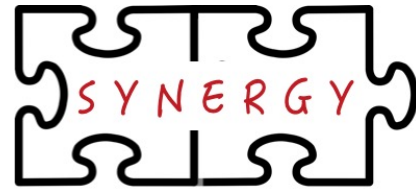




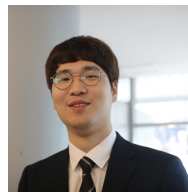
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Exercise 1: Getting Started with ASTRA-sim



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Agenda

Time (CET)	Time (ET)	Topic	Presenter
15:00 – 16:00	9:00 – 10:00	Introduction to Distributed Deep Learning Training Platforms	Tushar Krishna
16:00 – 17:00	10:00 – 11:00	ASTRA-sim	Saeed Rashidi
17:00 – 17:10	11:00 – 11:10	Break	
17:10 – 17:50	11:10 – 11:50	Demo and Exercises	William Won and Taekyung Heo
17:50 – 18:00	11:50 – 12:00	Extensions and Future Development	Tushar Krishna and Saeed Rashidi

Tutorial Website

includes agenda, slides, ASTRA-sim installation instructions (via source + docker image)

<https://astra-sim.github.io/tutorials/asplos-2022>

Attention: Tutorial is being recorded

Objective

- Installing ASTRA-sim
 - Download
 - Compilation
- Writing Input Files
 - Network
 - System
 - Workload
- Running ASTRA-sim
 - Running ASTRA-sim
 - Understanding Results

Downloading ASTRA-sim

Prerequisite: Check dependency installations

<https://astra-sim.github.io/tutorials/asplos-2022/installation>

(1) Clone ASTRA-sim tutorials GitHub repository

```
$ git clone https://github.com/astra-sim/tutorials.git
```

```
$ cd tutorials/asplos2022/
```

(2) Run setup script

```
$ ./clone_astra_sim.sh
```

Compiling ASTRA-sim

(1) Go to **Exercise 1** directory

```
$ cd exercise_1/
```

(2) Compile ASTRA-sim

```
$ ./build.sh
```

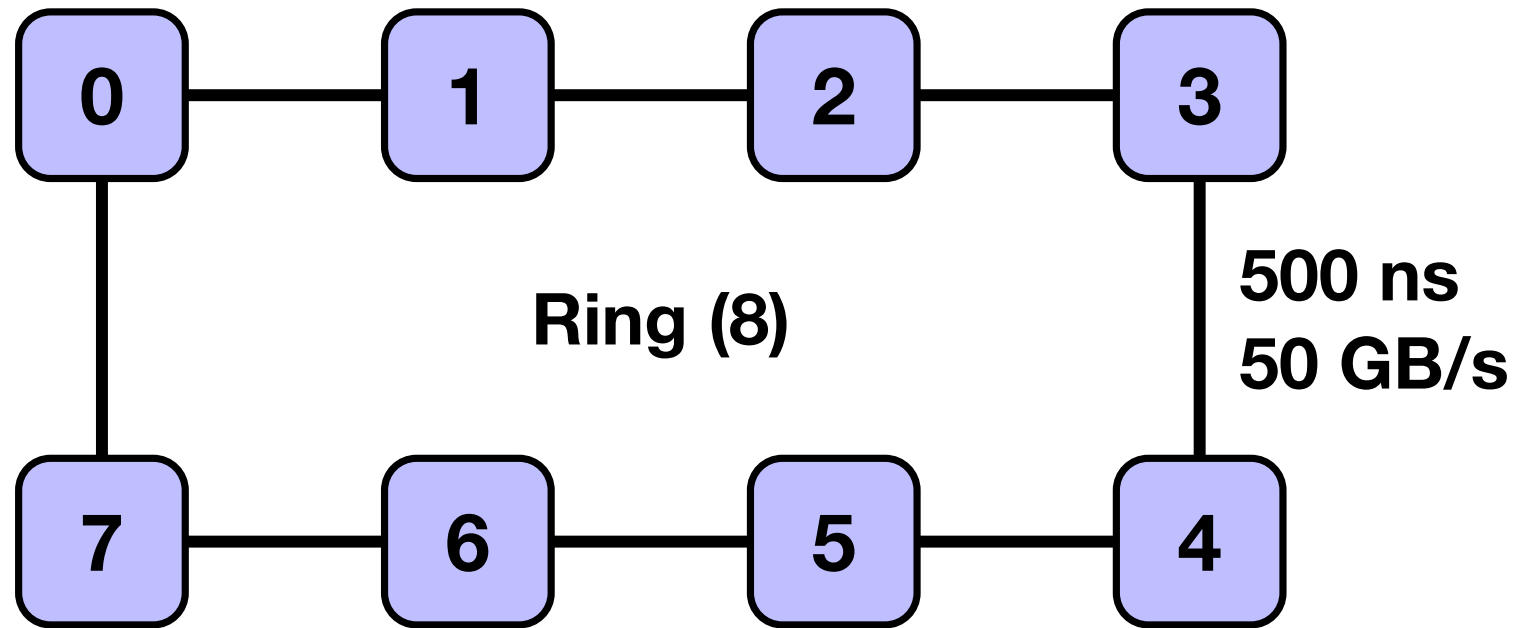
Exercise: Ring All-Reduce

Objective:

- (1) We will configure an 8-NPU Ring
- (2) And run **1 MB All-Reduce** on it

Configurations: Network

- **Ring topology with 8 NPUs**
- **500 ns** (latency), **50 GB/s** (bandwidth)
- **2 links** per NPU



Configurations: Network

inputs/ring.json

```
{  
  "dimensions-count": 1, ← 1D network  
  "topologies-per-dim": [ "Ring" ], ← Ring topology  
  "units-count": [ 8 ], ← 8 NPUs  
  "links-count": [ 2 ], ← 2 links per NPU  
  "link-latency": [ 500 ], ← 500ns link latency  
  "link-bandwidth": [ 50 ] ← 50GB/s link bandwidth  
}
```


Configurations: System

`inputs/ring.txt`

<code>scheduling-policy: LIFO</code>	←	LIFO chunk scheduling policy
<code>endpoint-delay: 10</code>	←	10ns delay per NPU
<code>active-chunks-per-dimension: 1</code>	←	1 active chunks
<code>preferred-dataset-splits: 4</code>	←	4 chunks per collective
<code>boost-mode: 1</code>	←	fast simulation when symmetric
<code>all-reduce-implementation: ring</code>	←	ring All-Reduce Algorithm
<code>all-gather-implementation: ring</code>	←	ring All-Gather Algorithm
<code>reduce-scatter-implementation: ring</code>	←	ring Reduce-Scatter Algorithm
<code>all-to-all-implementation: direct</code>	←	direct All-to-All Algorithm
<code>collective-optimization: localBWAware</code>	←	collective optimiation

Configurations: System

inputs/ring.txt

scheduling-policy: LIFO

endpoint-delay: 10

active-chunks-per-dimension: 1

preferred-dataset-splits: 4 ← 4 chunks per collective

boost-mode: 1

all-reduce-implementation: ring ← ring All-Reduce Algorithm

all-gather-implementation: ring

reduce-scatter-implementation: ring

all-to-all-implementation: direct

collective-optimization: localBWAware

Configurations: Workload

inputs/all_reduce.txt

MICRO ← training loop

1 ← #layers

allreduce -1 1 NONE 0 1 NONE 0 1 ALLREDUCE 1048576 1 ← layer data

Metadata			Forward		Input grad			Weight grad			Layer
Layer Name	(rsvd.)	Compute Time	Comm. Type	Comm. size	Compute Time	Comm. Type	Comm. Size	Compute Time	Comm. Type	Comm. Size	Delay
allreduce	-1	1	NONE	0	1	NONE	0	1	ALLREDUCE	1048576	1

1 MB

Running ASTRA-sim

Run ASTRA-sim

```
$ ./exercise_1.sh
```

exercise_1.sh

```
"${BINARY}" \
```

<code>--run-name="Exercise 1" \</code>	←	Run name
<code>--network-configuration="\${NETWORK}" \</code>	←	Network
<code>--system-configuration="\${SYSTEM}" \</code>	←	System
<code>--workload-configuration="\${WORKLOAD}" \</code>	←	Workload
<code>--path="\${RESULT_DIR}/"</code>	←	Result file path

Running ASTRA-sim

45,681 ns (45.681 μ s)

```
all passes finished at time: 45681, id of first layer: allreduce
path to create csvs is: /usr/scratch/will/tutorials/asplos2022/exercise_1/result/
success in opening file
*****
Time to exit: Sun Feb 27 06:46:51 2022
all-reduce Collective implementation: ring
reduce-scatter Collective implementation: ring
all-gather Collective implementation: ring
all-to-all Collective implementation: direct
Collective optimization: localBWAware
Total sim duration: 0:0 hours
Total streams injected: 4
Total streams finished: 4
Percentage of finished streams: 100 %
*****
Exiting
```

Understanding Results

result/tutorial_result.csv

Name	Total Time (us)	Compute Time (us)	Exposed Communication Time (us)	Total Message Size (MB)
Exercise 1	45.681	0	45.681	1.75

45.681 μ s

No compute

All communication exposed

1.75 MB/NPU