Concurrency is **NOT** Parallelism

by Vonnie Wu
Overview

- Definitions
- Distinction between both concepts
- Process vs. Thread vs. Coroutine
- Litmus Test
Phone Upgrade?

Both Phones Can:
- Receive texts while calling.
- Can play music while texting.
- Can use apps and still receive calls.
- Both can multitask to a certain extent.
- Can we say that both phones are running processes in parallel?
Definitions

- There is an inherent, yet subtle, difference between concurrency and parallelism.

- **Concurrency** is the act of running and managing multiple computations at the same time.

- **Parallelism** is the act of running multiple computations simultaneously.
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Not all Concurrency is Parallelism, but all Parallelism is Concurrency.
Difference in execution

*Assuming single processor for concurrent system and multiple processors for parallel system.
Question?

So if it’s this simple, why do people get confused?
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Process vs. Thread vs. Coroutine

**Process**: can be thought of as a program running in your OS.

**Thread**: can be thought of as a small sub-process that belongs to a process.

**Coroutine**: can be thought of as a small thread, that gets multiplexed onto a thread.
Process vs. Thread vs. Coroutine

OS

Process

Thread

Thread

Thread

Thread

Coroutines
Process

OS

Process A

Process B

Process C
Thread

Threads are created here

OS

Process A

Thread B.1

Process B

Thread B.2

Process C
Coroutine

OS

Process A
Thread B.1
Process B
Thread B.2
Process C
Thread C.1
Coroutine C.1.1-5
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So how can we tell if our programs run concurrently or in parallel?*

*Assuming that threads or coroutines are used in the program.
If we have a single processor, ALL of our programs will run concurrently.
Litmus Test: Multiple Processors

If we have multiple processors, our programs may run in parallel.
Back to my example

Both Phones Can:

- Can we say that both phones are running processes in parallel?
- NO. My old Pantech phone had only a single processor so its processes ran concurrently.
- My new Nokia phone has 4 processors, its processes may run in parallel.
Any questions?

Thank you for your time!