DRP-AI Extension Pack (Pruning Tool)

Sparse model processing speed check guide

Contents

1. Overview

DRP-AI has the function to accelerate the execution of the sparse model, but how much faster it actually is depending on the pruning rate and the structure of the AI model.

Therefore, this guide shows how to confirm how much faster a user's AI model can be by pruning it at different pruning rates.

Note: The procedure in this guide does not retrain the sparse model, so accuracy cannot be confirmed.

In this guide, the Sparse model will be created without retraining. Therefore, the processing performance can be quickly confirmed when pruning is applied.

Figure 1-1 shows the flow to confirm the Sparse model's performance. For more details on how to confirm it, refer to "How to confirm the processing speed of the Dense and Sparse models".

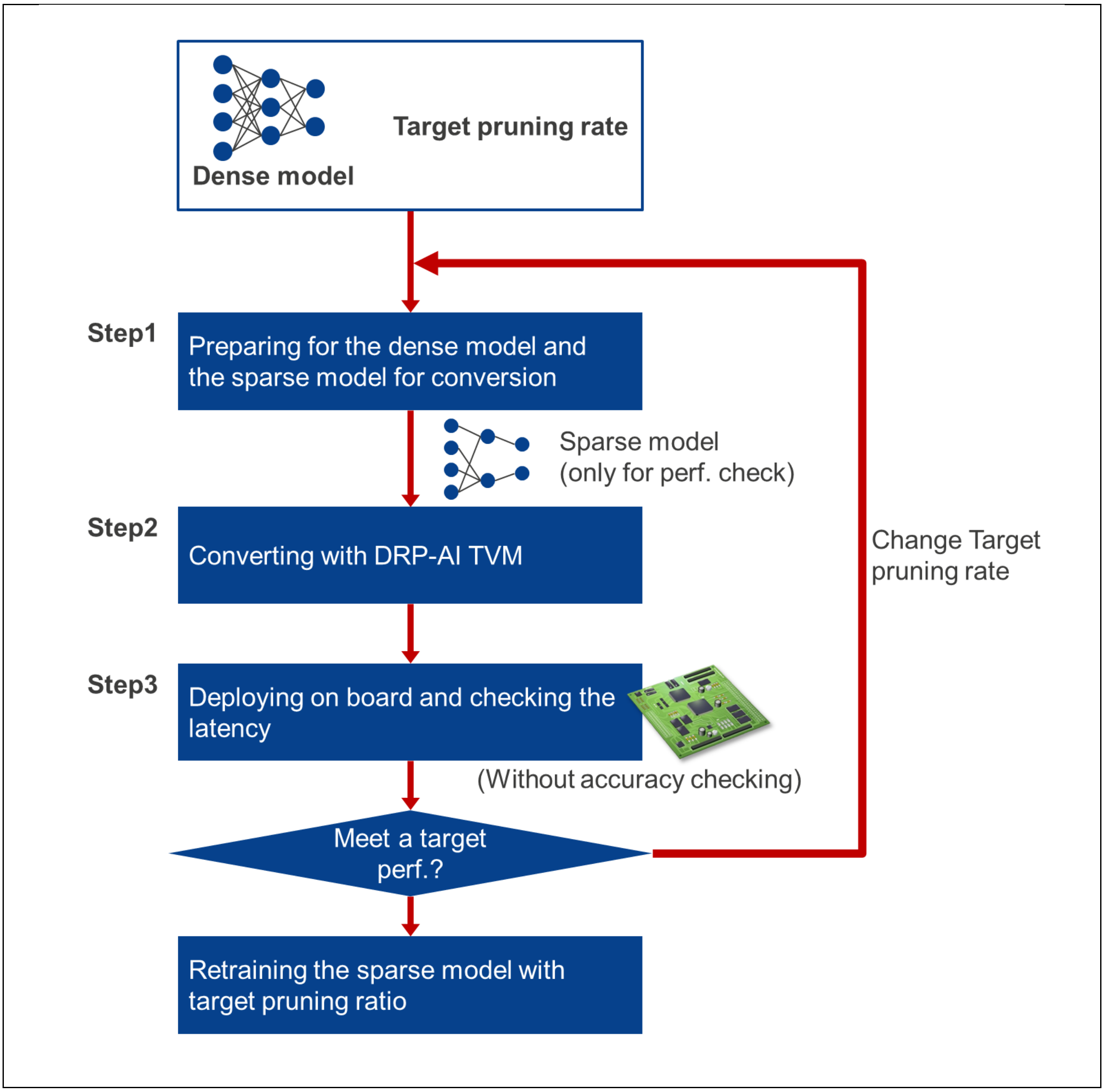

Dense model
Target pruning rate
Step1
Preparing for the dense model and the sparse model for conversion
Sparse model
(only for perf. check)
Step2
Converting with DRP-AI TVM
Change Target pruning rate
Step3
Deploying on board and checking the latency
(Without accuracy checking)
Meet a target perf.?
Retraining the sparse model with target pruning ratio

Figure 1-1 Flow of checking sparse model inference speed

1.1 Operating Environment

Thid document is based on the following operating environment.

- DRP-AI Extension Pack V1.0.0

Fore more details on how to setup DRP-AI Extension Pack, refer to the following document.

- DRP-AI TVM document: rzv_drp-ai_tvm/pruning/setup/README.md at main · renesas-rz/rzv_drp-ai_tvm (github.com)

1.2 Related documents

Related documents as follows.

- DRP-AI Extension Pack User’s Manual (R20UT5188)
- DRP-AI TVM document：renesas-rz/rzv_drp-ai_tvm: Extension package of Apache TVM (Machine Learning Compiler) for Renesas DRP-AI accelerators powered by Edgecortix MERA(TM) Based Apache TVM version: v0.11.1 (github.com)

2. How to confirm the processing speed of the Dense and Sparse models

To confirm how much faster the sparse model can be, use the flow shown in Figure 1-1. In this guide, the Sparse model will be created without retraining after pruning. Therefore, the processing performance can be quickly confirmed when pruning is applied.

Specifically, the processing performance when pruning is applied can be confirmed by executing the following three steps.

Step1. Prepare the Dense and Sparse models for conversion.

Step2. Convert the Dense and Sparse models with DRP-AI TVM.

Step3 Run the models on board and measure performance.

For more details about each step, see the following chapters.

2.1 Step1. Prepare the Dense and Sparse models for conversion

This chapter describes how to create the Dense and Sparse models to run on the board.

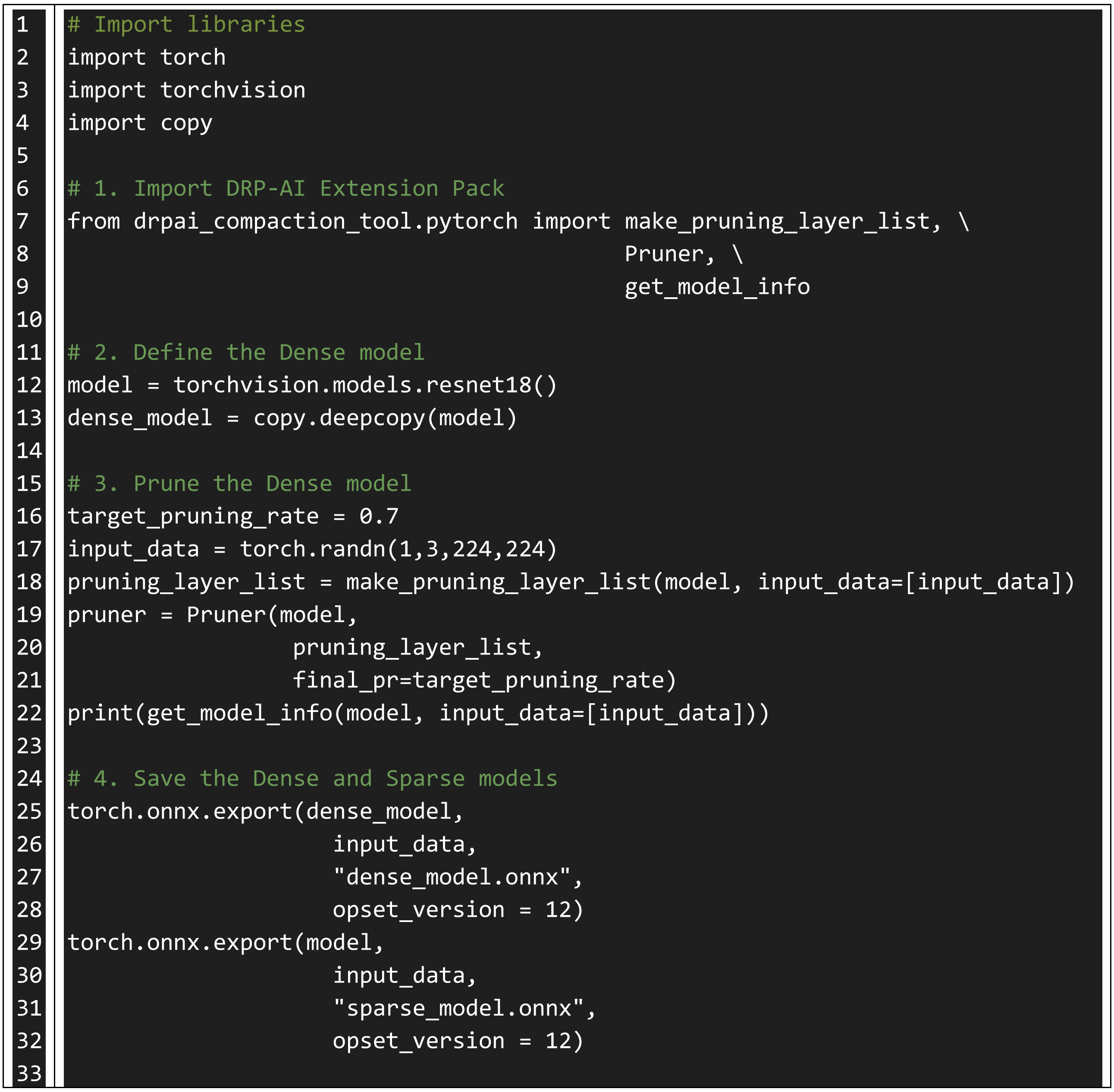
2.1.1 PyTorch

For PyTorch, follow the steps below to create the Dense and Sparse models for conversion.

1. Import DRP-AI Extension Pack
2. Define the Dense model
3. Prune the Dense model
4. Save the Dense and Sparse models

The following shows how to create it using torchvision resnet18.

Any Sparse model can be created by modifying the Dense model definition and the input data (input_data). The pruning rate can be changed by modifying the target_pruning_rate.



```
# Import libraries
import torch
import torchvision
import copy

# 1. Import DRP-AI Extension Pack
from drpai_compaction_tool.pytorch import make_pruning_layer_list, \
                                          Pruner, \
                                          get_model_info

# 2. Define the Dense model
model = torchvision.models.resnet18()
dense_model = copy.deepcopy(model)

# 3. Prune the Dense model
target_pruning_rate = 0.7
input_data = torch.randn(1,3,224,224)
pruning_layer_list = make_pruning_layer_list(model, input_data=[input_data])
pruner = Pruner(model,
                 pruning_layer_list,
                 final_pr=target_pruning_rate)
print(get_model_info(model, input_data=[input_data]))

# 4. Save the Dense and Sparse models
torch.onnx.export(dense_model,
                    input_data,
                    "dense_model.onnx",
                    opset_version = 12)
torch.onnx.export(model,
                    input_data,
                    "sparse_model.onnx",
                    opset_version = 12)

```

Figure 2-1 How to save the Dense and Sparse models (PyTorch)

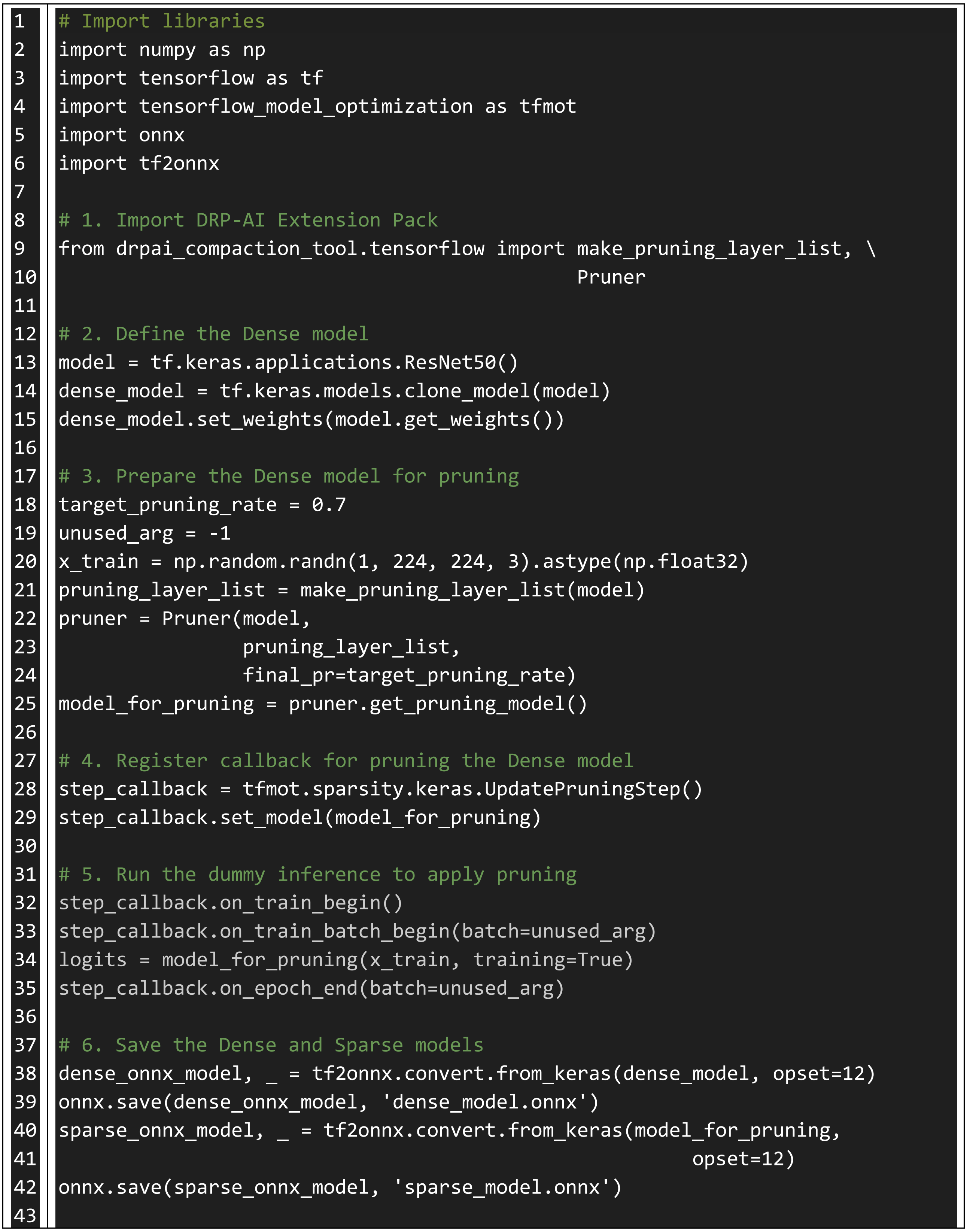
2.1.2 TensorFlow

For TensorFlow, follow the steps below to create the Dense and Sparse models for conversion.

1. Import DRP-AI Extension Pack
2. Define the Dense model
3. Prepare the Dense model for pruning
4. Register callback for pruning the Dense model
5. Run the dummy inference to apply pruning
6. Save the Dense and Sparse models

The following shows how to create it using TensorFlow applications resnet50.

Any Sparse model can be created by modifying the Dense model definition and the input data (x_train). The pruning rate can be changed by modifying the target_pruning_rate.



```python
# Import libraries
import numpy as np
import tensorflow as tf
import tensorflow_model_optimization as tfmot
import onnx
import tf2onnx

# 1. Import DRP-AI Extension Pack
from drpai_compaction_tool.tensorflow import make_pruning_layer_list, \
                                             Pruner

# 2. Define the Dense model
model = tf.keras.applications.ResNet50()
dense_model = tf.keras.models.clone_model(model)
dense_model.set_weights(model.get_weights())

# 3. Prepare the Dense model for pruning
target_pruning_rate = 0.7
unused_arg = -1
x_train = np.random.randn(1, 224, 224, 3).astype(np.float32)
pruning_layer_list = make_pruning_layer_list(model)
pruner = Pruner(model,
                pruning_layer_list,
                final_pr=target_pruning_rate)
model_for_pruning = pruner.get_pruning_model()

# 4. Register callback for pruning the Dense model
step_callback = tfmot.sparsity.keras.UpdatePruningStep()
step_callback.set_model(model_for_pruning)

# 5. Run the dummy inference to apply pruning
step_callback.on_train_begin()
step_callback.on_train_batch_begin(batch=unused_arg)
logits = model_for_pruning(x_train, training=True)
step_callback.on_epoch_end(batch=unused_arg)

# 6. Save the Dense and Sparse models
dense_onnx_model, _ = tf2onnx.convert.from_keras(dense_model, opset=12)
onnx.save(dense_onnx_model, 'dense_model.onnx')
sparse_onnx_model, _ = tf2onnx.convert.from_keras(model_for_pruning,
                                                       opset=12)
onnx.save(sparse_onnx_model, 'sparse_model.onnx')

```

Figure 2-2 How to save the Dense and Sparse models (TensorFlow)

2.2 Step2. Convert the Dense and Sparse models with DRP-AI TVM

Use DRP-AI TVM to convert the Dense and Sparse models created in Step 1 for execution on the board.

For more details on how to convert, please refer to the DRP-AI TVM documentation.

- renesas-rz/rzv_drp-ai_tvm: Extension package of Apache TVM (Machine Learning Compiler) for Renesas DRP-AI accelerators powered by Edgecortix MERA(TM) Based Apache TVM version: v0.11.1 (github.com)

2.3 Step3. Run the models on board and measure the performance

In order to confirm the processing performance when pruning is applied, let the AI model run on the board. Measure and compare the execution speed of the Dense model and the Sparse model.

For more details on how to run the converted model on the board, please refer to the following DRP-AI TVM documentation.

- renesas-rz/rzv_drp-ai_tvm: Extension package of Apache TVM (Machine Learning Compiler) for Renesas DRP-AI accelerators powered by Edgecortix MERA(TM) Based Apache TVM version: v0.11.1 (github.com)

Revision History

Rev.	Date	Description	
		Page	Summary
1.00	Apr.10.24	-	First edition issued

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