1. Concurrency is more than two tasks being processed in the same time frame. So 1) if three long-running programs are executed on a single core machine concurrently, executions of each of the three programs are interleaved between one another and the run time will be equal to the sum of time each program is executed. 2) Running these programs concurrently on three cores not in parallel doesn't make use of the multiple cores. It might work parallel because concurrency is a broader term. If the programmer makes use of multiple cores to execute them truly simultaneously 3) the total run time will be the maximum run time of each of these three programs. Finally, 4) Parallelism is not possible on a single core. 2

2. I would apply the logP model. The PRAM and BSP models are geared towards computation heavy algorithms. For server requests that require very small amounts of computation, each request can be handled per core or even multiple requests per core since every request is independent of each other.

3. S: 27% P: 63%

   A. P= 1 Speedup = 1/ 0.27 + 0.63 = 1 → No speedup

   B. P= 2 Speedup = 1/ (0.27 + (0.63 / 2)) = 1.71

   C. P= 4 Speedup = 1/ (0.27 + (0.63 / 4)) = 2.34

   D. P= 8 Speedup = 1/ (0.27 + (0.63 / 8)) = 2.87

   E. P= 12 Speedup = 1/ (0.27 + (0.63 / 12)) = 3.10

   F. P= 16 Speedup = 1/ (0.27 + (0.63 / 16)) = 3.23

   G. P= ∞ Speedup = 1/ (0.27 + (0.63 / ∞)) = 3.70

4. Pipeline hazards are situations where the next instruction in the instruction stream are not able to execute with in its designated clock cycle. Common types of pipeline hazards are data hazards, structural hazards and control hazards. It reduces the instructions per cycle because in order to compensate for these hazards 'bubbles' are inserted which are basically empty instructions.

5. Object – List of lists containing function name, return type, number of arguments, and data types of parameters. List of fields and a list of return types of those fields. Also a list of visibility for these functions and fields.

   Class inherits Object – visibility defaults to private

   Struct inherits Object – visibility defaults to public