NCCL

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- 特点：
  - multi-GPU Collective communication primitves
  - topology-aware: 会自动判断拓扑结构
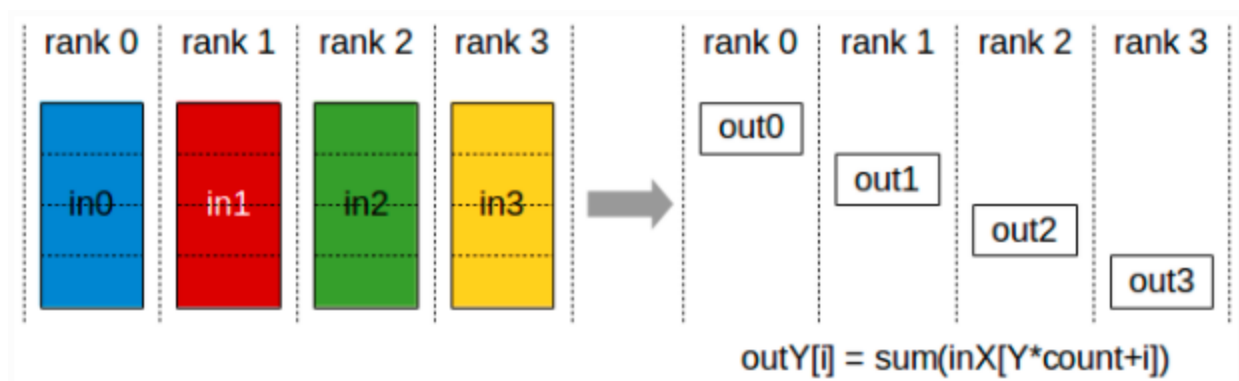
Overview of NCCL

- NCCL provides the following collective communication primitives:
  - AllReduce
  - Broadcast
  - Reduce
  - AllGather
  - ReduceScatter
- 好像会比较好学：文档里的原话：Anyone familiar with MPI with thus find NCCL's API very natural to use.

Creating a Communicator

- First call `ncclGetUniqueId` : create a unique object which will be used by all processes and threads to synchronize and understand they are part of the same communicator.

- Then `ncclCommInitRank` and `ncclCommInitAll` will: create communicator objects, each communicator object being associated to a fixed rank.

  - `ncclCommInitRank()` Creates a new communicator, each rank is associated to a CUDA device.

- `ncclCommDestroy( )` : destroy a Communicator

Collective Operations

- AllReduce: `ncclAllReduce()`

- Broadcast: `ncclBroadcast()`

- Reduce: `ncclReduce()`

- AllGather: `ncclAllGather()`

- ReduceScatter: `ReduceScatter()`

$$outY[i] = sum(inX[Y*count+i])$$

Group Calls

- 把很多的Calls合并为一个（提高性能，防止死锁）

- `ncclGroupStart` , `ncclGroupEnd`

- 提高性能的一个点是：Aggregaed Operations, this is useful for reducing the launch overhead, as it only occurs onece for multiple operations.

Point-to-point communication

`ncclSend()` , `ncclRecn()`

In-place Operations

For ncclBroadcast, ncclReduce and ncclAllreduce functions, this means that passing `sendBuff == recvBuff` will perform in place operations, storing final results at the same place as initial data was read from.

其他的一些API

- `ncclCommAbort()` : Frees resources that are allocated to a communicator object *comm.* Will abort any uncompleted operations before destroying the communicator.

- `ncclCommCount()` : Returns in count the number of ranks in the NCCL communicator comm.

- `ncclCommCuDevice()` : Returns in *device* the CUDA device associated with the NCCL communicator *comm*

- `ncclCommUserRank()` : Returns in *rank* the rank of the NCCL communicator *comm*

- 一些Communication Functions: https://docs.nvidia.com/deeplearning/nccl/user-guide/docs/api/colls.html

NCCL中的一些Types

https://docs.nvidia.com/deeplearning/nccl/user-guide/docs/api/types.html