ECE 528 Homework Assignment 4

Hardware/Software Co-design

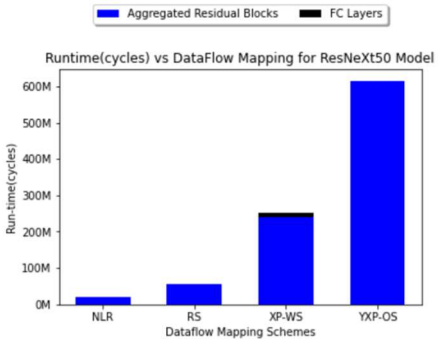
Q1. A) HW accelerator specifications:

Parameters	Units
Processing Elements (PEs)	256
L1 Memory Size	512 kB
L2 Memory Size	32768 kB
NoC Bandwidth	1024 Gbps

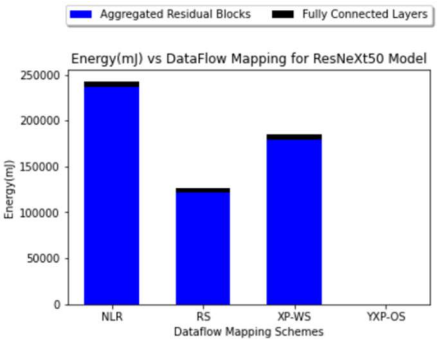
Software Model	Mapping Schemes	Runtime (Cycles)	Energy Consumption (mJ)
ResNeXt50	NLR	1,88,018	57,51,210
	RS	2,56,000	49,33,170
	XP_WS	1,22,88,001	60,14,480
	YXP_OS	0	1689950nJ
VGG_16	NLR	5,89,827	1,14,55,100
	RS	5,25,312	34,08,010
	XP_WS	31,45,729	36,58,330
	YXP_OS	10,48,577	47,92,240

The following four graphs are presented as follows:

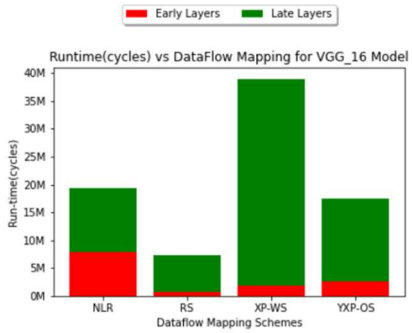
i) Runtime (in cycles) vs Dataflow Mapping Schemes for ResNeXt50 model



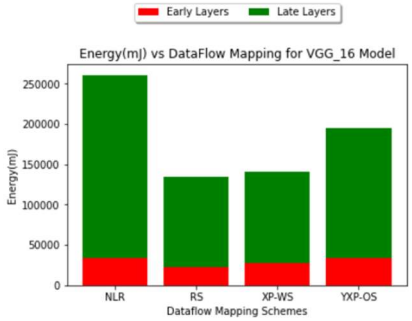
ii) Energy Consumption (in mJ) vs Dataflow Mapping Schemes for ResNeXt50 model



iii) Runtime (in cycles) vs Dataflow Mapping Schemes for VGG_16 model



iv) Energy Consumption (in mJ) vs Dataflow Mapping Schemes for VGG_16 model



Q1. B) From the above graphs, it is clear that NLR mapping scheme is the best among the four for ResNeXt50 model in terms of runtime, whereas RS mapping scheme is the best when considering Energy consumption. For the VGG_16 model, RS mapping scheme is the best when considering both runtime and energy consumption.

Q2. A) and B) HW accelerator specifications:

Parameters	Units
Processing Elements (PEs)	80W/0.15625W = 512
L1 Memory Size	256 kB
L2 Memory Size	2048 kB
NoC Bandwidth	20W/0.048W = 416.667 ≈ 256 Gbps as both PEs and NoC Bandwidth values are constrained to be powers of 2

Software Model	Mapping Schemes	Runtime (Cycles)	Energy Consumption (mJ)
UNet	KCP_WS	3,01,089	3,43,93,200
	NLR	3,01,089	6,32,144
	RS	1,48,994	3,71,79,400
	XP_WS	99,329	9,55,866
	YXP_OS	1,30,819	3,74,54,200
Resnet50	KCP_WS	4,42,419	35,84,010
	NLR	6,86,104	55,21,280

	RS	7,67,501	42,30,080
	XP_WS	1,22,88,001	60,14,480
	YXP_OS	1,43,36,001	51,00,860

From the above tabular, it is clear that XP_WS mapping scheme is the best among the five that achieves a lowest execution time in the UNet model, and KCP_WS mapping scheme is the best for the Resnet50 model.