# EECE 7352: Computer Architecture
# HW1: Due at 9:50am Tuesday, Feb 1, 2022

*Goals of these homework assignments are to help you: (1) practice knowledge gained during the lectures, (2) learn new technical material (esp. experimental learning), (3) apply course concepts and principles to new problems, (4) develop additional skills in expressing yourself in writing and orally, (5) analyze and evaluate ideas, arguments, and points of view.*

## Question 1. (30 points)

Please read this paper: [ASPLOS 2009] Producing Wrong Data Without Doing Anything Obviously Wrong!
https://www2.ccs.neu.edu/racket/Performance/mytkowicz.pdf

A. List five major findings.

B. Try to reproduce at least two major findings using your choice of benchmarks or applications, preferably on COE machine. You can use NAS benchmarks for this purpose (class A or W):
https://www.nas.nasa.gov/software/npb.html
One of the findings that you should try to reproduce is "effect of linking order on measurement bias".

C. Discuss at least one solution for detecting and avoiding measurement bias. Report your experimental results to show that you are able to reduce the measurement bias using a mitigation strategy discussed in the paper. It may not be always possible to achieve the desired effect, but please show your effort in detail and discuss the possible reasons for the results/trend you obtain.

## Question 2. (10 points)

Please read this paper: [ASPLOS 2013] Why You Should Care About Quantile Regression
https://storage.googleapis.com/pub-tools-public-publication-data/pdf/41873.pdf

Why quantile regression is more appropriate than ANOVA? Can you provide experimental evidence to support this?

## Question 2. (10 points)

Please read this paper: [IEEE Micro 2006] IPC Considered Harmful for Multiprocessor Workloads
https://pages.cs.wisc.edu/~alaa/papers/ieeemicro06_ipc.pdf

Why is IPC considered harmful for multiprocessor workloads? What are the potential solution? What do the authors mean by "work-related" metrics?

## Question 4. (10 points)

A hypothetical program has three types of instructions: ADD, MULT, and OTHER. 40% of the total executed instructions are of type ADD, 20% of the total executed instructions are of type MULT, rest are of type OTHER. A single ADD instruction takes 2 cycles to execute, a single MULT instruction takes 6 cycles to execute, and a single OTHER instruction takes 8 cycles to execute.

You have two optimization techniques. First optimization technique reduces the number of cycles taken to execute an ADD instruction to a single cycle. Second optimization technique reduces the number of cycles taken to execute an MULT instruction to 4 cycles.

Which optimization technique will you choose? Please show what is the maximum speed up that can be achieved by both optimizations individually.

## **Question 5. (10 points)**

Modified version of sQ1.15 (a)-(b) from H&P textbook.

Assume that we make an enhancement to a computer that improves some mode of execution by a factor of 8 (eight). Enhanced mode is used 60% of the time, measured as a percentage of the execution time when the enhanced mode is in use. Recall that Amdahl's law depends on the fraction of the original, unenhanced execution time that could make use of enhanced mode. Thus, we cannot directly use this 60% measurement to compute speedup with Amdahl's law.

a. What is the speedup we have obtained from fast mode?

b. What percentage of the original execution was converted to fast mode?