**PDC Midterm Project Report**

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**Part 1: Performance Comparison**

| **Approach** | **Description** | **Time (s)** | **Speedup** |
| --- | --- | --- | --- |
| Sequential | Single process, one image at a time | **18.24** | 1.00× |
| Parallel (2 workers) | 2 CPU processes | **9.45** | 1.93× |
| Parallel (4 workers) | 4 CPU processes | **6.12** | 2.98× |
| Parallel (8 workers) | 8 CPU processes | **4.88** | 3.73× |
| Distributed (2 nodes × Pool workers) | 2 simulated machines (each uses CPU pool) | **6.10** | 2.99× |

**Part 2: Best number of workers**

The best performance was achieved with 8 workers in the parallel setup.  
Beyond this, adding more processes does not improve performance significantly because:

* CPU cores become saturated as context-switching overhead increases.
* Disk I/O such as image reading/writing becomes the limiting factor.

**Part 3: “How parallelism improved performance and what bottlenecks still exist.”**

Parallelism **significantly improved performance** by distributing image processing tasks across multiple CPU cores reducing overall execution time as compared to sequential version.

 Reading and writing image files is relatively slow and shared among workers.

 Each process loads the Pillow library and images independently.