

Stable Diffusion XL Turbo UNet FP32 512x512

Shamith Achanta

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1 Assumptions

- The set of operators that have the same output memory size are likely to be fused and computed as a single operator to reduce the number of times the output needs to be read from memory. Hence, the total memory of the blocks in red are not counted in the analysis.
- The on-chip memory on the NPU is a parameter. In this analysis, the on-chip memory is set to 4 MB and data (weights + output) with memory size greater than the on-chip memory will need to be stored in the Last-level cache (if-any) or Main Memory

Figure 1: Optimization 1

Node	Operator	Memory (in Bytes)	Output Size	Inputs Memory (in Bytes)	Weights and Bias Memory (in Bytes)	Output Memory (in Bytes)	Weights and Bias Memory (in MB)	Output Memory (in MB)	Memory (in MB)
/down_blockReshape		2621440	655360	2621472	0	2621440	0	2.62144	2.62144
/down_blockTranspose		2621440	655360	2621440	0	2621440	0	2.62144	2.62144
Constant_0Constant		8	1	0	0	8	0	8.00E-06	8.00E-06
/down_blockUnsqueeze		8	1	8	0	8	0	8.00E-06	8.00E-06
Constant_1Constant		8	1	0	0	8	0	8.00E-06	8.00E-06
/down_blockUnsqueeze		8	1	8	0	8	0	8.00E-06	8.00E-06
Constant_2Constant		8	1	0	0	8	0	8.00E-06	8.00E-06
/down_blockUnsqueeze		8	1	8	0	8	0	8.00E-06	8.00E-06
/down_blockConcat		24	3	24	0	24	0	2.40E-05	2.40E-05
/down_blockReshape		2621440	655360	2621464	0	2621440	0	2.62144	2.62144
/down_blockMatMul		4259840	655360	2621440	1638400	2621440	1.6384	2.62144	4.25984
/down_blockAdd		2624000	655360	2621440	2560	2621440	0.00256	2.62144	2.624
/down_blockDiv		2621440	655360	2621440	0	2621440	0	2.62144	2.62144
/down_blockAdd		2621440	655360	5242880	0	2621440	0	2.62144	2.62144
/down_blockReduceMean		4096	1024	2621440	0	4096	0	0.004096	0.004096
/down_blockSub		2621440	655360	2625536	0	2621440	0	2.62144	2.62144
/down_blockPow		2621440	655360	2621440	0	2621440	0	2.62144	2.62144
/down_blockReduceMean		4096	1024	2621440	0	4096	0	0.004096	0.004096
/down_blockAdd		4096	1024	4096	0	4096	0	0.004096	0.004096
/down_blockSqrt		4096	1024	4096	0	4096	0	0.004096	0.004096
/down_blockDiv		2621440	655360	2625536	0	2621440	0	2.62144	2.62144
/down_blockMul		2624000	655360	2621440	2560	2621440	0.00256	2.62144	2.624
/down_blockAdd		2624000	655360	2621440	2560	2621440	0.00256	2.62144	2.624
/down_blockMatMul		4259840	655360	2621440	1638400	2621440	1.6384	2.62144	4.25984
/down_blockMatMul		5440000	49280	630784	5242880	197120	5.24288	0.19712	5.44
/down_blockMatMul		5440000	49280	630784	5242880	197120	5.24288	0.19712	5.44
/down_blockShape		24	3	2621440	0	24	0	2.40E-05	2.40E-05

2 Operator Memory Distribution

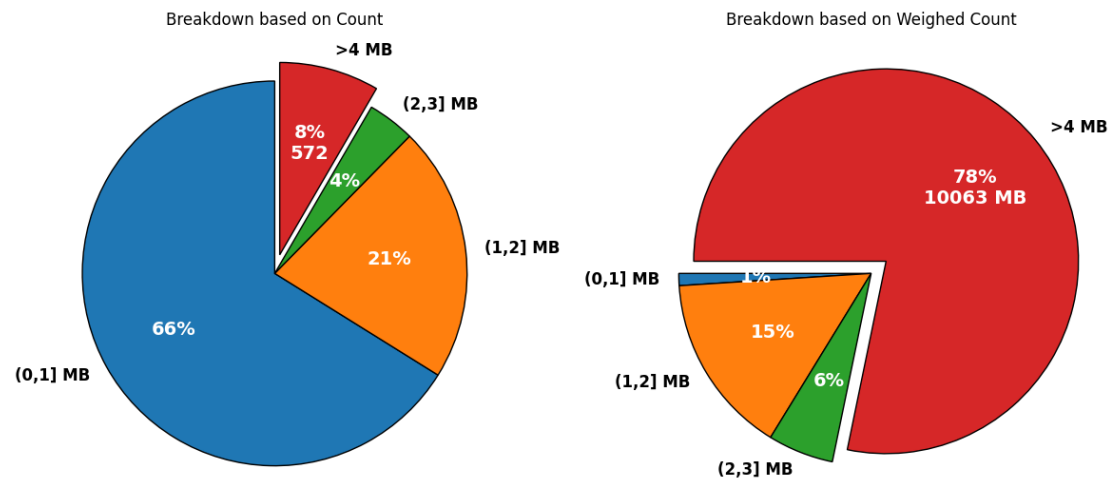
- Output + Weight matrices above on-chip memory size for an operator need to be stored in the Main Memory or last-level cache (if-any)
- Total memory of all operators that have memory size $>$ on-chip memory size is 10 GB

Figure 2: Operator Memory Distribution

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Should Weights + Output of an Operator
be stored in Main Memory or Last-level cache during single inference?

If memory size of the Operator > 4 MB
(on-chip memory) with no NPU cache



3 Memory Requirement of Individual Operators

Operators that have weights + output memory size $>$ on-chip memory size

Figure 3: Memory Requirement of Individual Operators > 4 MB

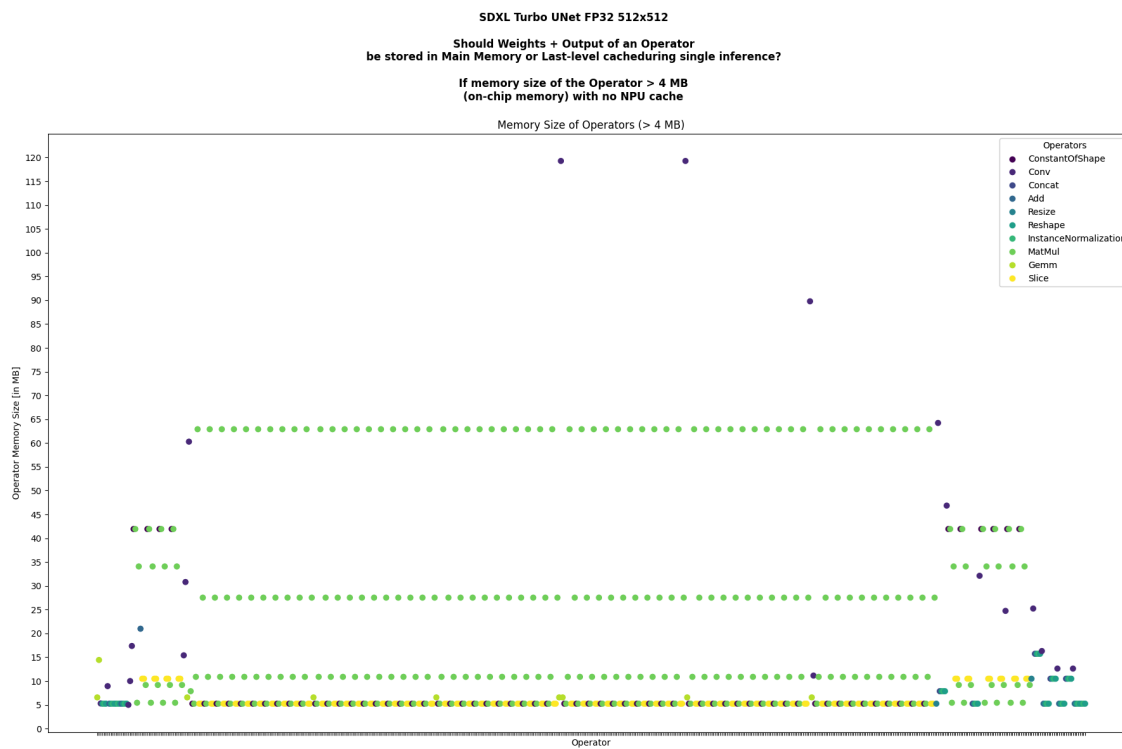


Figure 4: Memory Requirement of Individual Operators > 9 MB

