基于华山派开发板的图像分类

配置Docker开发环境

安装并配置docker：

```
sudo apt install docker.io
systemctl start docker
systemctl enable docker
sudo groupadd docker
sudo usermod -aG docker $USER
newgrp docker (use before reboot)
```

从docker hub获取镜像文件：

```
docker pull cvitek/cvitek_dev:1.7-ubuntu-18.04
```

执行下述命令运行docker：

```
docker run -itd -v $PWD:/work --name cvitek cvitek/cvitek_dev:1.7-ubuntu-18.04
docker exec -it cvitek bash
```

下载tpu开发所需要的包文件：

```
wget --user='cvitek_mlir_2022' --password='Bxc~b6n!Zn'
ftp://218.17.249.213/home/tpu_rel_v1.5.0-868-
g743c9d53a/cvimodel_samples_cv181x.tar.gz

wget --user='cvitek_mlir_2022' --password='Bxc~b6n!Zn'
ftp://218.17.249.213/home/tpu_rel_v1.5.0-868-
g743c9d53a/cvitek_tpu_samples.tar.gz

wget --user='cvitek_mlir_2022' --password='Bxc~b6n!Zn'
ftp://218.17.249.213/home/tpu_rel_v1.5.0-868-
g743c9d53a/cvitek_tpu_sdk_cv181x_musl_riscv64.tar.gz

wget --user='cvitek_mlir_2022' --password='Bxc~b6n!Zn'
ftp://218.17.249.213/home/cvitek_mlir_ubuntu-18.04_v1.5.0-872-g4818dc6ef.tar.gz
```

在部署模型之前，我们需要准备以下：

开发板的TPU sdk，训练并转换好的模型，测试图片，测试程序demo

`cvitek_tpu_sdk_cv181x_musl_riscv64.tar.gz` --TPU SDK

`cvitek_tpu_samples.tar.gz` --Demo例程

`cvimodel_samples_cv181x.tar.gz` --训练好的模型样例

编译demo

在主机端，我们搭建好编译环境

新建一个文件夹，把这些文件放到一起

```
root@e921088633cc:/work# mkdir tpu && cd tpu
root@e921088633cc:/work/tpu# ls
cvitek_tpu_samples.tar.gz       cvitek_tpu_sdk_cv181x_musl_riscv64.tar.gz
cvimodel_samples_cv181x.tar.gz
```

准备sdk环境：

```
tar zxf cvitek_tpu_sdk_mars_musl_riscv64.tar.gz
export TPU_SDK_PATH=$PWD/cvitek_tpu_sdk
cd cvitek_tpu_sdk && source ./envs_tpu_sdk.sh && cd ..
```

解压例程：

```
tar zxf cvitek_tpu_samples.tar.gz
cd cvitek_tpu_samples
```

在编译demo之前，做以下修改，

> 注意`cvitek_tpu_sdk/cmake/toolchain-riscv64-linux-musl-x86_64.cmake`文件需要做一些修改，将交叉工具链改成全路径

```
include(CMakeForceCompiler)

# The Generic system name is used for embedded targets (targets without OS) in
# CMake
set( CMAKE_SYSTEM_NAME          Linux )
set( CMAKE_SYSTEM_PROCESSOR     riscv )
set( ARCH riscv )
set( CROSS_COMPILE /work/sophpi-huashan/host-tools/gcc/riscv64-linux-musl-x86_64/bin/riscv64-unkn
own-linux-musl-)
```

编译例程，

```
mkdir build_soc
cd build_soc

cmake -G Ninja \
    -DCMAKE_BUILD_TYPE=RELEASE \
    -DCMAKE_C_FLAGS_RELEASE=-O3 -DCMAKE_CXX_FLAGS_RELEASE=-O3 \
    -DCMAKE_TOOLCHAIN_FILE=$TPU_SDK_PATH/cmake/toolchain-riscv64-linux-musl-
x86_64.cmake \
    -DTPU_SDK_PATH=$TPU_SDK_PATH \
    -DOPENCV_PATH=$TPU_SDK_PATH/opencv \
    -DCMAKE_INSTALL_PREFIX=../install_samples \
    ..

cmake --build . --target install
```

编译完成之后会生成相应的可执行文件，以物体分类模型为例，

```
root@e921088633cc:/work/tpu/cvitek_tpu_samples/build_soc/classifier_fused_prepro
cess# ls
CMakeFiles  cmake_install.cmake  cvi_sample_classifier_fused_preprocess
```

代码工作原理，
`cvitek_tpu_samples/classifier_fused_preprocess/classifier_fused_preprocess.cpp`

加载模型，

```
// load model file
  const char *model_file = argv[1];
  CVI_MODEL_HANDLE model = nullptr;
  int ret = CVI_NN_RegisterModel(model_file, &model);
  if (CVI_RC_SUCCESS != ret) {
    printf("CVI_NN_RegisterModel failed, err %d\n", ret);
    exit(1);
  }
```

获取模型输入输出Tensor，

```
// get input output tensors
  CVI_TENSOR *input_tensors;
  CVI_TENSOR *output_tensors;
  int32_t input_num;
  int32_t output_num;
  CVI_NN_GetInputOutputTensors(model, &input_tensors, &input_num,
&output_tensors,
                               &output_num);
  CVI_TENSOR *input = CVI_NN_GetTensorByName(CVI_NN_DEFAULT_TENSOR,
input_tensors, input_num);
  assert(input);
  CVI_TENSOR *output = CVI_NN_GetTensorByName(CVI_NN_DEFAULT_TENSOR,
output_tensors, output_num);
  assert(output);
```

读取输入图片并进行简单处理，

```
// imread
  cv::Mat image;
  image = cv::imread(argv[2]);
  if (!image.data) {
    printf("Could not open or find the image\n");
    return -1;
  }

  // resize
  cv::resize(image, image, cv::Size(IMG_RESIZE_DIMS, IMG_RESIZE_DIMS)); //
linear is default

  //Packed2Planar
  cv::Mat channels[3];
  for (int i = 0; i < 3; i++) {
    channels[i] = cv::Mat(image.rows, image.cols, CV_8SC1);
  }
```

```
  cv::split(image, channels);

  int8_t *ptr = (int8_t *)CVI_NN_TensorPtr(input);
  int channel_size = height * width;
  for (int i = 0; i < 3; ++i) {
    memcpy(ptr + i * channel_size, channels[i].data, channel_size);
  }
```

模型推理，

```
// run inference
  CVI_NN_Forward(model, input_tensors, input_num, output_tensors, output_num);
  printf("CVI_NN_Forward succeeded\n");
```

后处理并显示，

```
int32_t top_num = 5;
  float *prob = (float *)CVI_NN_TensorPtr(output);
  int32_t count = CVI_NN_TensorCount(output);
  // find top-k prob and cls        取最高的label
  std::vector<size_t> idx(count);
  std::iota(idx.begin(), idx.end(), 0);
  std::sort(idx.begin(), idx.end(), [&prob](size_t idx_0, size_t idx_1) {return
prob[idx_0] > prob[idx_1];});
  // show results.
  printf("------\n");
  for (size_t i = 0; i < top_num; i++) {
    int top_k_idx = idx[i];
    printf("  %f, idx %d", prob[top_k_idx], top_k_idx);
    if (!labels.empty())
      printf(", %s", labels[top_k_idx].c_str());
    printf("\n");
  }
```

在开发板上验证

运行release提供的sample预编译程序，需要如下文件：

`cvitek_tpu_sdk_mars_musl_riscv64.tar.gz`

`cvimodel_samples_cv181x.tar.gz` (需要用到其中的yolov5s模型)

`cvi_sample_classifier_fused_preprocess` (前面编译生成的可执行文件)

测试图片 `cat.jpg` （cvitek_tpu_samples/data路径下）

`synset_words.txt` (物体类，cvitek_tpu_samples/data路径下)

整理如下

```
[root@cvitek]/mnt/data/tpu_rt/mobilenetv2# ls
cat.jpg                                 mobilenet_v2_fused_preprocess.cvimodel
cvi_sample_classifier_fused_preprocess  synset_words.txt
```

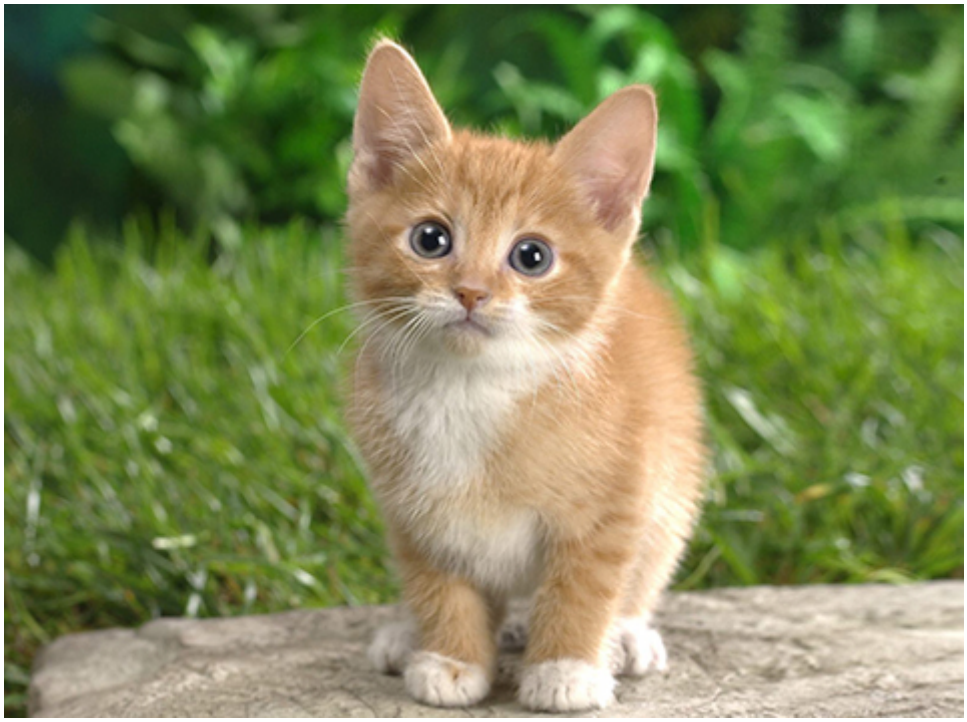
在上级目录 `tpu_rt` 下声明环境

```
export TPU_ROOT=$PWD/cvitek_tpu_sdk
cd cvitek_tpu_sdk && source ./envs_tpu_sdk.sh && cd ..
```

运行

```
./cvi_sample_classifier_fused_preprocess mobilenet_v2_fused_preprocess.cvimodel
cat.jpg synset_words.txt
```

测试图片以及输出如下，



```
[root@cvitek]/mnt/data/tpu_rt/mobilenetv2# ./cvi_sample_classifier_fused_preprocess mobilenet_v2_fused_preprocess.cvi
model cat.jpg synset_words.txt
version: 1.4.0
mobilenetv2 Build at 2022-09-26 04:09:35 For platform mars
Max SharedMem size:702464
CVI_NN_RegisterModel succeeded
CVI_NN_Forward succeeded
------
  0.326172, idx 282, n02123159 tiger cat
  0.326172, idx 285, n02124075 Egyptian cat
  0.099609, idx 281, n02123045 tabby, tabby cat
  0.071777, idx 287, n02127052 lynx, catamount
  0.041504, idx 331, n02326432 hare
------
CVI_NN_CleanupModel succeeded
```

在Docker仿真环境下验证

需要以下文件：

- `cvitek_mlir_ubuntu-18.04_v1.5.0-872-g4818dc6ef.tar.gz`（NN工具链）
- `cvitek_tpu_samples.tar.gz`（demo程序）
- `cvimodel_samples_cv181x.tar.gz`（模型文件）

TPU sdk准备：

```
tar zxf cvitek_mlir_ubuntu-18.04_v1.5.0-872-g4818dc6ef.tar.gz
source cvitek_mlir/cvitek_envs.sh
```

编译samples，安装至install_samples目录：

```
tar zxf cvitek_tpu_samples.tar.gz
cd cvitek_tpu_samples
mkdir build
cd build
cmake -G Ninja \
    -DCMAKE_BUILD_TYPE=RELEASE \
    -DCMAKE_C_FLAGS_RELEASE=-O3 -DCMAKE_CXX_FLAGS_RELEASE=-O3 \
    -DTPU_SDK_PATH=$MLIR_PATH/tpuc \
    -DCNPY_PATH=$MLIR_PATH/cnpy \
    -DOPENCV_PATH=$MLIR_PATH/opencv \
    -DCMAKE_INSTALL_PREFIX=../install_samples \
    ..

cmake --build . --target install
```

运行samples程序：

```
cd ../../
# envs
tar zxf cvimodel_samples_cv181x.tar.gz

./cvitek_tpu_samples/build/classifier_fused_preprocess/cvi_sample_classifier_fus
ed_preprocess ./cvimodel_samples/mobilenet_v2_fused_preprocess.cvimodel
./cvitek_tpu_samples/data/cat.jpg ./cvitek_tpu_samples/data/synset_words.txt
```

```
root@e921088633cc:/work/tpu# ./cvitek_tpu_samples/build/classifier_fused_preprocess/cvi_sample_classifi
er_fused_preprocess ./cvimodel_samples/mobilenet_v2_fused_preprocess.cvimodel ./cvitek_tpu_samples/data
/cat.jpg ./cvitek_tpu_samples/data/synset_words.txt
setenv:mars
Start TPU Simulator for mars
device[0] opened, 4294967296
version: 1.4.0
mobilenetv2 Build at 2022-09-26 04:09:35 For platform mars
Cmodel: bm_load_cmdbuf
Max SharedMem size:702464
CVI_NN_RegisterModel succeeded
Cmodel: bm_run_cmdbuf
CVI_NN_Forward succeeded
------
  0.326172, idx 282, n02123159 tiger cat
  0.326172, idx 285, n02124075 Egyptian cat
  0.099609, idx 281, n02123045 tabby, tabby cat
  0.071777, idx 287, n02127052 lynx, catamount
  0.041504, idx 331, n02326432 hare
------
device[0] closed
CVI_NN_CleanupModel succeeded
```