

## Problem 2: Cold Drink Manufacturing

### Importance of concurrent programming for this problem

- The packaging unit and sealing unit might access the unfinished tray at the same time, so there shouldn't be any inconsistency in the availability of the unfinished bottles.
- When the half-finished bottles are being put into the input trays of packaging and sealing units, they might also be taken out at the same time for packaging or sealing, these queues must be consistent during these operations. To know whether the queue is full or not and empty or not.
- The units take some time to process the bottles, so there is a need for synchronization with respect to time for the processes and for them to run in parallel.

### Use of concurrency and synchronization in the program

```
processingBottle.pack();
time--;

/* Waiting for sealing unit to process 1 second */
secPhaser.arriveAndAwaitAdvance();
```

```
processingBottle.seal();
time--;

/* Waiting for packaging unit to process 1 second */
secPhaser.arriveAndAwaitAdvance();
```

Whenever a second of time passes by in packaging or sealing unit, with the use of Phaser, it waits for the other to come to the same state by passing a second before proceeding further.

```
/* Synchronised method over B1 Input Tray to take a bottle from the Queue */
public Bottle b1InputQueueTakeBottle() {
    synchronized (b1InputQueue) {
        if (this.b1InputQueueSize() != 0) {
            return b1InputQueue.remove();
        } else {
            return null;
        }
    }
}
```

All access to the input queues of packaging and sealing units are synchronized by the use of synchronized methods to prevent any inconsistencies in data when both the threads access it.

## **Problems that would occur in the program without synchronization**

- When getting bottles from the unfinished tray, the threads might see bottles which are already taken by other thread for processing as available (unfinished) in the tray.
- When putting half-processed bottles in the input queues the threads might see that the queues are full even when they aren't, or as empty when they contain bottles.