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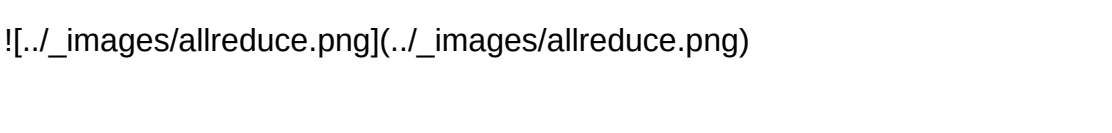
Collective OperationsÂ¶

Collective operations have to be called for each rank (hence CUDA device), using the same count and the same datatype, to form a complete collective operation. Failure to do so will result in undefined behavior, including hangs, crashes, or data corruption.

AllReduceÂ¶

The AllReduce operation performs reductions on data (for example, sum, min, max) across devices and stores the result in the receive buffer of every rank.

In a _sum_ allreduce operation between _k_ ranks, each rank will provide an array in of N values, and receive identical results in array out of N values, where out[i] = in0[i]+in1[i]+â€¦+in(k-1)[i].



All-Reduce operation: each rank receives the reduction of input values across ranks.

Related links: [`ncclAllReduce()`](../api/colls.html#c.ncclAllReduce "ncclAllReduce").

BroadcastÂ¶

The Broadcast operation copies an N-element buffer from the root rank to all

the ranks.

Broadcast operation: all ranks receive data from a â€œrootâ€• rank.

Important note: The root argument is one of the ranks, not a device number,
and is therefore impacted by a different rank to device mapping.

Related links: [`ncclBroadcast()`](../api/colls.html#c.ncclBroadcast
"ncclBroadcast").

ReduceÂ¶

The Reduce operation performs the same operation as AllReduce, but stores the
result only in the receive buffer of a specified root rank.

Reduce operation: one rank receives the reduction of input values across
ranks.

Important note: The root argument is one of the ranks (not a device number),
and is therefore impacted by a different rank to device mapping.

Note: A Reduce, followed by a Broadcast, is equivalent to the AllReduce
operation.

Related links: [`ncclReduce()`](../api/colls.html#c.ncclReduce "ncclReduce").

AllGatherÂ¶

The AllGather operation gathers N values from k ranks into an output buffer of size k*N, and distributes that result to all ranks.

The output is ordered by the rank index. The AllGather operation is therefore impacted by a different rank to device mapping.

AllGather operation: each rank receives the aggregation of data from all ranks in the order of the ranks.

Note: Executing ReduceScatter, followed by AllGather, is equivalent to the AllReduce operation.

Related links: [`ncclAllGather()`](../api/colls.html#c.ncclAllGather "ncclAllGather").

ReduceScatterÂ¶

The ReduceScatter operation performs the same operation as Reduce, except that the result is scattered in equal-sized blocks between ranks, each rank getting a chunk of data based on its rank index.

The ReduceScatter operation is impacted by a different rank to device mapping since the ranks determine the data layout.

Reduce-Scatter operation: input values are reduced across ranks, with each rank receiving a subpart of the result.

Related links: [`ncclReduceScatter()`](../api/colls.html#c.ncclReduceScatter "ncclReduceScatter")

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* * *