

## CSCI-GA.3033-017 Special Topic: Multicore Programming

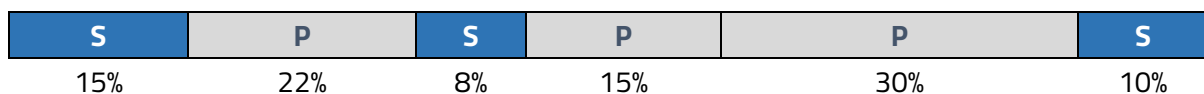
### Homework 1

**Due October 1, 2018**

Please solve the following and upload your solutions to your private GitHub repository for the class as homework1.pdf by 11:59pm on the due date above. If for some reason this poses a technical problem, or you wish to include diagrams that you don't wish to spend time drawing in a drawing application, you may hand in a printed copy (*not* hand-written) at the beginning of class (7:10pm) on the day of the deadline. **Unlike labs, late homeworks will be assigned a grade of 0.**

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1. Warmup: Why do we use caches? Please relate this to the von Neumann bottleneck.
2. Apply Amdahl's law to compute the speedup for the following program if you have (a) 1, (b) 2, (c) 4, (d) 8, (e) 12, (f) 16, and (g)  $\infty$  CPUs. In the following diagram, **S** portions are sequential and **P** are parallelizable.



3. Explain the difference between concurrency and parallelism with an example: if an operating system is executing three long-running programs, how would its scheduler execute the programs concurrently on one core, concurrently on three cores, or in parallel on three cores? Comment on running the programs in parallel on one core.
4. If we can have fast caches on the same die as a CPU core, why bother having main memory at all? Why not just have bigger caches? (There are multiple right answers here; see if you can think of one or more reasons, and explain each one. Guessing one correct answer and several wrong ones is worse than a single correct answer.)
5. Relatedly, what's the point of cache? Does its purpose differ between single- and multi-core processors (if so, how)? Does its implementation differ between single- and multi-core processors (if so, how and why)?
6. You are implementing a server that sends responses to requests, and requires very small amounts of computation to handle each request. Your application requires many clients and many servers to work together. Which of the programming models discussed in class are you likely to use to model this application, and why?