

Language Abstractions for Concurrent and Parallel Programming

Second-Cycle

5 Credits

Period 2

Parosh Aziz Abdulla

Department of Information Technology

Uppsala University

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Language Abstractions for **Concurrent** and Parallel Programming

we concentrate
on concurrency

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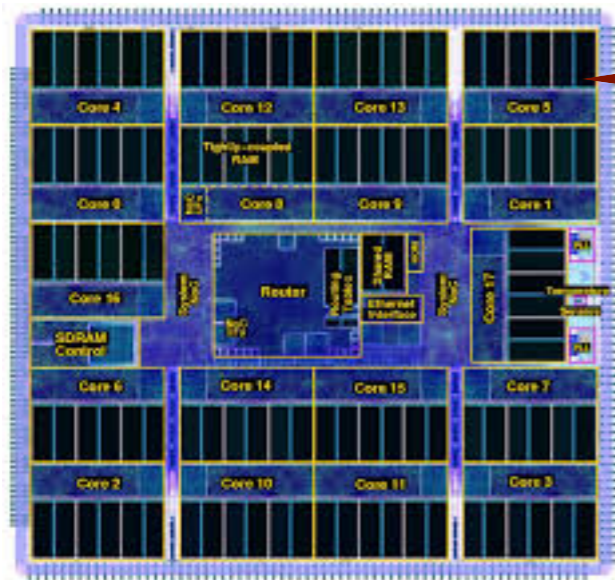
Uppsala University

Concurrency — Motivation

Concurrency — Motivation

**Concurrent systems
are everywhere**

Concurrency — Motivation



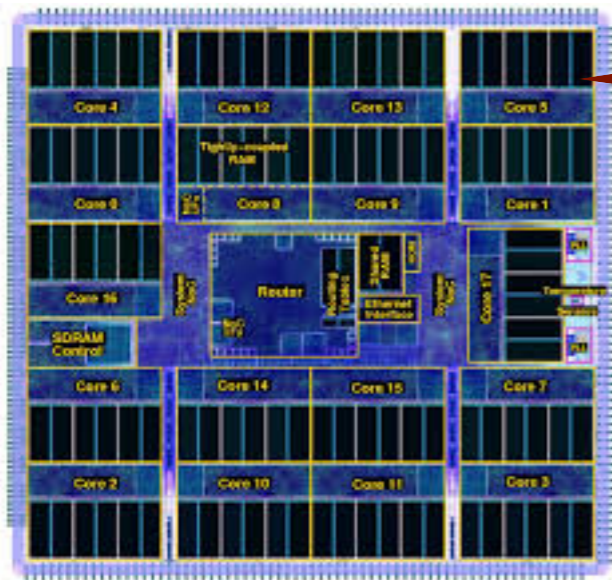
**Multicore
architectures**

**Concurrent systems
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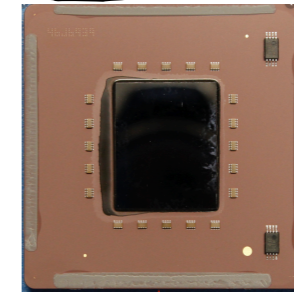
**Multicore
architectures**



intel



ARM

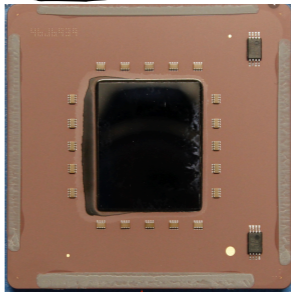
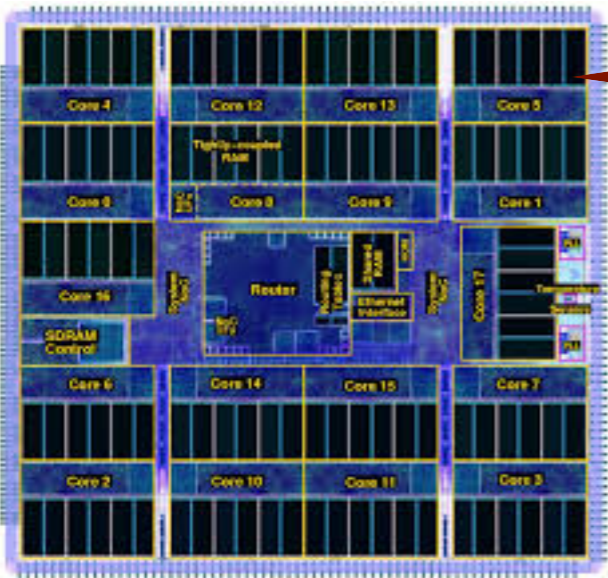


**IBM
Power**

Concurrency — Motivation

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Multicore architectures



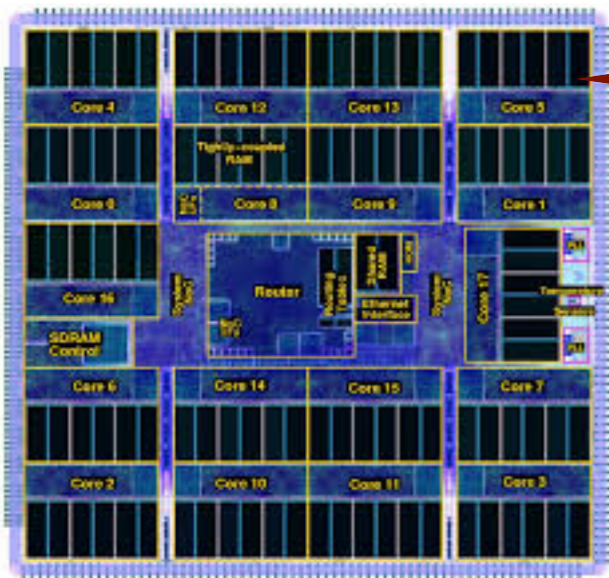
intel

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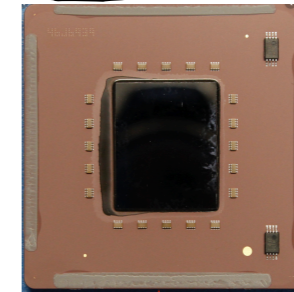
**Multicore
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intel



ARM



**IBM
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**Distributed
databases**



Facebook



Features

Use Cases

**Amazon
Aurora**

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**Difficult
Challenges**

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**Difficult
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even simple
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**Difficult
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**sequential
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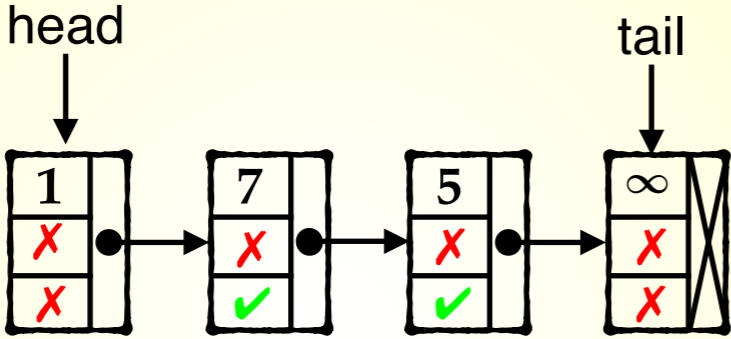
Stack

**simple
example**

**sequential
setting**

Concurrency — Motivation

Concurrent systems are everywhere



Difficult Challenges

Stack

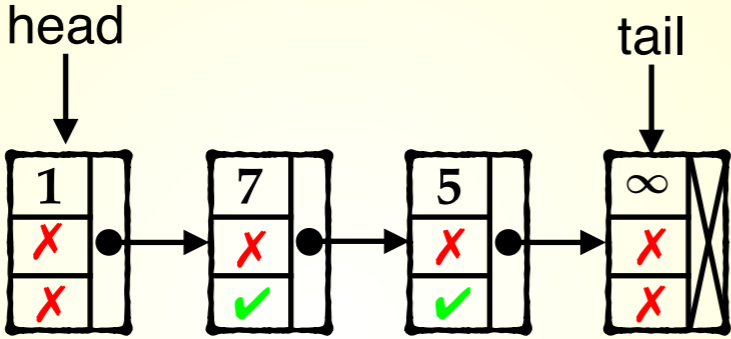
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push(4)

Stack

simple example

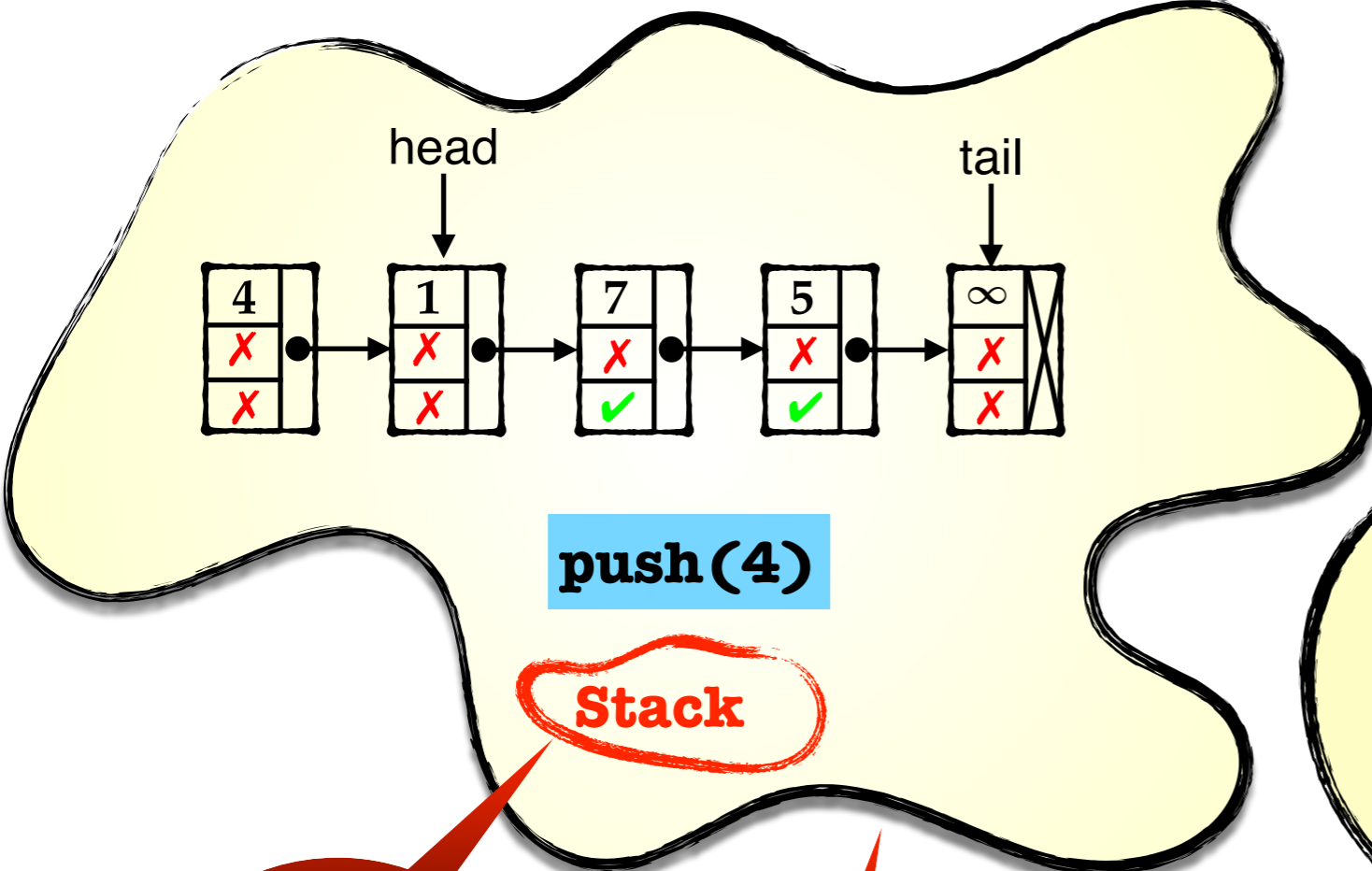
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Difficult Challenges

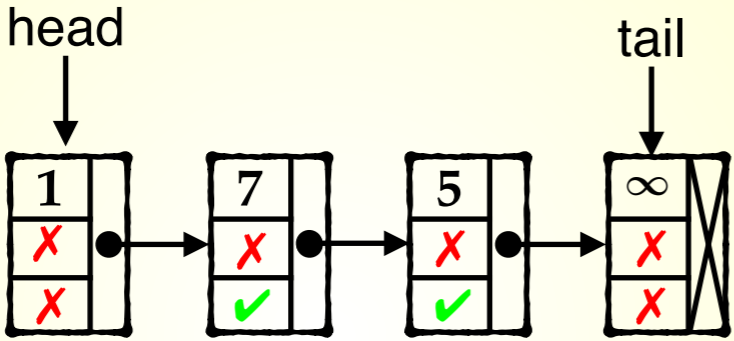
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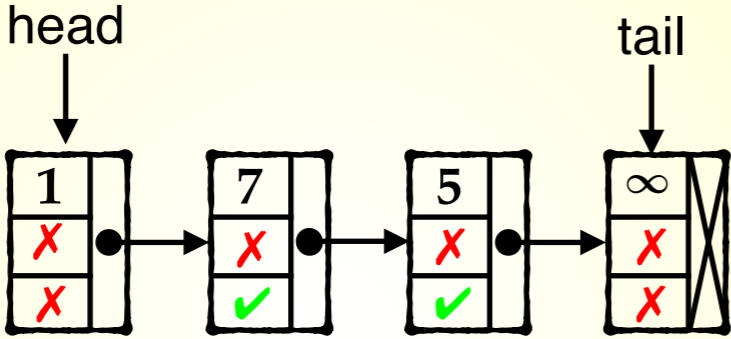
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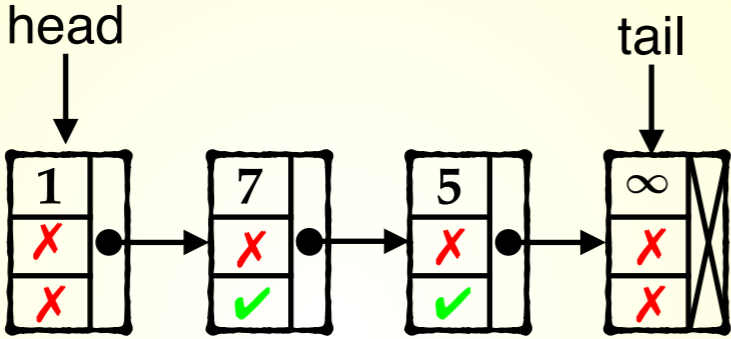
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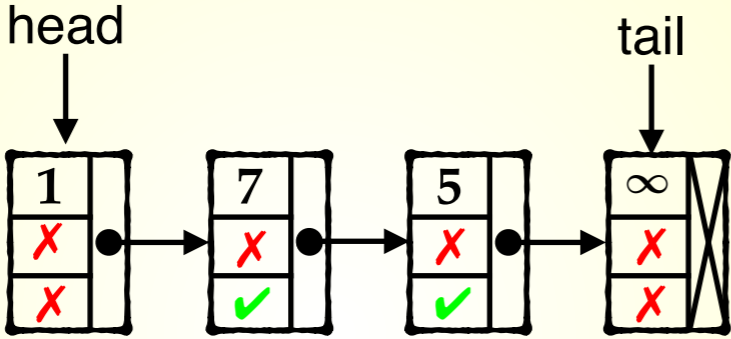
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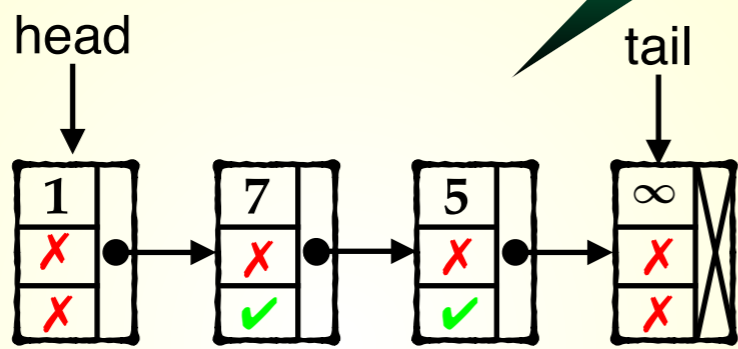
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concurrent setting

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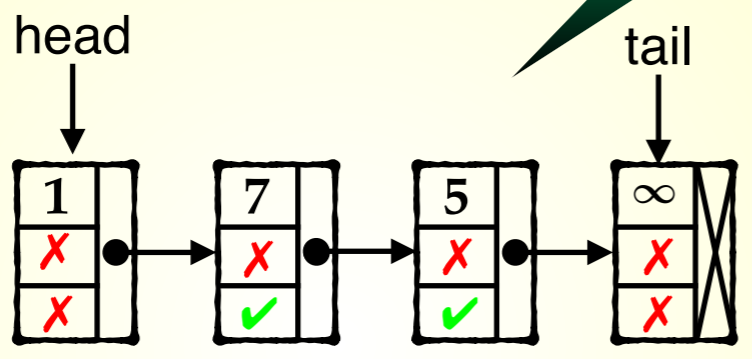
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~~sequential setting~~

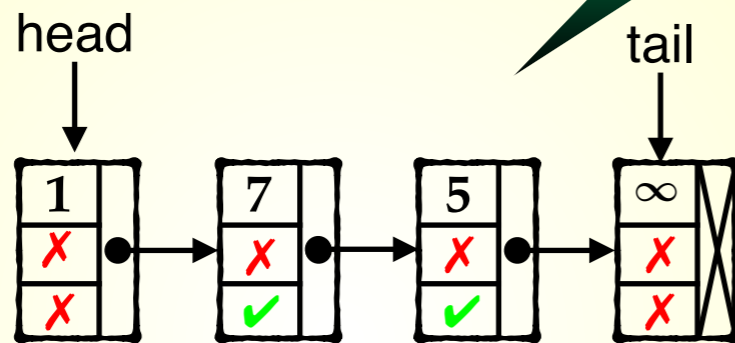
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Concurrency — Motivation

**Concurrent systems
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Thread 1

**more
complicated**



**concurrent
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Thread 2

Stack

~~simple
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**Difficult
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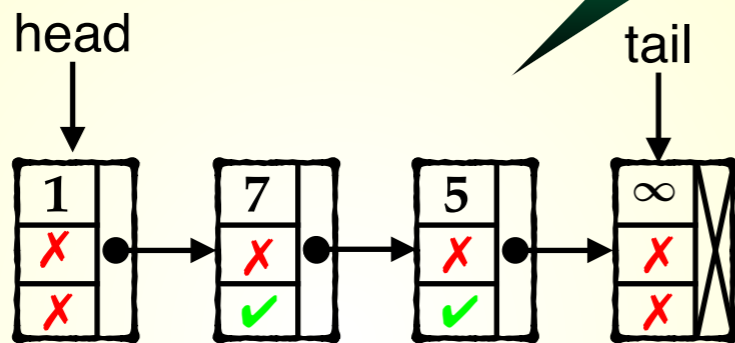
Concurrency — Motivation

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Thread 1

push(4)

**more
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**concurrent
setting**

Thread 2

push(8)

**simple
example**

Stack

**sequential
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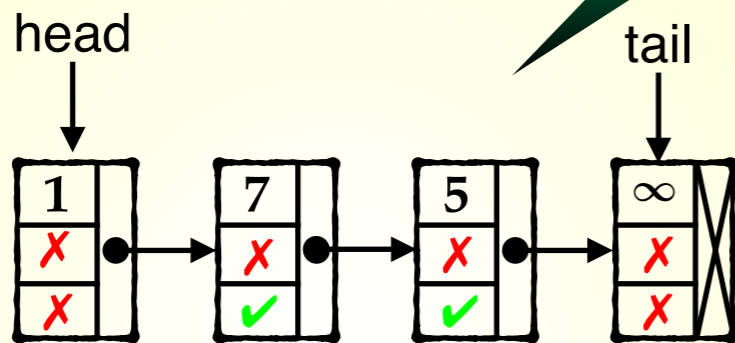
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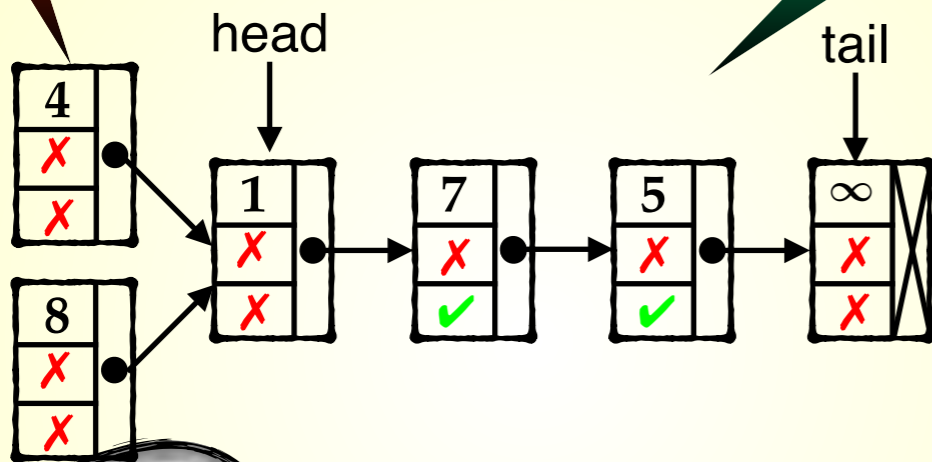
Thread 2

push(8)

simple example

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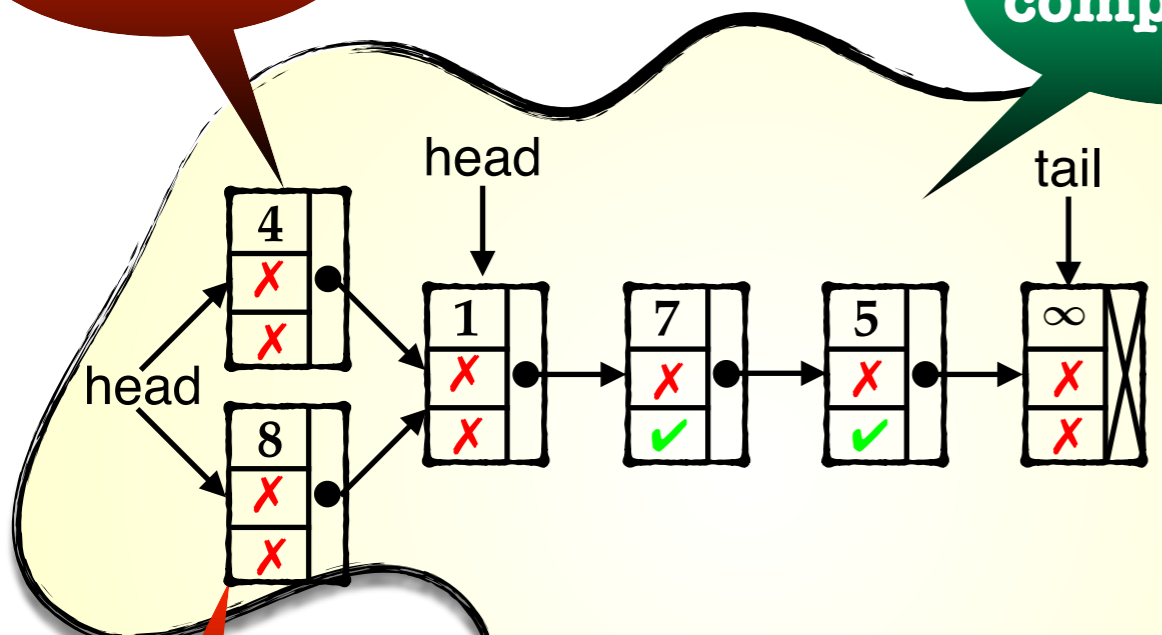
Thread 2

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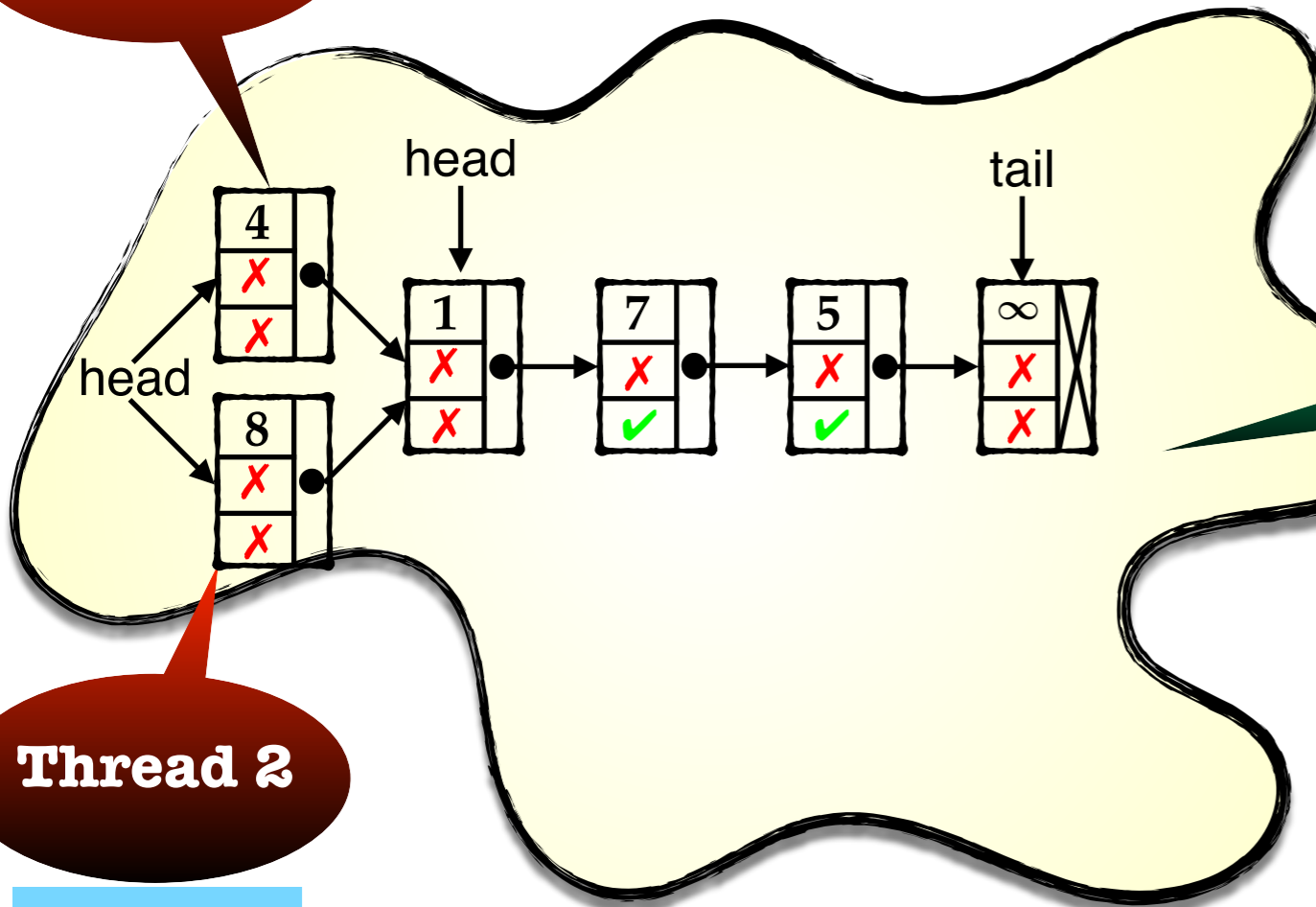


Concurrency — Motivation

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Thread 1

push(4)



**concurrent
setting**

**Difficult
Challenges**

Thread 2

push(8)

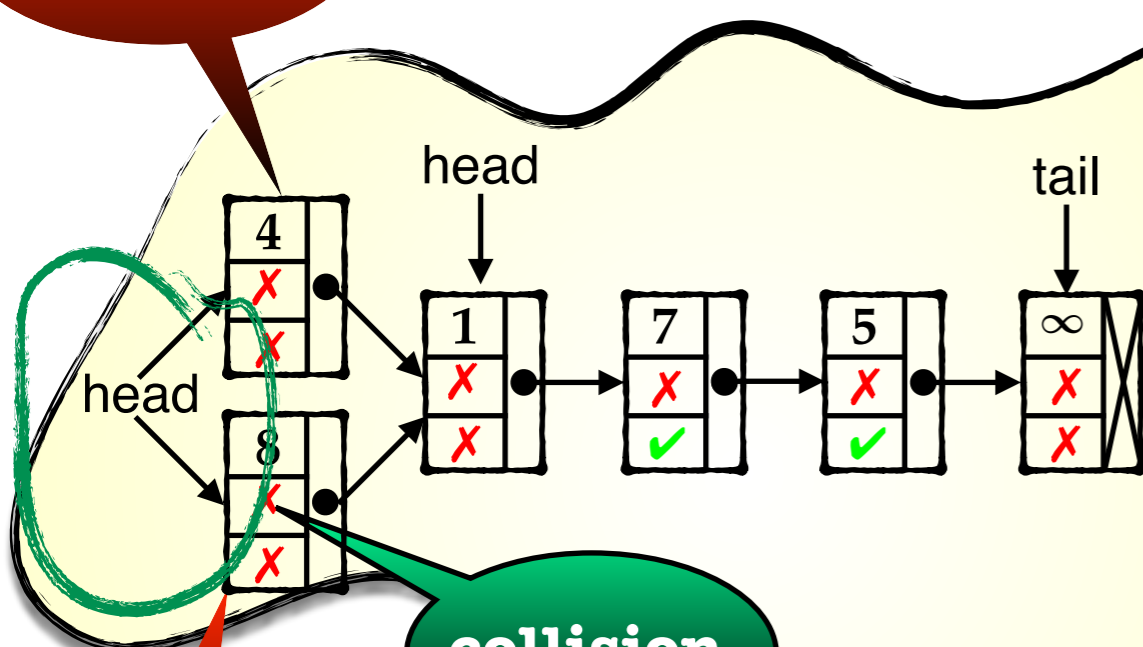
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Concurrency — Motivation

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Thread 1

push(4)



**concurrent
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Thread 2

push(8)

collision

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Course Contents

Goal

- **concurrent algorithms and data structures**

Concurrent systems are everywhere

Difficult Challenges

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Difficult Challenges

Contents

- **notions of correctness**
 - **linearizability, serializability, ...**
- **concurrent data structures**
 - **sets, stacks, queues, trees, skip lists, ...**
- **transactional memories**
- **distributed data stores**

Prerequisites

- **120 credits, at least 60 in Computer Science**
- **Introduction to Parallel Programming**
- **Second course in programming, C , C++**
- **Algorithms and data structures**

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Examination

- **written assignments**
- **projects**
- **no written exam**