CSE 332 Autumn 2023
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

share your hometown with your partner

determine which of you is older

release partnership

if you were older 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:
  - Anjali
  - Nile
  - Hans
  - Arya
  - Allyson
  - Aashna
  - James
  - Amanda

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_au23@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
- Anonymous feedback link
  - For good and bad: if you don’t tell us, we won’t know!

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

- 12 Weekly individual homework exercises (25%)
  - Lowest two dropped
- 3 programming projects (with phases) (35%)
  - Use Java and IntelliJ, Gitlab
  - Done individually
- Midterm and final exam (40%)
  - In-person, in this room (CSE2 G20)
- Dates:
  - Midterm: Monday Oct 30, during lecture
  - Final Exam: Thursday Dec 14, 8:30-10:20am

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

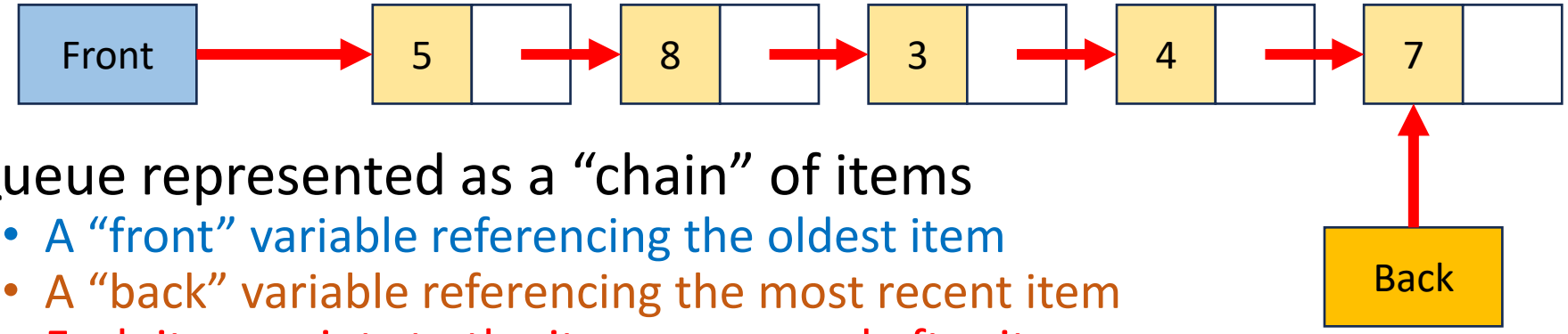
ADT: Queue

- What is it?
  - Collection of items, “FIFO”
- What Operations do we need?
  - Enqueue: add an item
  - Dequeue: removes the “oldest” item
  - isEmpty: is it empty?

ADT: Queue

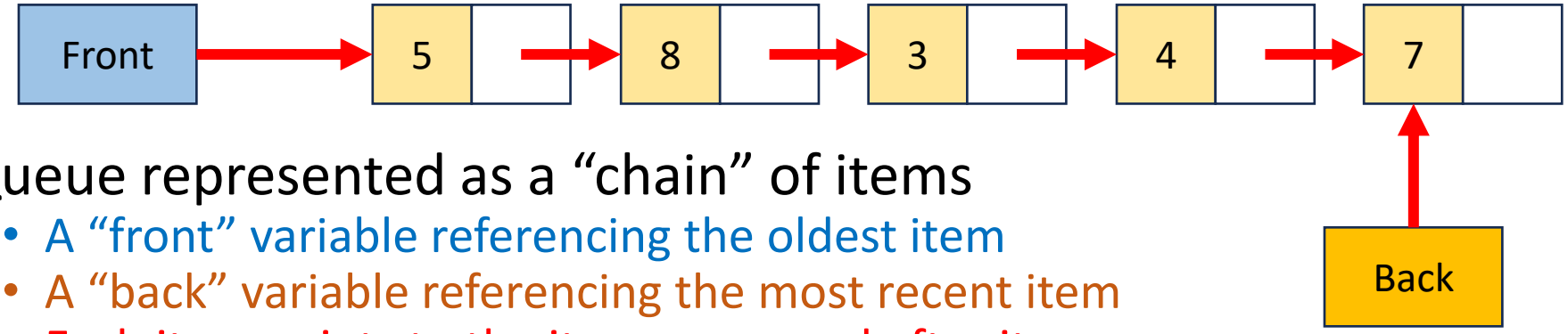
- What is it?
  - A “First In First Out” (FIFO) collection of items
- What Operations do we need?
  - Enqueue
    - Add a new item to the queue
  - Dequeue
    - Remove the “oldest” item from the queue
  - Is_empty
    - Indicate whether or not there are items still on the queue

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



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  - A “front” variable referencing the oldest item
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  - Each item points to the item enqueued after it
- Enqueue Procedure:

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

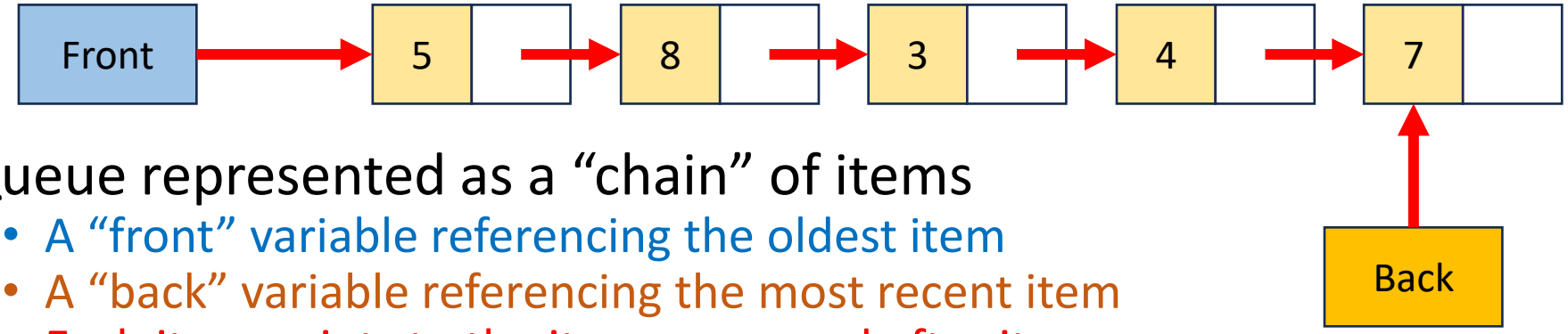
- Dequeue Procedure:

```
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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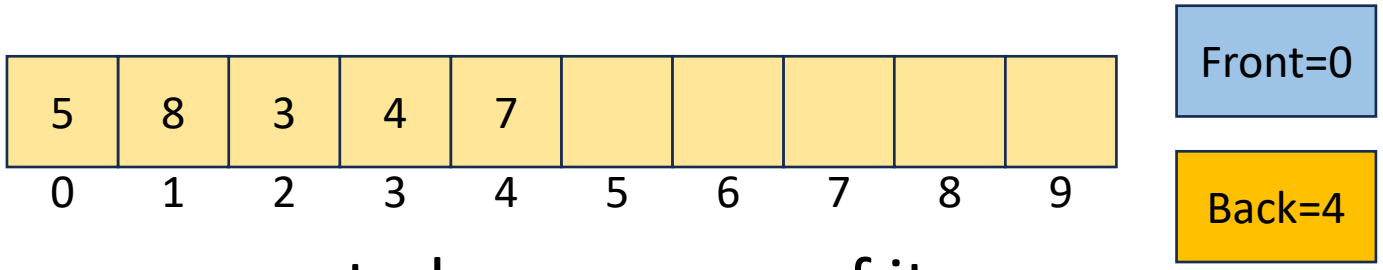
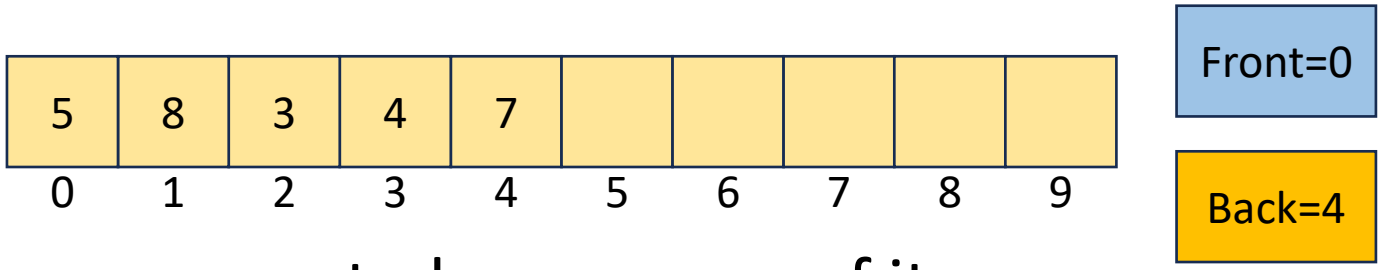
Circular Array – Queue Data Structure



- 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:
- Dequeue Procedure:
- Is_empty Procedure:

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