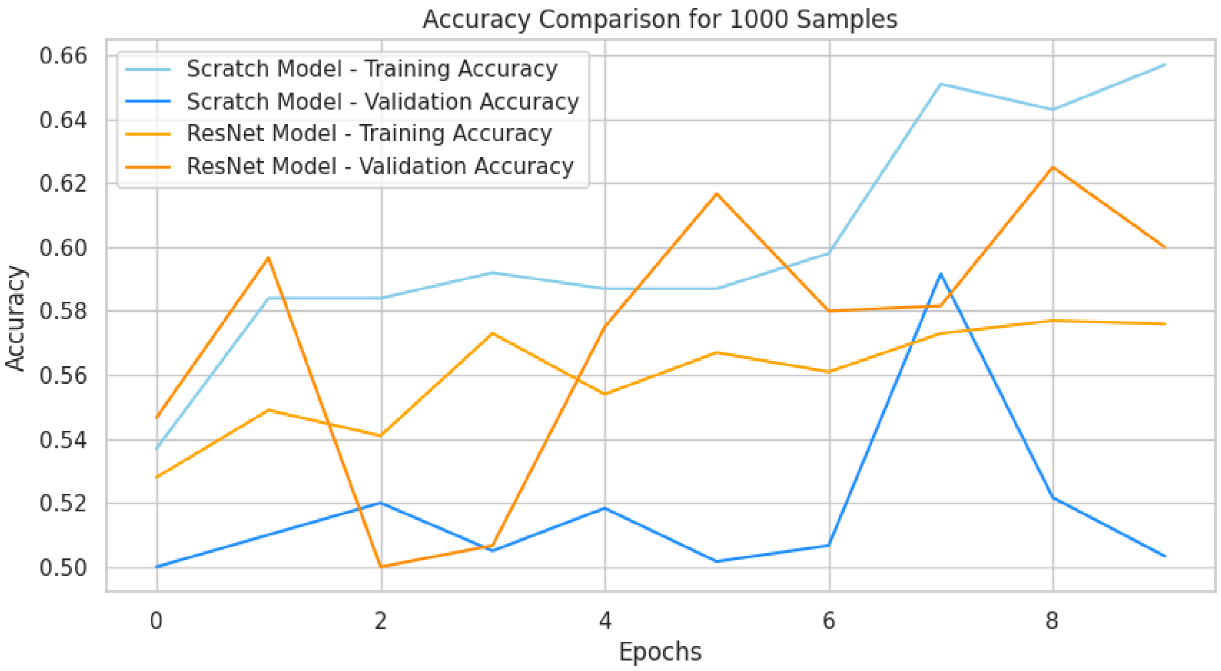


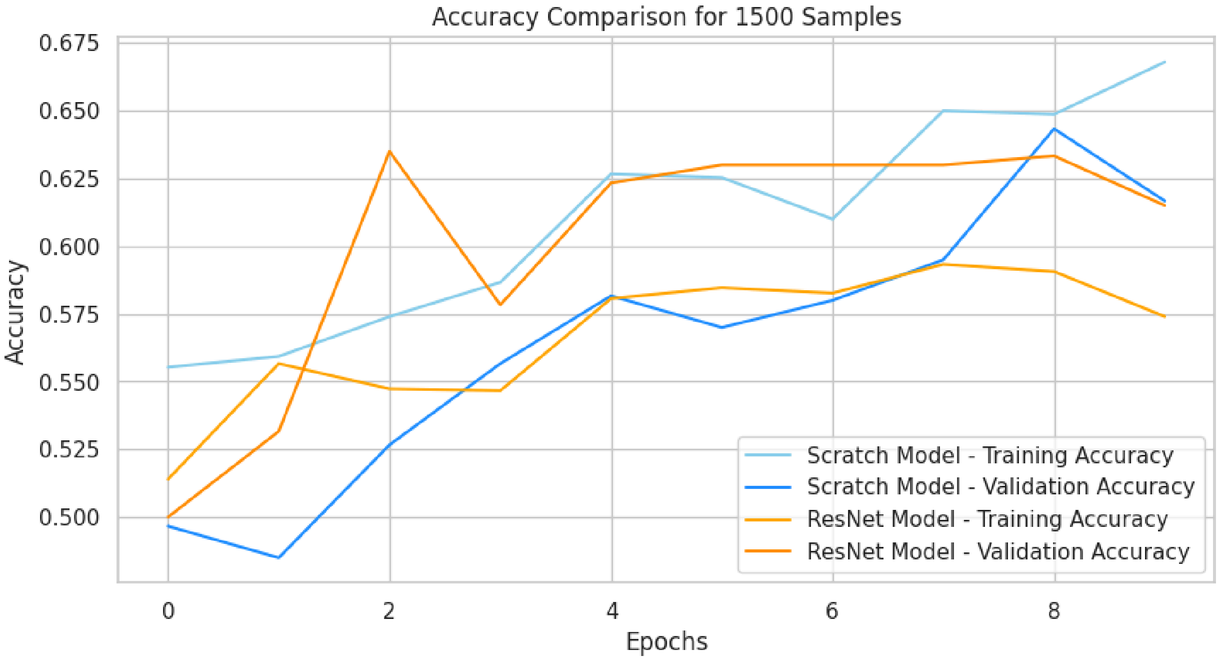


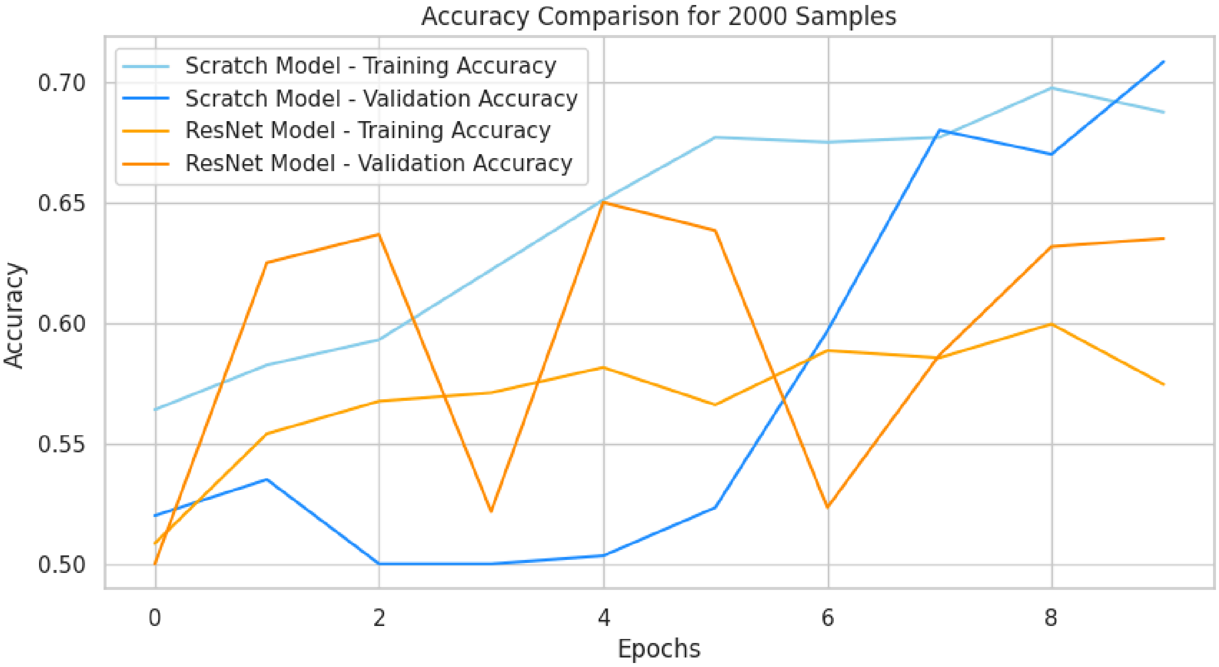
Comparison Across Sample Sizes

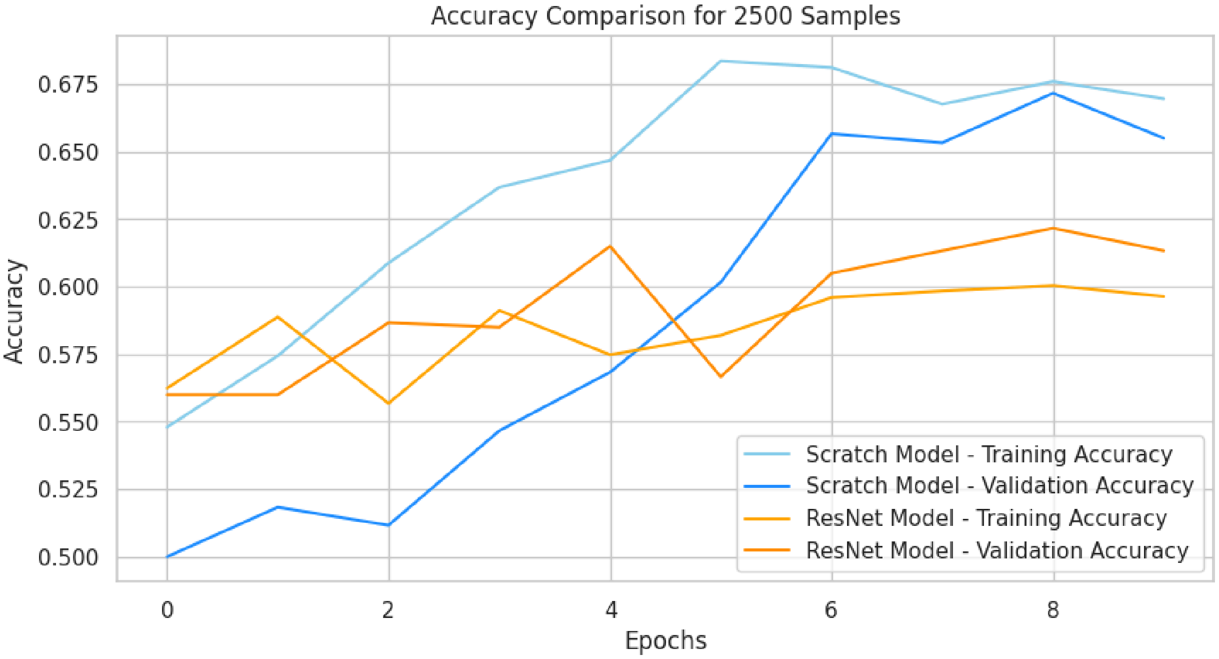
In [15]:

```
compare_model_performance(sample_set_sizes, evaluation_results)
```


Accuracy Comparison for 1000 Samples
Scratch Model - Training Accuracy
Scratch Model - Validation Accuracy
ResNet Model - Training Accuracy
ResNet Model - Validation Accuracy
Accuracy
0.66
0.64
0.62
0.60
0.58
0.56
0.54
0.52
0.50
Epochs
0
2
4
6
8


Accuracy Comparison for 1500 Samples
Scratch Model - Training Accuracy
Scratch Model - Validation Accuracy
ResNet Model - Training Accuracy
ResNet Model - Validation Accuracy
Accuracy
0.675
0.650
0.625
0.600
0.575
0.550
0.525
0.500
Epochs
0
2
4
6
8


Accuracy Comparison for 2000 Samples
Scratch Model - Training Accuracy
Scratch Model - Validation Accuracy
ResNet Model - Training Accuracy
ResNet Model - Validation Accuracy
Accuracy
0.70
0.65
0.60
0.55
0.50
Epochs
0
2
4
6
8


Accuracy Comparison for 2500 Samples
Scratch Model - Training Accuracy
Scratch Model - Validation Accuracy
ResNet Model - Training Accuracy
ResNet Model - Validation Accuracy
Accuracy
0.675
0.650
0.625
0.600
0.575
0.550
0.525
0.500
Epochs
0
2
4
6
8