Review: Threads vs. Processes

How are threads and processes the same?

- **Local vs. Thread**
- **Memory**
- **Stack**

How does a thread differ from a process?

- Each process has its own memory
- A thread is part of a process

Why threads?

- Parallelism
- Simplifies some coding

**Atomic Operations**

What is it?

- Happens or it doesn't

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**The Too Much Milk Problem**

<table>
<thead>
<tr>
<th>Time</th>
<th>Person A</th>
<th>Person B</th>
</tr>
</thead>
<tbody>
<tr>
<td>3:05</td>
<td>Leave for store.</td>
<td>Leave for store.</td>
</tr>
<tr>
<td>3:10</td>
<td>Arrive at store.</td>
<td>Arrive at store.</td>
</tr>
<tr>
<td>3:15</td>
<td>Leave store.</td>
<td>Leave store.</td>
</tr>
<tr>
<td>3:20</td>
<td>Arrive home, put milk away.</td>
<td>Arrive home. OH NO!</td>
</tr>
<tr>
<td>3:25</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3:30</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

First, what are our goals?

- **Safety**
- **Progress/Starvation**

Next, what mechanism is used?
Three elements of locking:

<table>
<thead>
<tr>
<th></th>
<th>Must lock before using.</th>
<th>leave note</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.</td>
<td>Must unlock when done.</td>
<td>remove note</td>
</tr>
<tr>
<td>3.</td>
<td>Must wait if locked.</td>
<td>do not shop if note</td>
</tr>
</tbody>
</table>

Locks are used to provide
- Mutual Exclusion – only 1 thread in CS at a time
- Critical Sections – second code that should have

Four Rules in General for Working with Concurrency:

1) no two processes may be simultaneously inside their critical sections.
2) no assumptions may be made about speeds or the number of CPUs.
3) no process running outside its critical section may block other processes.
4) no process should have to wait forever to enter its critical section (i.e., no starvation)

Let’s brainstorm some milk buying solutions. Focus on notes and correctness (amount of milk).

A
if no note
  if no milk
    buy milk
  leave note
B
if no note
  if no milk
    buy milk
  leave note
get it need
get 1
2 Notes

A

A1: learn note A
A2: it is no note A
A3: By milk
A4: busy
A5: waiting
A6: spin lock

B

B1: learn note B
B2: it is no note A
B3: it is milk
B4: busy
B5: renew note B

Note: 3 notes B