The Challenges of Irregular Parallelism

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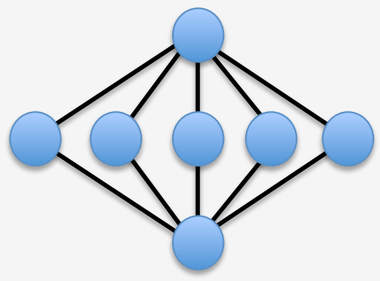
Regular

Example problems

- Matrix multiplication
- Ray tracing
- Web servers



*Problems where it is **easy** to find independent sub-tasks*

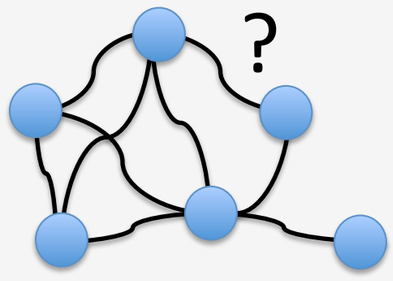
Tools and techniques

- Processes, threads, actors
- Futures, sparks, fork-join
- Parallel arrays
- **Dataflow**

Irregular

Example problems

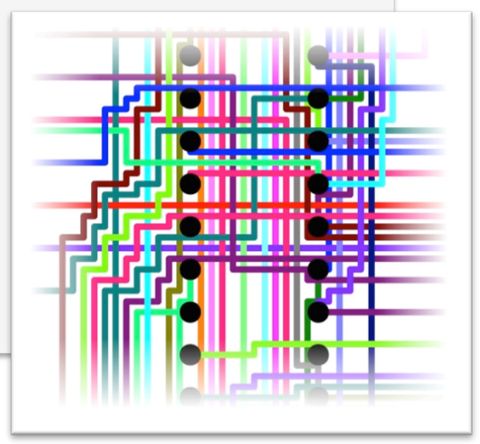
- Airline seat booking
- Web and social graphs
- Circuit routing



*Problems where it is **hard** to find independent sub-tasks*

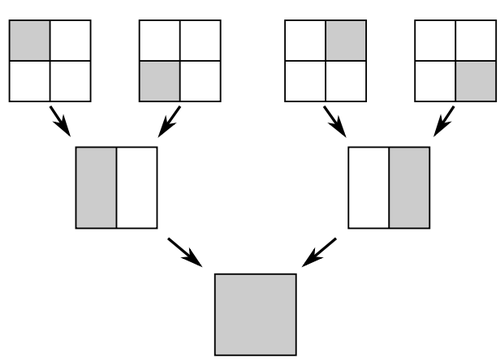
Tools and techniques

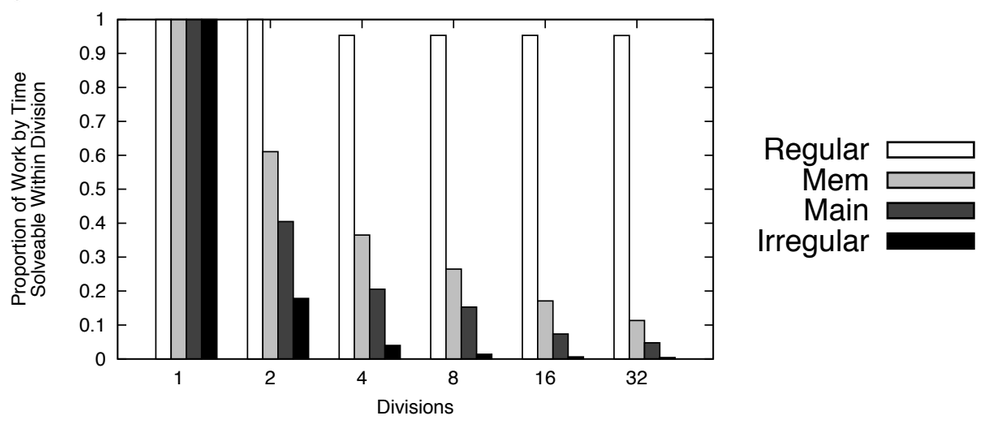
- Heuristics, over-estimation
- Graph colouring
- Optimistic execution
- **Transactional memory**



Why don't the regular techniques work?

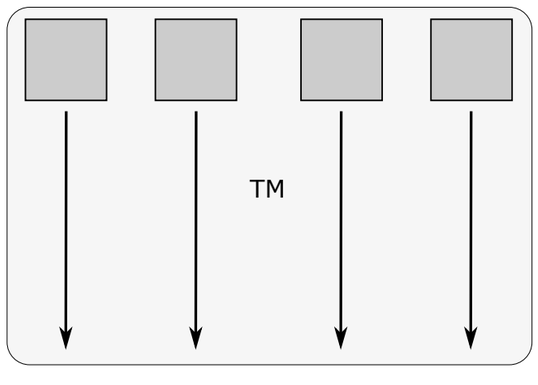
*They rely on knowing which tasks are independent of each other **before** you start the task*





Why aren't the irregular techniques enough on their own?

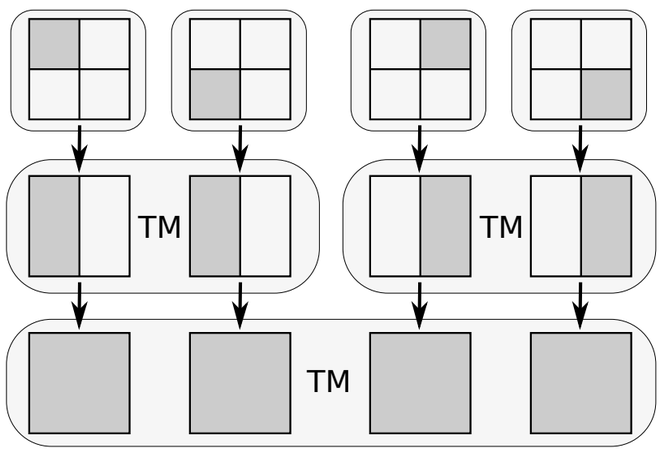
The regular techniques gave us important benefits that we lost with the irregular ones



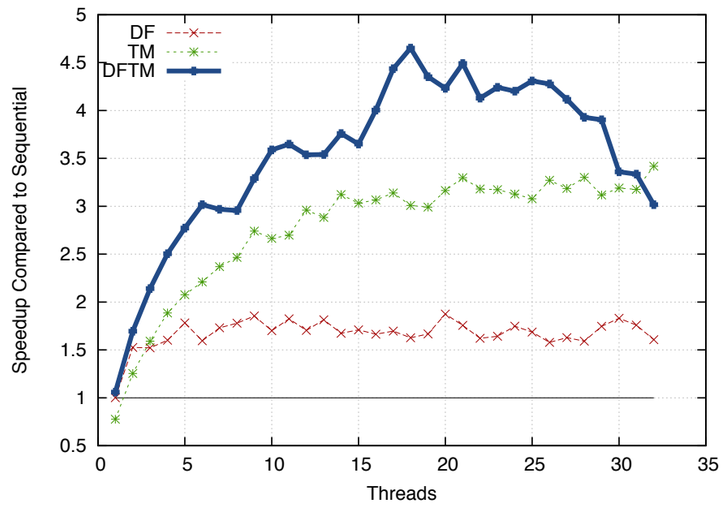
- We're doing 'optimistic' execution – but do we need to blindly hope for the best?
- Lost temporal and spatial locality
- Lost efficient use of cache
- We need to consider NUMA and distributed architectures

Trying a Combined Approach

Use a regular technique, and solve just the irregular parts using an irregular technique



Dataflow
+
Transactional memory



- D. Goodman, S. Khan, C. Seaton, Y. Guskov, B. Khan, M. Luján, and I. Watson. **DFScala: High level dataflow support for Scala**. In Proceedings of the 2nd International Workshop on Data-Flow Models For Extreme Scale Computing (DFM), 2012.
- C. Seaton, D. Goodman, M. Luján, and I. Watson. **Applying dataflow and transactions to Lee routing**. In Proceedings of the 7th Workshop on Programmability Issues for Heterogeneous Multicores (MULTIPROG), 2012.