CSE 332 Winter 2024
Lecture 1: Intro to ADTs, Stacks, Queues

Nathan Brunelle

http://www.cs.uw.edu/332

Nathan Brunelle

- Born: Virginia Beach, VA
- Ugrad: Math and CS at University of Virginia
- Grad: CS at University of Virginia
- Taught at UVA for 6 years
  - Intro to programming (e.g. 121)
  - Discrete Math (e.g. 311)
  - Algorithms (e.g. 412)
  - Theory of Computation (e.g. 431)

Warm Up!

Put up one hand (you can switch if it gets tired)!

While (you and at least one other person have a hand up){

make a partnership with someone whose hand is still raised

share your name with your partner

determine which of you has run the longest distance (as a single run)

release partnership

if you ran the shorter distance, then put your hand down and return to your seat

}

About this course

Topics covered:

- Data Structures
  - Specific “classic” data structures
- Introduction to Algorithms and Analysis
- Parallelism and Concurrency
  - Parallelism: Use multiple processors to finish sooner
  - Concurrency: Correct access to shared resources

Course Staff

- Instructor:
  - Nathan Brunelle
- TAs:

Course Info

- Text (optional):
  - Data Structures & Algorithm Analysis in Java, (Mark Allen Weiss), 3rd edition, 2012
    (2nd edition also o.k.)
- Course Page:
  - http://www.cs.uw.edu/332

Communication

- Course email list:
  - cse332_wi24@uw
  - You are already subscribed
  - You must get and read announcements sent there

- Ed STEM Discussion board
  - Your first stop for questions about course content & assignments

Course Meetings

- Lecture
  - Materials posted (slides before class, inked slides after)
  - Recorded using Panopto
  - Ask questions, focus on key ideas (rarely coding details)

- Section
  - Practice problems!
  - Answer Java/project/homework questions, etc.
  - Occasionally may introduce new material
  - An important part of the course (not optional)

- Office hours
  - Use them: *please visit us!*

Grading

- 12ish Weekly individual homework exercises (25%)
  - Lowest 2ish dropped (best 10 count)
- 3 programming projects (with phases) (35%)
  - Use Java and IntelliJ, Gitlab
  - Done individually
- Midterm and final exam (40%)
  - In-person
  - Midterm in this room
  - Final location TBD
- Dates:
  - Midterm: Monday Feb 5, during lecture
  - Final Exam: Thursday March 14, 12:30pm-2:20pm

Collaboration

- Try it yourself first
- Collaborate with classmates (no external interactive help on assignments permitted)
  - Collaboration is “whiteboard only”
  - Looking for a collaborator?
    - Post on the Ed Discussion board
    - Go to the CSE study room (Allen Center 006, there’s a table specifically for 332!)
- Cite your sources!

Terminology

- Abstract Data Type (ADT)
  - Mathematical description of a “thing” with set of operations on that “thing”
- Algorithm
  - A high level, language-independent description of a step-by-step process
- Data structure
  - A specific organization of data and family of algorithms for implementing an ADT
- Implementation of a data structure
  - A specific implementation in a specific language

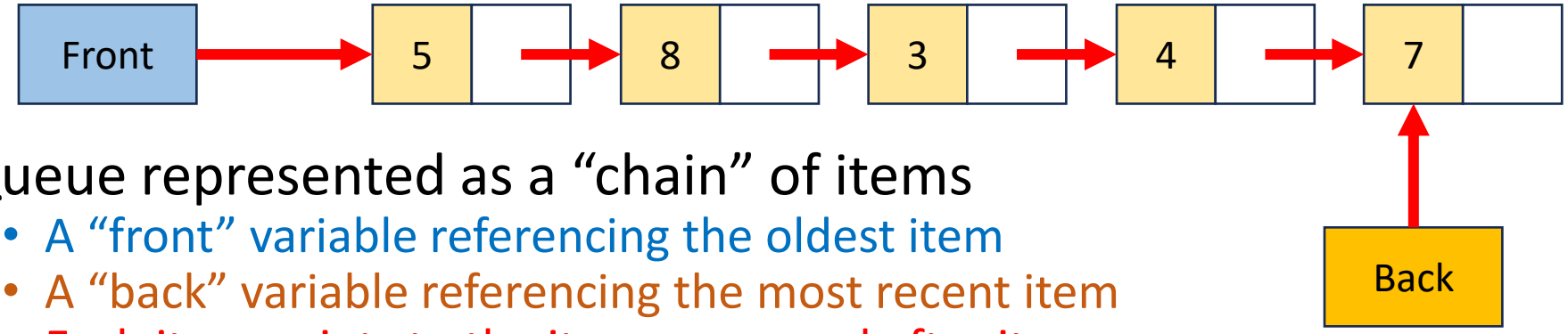
ADT: Queue

- What is it?
- What Operations do we need?
  - Enqueue:
  - Dequeue:
  - isEmpty:

ADT: Queue

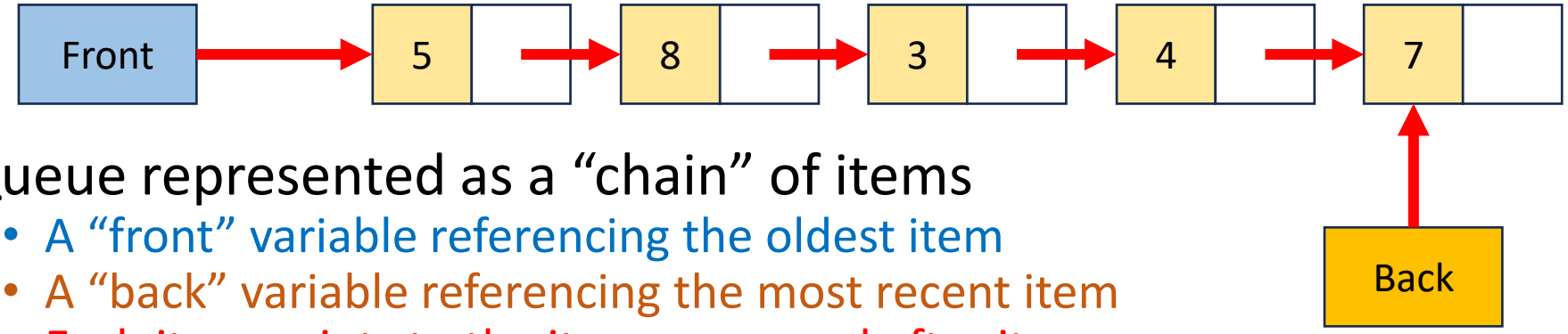
- What is it?
  - A “First In First Out” (FIFO) collection of items
- What Operations do we need?
  - Enqueue
    - Add a new item to the queue
  - Dequeue
    - Remove the “oldest” item from the queue
  - IsEmpty
    - Indicate whether or not there are items still on the queue

Linked List – Queue Data Structure



- Queue represented as a “chain” of items
  - A “front” variable referencing the oldest item
  - A “back” variable referencing the most recent item
  - Each item points to the item enqueued after it
- Enqueue Procedure:
- Dequeue Procedure:
- Is_empty Procedure:

Linked List – Queue Data Structure



- Queue represented as a “chain” of items
  - A “front” variable referencing the oldest item
  - A “back” variable referencing the most recent item
  - Each item points to the item enqueued after it
- Enqueue Procedure:

```
enqueue(x){
    last = new Node(x)
    back.next = last
    back = last
}
```

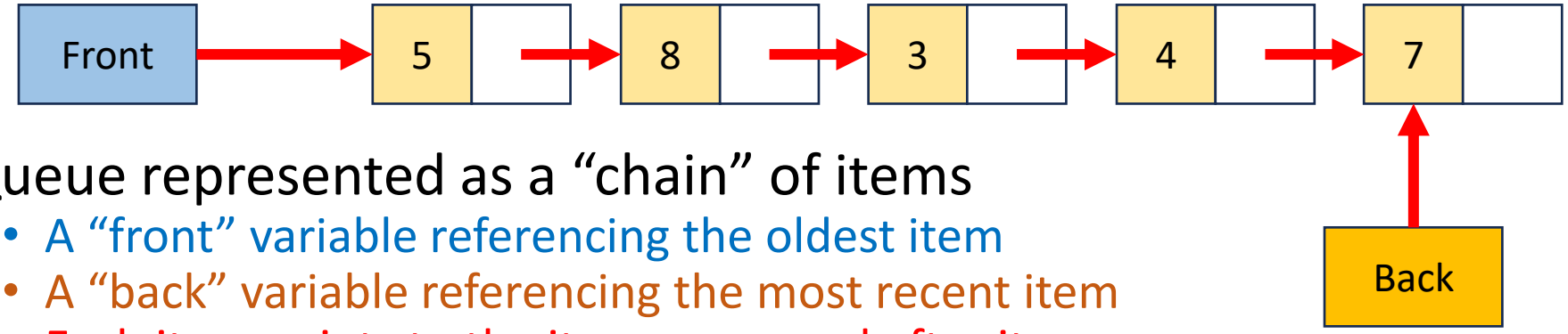
- Dequeue Procedure:

```
dequeue(){
    first = front.item
    front = front.next
    return first
}
```

- Is_empty Procedure:

```
is_empty(){
    return front.equals(Null)
}
```

Circular Array – Queue Data Structure



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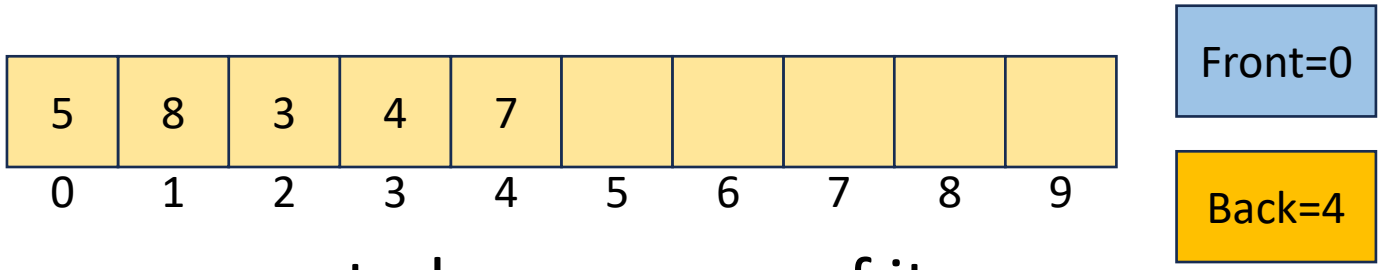
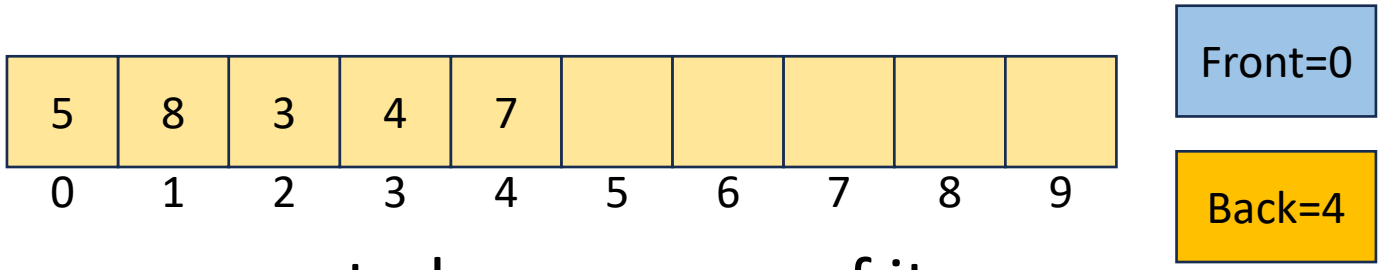
- Is_empty Procedure:

Circular Array – Queue Data Structure



- Queue represented as an array of items
  - A “front” index to indicate the oldest item in the queue
  - A “back” index to indicate the most recent item in the queue
- Enqueue Procedure:
- Dequeue Procedure:
- Is_empty Procedure:

Circular Array – Queue Data Structure



- Queue represented as an array of items
  - A “front” index to indicate the oldest item in the queue
  - A “back” index to indicate the most recent item in the queue
- Enqueue Procedure:

```
enqueue(x){
    queue[back] = x
    back = (back + 1) % queue.length
}
```

- Dequeue Procedure:

```
dequeue(){
    first = queue[front]
    front = (front + 1) % queue.length
}
```

- Is_empty Procedure:

```
is_empty(){
    return front == back
}
```

Linked List vs. Circular Array

ADT: Stack

- What is it?
- What Operations do we need?

ADT: Stack

- What is it?
  - A “Last In First Out” (LIFO) collection of items (sometimes called FILO)
- What Operations do we need?
  - Push
    - Add a new item onto the stack
  - Peek
    - Return the value of the most recently pushed item
  - Pop
    - Return the value of the most recently pushed item and remove it from the stack
  - Is_empty
    - Indicate whether or not there are items still on the stack