ECE 611 – Assignment 3 Spring 2017

(1 week assignment, 100 points) Due Date 03/02/2017

Electrical and Computer Engineering
George Mason University

1. Objective

Modeling performance based on observations.

In this assignment, you need to vary the size of several processor units presented in table below. Then, based on your observations (IPCs in different cases), you are supposed to model the processor performance (IPC) using the given parameters (unit sizes).

Param. #	Unit(s)	Name in the shell script	size
1	Fetch width	Core/Fetch/single_limit, Core/Fetch/total_limit	1, 2, 4
	Decode width	Core/Decode/total_limit	
	Commit width	Core/Commit/single_limit Core/Commit/total_limit	
2	Int. Phy. Reg. file	Core/Rename/int_rename_regs	32, 64, 128
	Float Phy. Reg. file	Core/Rename/float_rename_regs	
3	Load and store queue size	Core/loadstore_queue_size	16, 32,48
	Integer queue size	Core/Queue/int_queue_size	
	floating point queue size	Core/Queue/float_queue_size	

As shown in the table, there are 3 sets of units. The design space includes 3x3x3 = 27 cases each for each benchmark. You need to run the simulation for all 6 provided benchmarks (applu, apsi, bwave, bazip, catus and crafty). Fetch, decode and commit widths should vary together and at the same time. The same case is applied to register files, and load/integer/float Qs.

In order to model the performance using the micro-architectural parameters, you need to use the linier regression model. You can use Microsoft Excel, MATLAB and R programming language to build your model. Your regression model (for every benchmark) is similar to the equation below:

$$IPC = \beta_0 + \beta_1 W + \beta_2 R + \beta_3 Q$$

Where β_0 is the y-intercept and β_1 to β_3 are the coefficient. You are supposed to find β_0 to β_3 for every benchmark.

You can learn about regression model at the link and the paper below:

Joseph, P. J., KapilVaswani, and Matthew J. Thazhuthaveetil. "Construction and use of linear regression models for processor performance analysis." *HighPerformance Computer Architecture, 2006.The Twelfth International Symposium on*.IEEE, 2006.

1- http://en.wikipedia.org/wiki/Linear_regression

Make sure that the units' sizes below are set fixed for all your simulations

Unit(s)	**Name in the shell script**	**size**
Issue width	Core/Queue/max_int_issue, Core/Queue/max_float_issue, Core/Queue/max_ldst_issue,	2
ROB size	Thread/reorder_buffer_size	48
L1 Dcache (size & associativity)	(Core/DCache/size_kb, Core/DCache/assoc)	(16,4)
L1 Icache (size & associativity)	(Core/ICache/size_kb, Core/ICache/assoc)	
L2 cache size	Global/Mem/L2Cache/size_kb 512	256

2- **Instruction**

1. **Shell generation using the python**. For each configuration and per benchmark you need to create a shell file
2. **Running the shells**. Run the generated shells.
3. **Extracting IPCs from the output files**. Since there are a large number of output files (results), it is recommended to use a python or etc. programming language to extract the data.

4. Build a regression model relating the IPC and the presented parameters in the first table for each benchmark.
5. Calculate the IPC for each benchmark using the build model.

List of Deliverables:

Please include the followings in your report:

1- Regression models (equation) for all the benchmarks.

2- Tables showing Coefficients for each parameter for every benchmarks. (total 6 tables)

3- IPC graphs

   a. Draw the IPC graph for each benchmark, comparing the real IPC (the ones you obtain from the simulation) and the IPC calculated using your regression model. (total 6 graphs)

4- A table showing the sum of squared differences (between the real the real and modeled IPC) for every benchmarks.

5- Discussion on which and what each unit contributes in your prediction model. (Think about the sign and the magnitude of each coefficient) 6- All Simulation output files.

Please report the items above for every benchmark separately.

Once completed, submit a ZIPPED file with the following syntax assignmentnumber_first_last.zip where first_last is your first and last name. For instance, file should be named like this → assignment1_Bhoopal_Gunna.zip.

Submit the zipped file through the blackboard. Please submit a pdf copy of your report.

WARNING: Points will be taken off if you do not follow the above instructions