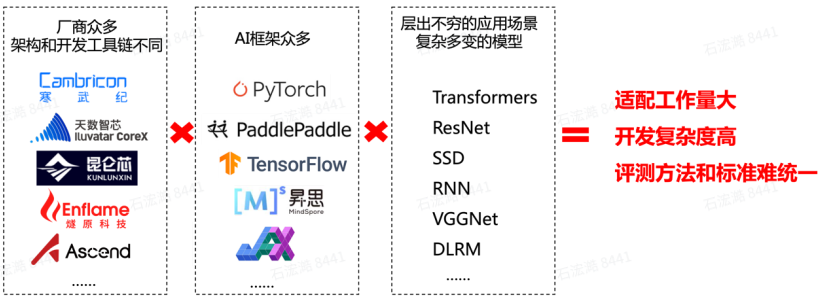
第一篇FlagPerf，开箱即用的AI芯片Benchmark平台

AI芯片基准测试，能指导用户选型，能帮助芯片软硬件改进，是AI产业生态重要的组成部分。但是，这个领域却一直没有公认的规范和标准，为什么？

答案很简单，难搞呗~~首先，AI芯片百花齐放，软硬件技术栈各（兼）有（容）千（性）秋（差）。其次，AI框架众多，应用场景层出不穷，模型复杂多变。

由于整个技术栈的复杂度高，制定统一的评测方法和标准本身就非常困难。具体到实现层面，叠加芯片、框架和模型三重考虑，benchmark的开发复杂度高，异构芯片的适配工作量非常大（X款芯片，Y个框架，Z个模型，要做X*Y*Z个case），光适配就要做到地老天荒。看看下面这张图，每个框里的内容还在不停地增长……惊（绝）喜（望）不？



别急，FlagPerf来了~~虽然他很年轻，但他站在巨人们的肩膀上，由智源研究院和多家硬件厂商、框架团队共同开发，立志给大家一个开箱即用的benchmark，无须自行适配，无须完成复杂的环境部署，只要改改配置，一条命令即可启动一组测试。

具体怎么玩呢？四步走：部署安装、配置benchmark、启动测试、结束后查看日志。

1. 部署安装

建议使用Linux Ubuntu 20.04，Python 3.8或以上，并安装Docker的集群（我们的环境用Docker 20.10.9开发测试）。

首先，在测试集群所有服务器上执行以下命令即可完成部署安装：

```
# git clone https://github.com/FlagOpen/FlagPerf.git
# cd FlagPerf/training/
# pip3 install -r requirements.txt
```

我们可以看到FlagPerf的目录结构，关注training下面的：

```
└── training
```

```
├── benchmarks  # benchmark的标准实现
├── nvidia     # nvidia配置及扩展，其它芯片也有单独目录
├── requirements.txt # FlagPerf依赖的python包
├── run_benchmarks # 测试任务的脚本和配置
└── utils # 测试任务执行需要胡工具
```

然后，配置测试集群各服务器间root帐号的ssh信任关系，确保可以免密登录。

2. 配置benchmark

1. 修改集群配置文件training/run_benchmarks/config/cluster_conf.py

```
# cd Flagperf/training/
# vim run_benchmarks/config/cluster_conf.py
```

集群配置文件主要包括集群服务器列表和SSH端口，按需改成您的服务器IP地址和SSH端口即可，示例如下：

```
# Hosts to run the benchmark. Each item is an IP address or a hostname.
HOSTS = ["10.1.2.3", "10.1.2.4", "10.1.2.5", "10.1.2.6"]
# ssh connection port
SSH_PORT = "22"
```

2. 修改测试配置文件training/run_benchmarks/config/test_conf.py

测试配置中主要包括FlagPerf的部署路径、数据和模型checkpoint的路径、要跑的测试benchmark case列表和每个benchmark case的配置信息等。

Tips：

- *请根据自己所在地区，选用合适的pip源来配置PIP_SOURCE*
- *每次运行可配置多个benchmark case，每个benchmark case可以通过repeat来配置运行次数*

示例如下，如果跑nvidia GPU测试，通常您只需要修改**FLAGPERF_PATH_HOST**指定FlagPerf在集群服务器上的部署路径，修改**CASES**指定要跑的benchmark Case列表，并为每个benchmark Case配置相关信息即可。

```
# Set accelerator's vendor name, e.g. iluvatar, cambricon and kunlun.
```

```
# We will run benchmarks in training/<vendor>
VENDOR = "nvidia"
# Accelerator options for docker.
ACCE_CONTAINER_OPT = " --gpus all"
# XXX_VISIBLE_DEVICE item name in env
# nvidia use CUDA_VISIBLE_DEVICE and cambricon MLU_VISIBLE_DEVICES
ACCE_VISIBLE_DEVICE_ENV_NAME = "CUDA_VISIBLE_DEVICES"

# Set type of benchmarks, default or customized.
# default: run benchmarks in training/benchmarks/
# [NOT SUPPORTED] customized: run benchmarks in training/<vendor>/benchmarks/
TEST_TYPE = "default"

# Set pip source, which will be used in preparing envs in container
PIP_SOURCE = "https://mirrors.aliyun.com/pypi/simple"

# The path that flagperf deploy in the cluster.
# If not set, it will be os.path.dirname(run.py)/../../training/
FLAGPERF_PATH_HOST = "/home/flagperf/training"

# Set the mapping directory of flagperf in container.
FLAGPERF_PATH_CONTAINER = "/workspace/flagperf/training"

# Set log path on the host here.
FLAGPERF_LOG_PATH_HOST = FLAGPERF_PATH_HOST + "/result/"
# Set log path in container here.
FLAGPERF_LOG_PATH_CONTAINER = FLAGPERF_PATH_CONTAINER + "/result/"
# Set log level. It should be 'debug', 'info', 'warning' or 'error'.
FLAGPERF_LOG_LEVEL = 'debug'

# System config
```

```
# Share memory size
SHM_SIZE = "32G"
# Clear cache config. Clean system cache before running testcase.
CLEAR_CACHES = True

# Set cases you want to run here.
# cases is a list of case name.
CASES = ['BERT_PADDLE_DEMO_A100_1X8',
      'GLM_TORCH_DEMO_A100_1X8',
      'CPM_TORCH_DEMO_A100_1X8']

# Config each case in a dictionary like this.
BERT_PADDLE_DEMO_A100_1X8 = { # benchmark case name, one in CASES
  "model": "bert", # model name
  "framework": "paddle", # AI framework
  "config": "config_A100x1x8", # config module in <vendor>/<model>-<framework>/<config>
  "repeat": 1, # How many times to run this case
  "nnodes": 1, #  HHow many hosts to run this case
  "nproc": 8, # How many processes will run on each host
  "data_dir_host": "/home/datasets_ckpt/bert/train/", # Data path on host
  "data_dir_container": "/mnt/data/bert/train/", # Data path in container
}
```

3）修改Vendor目录下的benchmark case配置文件（视自身需求，也可不修改）

benchmark case配置文件在<vendor>/<modle>-<framework>/config目录下，在case配置时指定，例如上面**BERT_PADDLE_DEMO_A100_1X8**的case里，config配置为confg_A100x1x8，即为nvidia/bert-paddle/config/config_A100x1x8.py，主要包括模型训练的参数，示例如下：

```
target_mlm_accuracy = 0.67
gradient_accumulation_steps = 1
max_steps = 10000
```

start_warmup_step = 0

warmup_proportion = 0

warmup_steps = 2000

learning_rate = 1e-4

weight_decay_rate = 0.01

opt_lamb_beta_1 = 0.9

opt_lamb_beta_2 = 0.999

train_batch_size = 12

eval_batch_size = train_batch_size

max_samples_termination = 4500000

cache_eval_data = False

seed = 9031

3. 启动测试

首先，当然要准备数据集和模型checkpoint，我们也为大家选好了标准数据集，准备方法参见training/benchmarks/<model>/<framework>/README.md。将数据集和模型checkpoint文件放在benchmark case配置里xxx 指定的路径即可。上面的例子里是：

然后，在修改好配置的服务器上进入training目录 ，用以下一条命令即可启动测试。

 # python3 ./run_benchmarks/run.py

为了防止终端断连等异常，推荐采用nohup命令启动：

 # python3 ./run_benchmarks/run.py &

启动后可以在终端或者nohup.out中，看到benchmark执行过程，结束后，会提示去哪里查看benchmark case执行日志，示例如下：

21 20:36:23,239 [INFO] [run.py,412]Congrats! See all logs in /home/FlagPerf/training/result/run20221121191924

2022-11-21 20:36:23,239 [INFO] [run.py,595]Stop FlagperfLogger.

4. 查看日志

从上面可以看出来，日志放在指定的日志路径里run<timestamp>目录下。

日志目录结构按如下方式组织：

```
├── BERT_PADDLE_DEMO_A100_1X8 # 每个benchmark case一个目录
│   └── round1 # 每轮测试一个子目录
│       └── 10.8.200.155_noderank0 # 每个服务器一个目录，<IP>_noderank编号
│           ├── cpu_monitor.log   # CPU利用率
│           ├── mem_monitor.log   # 内存利用率
│           ├── nvidia_monitor.log # GPU显卡使用情况采样
│           ├── pwr_monitor.log   # 带外监控采样
│           ├── rank0.out.log     # rank0进程的日志，每rank一个，下同
│           ├── rank1.out.log
│           ├── rank2.out.log
│           ├── rank3.out.log
│           ├── rank4.out.log
│           ├── rank5.out.log
│           ├── rank6.out.log
│           ├── rank7.out.log
│           └── start_paddle_task.log # 容器内启动训练任务脚本的日志
├── flagperf_run.log # run.py脚本的终端输出在这里也记录了一份
└── start_paddle_task.pid # pid文件，可忽略。
```

通常，结束测试后，rank0的日志文件里会输出benchmark case运行的情况，包括运行时间，运行的step数，最终的Loss值，模型是否收敛到目标精度，模型收敛到的精度等等。示例如下：

[PerfLog] {"event": "STEP_END", "value": {"loss": 2.679504871368408, "embedding_average": 0.916015625, "epoch": 1, "end_training": true, "global_steps": 3397, "num_trained_samples": 869632, "learning_rate": 0.000175375, "seq/s": 822.455385237589}, "metadata": {"file": "/workspace/flagperf/training/benchmarks/cpm/pytorch/run_pretraining.py", "lineno": 127, "time_ms": 1669034171032, "rank": 0}}

[PerfLog] {"event": "EVALUATE", "metadata": {"file": "/workspace/flagperf/training/benchmarks/cpm/pytorch/run_pretraining.py", "lineno": 127, "time_ms": 1669034171032, "rank": 0}}

[PerfLog] {"event": "EPOCH_END", "metadata": {"file": "/workspace/flagperf/training/benchmarks/cpm/pytorch/run_pretraining.py", "lineno": 127, "time_ms": 1669034171159, "rank": 0}}

[PerfLog] {"event": "TRAIN_END", "metadata": {"file": "/workspace/flagperf/training/benchmarks/cpm/pytorch/run_pretraining.py", "lineno": 136, "time_ms": 1669034171159, "ran

k": 0}}

[PerfLog] {"event": "FINISHED", "value": {"e2e_time": 1661.6114165782928, "training_sequences_per_second": 579.0933420700227, "converged": true, "final_loss": 3.06671810150 1465, "final_mlm_accuracy": 0.920166015625, "raw_train_time": 1501.713, "init_time": 14 8.937}, "metadata": {"file": "/workspace/flagperf/training/benchmarks/cpm/pytorch/run_ pretraining.py", "lineno": 158, "time_ms": 1669034171646, "rank": 0}}

好啦，这样我们就跑完了一组benchmark基准测试啦~~~很容易吧~~~更多的玩法请参考：https://github.com/FlagOpen/FlagPerf

有小伙伴问，目前没有我想要的benchmark case或者AI框架，怎么办？

两个办法，一是github上提个issue，二是自己动手丰衣足食，在FlagPerf里加个框架加个case也不难。具体怎么加，请听下回分解。