Intel® Cloud Optimization Modules for GCP*: nanoGPT Distributed Training

This module illustrates the process of fine-tuning a large language model (LLM) on 4th Generation Intel® Xeon® Scalable Processors on GCP in a distributed architecture. We will employ the nanoGPT implementation and use the OpenWebText dataset from Hugging Face*.

To capitalize on the capabilities of Intel hardware, we also integrate Intel AI software offerings, like the Intel® Extension for PyTorch* and the Intel® oneAPI Collective Communications Library (oneCCL).

GCP Cluster Setup

For distributed training, our example deploys a cluster consisting of three 4th Gen. Xeon® CPUs from the C3 series with an Ubuntu 22.04 image and 256 GiB of storage deployed on GCP. For maximum performance, we recommend using **bfloat16** precision. The 4th Gen CPUs come with a deep learning acceleration engine called Intel® Advanced Matrix Extensions (Intel® AMX).

If you are using a 4th Gen Xeon, you can verify AMX support by running:

```
lscpu | grep amx
```

You should see the following flags:

```
amx_bf16 amx_tile amx_int8
```

Intel® Extension for PyTorch*

Intel **upstreams** as many optimizations as possible to PyTorch. These features, however, often debut in the Intel® Extension for PyTorch. Install PyTorch (guide), and then the Intel Extension for PyTorch:

```
pip install intel_extension_for_pytorch==1.13.100 --extra-index-url
https://developer.intel.com/ipex-whl-stable-cpu
```

To enable the optimizations, only add these **two lines** to your Python code:

```
import intel_extension_for_pytorch as ipex

model.train()
model, optimizer = ipex.optimize(model, optimizer=optimizer,
                                 dtype="torch.bfloat16", level="O1", inplace=True)
```

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Install oneCCL

Download the appropriate wheel file and install it using the following commands:

```
wget https://intel-extension-for-
pytorch.s3.amazonaws.com/torch_ccl/cpu/oneccl_bind_pt-1.13.0%2Bcpu-cp310-cp310-
linux_x86_64.whl
pip install oneccl_bind_pt-1.13.0+cpu-cp310-cp310-linux_x86_64.whl
```

To use oneccl_bindings_for_pytorch, source the environment by running the following command:

```
oneccl_path=$(python -c "from oneccl_bindings_for_pytorch import cwd; print(cwd)")
source $oneccl_path/env/setvars.sh
```

To launch distributed fine-tuning:

```
mpirun -f ~/hosts -n 3 -ppn 1 -genv LD_PRELOAD="/usr/lib/x86_64-linux-
gnu/libtcmalloc.so" accelerate launch --config_file ./multi_config.yaml main.py
```

The `mpirun` command runs the fine-tuning process on multiple-machine (`-n 3`) with one process per machine (`-ppn 1`). Additionally, environment variables can be set using `-genv` argument.

Next Steps:

All Cloud Modules | GitHub Repo | DevMesh Discord