

# Concurrency & Parallelism

## Sample Test

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1. **C** -
  2. **C** - Partitioning is part of the process of parallelization of an algorithm. In this case, task partitioning.
  3. **B** -
  4. **C** - MapReduce operates on arbitrary kinds of elements, it is up to the programmer.
  5. **D** - Also called the master/slave pattern, farm works over streams since the tasks are distributed by the master.
  6. **C** - Map works over collections, the only statement which does the same is C.
  7. **B** - In line 4 the statement combines two elements using `f`, thus we have a reduce pattern.
  8. **B** - From the IBM documentation<sup>1</sup> we have: *The omp single directive identifies a section of code that must be run by a single available thread.*
  9. **B** - From the moment the stack is popped local variables (not allocated on the heap) become invalid.
  10. **A** - Monte Carlo methods, are a broad class of computational algorithms that rely on repeated random sampling to obtain numerical results.<sup>2</sup>
  11. **D** - RAW, WAR and WAW affect the correctness of the program given the program is only correct if the dependency relationship is uphold.
  12. **D** - If we run some iterations of the loop we see `a[1][0] = a[0][1]`, `a[1][2] = a[0][3]`, `a[2][0] = a[1][1]`, `a[2][2] = a[1][3]`. Thus there are no dependencies between loop iterations.
  13. **A** - If we assume the whole program takes  $T$  time to run we have:
$$0.5T + 0.5\frac{T}{100} = 0.505T$$
$$0.1T + 0.9\frac{T}{3} = 0.4T$$
$$0.4T + 0.6\frac{T}{50} = 0.412T$$
$$0.3T + 0.7\frac{T}{30} = 0.323T$$
  14. **A** -
  15. **D** - The span is defined as the critical-path length, that is, the minimum of steps the algorithm must execute.
  16. **D** - See Question 15.
  17. **B** - A thread cannot acquire a lock if it is not free, thus the holder thread must first release it, synchronizing both events.
  18. **D** - When the queue is empty  $n = 0$  and thus the implication does not apply.
  19. **D** - We cannot make guarantees about  $T(op)$  based on  $T_e(op)$ .
  20. **D** - The implementation does not ensure progress since the processes can be synchronized and do the following:
    - (a) Put their flag up.
    - (b) See the other flag as up.
    - (c) Put their flag down.
    - (d) Since their flag is not up this process repeats *ad eternum*.
  21. **C** - The lock-freedom condition states that when the program threads are run sufficiently long, at least one makes progress.
  22. **A** - Iterate the list until we arrive at the possible candidate.
  23. **B** - We validate the previous and current nodes to check for deletions and "chain" correctness, that is `pred.next == curr`.
  24. **A** - We see if the key exists, if it does we check if it is not marked for deletion.
  25. **B** - The *LockSet* is initialized to the universal set.
  26. **?** -
- And so we can conclude that having 70% of the code run 30 times faster is the better choice.

<sup>1</sup><https://tinyurl.com/y7qszwxh>

<sup>2</sup>[https://en.wikipedia.org/wiki/Monte\\_Carlo\\_method](https://en.wikipedia.org/wiki/Monte_Carlo_method)

27. **A** - When a new process enters a system, it must declare the maximum number of instances of each resource type that it may ever claim; clearly, that number may not exceed the total number of resources in the systems.<sup>3</sup>
28. **C** - See the labs.

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<sup>3</sup>[https://en.wikipedia.org/wiki/Banker's\\_algorithm](https://en.wikipedia.org/wiki/Banker's_algorithm)