MTL/ARL/LNL Platform NPU Benchmarking

Customer Communication

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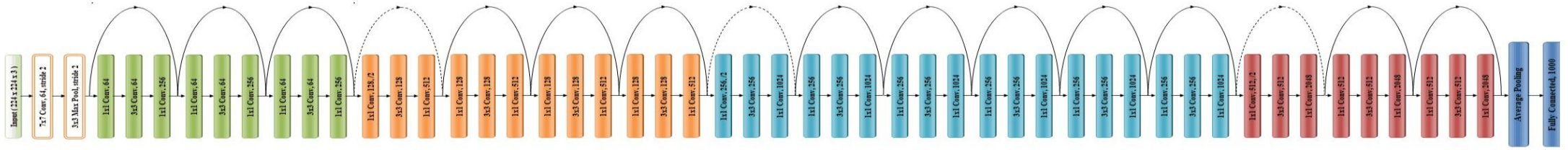
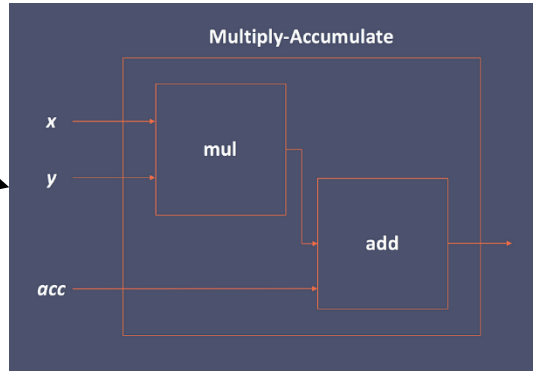
Resnet50 (Meteor Lake)



Input 224x224

Workload
(MACs operations on NPU)



One multiply-accumulate is two operations

Output (frame)

- Operations per frame: constant value per network, for Resnet50 it's 8.216 GOPs

- Peak TOPS (pTOPS) = peak theoretical max performance

  pTOPS = max frequency * (MAC / clock) * 2

  NPU is 11 pTOPS

- Effective TOPS (eTOPS) = real performance on a given AI workload (the efficiency of pTOPS)

  eTOPS = (fps * each frame GOPs)/1000

  *NPU 8.2 eTOPS = (1000 * 8.216) / 1000*

- We use ResNet50: a common network + a good mix of a memory & compute bound network. Is it Perfect? -> No, but it's better than pTOPS as eTOPS shows real workload measured across many HW configs

Run Resnet50 on MTL/ARL NPU

1. Download NPU driver from RDC and install the driver
2. Install one of Python 3.8 - 3.11, open cmd terminal and follow below steps to create virtual environment, ov_24.2 under C:\Users\Public\

```
cd C:\Users\Public\
python -m venv ov_24.2
ov_24.2\Scripts\activate
python -m pip install --upgrade pip
pip install openvino==2024.2.0
```

3. Download Resnet50 model from RDC Kit#823845 (only for test purpose), unzip to C:\Users\Public
   C:\Users\Public\resnet-50-v1_5-sparse50.xml
   C:\Users\Public\resnet-50-v1_5-sparse50.bin
4. Create npu_config.json and add below line to it, and then save it at C:\Users\Public\

```
{"NPU": {"NPU_COMPILER_TYPE": "DRIVER", "NPU_COMPILATION_MODE_PARAMS": "enable-activation-sparsity=true" }}
```

5. Pre-check:

Required Files	File Path
ResNet50 int8 with 50% sparsity (IR model)	C:\Users\Public\resnet-50-v1_5-sparse50.xml C:\Users\Public\resnet-50-v1_5-sparse50.bin
NPU configuration	C:\Users\Public\npu_config.json

Run Resnet50 on MTL/ARL NPU (Cont.)

6. Open cmd terminal and then run below commands to setup environment

```
C:\Users\Public\ov_24.2\Scripts\activate
cd C:\Users\Public\
```

7. Run NPU in Throughput mode

```
benchmark_app -d NPU -m resnet-50-v1_5-sparse50.xml -t 180 -layout [NCHW] -ip f16 -op f16 -hint throughput -load_config npu_config.json
```

8. Run NPU in Latency mode

```
benchmark_app -d NPU -m resnet-50-v1_5-sparse50.xml -t 180 -layout [NCHW] -ip f16 -op f16 -api sync -load_config npu_config.json
```

Result for reference:

- Configuration:
  - MTL-H 28W/ARL-S A2 RVP
  - NPU driver: 32.0.100.2540
  - OpenVINO 2024.2
  - MEMORY size: 16GB
  - Power mode: AC Best Performance
- Performance on NPU:

Execution Mode	MTL-H28	ARL-S
Throughput	8.47	9.17
Latency	6.79	7.46

Unit: eTOPs

One-click Script for Test (MTL/ARL)

- Pre-check:

Required Files	File Path
Python environment	C:\Users\Public\ov_24.2\
ResNet50 int8 with 50% sparsity (IR model)	• C:\Users\Public\resnet-50-v1_5-sparse50.xml • C:\Users\Public\resnet-50-v1_5-sparse50.bin
NPU configuration	C:\Users\Public\npu_config.json

- Create resnet50.bat and add below lines into it, and then save it at C:\Users\Public\

```
call C:\Users\Public\ov_24.2\Scripts\activate
cd C:\Users\Public\
benchmark_app -d NPU -m resnet-50-v1_5-sparse50.xml -t 180 -layout [NCHW] -ip f16 -op f16 -hint throughput -load_config npu_config.json
benchmark_app -d NPU -m resnet-50-v1_5-sparse50.xml -t 180 -layout [NCHW] -ip f16 -op f16 -api sync -load_config npu_config.json

pause
```

Run Resnet50 on LNL NPU

1. Download NPU driver from RDC and install the driver
2. Install one of Python 3.8 - 3.11, open cmd terminal and follow below steps to create virtual environment, ov_24.2 under C:\Users\Public\

```
cd C:\Users\Public\
python -m venv ov_24.2
ov_24.2\Scripts\activate
python -m pip install --upgrade pip
pip install openvino==2024.2.0
```

3. Download Resnet50 model from RDC Kit#823845 (only for test purpose), unzip to C:\Users\Public
   C:\Users\Public\resnet-50-v1_5-sparse50.xml
   C:\Users\Public\resnet-50-v1_5-sparse50.bin
4. Pre-check:

Required Files	File Path
ResNet50 int8 with 50% sparsity (IR model)	C:\Users\Public\resnet-50-v1_5-sparse50.xml C:\Users\Public\resnet-50-v1_5-sparse50.bin

Run Resnet50 on LNL NPU (Cont.)

5. Open cmd terminal and then run below commands to setup environment

```
C:\Users\Public\ov_24.2\Scripts\activate
cd C:\Users\Public\
```

6. Run NPU in Throughput mode

```
benchmark_app -d NPU -m resnet-50-v1_5-sparse50.xml -t 180 -ip f16 -op f16 -hint throughput
```

7. Run NPU in Latency mode

```
benchmark_app -d NPU -m resnet-50-v1_5-sparse50.xml -t 180 -layout [NCHW] -ip f16 -op f16 -api sync
```

Result for reference:

- Configuration:
  - LNL B0 L0MO Ultra 5
  - NPU driver: 32.0.100.2565
  - OpenVINO 2024.2
  - MEMORY size: 16GB
  - Power mode: AC Best Performance
- Performance on LNL NPU:

Execution Mode	NPU
Throughput	19.34
Latency	13.30

Unit: eTOPs

One-click Script for Test (LNL)

- Pre-check:

Required Files	File Path
Python environment	C:\Users\Public\ov_24.2\
ResNet50 int8 with 50% sparsity (IR model)	• C:\Users\Public\resnet-50-v1_5-sparse50.xml • C:\Users\Public\resnet-50-v1_5-sparse50.bin

- Create resnet50.bat and add below lines into it, and then save it at C:\Users\Public\

```
call C:\Users\Public\ov_24.1\Scripts\activate
cd C:\Users\Public\
benchmark_app -d NPU -m resnet-50-v1_5-sparse50.xml -t 180 -ip f16 -op f16 -hint throughput
benchmark_app -d NPU -m resnet-50-v1_5-sparse50.xml -t 180 -layout [NCHW] -ip f16 -op f16 -api sync

pause
```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