

pml-project-1

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0.1 Project 1:

0.1.1 Practical_Image_Processing_and_Natural_Language_Processing_Second Trimester 2026

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1 Import

```
[ ]: import os
import numpy as np
import torch
from torchvision import datasets, transforms as T, models
from torch import nn, optim
from torch.utils.data import DataLoader
import warnings
warnings.filterwarnings("ignore")
from tqdm import tqdm
from sklearn.metrics import confusion_matrix, accuracy_score, precision_score, recall_score, f1_score, classification_report
import matplotlib.pyplot as plt
import numpy as np
import seaborn as sns
from sklearn.metrics import roc_curve
import matplotlib.pyplot as plt
from sklearn.metrics import auc
```

2 PreProcessing, Copy, Resized images to new directory

```
[ ]: from PIL import Image
import os

input_root = '/kaggle/input/datasets/mohamedmaher5/vehicle-classification/Vehicles'
output_root = '/kaggle/working/output/'
resize_size = (256, 256)
```

```

os.makedirs(output_root, exist_ok=True)

for class_name in os.listdir(input_root):
    class_path = os.path.join(input_root, class_name)

    if not os.path.isdir(class_path):
        continue

    output_class_dir = os.path.join(output_root, class_name)
    os.makedirs(output_class_dir, exist_ok=True)

    for root, dirs, files in os.walk(class_path):
        for file in files:
            if file.lower().endswith(('.png', '.jpg', '.jpeg', '.bmp', '.
↳tiff')):
                input_image_path = os.path.join(root, file)
                output_image_name = os.path.splitext(file)[0] + '.jpg'
                output_image_path = os.path.join(output_class_dir,
↳output_image_name)

                try:
                    with Image.open(input_image_path) as img:
                        img = img.convert('RGB')
                        img = img.resize(resize_size)
                        img.save(output_image_path, 'JPEG')
                except Exception as e:
                    print(f"Failed to process {input_image_path}: {e}")

```

3 Splitting New DataSet to 70/10/20

```

[ ]: import shutil
from sklearn.model_selection import train_test_split

original_dataset_dir = '/kaggle/working/output/'
base_dir = '/kaggle/working/NewDataset'

train_dir = os.path.join(base_dir, 'train')
validation_dir = os.path.join(base_dir, 'validation')
test_dir = os.path.join(base_dir, 'test')

for d in [train_dir, validation_dir, test_dir]:
    os.makedirs(d, exist_ok=True)

train_ratio = 0.7
val_ratio = 0.1

```

```

test_ratio = 0.2

def collect_all_images(class_dir):
    """Recursively collect all image paths inside a class folder."""
    image_paths = []
    for root, _, files in os.walk(class_dir):
        for f in files:
            if f.lower().endswith(('.jpg', '.jpeg', '.png', '.bmp', '.tiff')):
                image_paths.append(os.path.join(root, f))
    return image_paths

def split_and_copy(class_name, class_dir):
    all_images = collect_all_images(class_dir)

    # Split 70% train, 30% temp
    train_imgs, temp_imgs = train_test_split(
        all_images, test_size=(1 - train_ratio), random_state=42
    )

    # Split temp into 10% val and 20% test
    val_imgs, test_imgs = train_test_split(
        temp_imgs,
        test_size=test_ratio / (val_ratio + test_ratio),
        random_state=42
    )

    def copy_files(file_list, split_folder):
        for file_path in file_list:
            rel_path = os.path.relpath(file_path, class_dir)

            dest_path = os.path.join(base_dir, split_folder, class_name,
↪rel_path)

            os.makedirs(os.path.dirname(dest_path), exist_ok=True)

            # Copy file
            shutil.copy(file_path, dest_path)

    # Copy to train/val/test
    copy_files(train_imgs, 'train')
    copy_files(val_imgs, 'validation')
    copy_files(test_imgs, 'test')

# Apply to all class folders
for class_name in os.listdir(original_dataset_dir):
    class_dir = os.path.join(original_dataset_dir, class_name)

```

```

if os.path.isdir(class_dir):
    print(f"Splitting class: {class_name}")
    split_and_copy(class_name, class_dir)

```

```

Splitting class: Auto Rickshaws
Splitting class: Bikes
Splitting class: Cars
Splitting class: Planes
Splitting class: Trains
Splitting class: Ships
Splitting class: Motorcycles

```

4 classes in each split

```

[ ]: import os

root = "/kaggle/working/NewDataset"
splits = ["train", "validation", "test"]

for split in splits:
    split_dir = os.path.join(root, split)
    classes = sorted([
        d for d in os.listdir(split_dir)
        if os.path.isdir(os.path.join(split_dir, d))
    ])
    print(f"{split}: {classes}")

```

```

train: ['Auto Rickshaws', 'Bikes', 'Cars', 'Motorcycles', 'Planes', 'Ships',
'Trains']
validation: ['Auto Rickshaws', 'Bikes', 'Cars', 'Motorcycles', 'Planes',
'Ships', 'Trains']
test: ['Auto Rickshaws', 'Bikes', 'Cars', 'Motorcycles', 'Planes', 'Ships',
'Trains']

```

5 Image augmentation and preprocessing

```

[ ]: def get_data_loaders(data_dir, batch_size, train=False):
    """Prepare data loaders for training, validation, and testing."""

    if train:
        transform = T.Compose([
            T.RandomHorizontalFlip(),
            T.RandomVerticalFlip(),
            T.RandomRotation(10),
            T.Resize((299, 299)),
            T.ToTensor(),

```

```

        T.Normalize(mean=[0.485, 0.456, 0.406],
                     std=[0.229, 0.224, 0.225])
    ])

    train_data = datasets.ImageFolder(os.path.join(data_dir, "train"),
    ↪transform=transform)

    train_loader = DataLoader(
        train_data,
        batch_size=batch_size,
        shuffle=True,
        num_workers=4,
        pin_memory=True,
        persistent_workers=True
    )

    return train_loader, len(train_data)

else:
    transform = T.Compose([
        T.Resize((299, 299)),
        T.ToTensor(),
        T.Normalize(mean=[0.485, 0.456, 0.406],
                     std=[0.229, 0.224, 0.225])
    ])

    val_data = datasets.ImageFolder(os.path.join(data_dir, "validation"),
    ↪transform=transform)

    test_data = datasets.ImageFolder(os.path.join(data_dir, "test"),
    ↪transform=transform)

    val_loader = DataLoader(
        val_data,
        batch_size=batch_size,
        shuffle=False,
        num_workers=4,
        pin_memory=True,
        persistent_workers=True
    )

    test_loader = DataLoader(
        test_data,
        batch_size=batch_size,
        shuffle=False,
        num_workers=4,
        pin_memory=True,
        persistent_workers=True
    )

```

```

    )

    return val_loader, test_loader, len(val_data), len(test_data)

dataset_path = "/kaggle/working/NewDataset"
batch_size = 32

train_loader, train_data_len = get_data_loaders(dataset_path, batch_size,
    ↪train=True)
val_loader, test_loader, valid_data_len, test_data_len =
    ↪get_data_loaders(dataset_path, batch_size, train=False)

train_data = train_loader.dataset
classes = train_data.classes
num_classes = len(classes)

dataloaders = {"train": train_loader, "val": val_loader}
dataset_sizes = {"train": train_data_len, "val": valid_data_len}

device = torch.device('cuda' if torch.cuda.is_available() else 'cpu')

```

6 Smple Image per class before and after

```

[ ]: from PIL import Image
import random

def show_original_vs_preprocessed(dataset, transform, classes,
    ↪samples_per_class=2):
    plt.figure(figsize=(12, 4 * len(classes)))

    class_to_idx = dataset.class_to_idx
    idx_to_class = {v: k for k, v in class_to_idx.items()}

    # Group images by class
    class_images = {cls: [] for cls in classes}
    for path, label in dataset.samples:
        class_images[idx_to_class[label]].append(path)

    plot_idx = 1

    for cls in classes:
        # Pick random samples from this class
        selected_paths = random.sample(class_images[cls], samples_per_class)

        for img_path in selected_paths:
            # Load original

```

```

original = Image.open(img_path).convert("RGB")

# Apply preprocessing
preprocessed = transform(original)
preprocessed_img = denormalize(preprocessed)

# Plot
plt.subplot(len(classes), samples_per_class * 2, plot_idx)
plt.imshow(original)
plt.title(f"{cls} - Original")
plt.axis("off")
plot_idx += 1

plt.subplot(len(classes), samples_per_class * 2, plot_idx)
plt.imshow(preprocessed_img)
plt.title(f"{cls} - Preprocessed")
plt.axis("off")
plot_idx += 1

plt.tight_layout()
plt.show()

```

6.1 Samples before and after Preprocessing and Augmentation - Train

```

[ ]: show_original_vs_preprocessed(train_loader.dataset, train_loader.dataset.
    ↪ transform, classes)

```

Auto Rickshaws — Original



Auto Rickshaws — Preprocessed



Auto Rickshaws — Original



Auto Rickshaws — Preprocessed



Bikes — Original



Bikes — Preprocessed



Bikes — Original



Bikes — Preprocessed



Cars — Original



Cars — Preprocessed



Cars — Original



Cars — Preprocessed



Motorcycles — Original



Motorcycles — Preprocessed



Motorcycles — Original



Motorcycles — Preprocessed



Planes — Original



Planes — Preprocessed



Planes — Original



Planes — Preprocessed



Ships — Original



Ships — Preprocessed



Ships — Original



Ships — Preprocessed



Trains — Original



Trains — Preprocessed



Trains — Original



Trains — Preprocessed



6.2 Samples before and after preprocessing - Validation and Test

```
[ ]: show_original_vs_preprocessed(test_loader.dataset, test_loader.dataset.  
    ↪transform, classes)
```

Auto Rickshaws — Original



Auto Rickshaws — Preprocessed



Auto Rickshaws — Original



Auto Rickshaws — Preprocessed



Bikes — Original



Bikes — Preprocessed



Bikes — Original



Bikes — Preprocessed



Cars — Original



Cars — Preprocessed



Cars — Original



Cars — Preprocessed



Motorcycles — Original



Motorcycles — Preprocessed



Motorcycles — Original



Motorcycles — Preprocessed



Planes — Original



Planes — Preprocessed



Planes — Original



Planes — Preprocessed



Ships — Original



Ships — Preprocessed



Ships — Original



Ships — Preprocessed



Trains — Original



Trains — Preprocessed



Trains — Original



Trains — Preprocessed



7 Model Architecture on Efficientnet_B0

```
[ ]: model = models.efficientnet_b0(pretrained=True)
model.classifier[1] = nn.Linear(model.classifier[1].in_features,num_classes)
model = model.to(device)
criterion = nn.CrossEntropyLoss()
criterion = criterion.to(device)
optimizer = optim.AdamW(model.parameters(), lr=0.001)
exp_lr_scheduler = optim.lr_scheduler.StepLR(optimizer, step_size=3,gamma=0.97)
```

Downloading:

"https://download.pytorch.org/models/efficientnet_b0_rwightman-7f5810bc.pth" to
/root/.cache/torch/hub/checkpoints/efficientnet_b0_rwightman-7f5810bc.pth

100%| | 20.5M/20.5M [00:00<00:00, 137MB/s]

7.1 Train Model configuration

```
[ ]: def train_model(model, criterion, optimizer, scheduler, num_epochs=20):
    for epoch in range(num_epochs):
        print(f"Epoch {epoch+1}/{num_epochs}")
        print('-' * 10)

        for phase in ['train', 'val']:
            if phase == 'train':
                model.train()
            else:
                model.eval()

            running_loss = 0.0
            running_corrects = 0

            for inputs, labels in dataloaders[phase]:
                inputs = inputs.to(device)
                labels = labels.to(device)

                optimizer.zero_grad()

                with torch.set_grad_enabled(phase == 'train'):
                    outputs = model(inputs)          # EfficientNet output
                    loss = criterion(outputs, labels)

                    _, preds = torch.max(outputs, 1)
```

```

        if phase == 'train':
            loss.backward()
            optimizer.step()

        running_loss += loss.item() * inputs.size(0)
        running_corrects += torch.sum(preds == labels)

    if phase == 'train':
        scheduler.step()

    epoch_loss = running_loss / dataset_sizes[phase]
    epoch_acc = running_corrects.double() / dataset_sizes[phase]

    print(f"{phase} Loss: {epoch_loss:.4f} Acc: {epoch_acc:.4f}")

    return model

```

7.2 Run Training

```
[ ]: model = train_model(model, criterion, optimizer, exp_lr_scheduler, num_epochs=10)
```

```

Epoch 1/10
-----
train Loss: 0.3498 Acc: 0.8904
val Loss: 0.2499 Acc: 0.9267
Epoch 2/10
-----
train Loss: 0.1552 Acc: 0.9536
val Loss: 0.0812 Acc: 0.9714
Epoch 3/10
-----
train Loss: 0.1300 Acc: 0.9603
val Loss: 0.1025 Acc: 0.9678
Epoch 4/10
-----
train Loss: 0.0849 Acc: 0.9718
val Loss: 0.1057 Acc: 0.9732
Epoch 5/10
-----
train Loss: 0.0874 Acc: 0.9723
val Loss: 0.0845 Acc: 0.9785
Epoch 6/10
-----
train Loss: 0.0594 Acc: 0.9813
val Loss: 0.0932 Acc: 0.9732
Epoch 7/10
-----

```

```

train Loss: 0.0644 Acc: 0.9798
val Loss: 0.1864 Acc: 0.9499
Epoch 8/10
-----
train Loss: 0.0804 Acc: 0.9728
val Loss: 0.1604 Acc: 0.9553
Epoch 9/10
-----
train Loss: 0.0687 Acc: 0.9769
val Loss: 0.0844 Acc: 0.9803
Epoch 10/10
-----
train Loss: 0.0419 Acc: 0.9887
val Loss: 0.0923 Acc: 0.9696

```

7.3 Evaluation EfficientNet_B0

```

[ ]: def evaluate_model(model_name, y_true, y_pred, classes):
    accuracy = accuracy_score(y_true, y_pred)
    precision = precision_score(y_true, y_pred, average='weighted')
    recall = recall_score(y_true, y_pred, average='weighted')
    f1 = f1_score(y_true, y_pred, average='weighted')
    cm = confusion_matrix(y_true, y_pred)

    print(f"\nModel: {model_name}")
    print(f"Accuracy: {accuracy:.4f}")
    print(f"Precision: {precision:.4f}")
    print(f"Recall: {recall:.4f}")
    print(f"F1-score: {f1:.4f}")

    print("\nClassification Report:")
    print(classification_report(y_true, y_pred, target_names=classes))

    plt.figure(figsize=(6, 5))
    sns.heatmap(cm, annot=True, fmt='d', cmap='Blues',
                xticklabels=classes, yticklabels=classes)
    plt.xlabel("Predicted Label")
    plt.ylabel("True Label")
    plt.title("Confusion Matrix")
    plt.show()

```

```

[ ]: y_true = []
    y_proba = []
    y_pred = []

    model.eval()

```

```

with torch.no_grad():
    for x, y in tqdm(test_loader):
        x = x.to(device)

        output = model(x)

        y_true.extend(y.cpu().numpy())

        # Softmax probabilities
        probabilities = torch.softmax(output, dim=1)
        y_proba.extend(probabilities.cpu().numpy())

        # Predicted classes
        pred = torch.argmax(probabilities, dim=1).cpu().numpy()
        y_pred.extend(pred)

# Convert to numpy arrays
y_true = np.array(y_true)
y_proba = np.array(y_proba)
y_pred = np.array(y_pred)

evaluate_model("EfficientNet-B0", y_true, y_pred, classes)

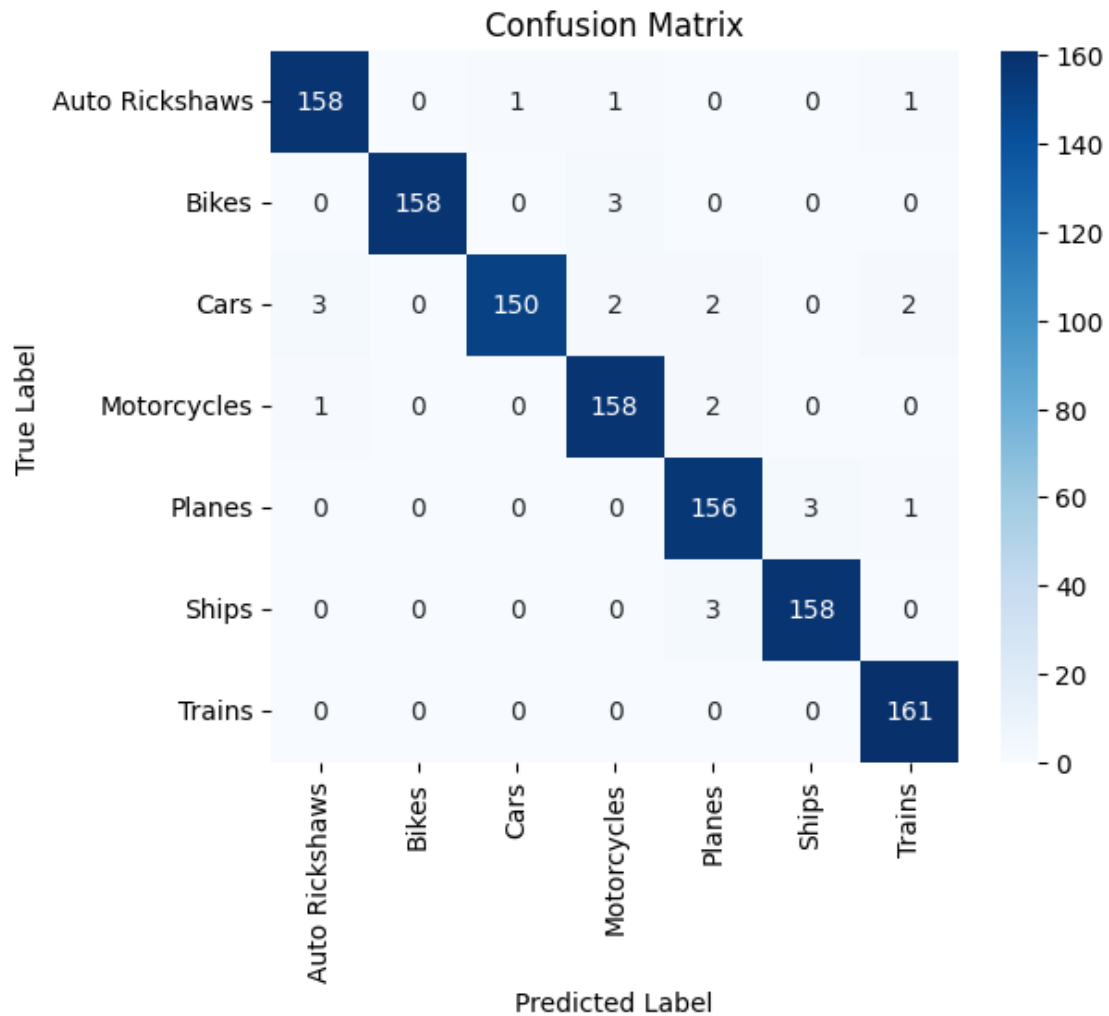
```

100%| | 36/36 [00:03<00:00, 11.20it/s]

Model: EfficientNet-B0
Accuracy: 0.9778
Precision: 0.9780
Recall: 0.9778
F1-score: 0.9777

Classification Report:

	precision	recall	f1-score	support
Auto Rickshaws	0.98	0.98	0.98	161
Bikes	1.00	0.98	0.99	161
Cars	0.99	0.94	0.97	159
Motorcycles	0.96	0.98	0.97	161
Planes	0.96	0.97	0.97	160
Ships	0.98	0.98	0.98	161
Trains	0.98	1.00	0.99	161
accuracy			0.98	1124
macro avg	0.98	0.98	0.98	1124
weighted avg	0.98	0.98	0.98	1124



```
[ ]: from sklearn.metrics import (
    accuracy_score, precision_score, recall_score,
    f1_score, classification_report, confusion_matrix
)

def print_test_results(y_true, y_pred, classes):
    # Compute metrics
    accuracy = accuracy_score(y_true, y_pred)
    precision = precision_score(y_true, y_pred, average='weighted')
    recall = recall_score(y_true, y_pred, average='weighted')
    f1 = f1_score(y_true, y_pred, average='weighted')
    cm = confusion_matrix(y_true, y_pred)

    # Header
    print("="*60)
```

```

print("TEST SET EVALUATION RESULTS")
print("="*60)

# Overall accuracy
print(f"Overall Accuracy : {accuracy:.4f} ({accuracy*100:.2f}%)\\n")

# Classification report (with class names)
report = classification_report(
    y_true, y_pred, target_names=classes, digits=4
)
print(report)

```

```
[ ]: print_test_results(y_true, y_pred, classes)
```

```

=====
TEST SET EVALUATION RESULTS
=====
Overall Accuracy : 0.9778 (97.78%)


```

	precision	recall	f1-score	support
Auto Rickshaws	0.9753	0.9814	0.9783	161
Bikes	1.0000	0.9814	0.9906	161
Cars	0.9934	0.9434	0.9677	159
Motorcycles	0.9634	0.9814	0.9723	161
Planes	0.9571	0.9750	0.9659	160
Ships	0.9814	0.9814	0.9814	161
Trains	0.9758	1.0000	0.9877	161
accuracy			0.9778	1124
macro avg	0.9780	0.9777	0.9777	1124
weighted avg	0.9780	0.9778	0.9777	1124

8 Model Architecture on ResNet_18

```

[ ]: from torchvision import models
import torch.nn as nn
import torch.optim as optim

model = models.resnet18(weights=models.ResNet18_Weights.IMAGENET1K_V1)

model.fc = nn.Linear(model.fc.in_features, num_classes)
model = model.to(device)

criterion = nn.CrossEntropyLoss()

```

```
criterion = criterion.to(device)
optimizer = optim.AdamW(model.parameters(), lr=0.001)

exp_lr_scheduler = optim.lr_scheduler.StepLR(optimizer, step_size=3, gamma=0.97)
model = train_model(model, criterion, optimizer, exp_lr_scheduler, num_epochs=10)
```

Downloading: "https://download.pytorch.org/models/resnet18-f37072fd.pth" to
/root/.cache/torch/hub/checkpoints/resnet18-f37072fd.pth

100%| | 44.7M/44.7M [00:00<00:00, 183MB/s]

Epoch 1/10

train Loss: 0.5247 Acc: 0.8271

val Loss: 0.7481 Acc: 0.7800

Epoch 2/10

train Loss: 0.3495 Acc: 0.8819

val Loss: 0.6414 Acc: 0.7764

Epoch 3/10

train Loss: 0.2671 Acc: 0.9129

val Loss: 0.7022 Acc: 0.7835

Epoch 4/10

train Loss: 0.2242 Acc: 0.9216

val Loss: 0.5523 Acc: 0.8676

Epoch 5/10

train Loss: 0.2223 Acc: 0.9301

val Loss: 0.3701 Acc: 0.8945

Epoch 6/10

train Loss: 0.2130 Acc: 0.9285

val Loss: 0.1936 Acc: 0.9302

Epoch 7/10

train Loss: 0.1716 Acc: 0.9462

val Loss: 0.5235 Acc: 0.8462

Epoch 8/10

train Loss: 0.1445 Acc: 0.9508

val Loss: 0.1606 Acc: 0.9356

Epoch 9/10

train Loss: 0.1253 Acc: 0.9557

val Loss: 0.1988 Acc: 0.9249

Epoch 10/10

train Loss: 0.1382 Acc: 0.9521
val Loss: 0.3626 Acc: 0.8837

8.1 evaluate on Resnet_18

```
[ ]: y_true = []  
y_proba = []  
y_pred = []  
  
model.eval()  
  
with torch.no_grad():  
    for x, y in tqdm(test_loader):  
        x = x.to(device)  
  
        output = model(x)  
  
        y_true.extend(y.cpu().numpy())  
  
        probabilities = torch.softmax(output, dim=1)  
        y_proba.extend(probabilities.cpu().numpy())  
  
        pred = torch.argmax(probabilities, dim=1).cpu().numpy()  
        y_pred.extend(pred)  
  
y_true = np.array(y_true)  
y_proba = np.array(y_proba)  
y_pred = np.array(y_pred)  
  
evaluate_model("ResNet18", y_true, y_pred, classes)
```

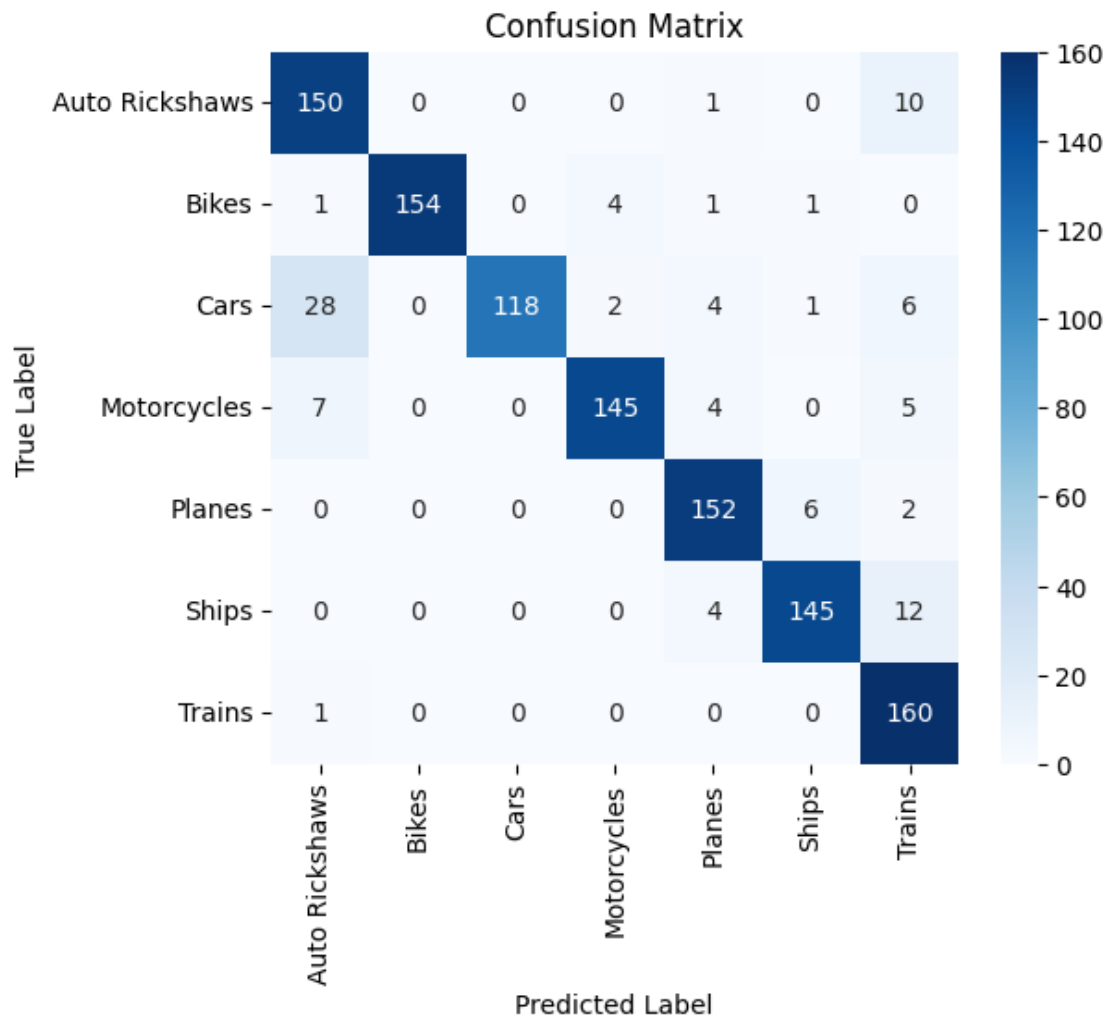
100%| | 36/36 [00:02<00:00, 14.17it/s]

Model: ResNet18
Accuracy: 0.9110
Precision: 0.9208
Recall: 0.9110
F1-score: 0.9110

Classification Report:

	precision	recall	f1-score	support
Auto Rickshaws	0.80	0.93	0.86	161
Bikes	1.00	0.96	0.98	161
Cars	1.00	0.74	0.85	159
Motorcycles	0.96	0.90	0.93	161

Planes	0.92	0.95	0.93	160
Ships	0.95	0.90	0.92	161
Trains	0.82	0.99	0.90	161
accuracy			0.91	1124
macro avg	0.92	0.91	0.91	1124
weighted avg	0.92	0.91	0.91	1124



```
[ ]: from sklearn.metrics import (
    accuracy_score, precision_score, recall_score,
    f1_score, classification_report, confusion_matrix
)

def print_test_results(y_true, y_pred, classes):
```

```

accuracy = accuracy_score(y_true, y_pred)
precision = precision_score(y_true, y_pred, average='weighted')
recall = recall_score(y_true, y_pred, average='weighted')
f1 = f1_score(y_true, y_pred, average='weighted')
cm = confusion_matrix(y_true, y_pred)

print("="*60)
print("TEST SET EVALUATION RESULTS FOR RESNET-18")
print("="*60)

print(f"Overall Accuracy : {accuracy:.4f}  ({accuracy*100:.2f}%)\\n")

report = classification_report(
    y_true, y_pred, target_names=classes, digits=4
)
print(report)

plt.figure(figsize=(6, 5))
sns.heatmap(cm, annot=True, fmt='d', cmap='Blues',
            xticklabels=classes, yticklabels=classes)
plt.xlabel("Predicted Label")
plt.ylabel("True Label")
plt.title("Confusion Matrix")
plt.show()
print_test_results(y_true, y_pred, classes)

```

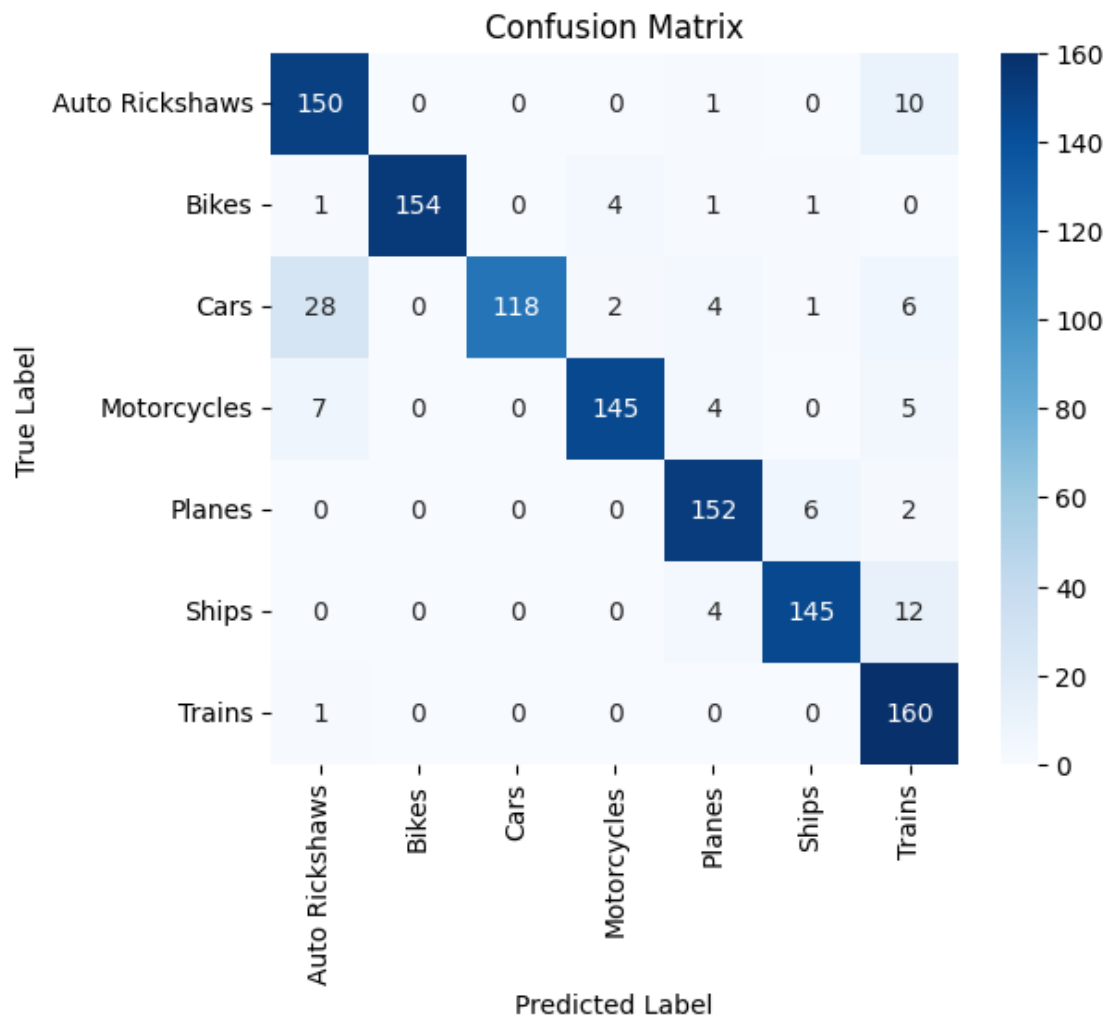
```

=====
TEST SET EVALUATION RESULTS FOR RESNET-18
=====

```

Overall Accuracy : 0.9110 (91.10%)

	precision	recall	f1-score	support
Auto Rickshaws	0.8021	0.9317	0.8621	161
Bikes	1.0000	0.9565	0.9778	161
Cars	1.0000	0.7421	0.8520	159
Motorcycles	0.9603	0.9006	0.9295	161
Planes	0.9157	0.9500	0.9325	160
Ships	0.9477	0.9006	0.9236	161
Trains	0.8205	0.9938	0.8989	161
accuracy			0.9110	1124
macro avg	0.9209	0.9108	0.9109	1124
weighted avg	0.9208	0.9110	0.9110	1124



9 Model Architecture on MobileNet_V3

```
[ ]: from torchvision import models
import torch.nn as nn
import torch.optim as optim

# 1. Load pretrained MobileNetV3-Large
model = models.mobilenet_v3_large(weights=models.MobileNet_V3_Large_Weights.
    ↪ IMAGENET1K_V1)

# 2. Replace classifier
in_features = model.classifier[3].in_features
model.classifier[3] = nn.Linear(in_features, num_classes)
```

```

model = model.to(device)

# 3. Loss function
criterion = nn.CrossEntropyLoss().to(device)

# 4. Optimizer
optimizer = optim.AdamW(model.parameters(), lr=0.001)

# 5. Scheduler
exp_lr_scheduler = optim.lr_scheduler.StepLR(optimizer, step_size=3, gamma=0.97)

# 6. Train
model = train_model(model, criterion, optimizer, exp_lr_scheduler,
    ↪ num_epochs=10)

```

Downloading:

"https://download.pytorch.org/models/mobilenet_v3_large-8738ca79.pth" to
 /root/.cache/torch/hub/checkpoints/mobilenet_v3_large-8738ca79.pth

100%| | 21.1M/21.1M [00:00<00:00, 33.1MB/s]

Epoch 1/10

train Loss: 0.3182 Acc: 0.8924

val Loss: 1.1436 Acc: 0.8068

Epoch 2/10

train Loss: 0.1610 Acc: 0.9472

val Loss: 0.5268 Acc: 0.8766

Epoch 3/10

train Loss: 0.1301 Acc: 0.9582

val Loss: 0.2563 Acc: 0.9410

Epoch 4/10

train Loss: 0.1011 Acc: 0.9657

val Loss: 0.1738 Acc: 0.9445

Epoch 5/10

train Loss: 0.0607 Acc: 0.9795

val Loss: 0.3744 Acc: 0.9177

Epoch 6/10

train Loss: 0.0722 Acc: 0.9746

val Loss: 1.0804 Acc: 0.7979

Epoch 7/10

train Loss: 0.0841 Acc: 0.9736

```

val Loss: 0.1750 Acc: 0.9463
Epoch 8/10
-----
train Loss: 0.0612 Acc: 0.9782
val Loss: 0.2156 Acc: 0.9445
Epoch 9/10
-----
train Loss: 0.0752 Acc: 0.9757
val Loss: 0.4819 Acc: 0.8909
Epoch 10/10
-----
train Loss: 0.0475 Acc: 0.9846
val Loss: 0.1490 Acc: 0.9624

```

9.1 Evaluate on MobileNet_V3

```

[ ]: y_true = []
     y_pred = []
     y_proba = []
     model.eval()
     with torch.no_grad():
         for x, y in tqdm(test_loader):
             x = x.to(device)
             output = model(x)

             y_true.extend(y.cpu().numpy())
             probabilities = torch.softmax(output, dim=1)
             y_proba.extend(probabilities.cpu().numpy())
             pred = torch.argmax(probabilities, dim=1).cpu().numpy()
             y_pred.extend(pred)

     y_true = np.array(y_true)
     y_pred = np.array(y_pred)
     y_proba = np.array(y_proba)
     print_test_results(y_true, y_pred, classes)

```

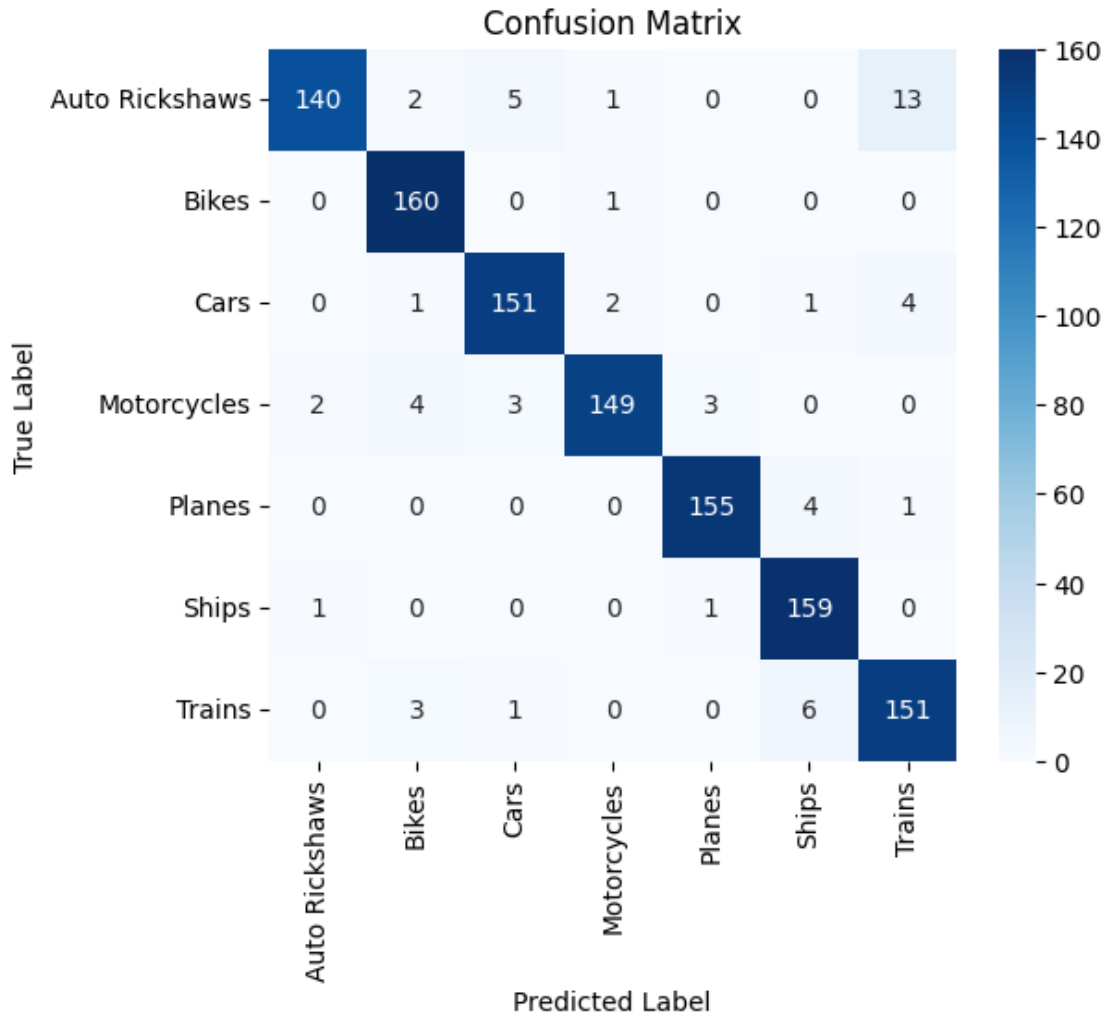
```
100%|      | 36/36 [00:02<00:00, 15.96it/s]
```

```
=====
TEST SET EVALUATION RESULTS FOR RESNET-18
=====
```

```
Overall Accuracy : 0.9475 (94.75%)
```

	precision	recall	f1-score	support
Auto Rickshaws	0.9790	0.8696	0.9211	161
Bikes	0.9412	0.9938	0.9668	161
Cars	0.9437	0.9497	0.9467	159

Motorcycles	0.9739	0.9255	0.9490	161
Planes	0.9748	0.9688	0.9718	160
Ships	0.9353	0.9876	0.9607	161
Trains	0.8935	0.9379	0.9152	161
accuracy			0.9475	1124
macro avg	0.9488	0.9475	0.9473	1124
weighted avg	0.9488	0.9475	0.9473	1124



```
[1]: from google.colab import drive
drive.mount('/content/drive')
```

Mounted at /content/drive

```
[ ]: # 1. Install missing core fonts and the generic texlive engine
!apt-get update
!apt-get install -y texlive-xetex texlive-fonts-recommended
↳texlive-plain-generic pandoc

# 2. Run the original conversion command
!jupyter nbconvert --to pdf "/content/drive/MyDrive/Thesis_Model/PML_dataset/
↳pml-project-1.ipynb"
```

```
0% [Working]          Get:1 https://cli.github.com/packages stable
InRelease [3,917 B]
Get:2 https://cloud.r-project.org/bin/linux/ubuntu jammy-cran40/ InRelease
[3,632 B]
Get:3 https://cli.github.com/packages stable/main amd64 Packages [354 B]
Get:4 http://security.ubuntu.com/ubuntu jammy-security InRelease [129 kB]
Get:5 https://cloud.r-project.org/bin/linux/ubuntu jammy-cran40/ Packages [99.9
kB]
Get:6 https://r2u.stat.illinois.edu/ubuntu jammy InRelease [6,555 B]
Hit:7 http://archive.ubuntu.com/ubuntu jammy InRelease
Get:8 http://security.ubuntu.com/ubuntu jammy-security/universe amd64 Packages
[1,308 kB]
Get:9 http://security.ubuntu.com/ubuntu jammy-security/main amd64 Packages
[4,049 kB]
Get:10 http://security.ubuntu.com/ubuntu jammy-security/restricted amd64
Packages [7,258 kB]
Get:11 http://archive.ubuntu.com/ubuntu jammy-updates InRelease [128 kB]
Get:12 https://r2u.stat.illinois.edu/ubuntu jammy/main all Packages [10.5 MB]
Get:13 http://archive.ubuntu.com/ubuntu jammy-backports InRelease [127 kB]
Get:14 https://ppa.launchpadcontent.net/deadsnakes/ppa/ubuntu jammy InRelease
[18.1 kB]
Hit:15 https://ppa.launchpadcontent.net/ubuntugis/ppa/ubuntu jammy InRelease
Get:16 http://archive.ubuntu.com/ubuntu jammy-updates/restricted amd64 Packages
[7,526 kB]
Get:17 https://r2u.stat.illinois.edu/ubuntu jammy/main amd64 Packages [3,085 kB]
Get:18 http://archive.ubuntu.com/ubuntu jammy-updates/universe amd64 Packages
[1,613 kB]
Get:19 http://archive.ubuntu.com/ubuntu jammy-updates/main amd64 Packages [4,382
kB]
Get:20 https://ppa.launchpadcontent.net/deadsnakes/ppa/ubuntu jammy/main amd64
Packages [38.6 kB]
Get:21 http://archive.ubuntu.com/ubuntu jammy-backports/main amd64 Packages
[82.8 kB]
Get:22 http://archive.ubuntu.com/ubuntu jammy-backports/universe amd64 Packages
[35.6 kB]
Fetched 40.4 MB in 2s (19.8 MB/s)
Reading package lists... Done
W: Skipping acquire of configured file 'main/source/Sources' as repository
```

'https://r2u.stat.illinois.edu/ubuntu jammy InRelease' does not seem to provide it (sources.list entry misspelt?)

Reading package lists... Done

Building dependency tree... Done

Reading state information... Done

pandoc is already the newest version (2.9.2.1-3ubuntu2).

pandoc set to manually installed.

The following additional packages will be installed:

dvisvgm fonts-droid-fallback fonts-lato fonts-lmodern fonts-noto-mono
fonts-texgyre fonts-urw-base35 libapache-pom-java libcommons-logging-java
libcommons-parent-java libfontbox-java libgs9 libgs9-common libidn12
libijs-0.35 libjbig2dec0 libkpathsea6 libpdfbox-java libptexenc1 libruby3.0
libsynctex2 libteckit0 libtexlua53 libtexluajit2 libwoff1 libzip-0-13
lmodern poppler-data preview-latex-style rake ruby ruby-net-telnet
ruby-rubygems ruby-webrick ruby-xmlrpc ruby3.0 rubygems-integration t1utils
teckit tex-common tex-gyre texlive-base texlive-binaries texlive-latex-base
texlive-latex-extra texlive-latex-recommended texlive-pictures tipa
xfonts-encodings xfonts-utils

Suggested packages:

fonts-noto fonts-freefont-otf | fonts-freefont-ttf libavalon-framework-java
libcommons-logging-java-doc libexcalibur-logkit-java liblog4j1.2-java
poppler-utils ghostscript fonts-japanese-mincho | fonts-ipafont-mincho
fonts-japanese-gothic | fonts-ipafont-gothic fonts-arphic-ukai
fonts-arphic-uming fonts-nanum ri ruby-dev bundler debhelper gv
| postscript-viewer perl-tk xpdf | pdf-viewer xzdec
texlive-fonts-recommended-doc texlive-latex-base-doc python3-pygments
icc-profiles libfile-which-perl libspreadsheet-parseexcel-perl
texlive-latex-extra-doc texlive-latex-recommended-doc texlive-luatex
texlive-pstricks dot2tex prerex texlive-pictures-doc vprerex
default-jre-headless tipa-doc

The following NEW packages will be installed:

dvisvgm fonts-droid-fallback fonts-lato fonts-lmodern fonts-noto-mono
fonts-texgyre fonts-urw-base35 libapache-pom-java libcommons-logging-java
libcommons-parent-java libfontbox-java libgs9 libgs9-common libidn12
libijs-0.35 libjbig2dec0 libkpathsea6 libpdfbox-java libptexenc1 libruby3.0
libsynctex2 libteckit0 libtexlua53 libtexluajit2 libwoff1 libzip-0-13
lmodern poppler-data preview-latex-style rake ruby ruby-net-telnet
ruby-rubygems ruby-webrick ruby-xmlrpc ruby3.0 rubygems-integration t1utils
teckit tex-common tex-gyre texlive-base texlive-binaries
texlive-fonts-recommended texlive-latex-base texlive-latex-extra
texlive-latex-recommended texlive-pictures texlive-plain-generic
texlive-xetex tipa xfonts-encodings xfonts-utils

0 upgraded, 53 newly installed, 0 to remove and 65 not upgraded.

Need to get 182 MB of archives.

After this operation, 571 MB of additional disk space will be used.

Get:1 <http://archive.ubuntu.com/ubuntu jammy/main amd64 fonts-droid-fallback all 1:6.0.1r16-1.1build1> [1,805 kB]

Get:2 <http://archive.ubuntu.com/ubuntu jammy/main amd64 fonts-lato all 2.0-2.1>

[2,696 kB]
Get:3 <http://archive.ubuntu.com/ubuntu> jammy/main amd64 poppler-data all 0.4.11-1 [2,171 kB]
Get:4 <http://archive.ubuntu.com/ubuntu> jammy/universe amd64 tex-common all 6.17 [33.7 kB]
Get:5 <http://archive.ubuntu.com/ubuntu> jammy/main amd64 fonts-urw-base35 all 20200910-1 [6,367 kB]
Get:6 <http://archive.ubuntu.com/ubuntu> jammy-updates/main amd64 libgs9-common all 9.55.0~dfsg1-0ubuntu5.13 [753 kB]
Get:7 <http://archive.ubuntu.com/ubuntu> jammy-updates/main amd64 libidn12 amd64 1.38-4ubuntu1 [60.0 kB]
Get:8 <http://archive.ubuntu.com/ubuntu> jammy/main amd64 libijs-0.35 amd64 0.35-15build2 [16.5 kB]
Get:9 <http://archive.ubuntu.com/ubuntu> jammy/main amd64 libjbig2dec0 amd64 0.19-3build2 [64.7 kB]
Get:10 <http://archive.ubuntu.com/ubuntu> jammy-updates/main amd64 libgs9 amd64 9.55.0~dfsg1-0ubuntu5.13 [5,032 kB]
Get:11 <http://archive.ubuntu.com/ubuntu> jammy-updates/main amd64 libkpathsea6 amd64 2021.20210626.59705-1ubuntu0.3 [60.6 kB]
Get:12 <http://archive.ubuntu.com/ubuntu> jammy/main amd64 libwoff1 amd64 1.0.2-1build4 [45.2 kB]
Get:13 <http://archive.ubuntu.com/ubuntu> jammy/universe amd64 dvisvgm amd64 2.13.1-1 [1,221 kB]
Get:14 <http://archive.ubuntu.com/ubuntu> jammy/universe amd64 fonts-lmodern all 2.004.5-6.1 [4,532 kB]
Get:15 <http://archive.ubuntu.com/ubuntu> jammy/main amd64 fonts-noto-mono all 20201225-1build1 [397 kB]
Get:16 <http://archive.ubuntu.com/ubuntu> jammy/universe amd64 fonts-texgyre all 20180621-3.1 [10.2 MB]
Get:17 <http://archive.ubuntu.com/ubuntu> jammy/universe amd64 libapache-pom-java all 18-1 [4,720 B]
Get:18 <http://archive.ubuntu.com/ubuntu> jammy/universe amd64 libcommons-parent-java all 43-1 [10.8 kB]
Get:19 <http://archive.ubuntu.com/ubuntu> jammy/universe amd64 libcommons-logging-java all 1.2-2 [60.3 kB]
Get:20 <http://archive.ubuntu.com/ubuntu> jammy-updates/main amd64 libptexenc1 amd64 2021.20210626.59705-1ubuntu0.3 [39.1 kB]
Get:21 <http://archive.ubuntu.com/ubuntu> jammy/main amd64 rubygems-integration all 1.18 [5,336 B]
Get:22 <http://archive.ubuntu.com/ubuntu> jammy-updates/main amd64 ruby3.0 amd64 3.0.2-7ubuntu2.12 [50.1 kB]
Get:23 <http://archive.ubuntu.com/ubuntu> jammy-updates/main amd64 ruby-rubygems all 3.3.5-2ubuntu1.2 [228 kB]
Get:24 <http://archive.ubuntu.com/ubuntu> jammy/main amd64 ruby amd64 1:3.0~exp1 [5,100 B]
Get:25 <http://archive.ubuntu.com/ubuntu> jammy/main amd64 rake all 13.0.6-2 [61.7 kB]
Get:26 <http://archive.ubuntu.com/ubuntu> jammy/main amd64 ruby-net-telnet all

0.1.1-2 [12.6 kB]
 Get:27 <http://archive.ubuntu.com/ubuntu> jammy-updates/main amd64 ruby-webrick
 all 1.7.0-3ubuntu0.2 [52.5 kB]
 Get:28 <http://archive.ubuntu.com/ubuntu> jammy-updates/main amd64 ruby-xmlrpc all
 0.3.2-1ubuntu0.1 [24.9 kB]
 Get:29 <http://archive.ubuntu.com/ubuntu> jammy-updates/main amd64 libruby3.0
 amd64 3.0.2-7ubuntu2.12 [5,113 kB]
 Get:30 <http://archive.ubuntu.com/ubuntu> jammy-updates/main amd64 libsyntax2
 amd64 2021.20210626.59705-1ubuntu0.3 [55.8 kB]
 Get:31 <http://archive.ubuntu.com/ubuntu> jammy/universe amd64 libteckit0 amd64
 2.5.11+ds1-1 [421 kB]
 Get:32 <http://archive.ubuntu.com/ubuntu> jammy-updates/main amd64 libtexlua53
 amd64 2021.20210626.59705-1ubuntu0.3 [120 kB]
 Get:33 <http://archive.ubuntu.com/ubuntu> jammy-updates/main amd64 libtexluajit2
 amd64 2021.20210626.59705-1ubuntu0.3 [267 kB]
 Get:34 <http://archive.ubuntu.com/ubuntu> jammy/universe amd64 libzip-0-13 amd64
 0.13.72+dfsg.1-1.1 [27.0 kB]
 Get:35 <http://archive.ubuntu.com/ubuntu> jammy/main amd64 xfonts-encodings all
 1:1.0.5-0ubuntu2 [578 kB]
 Get:36 <http://archive.ubuntu.com/ubuntu> jammy/main amd64 xfonts-utils amd64
 1:7.7+6build2 [94.6 kB]
 Get:37 <http://archive.ubuntu.com/ubuntu> jammy/universe amd64 lmodern all
 2.004.5-6.1 [9,471 kB]
 Get:38 <http://archive.ubuntu.com/ubuntu> jammy/universe amd64 preview-latex-style
 all 12.2-1ubuntu1 [185 kB]
 Get:39 <http://archive.ubuntu.com/ubuntu> jammy/main amd64 t1utils amd64
 1.41-4build2 [61.3 kB]
 Get:40 <http://archive.ubuntu.com/ubuntu> jammy/universe amd64 teckit amd64
 2.5.11+ds1-1 [699 kB]
 Get:41 <http://archive.ubuntu.com/ubuntu> jammy/universe amd64 tex-gyre all
 20180621-3.1 [6,209 kB]
 Get:42 <http://archive.ubuntu.com/ubuntu> jammy-updates/universe amd64 texlive-
 binaries amd64 2021.20210626.59705-1ubuntu0.3 [9,861 kB]
 Get:43 <http://archive.ubuntu.com/ubuntu> jammy/universe amd64 texlive-base all
 2021.20220204-1 [21.0 MB]
 Get:44 <http://archive.ubuntu.com/ubuntu> jammy/universe amd64 texlive-fonts-
 recommended all 2021.20220204-1 [4,972 kB]
 Get:45 <http://archive.ubuntu.com/ubuntu> jammy/universe amd64 texlive-latex-base
 all 2021.20220204-1 [1,128 kB]
 Get:46 <http://archive.ubuntu.com/ubuntu> jammy/universe amd64 libfontbox-java all
 1:1.8.16-2 [207 kB]
 Get:47 <http://archive.ubuntu.com/ubuntu> jammy/universe amd64 libpdfbox-java all
 1:1.8.16-2 [5,199 kB]
 Get:48 <http://archive.ubuntu.com/ubuntu> jammy/universe amd64 texlive-latex-
 recommended all 2021.20220204-1 [14.4 MB]
 Get:49 <http://archive.ubuntu.com/ubuntu> jammy/universe amd64 texlive-pictures
 all 2021.20220204-1 [8,720 kB]
 Get:50 <http://archive.ubuntu.com/ubuntu> jammy/universe amd64 texlive-latex-extra

```

all 2021.20220204-1 [13.9 MB]
Get:51 http://archive.ubuntu.com/ubuntu jammy/universe amd64 texlive-plain-
generic all 2021.20220204-1 [27.5 MB]
Get:52 http://archive.ubuntu.com/ubuntu jammy/universe amd64 tipa all 2:1.3-21
[2,967 kB]
Get:53 http://archive.ubuntu.com/ubuntu jammy/universe amd64 texlive-xetex all
2021.20220204-1 [12.4 MB]
Fetched 182 MB in 2s (85.3 MB/s)
Extracting templates from packages: 100%
Preconfiguring packages ...
Selecting previously unselected package fonts-droid-fallback.
(Reading database ... 118243 files and directories currently installed.)
Preparing to unpack .../00-fonts-droid-fallback_1%3a6.0.1r16-1.1build1_all.deb
...
Unpacking fonts-droid-fallback (1:6.0.1r16-1.1build1) ...
Selecting previously unselected package fonts-lato.
Preparing to unpack .../01-fonts-lato_2.0-2.1_all.deb ...
Unpacking fonts-lato (2.0-2.1) ...
Selecting previously unselected package poppler-data.
Preparing to unpack .../02-poppler-data_0.4.11-1_all.deb ...
Unpacking poppler-data (0.4.11-1) ...
Selecting previously unselected package tex-common.
Preparing to unpack .../03-tex-common_6.17_all.deb ...
Unpacking tex-common (6.17) ...
Selecting previously unselected package fonts-urw-base35.
Preparing to unpack .../04-fonts-urw-base35_20200910-1_all.deb ...
Unpacking fonts-urw-base35 (20200910-1) ...
Selecting previously unselected package libgs9-common.
Preparing to unpack .../05-libgs9-common_9.55.0~dfsg1-0ubuntu5.13_all.deb ...
Unpacking libgs9-common (9.55.0~dfsg1-0ubuntu5.13) ...
Selecting previously unselected package libidn12:amd64.
Preparing to unpack .../06-libidn12_1.38-4ubuntu1_amd64.deb ...
Unpacking libidn12:amd64 (1.38-4ubuntu1) ...
Selecting previously unselected package libijs-0.35:amd64.
Preparing to unpack .../07-libijs-0.35_0.35-15build2_amd64.deb ...
Unpacking libijs-0.35:amd64 (0.35-15build2) ...
Selecting previously unselected package libjbig2dec0:amd64.
Preparing to unpack .../08-libjbig2dec0_0.19-3build2_amd64.deb ...
Unpacking libjbig2dec0:amd64 (0.19-3build2) ...
Selecting previously unselected package libgs9:amd64.
Preparing to unpack .../09-libgs9_9.55.0~dfsg1-0ubuntu5.13_amd64.deb ...
Unpacking libgs9:amd64 (9.55.0~dfsg1-0ubuntu5.13) ...
Selecting previously unselected package libkpathsea6:amd64.
Preparing to unpack .../10-libkpathsea6_2021.20210626.59705-1ubuntu0.3_amd64.deb
...
Unpacking libkpathsea6:amd64 (2021.20210626.59705-1ubuntu0.3) ...
Selecting previously unselected package libwoff1:amd64.
Preparing to unpack .../11-libwoff1_1.0.2-1build4_amd64.deb ...

```

```

Unpacking libwoff1:amd64 (1.0.2-1build4) ...
Selecting previously unselected package dvisvgm.
Preparing to unpack .../12-dvisvgm_2.13.1-1_amd64.deb ...
Unpacking dvisvgm (2.13.1-1) ...
Selecting previously unselected package fonts-lmodern.
Preparing to unpack .../13-fonts-lmodern_2.004.5-6.1_all.deb ...
Unpacking fonts-lmodern (2.004.5-6.1) ...
Selecting previously unselected package fonts-noto-mono.
Preparing to unpack .../14-fonts-noto-mono_20201225-1build1_all.deb ...
Unpacking fonts-noto-mono (20201225-1build1) ...
Selecting previously unselected package fonts-texgyre.
Preparing to unpack .../15-fonts-texgyre_20180621-3.1_all.deb ...
Unpacking fonts-texgyre (20180621-3.1) ...
Selecting previously unselected package libapache-pom-java.
Preparing to unpack .../16-libapache-pom-java_18-1_all.deb ...
Unpacking libapache-pom-java (18-1) ...
Selecting previously unselected package libcommons-parent-java.
Preparing to unpack .../17-libcommons-parent-java_43-1_all.deb ...
Unpacking libcommons-parent-java (43-1) ...
Selecting previously unselected package libcommons-logging-java.
Preparing to unpack .../18-libcommons-logging-java_1.2-2_all.deb ...
Unpacking libcommons-logging-java (1.2-2) ...
Selecting previously unselected package libptexenc1:amd64.
Preparing to unpack .../19-libptexenc1_2021.20210626.59705-1ubuntu0.3_amd64.deb
...
Unpacking libptexenc1:amd64 (2021.20210626.59705-1ubuntu0.3) ...
Selecting previously unselected package rubygems-integration.
Preparing to unpack .../20-rubygems-integration_1.18_all.deb ...
Unpacking rubygems-integration (1.18) ...
Selecting previously unselected package ruby3.0.
Preparing to unpack .../21-ruby3.0_3.0.2-7ubuntu2.12_amd64.deb ...
Unpacking ruby3.0 (3.0.2-7ubuntu2.12) ...
Selecting previously unselected package ruby-rubygems.
Preparing to unpack .../22-ruby-rubygems_3.3.5-2ubuntu1.2_all.deb ...
Unpacking ruby-rubygems (3.3.5-2ubuntu1.2) ...
Selecting previously unselected package ruby.
Preparing to unpack .../23-ruby_1%3a3.0~exp1_amd64.deb ...
Unpacking ruby (1:3.0~exp1) ...
Selecting previously unselected package rake.
Preparing to unpack .../24-rake_13.0.6-2_all.deb ...
Unpacking rake (13.0.6-2) ...
Selecting previously unselected package ruby-net-telnet.
Preparing to unpack .../25-ruby-net-telnet_0.1.1-2_all.deb ...
Unpacking ruby-net-telnet (0.1.1-2) ...
Selecting previously unselected package ruby-webrick.
Preparing to unpack .../26-ruby-webrick_1.7.0-3ubuntu0.2_all.deb ...
Unpacking ruby-webrick (1.7.0-3ubuntu0.2) ...
Selecting previously unselected package ruby-xmlrpc.

```

```

Preparing to unpack .../27-ruby-xmlrpc_0.3.2-1ubuntu0.1_all.deb ...
Unpacking ruby-xmlrpc (0.3.2-1ubuntu0.1) ...
Selecting previously unselected package libruby3.0:amd64.
Preparing to unpack .../28-libruby3.0_3.0.2-7ubuntu2.12_amd64.deb ...
Unpacking libruby3.0:amd64 (3.0.2-7ubuntu2.12) ...
Selecting previously unselected package libsyntax2:amd64.
Preparing to unpack .../29-libsyntax2_2021.20210626.59705-1ubuntu0.3_amd64.deb
...
Unpacking libsyntax2:amd64 (2021.20210626.59705-1ubuntu0.3) ...
Selecting previously unselected package libteckit0:amd64.
Preparing to unpack .../30-libteckit0_2.5.11+ds1-1_amd64.deb ...
Unpacking libteckit0:amd64 (2.5.11+ds1-1) ...
Selecting previously unselected package libtexlua53:amd64.
Preparing to unpack .../31-libtexlua53_2021.20210626.59705-1ubuntu0.3_amd64.deb
...
Unpacking libtexlua53:amd64 (2021.20210626.59705-1ubuntu0.3) ...
Selecting previously unselected package libtexlua53:amd64.
Preparing to unpack
.../32-libtexlua53_2021.20210626.59705-1ubuntu0.3_amd64.deb ...
Unpacking libtexlua53:amd64 (2021.20210626.59705-1ubuntu0.3) ...
Selecting previously unselected package libzip-0-13:amd64.
Preparing to unpack .../33-libzip-0-13_0.13.7+dfsg.1-1.1_amd64.deb ...
Unpacking libzip-0-13:amd64 (0.13.7+dfsg.1-1.1) ...
Selecting previously unselected package xfonts-encodings.
Preparing to unpack .../34-xfonts-encodings_1%3a1.0.5-0ubuntu2_all.deb ...
Unpacking xfonts-encodings (1:1.0.5-0ubuntu2) ...
Selecting previously unselected package xfonts-utils.
Preparing to unpack .../35-xfonts-utils_1%3a7.7+6build2_amd64.deb ...
Unpacking xfonts-utils (1:7.7+6build2) ...
Selecting previously unselected package lmodern.
Preparing to unpack .../36-lmodern_2.004.5-6.1_all.deb ...
Unpacking lmodern (2.004.5-6.1) ...
Selecting previously unselected package preview-latex-style.
Preparing to unpack .../37-preview-latex-style_12.2-1ubuntu1_all.deb ...
Unpacking preview-latex-style (12.2-1ubuntu1) ...
Selecting previously unselected package t1utils.
Preparing to unpack .../38-t1utils_1.41-4build2_amd64.deb ...
Unpacking t1utils (1.41-4build2) ...
Selecting previously unselected package teckit.
Preparing to unpack .../39-teckit_2.5.11+ds1-1_amd64.deb ...
Unpacking teckit (2.5.11+ds1-1) ...
Selecting previously unselected package tex-gyre.
Preparing to unpack .../40-tex-gyre_20180621-3.1_all.deb ...
Unpacking tex-gyre (20180621-3.1) ...
Selecting previously unselected package texlive-binaries.
Preparing to unpack .../41-texlive-
binaries_2021.20210626.59705-1ubuntu0.3_amd64.deb ...
Unpacking texlive-binaries (2021.20210626.59705-1ubuntu0.3) ...

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Selecting previously unselected package texlive-base.
Preparing to unpack .../42-texlive-base_2021.20220204-1_all.deb ...
Unpacking texlive-base (2021.20220204-1) ...
Selecting previously unselected package texlive-fonts-recommended.
Preparing to unpack .../43-texlive-fonts-recommended_2021.20220204-1_all.deb ...
Unpacking texlive-fonts-recommended (2021.20220204-1) ...
Selecting previously unselected package texlive-latex-base.
Preparing to unpack .../44-texlive-latex-base_2021.20220204-1_all.deb ...
Unpacking texlive-latex-base (2021.20220204-1) ...
Selecting previously unselected package libfontbox-java.
Preparing to unpack .../45-libfontbox-java_1%3a1.8.16-2_all.deb ...
Unpacking libfontbox-java (1:1.8.16-2) ...
Selecting previously unselected package libpdfbox-java.
Preparing to unpack .../46-libpdfbox-java_1%3a1.8.16-2_all.deb ...
Unpacking libpdfbox-java (1:1.8.16-2) ...
Selecting previously unselected package texlive-latex-recommended.
Preparing to unpack .../47-texlive-latex-recommended_2021.20220204-1_all.deb ...
Unpacking texlive-latex-recommended (2021.20220204-1) ...
Selecting previously unselected package texlive-pictures.
Preparing to unpack .../48-texlive-pictures_2021.20220204-1_all.deb ...
Unpacking texlive-pictures (2021.20220204-1) ...
Selecting previously unselected package texlive-latex-extra.
Preparing to unpack .../49-texlive-latex-extra_2021.20220204-1_all.deb ...
Unpacking texlive-latex-extra (2021.20220204-1) ...
Selecting previously unselected package texlive-plain-generic.
Preparing to unpack .../50-texlive-plain-generic_2021.20220204-1_all.deb ...
Unpacking texlive-plain-generic (2021.20220204-1) ...
Selecting previously unselected package tipa.
Preparing to unpack .../51-tipa_2%3a1.3-21_all.deb ...
Unpacking tipa (2:1.3-21) ...
Selecting previously unselected package texlive-xetex.
Preparing to unpack .../52-texlive-xetex_2021.20220204-1_all.deb ...
Unpacking texlive-xetex (2021.20220204-1) ...
Setting up fonts-lato (2.0-2.1) ...
Setting up fonts-noto-mono (20201225-1build1) ...
Setting up libwoff1:amd64 (1.0.2-1build4) ...
Setting up libtexlua53:amd64 (2021.20210626.59705-1ubuntu0.3) ...
Setting up libijs-0.35:amd64 (0.35-15build2) ...
Setting up libtexluaajit2:amd64 (2021.20210626.59705-1ubuntu0.3) ...
Setting up libfontbox-java (1:1.8.16-2) ...
Setting up rubygems-integration (1.18) ...
Setting up libzip-0-13:amd64 (0.13.72+dfsg.1-1.1) ...
Setting up fonts-urw-base35 (20200910-1) ...
Setting up poppler-data (0.4.11-1) ...
Setting up tex-common (6.17) ...
update-language: texlive-base not installed and configured, doing nothing!
Setting up libbig2dec0:amd64 (0.19-3build2) ...
Setting up libteckit0:amd64 (2.5.11+ds1-1) ...

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Setting up libapache-pom-java (18-1) ...
Setting up ruby-net-telnet (0.1.1-2) ...
Setting up xfonts-encodings (1:1.0.5-0ubuntu2) ...
Setting up t1utils (1.41-4build2) ...
Setting up libidn12:amd64 (1.38-4ubuntu1) ...
Setting up fonts-texgyre (20180621-3.1) ...
Setting up libkpathsea6:amd64 (2021.20210626.59705-1ubuntu0.3) ...
Setting up ruby-webrick (1.7.0-3ubuntu0.2) ...
Setting up fonts-lmodern (2.004.5-6.1) ...
Setting up fonts-droid-fallback (1:6.0.1r16-1.1build1) ...
Setting up ruby-xmlrpc (0.3.2-1ubuntu0.1) ...
Setting up libsystex2:amd64 (2021.20210626.59705-1ubuntu0.3) ...
Setting up libgs9-common (9.55.0~dfsg1-0ubuntu5.13) ...
Setting up teckit (2.5.11+ds1-1) ...
Setting up libpdfbox-java (1:1.8.16-2) ...
Setting up libgs9:amd64 (9.55.0~dfsg1-0ubuntu5.13) ...
Setting up preview-latex-style (12.2-1ubuntu1) ...
Setting up libcommons-parent-java (43-1) ...
Setting up dvisvgm (2.13.1-1) ...
Setting up libcommons-logging-java (1.2-2) ...
Setting up xfonts-utils (1:7.7+6build2) ...
Setting up libptexenc1:amd64 (2021.20210626.59705-1ubuntu0.3) ...
Setting up texlive-binaries (2021.20210626.59705-1ubuntu0.3) ...
update-alternatives: using /usr/bin/xdvi-xaw to provide /usr/bin/xdvi.bin
(xdvi.bin) in auto mode
update-alternatives: using /usr/bin/bibtex.original to provide /usr/bin/bibtex
(bibtex) in auto mode
Setting up lmodern (2.004.5-6.1) ...
Setting up texlive-base (2021.20220204-1) ...
/usr/bin/ucfr
/usr/bin/ucfr
/usr/bin/ucfr
/usr/bin/ucfr
mktexlsr: Updating /var/lib/texmf/ls-R-TEXLIVEDIST...
mktexlsr: Updating /var/lib/texmf/ls-R-TEXMFMAIN...
mktexlsr: Updating /var/lib/texmf/ls-R...
mktexlsr: Done.
tl-paper: setting paper size for dvips to a4:
/var/lib/texmf/dvips/config/config-paper.ps
tl-paper: setting paper size for dvipdfmx to a4:
/var/lib/texmf/dvipdfmx/dvipdfmx-paper.cfg
tl-paper: setting paper size for xdvi to a4: /var/lib/texmf/xdvi/XDvi-paper
tl-paper: setting paper size for pdftex to a4: /var/lib/texmf/tex/generic/tex-
ini-files/pdftexconfig.tex
Setting up tex-gyre (20180621-3.1) ...
Setting up texlive-plain-generic (2021.20220204-1) ...
Setting up texlive-latex-base (2021.20220204-1) ...
Setting up texlive-latex-recommended (2021.20220204-1) ...

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Setting up texlive-pictures (2021.20220204-1) ...
Setting up texlive-fonts-recommended (2021.20220204-1) ...
Setting up tipa (2:1.3-21) ...
Setting up texlive-latex-extra (2021.20220204-1) ...
Setting up texlive-xetex (2021.20220204-1) ...
Setting up rake (13.0.6-2) ...
Setting up libruby3.0:amd64 (3.0.2-7ubuntu2.12) ...
Setting up ruby3.0 (3.0.2-7ubuntu2.12) ...
Setting up ruby (1:3.0~exp1) ...
Setting up ruby-rubygems (3.3.5-2ubuntu1.2) ...
Processing triggers for man-db (2.10.2-1) ...
Processing triggers for mailcap (3.70+nmu1ubuntu1) ...
Processing triggers for fontconfig (2.13.1-4.2ubuntu5) ...
Processing triggers for libc-bin (2.35-0ubuntu3.13) ...
/sbin/ldconfig.real: /usr/local/lib/libtbbmalloc_proxy.so.2 is not a symbolic
link

/sbin/ldconfig.real: /usr/local/lib/libur_loader.so.0 is not a symbolic link

/sbin/ldconfig.real: /usr/local/lib/libur_adapter_level_zero_v2.so.0 is not a
symbolic link

/sbin/ldconfig.real: /usr/local/lib/libtcm_debug.so.1 is not a symbolic link

/sbin/ldconfig.real: /usr/local/lib/libhwloc.so.15 is not a symbolic link

/sbin/ldconfig.real: /usr/local/lib/libtbbbind.so.3 is not a symbolic link

/sbin/ldconfig.real: /usr/local/lib/libur_adapter_level_zero.so.0 is not a
symbolic link

/sbin/ldconfig.real: /usr/local/lib/libur_adapter_opencl.so.0 is not a symbolic
link

/sbin/ldconfig.real: /usr/local/lib/libtbbbind_2_0.so.3 is not a symbolic link

/sbin/ldconfig.real: /usr/local/lib/libtbbbind_2_5.so.3 is not a symbolic link

/sbin/ldconfig.real: /usr/local/lib/libtbb.so.12 is not a symbolic link

/sbin/ldconfig.real: /usr/local/lib/libtbbmalloc.so.2 is not a symbolic link

/sbin/ldconfig.real: /usr/local/lib/libumf.so.1 is not a symbolic link

/sbin/ldconfig.real: /usr/local/lib/libtcm.so.1 is not a symbolic link

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