

Overview of Parallel Programming Concepts

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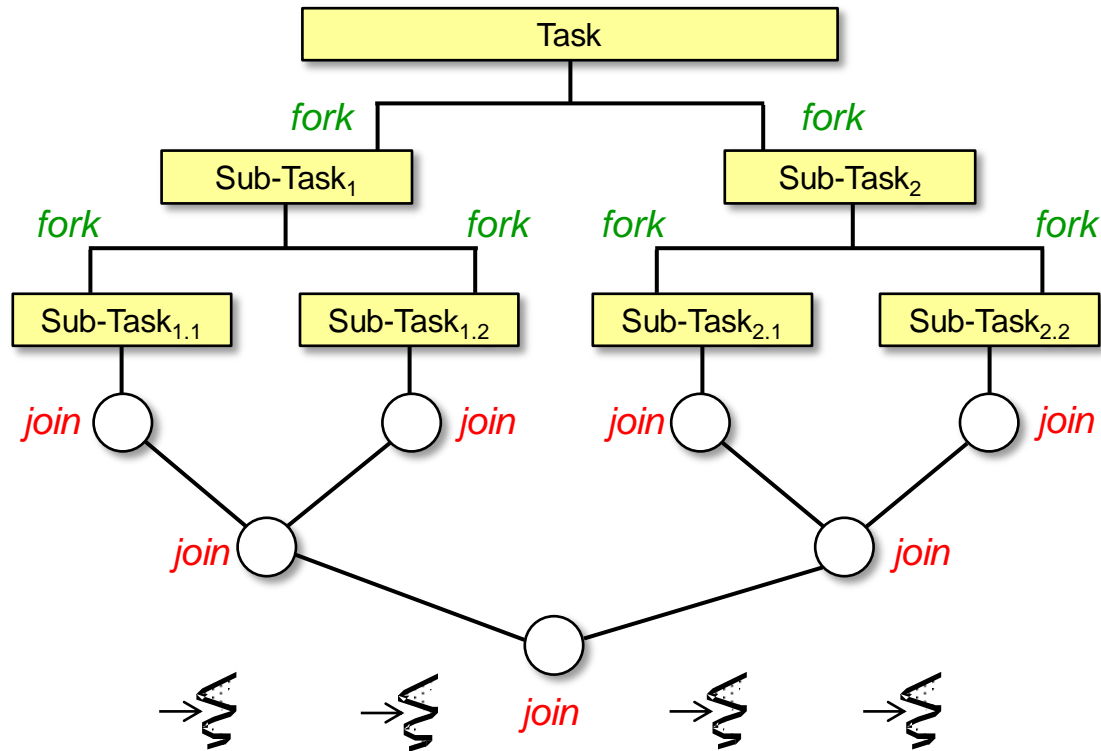
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Learning Objectives in this Part of the Lesson

- Understand the meaning of key parallel programming concepts



See en.wikipedia.org/wiki/Parallel_computing

Learning Objectives in this Part of the Lesson

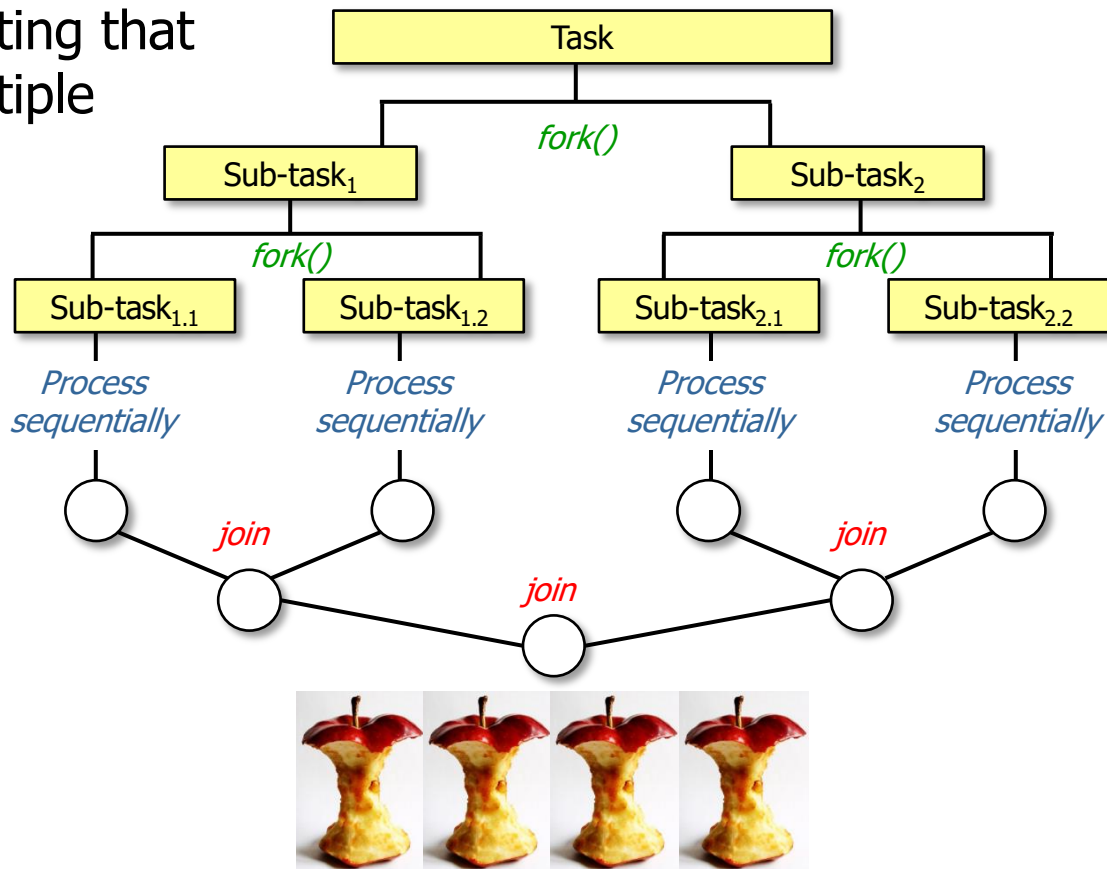
- Understand the meaning of key parallel programming concepts
- Know when to apply parallelism



An Overview of Parallel Programming

An Overview of Parallel Programming

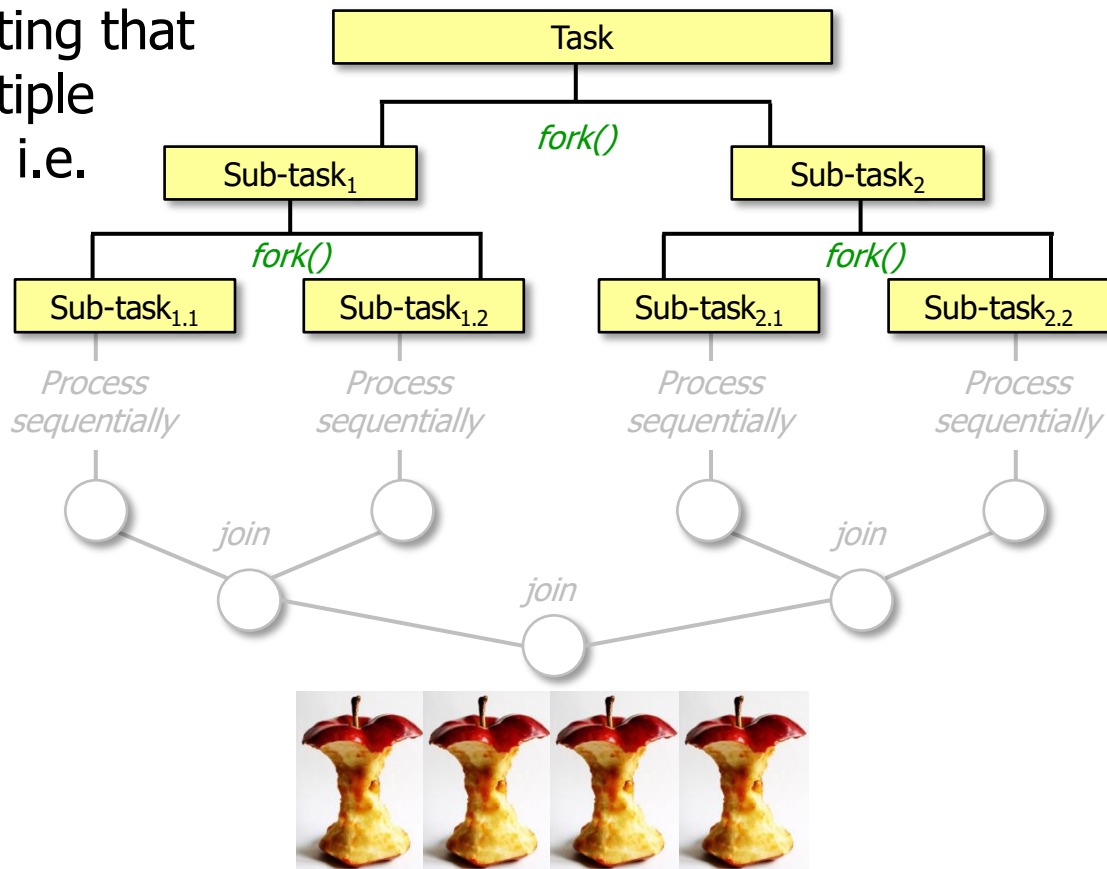
- Parallelism is a form of computing that performs several steps on multiple processors or processor cores



See www.jstatsoft.org/article/view/v040i01/v40i01.pdf

An Overview of Parallel Programming

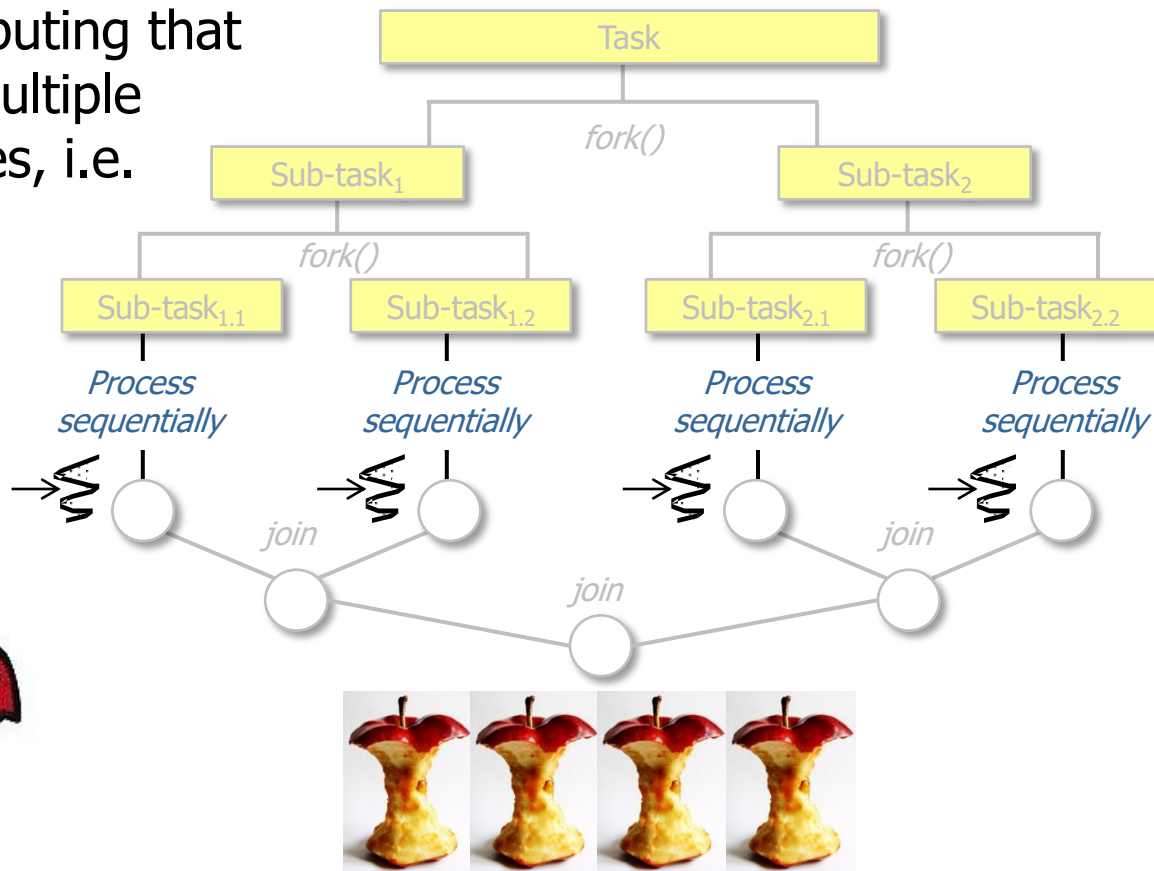
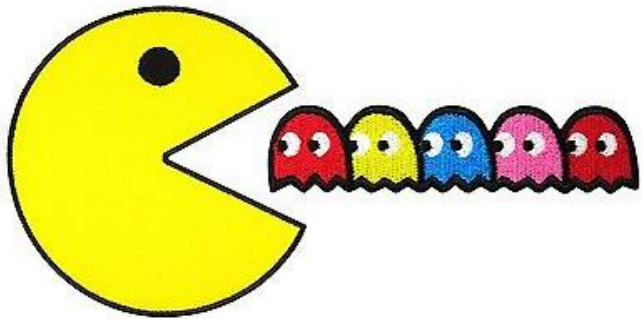
- Parallelism is a form of computing that performs several steps on multiple processors or processor cores, i.e.
 - Split – partition a task into sub-tasks



Ideally sub-tasks are split efficiently & evenly

An Overview of Parallel Programming

- Parallelism is a form of computing that performs several steps on multiple processors or processor cores, i.e.
 - Split – partition a task into sub-tasks
 - Apply – Run independent sub-tasks in parallel

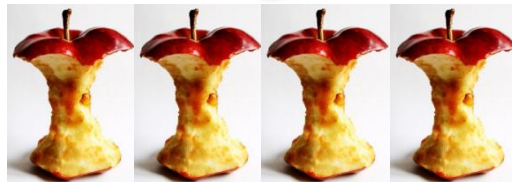
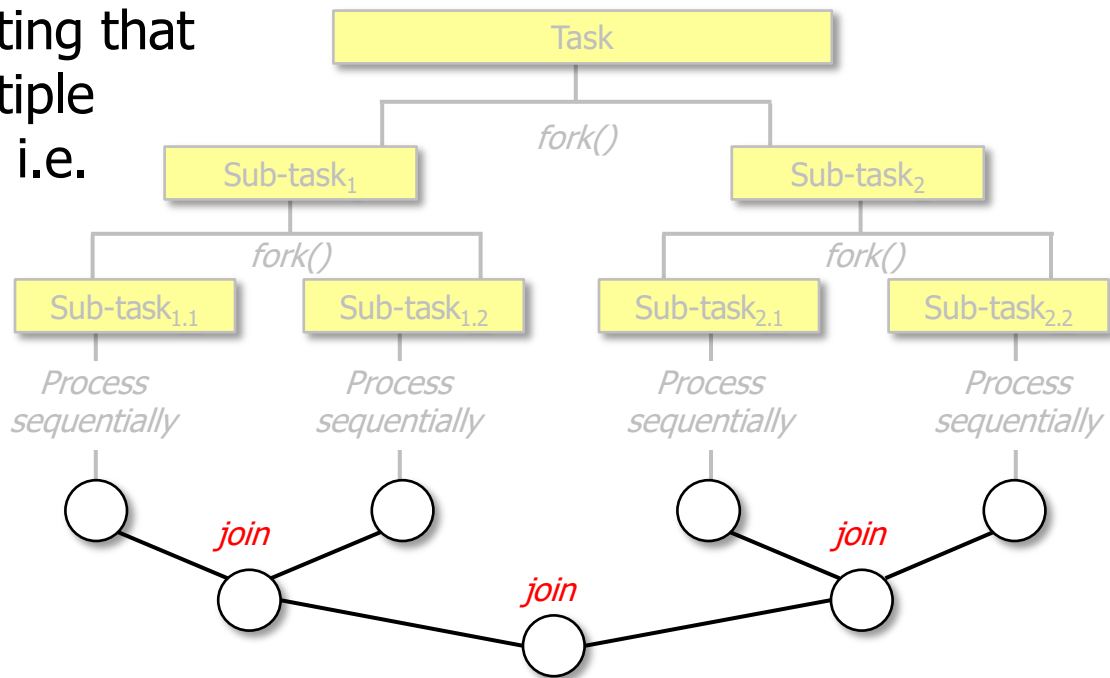


Each sub-task runs sequentially, but together they run in parallel

An Overview of Parallel Programming

- Parallelism is a form of computing that performs several steps on multiple processors or processor cores, i.e.

- Split – partition a task into sub-tasks
- Apply – Run independent sub-tasks in parallel
- Combine – Merge the sub-results from sub-tasks into a single “reduced” result



An Overview of Parallel Programming

- A key goal of parallelism is to *efficiently* partition tasks into sub-tasks & combine results



An Overview of Parallel Programming

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- Parallelism can thus be viewed as an optimization to improve performance



See developer.ibm.com/articles/j-java-streams-4-brian-goetz

An Overview of Parallel Programming

- A key goal of parallelism is to *efficiently* partition tasks into sub-tasks & combine results
- Parallelism can thus be viewed as an optimization to improve performance
 - e.g., throughput, scalability, & latency



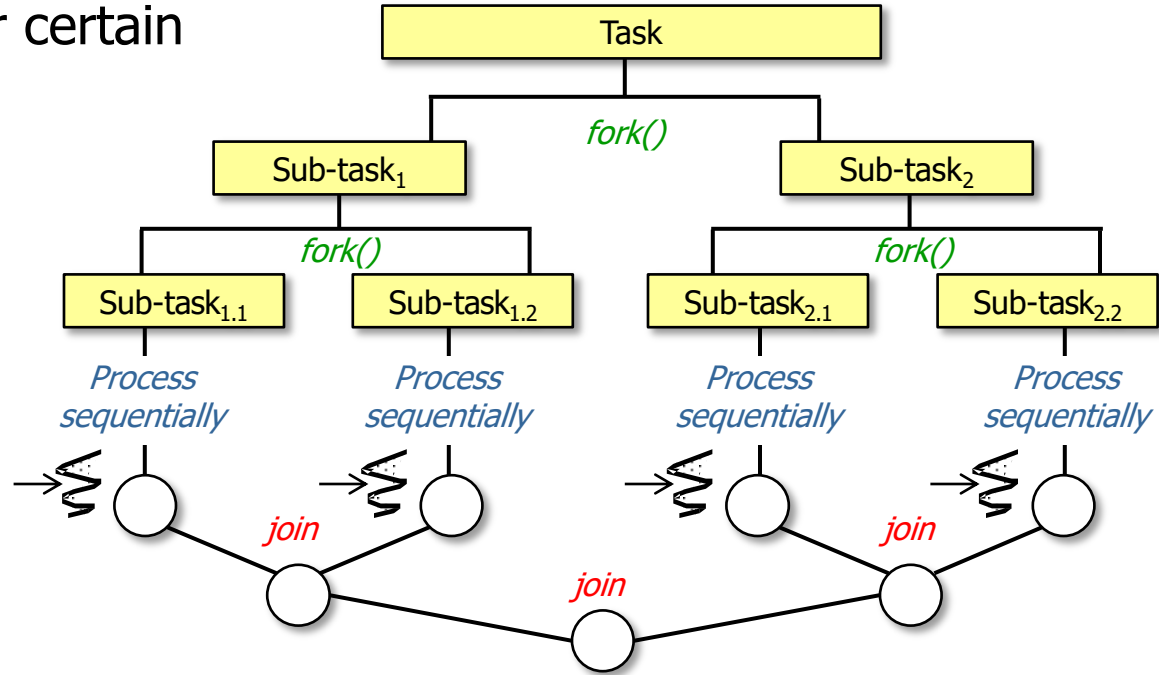
See en.wikipedia.org/wiki/Up_to_eleven

When to Apply Parallelism

When to Apply Parallelism

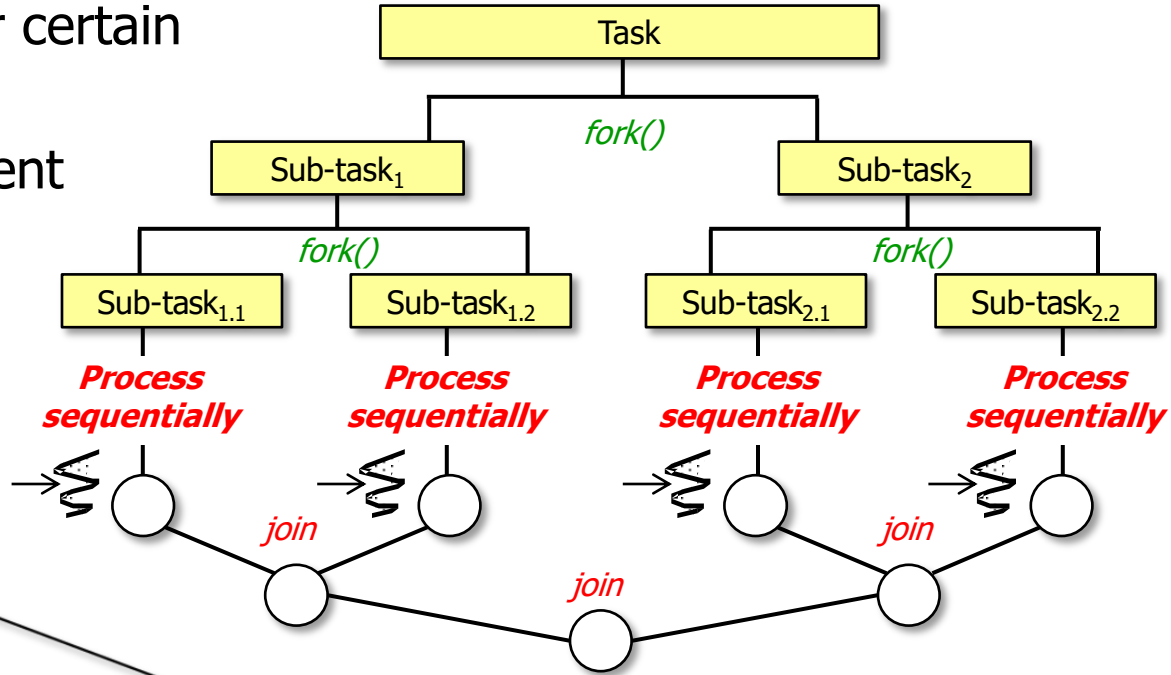
- Parallelism works best under certain conditions

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When to Apply Parallelism

- Parallelism works best under certain conditions, e.g.
 - When tasks are independent



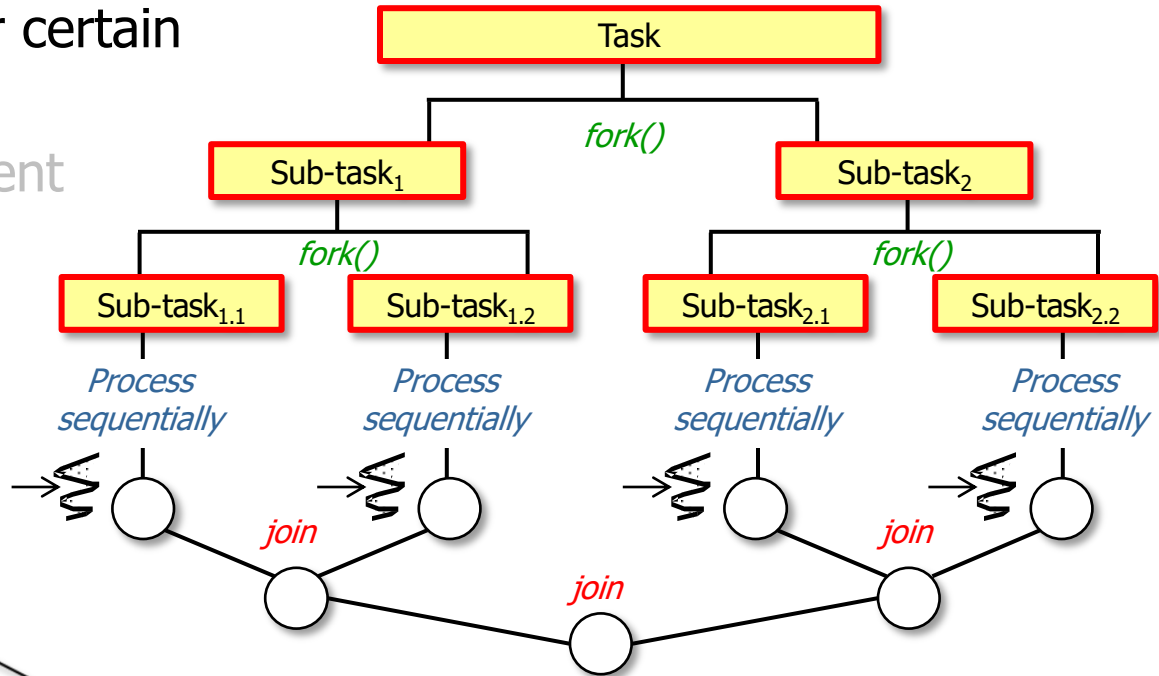
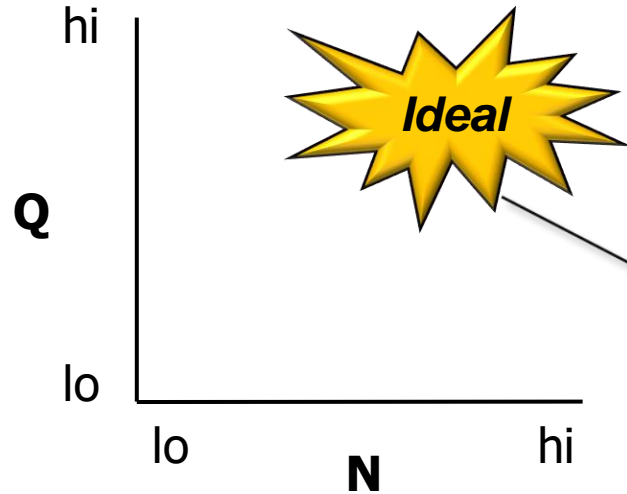
"Embarrassingly parallel" tasks have little/no dependency or need for communication between tasks or for sharing results between them

See en.wikipedia.org/wiki/Embarrassingly_parallel

When to Apply Parallelism

- Parallelism works best under certain conditions, e.g.

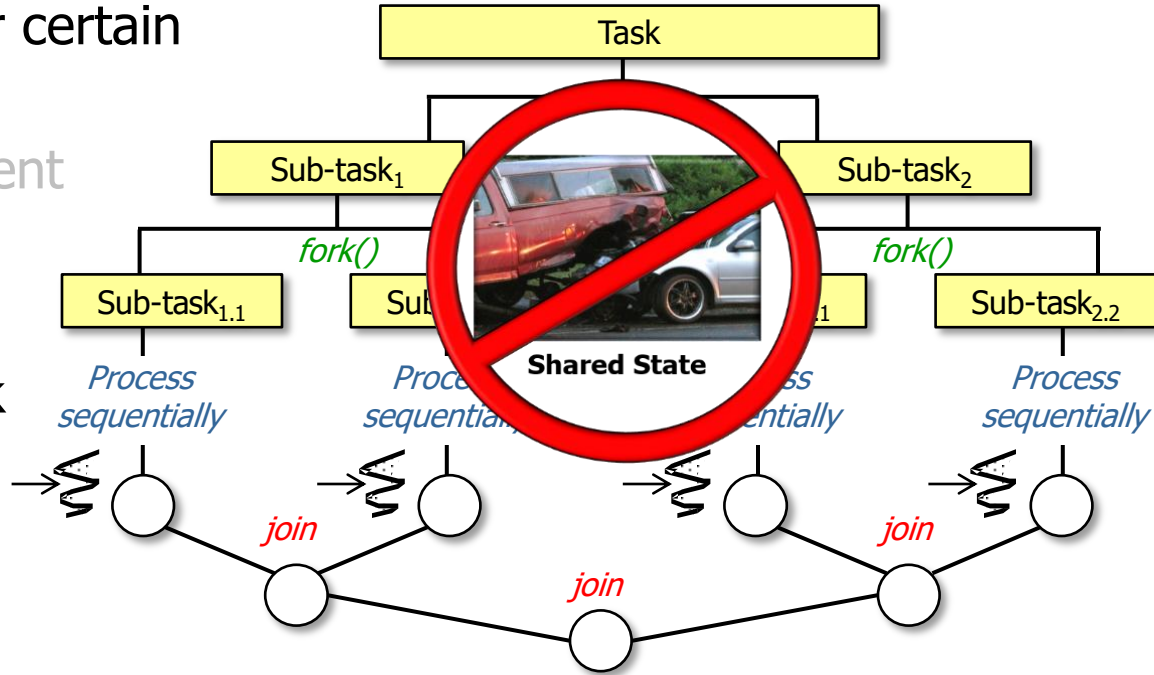
- When tasks are independent
- When there's lots of data & processing to perform



- N is the # of data elements to process per thread
- Q quantifies how CPU-intensive the processing is

When to Apply Parallelism

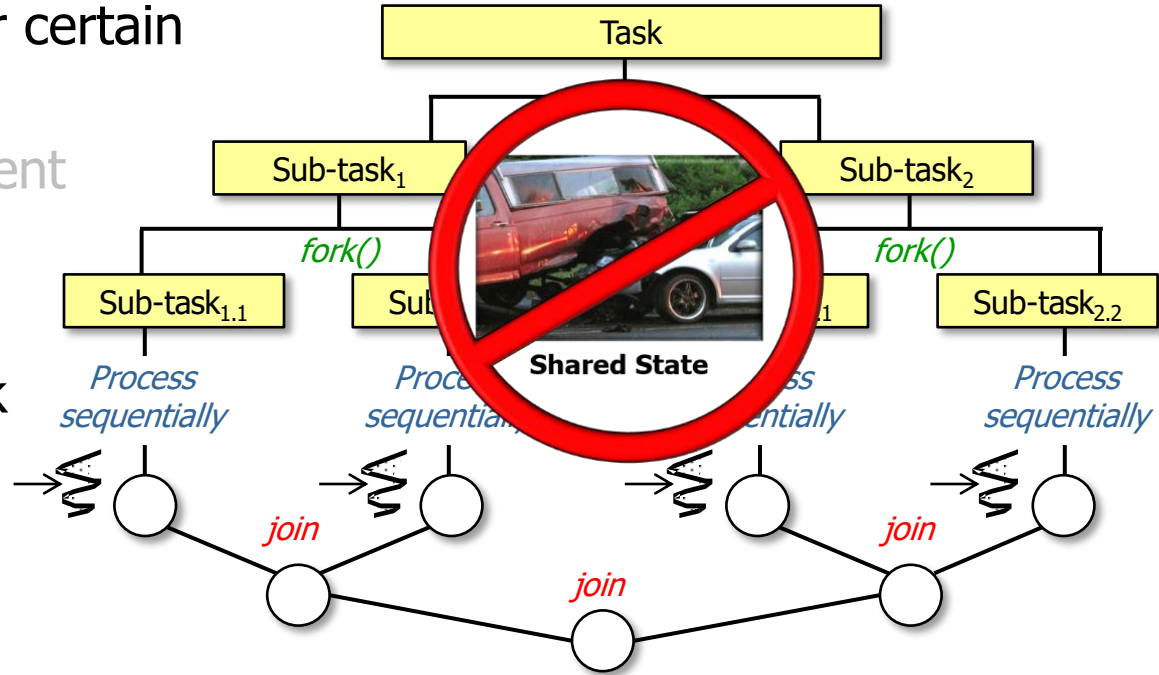
- Parallelism works best under certain conditions, e.g.
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 - When there's lots of data & processing to perform
 - When threads neither block nor share mutable state



When to Apply Parallelism

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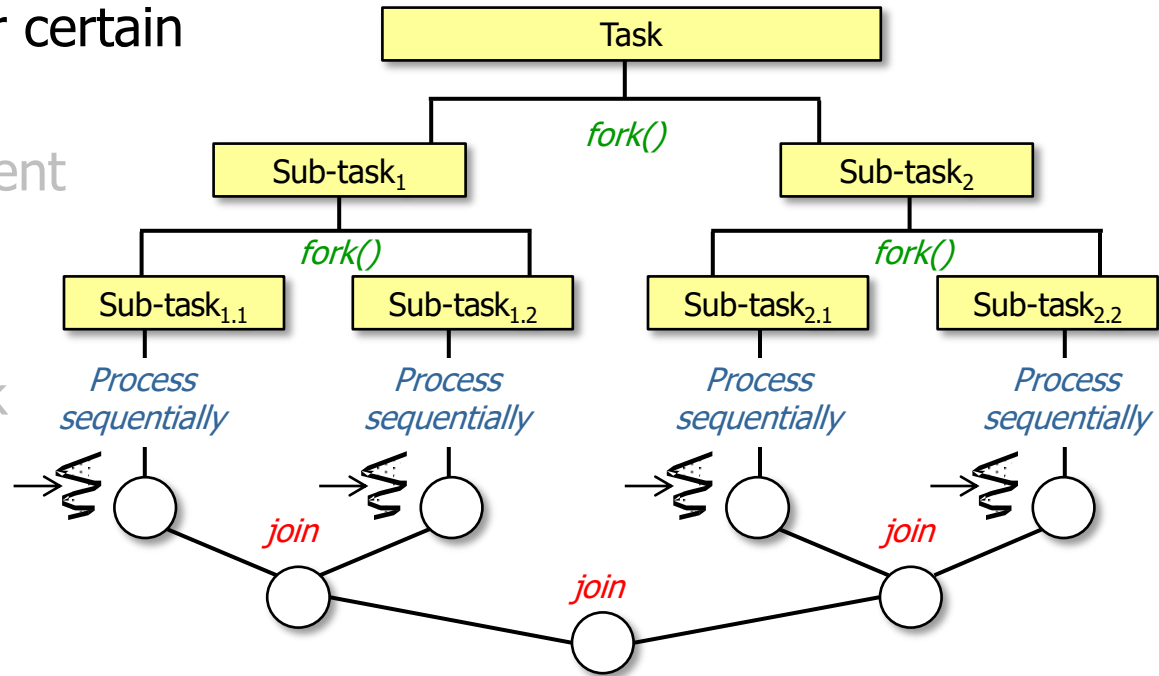
- When tasks are independent
- When there's lots of data & processing to perform
- When threads neither block nor share mutable state
 - Hence Java's "fork-join" & "work-stealing" foci



When to Apply Parallelism

- Parallelism works best under certain conditions, e.g.

- When tasks are independent
- When there's lots of data & processing to perform
- When threads neither block nor share mutable state
- When there are many cores and/or processors



End of Overview of Parallel Programming Concepts