CSC148 winter 2016

test, assignment, linked list queues — week 5

Danny Heap
heap@cs.toronto.edu
BA4270 (behind elevators)
http://www.cdf.toronto.edu/~heap/148/W16/
416-978-5899

February 11, 2016

Outline

test

assignment #1

linked list queues

where we've been

- class design and implementation
- composition and inheritance
- stacks, sacks, containers
- linked lists

where to look

class design: Week 1 course website examples, lab #1 (also solutions), course notes, How to think like a computer scientist.

composition and inheritance: Week 2 course website examples, lab #2 (also solutions), course notes

stacks, sacks, containers: Week 3 course website examples, lab #3 (also solutions)

linked lists: Week 4 course website examples, lab #4, How to think like a computer scientist

how to study

- look at material from all three lecturers
- work on a handout, or incomplete code, **before** looking at solution
- study groups can challenge each other, critique solutions
- office hour Tuesday 2–4:30, BA7172

What is it?

- Assignment 1 is a ride-sharing simulation
  - Riders request drivers to pick them up at their current location and drop them off somewhere else
  - Drivers request riders
- A text file is used to set up the initial riders and drivers
- ... and then the simulation runs, and we see what happens!
  - Useful for answering questions about real-world events
  - "How long did riders wait for a pickup, on average?"
  - "How much distance is traveled by drivers, on average?"

Starting the World

- We start the world of the simulation by using a text file of events
- The text file has only two types of events
  - **RiderRequest**: rider requests a driver
  - **DriverRequest**: driver requests a rider
  - i.e. the word before **Request** is the type of person doing the requesting
- Each rider has exactly one **RiderRequest** event in the file
- Each driver has exactly one **DriverRequest** event in the file, but **Pickup** or **Dropoff** events may generate new **DriverRequest**

Sample Text File

```
#At time 1, Dan exists
#Dan is at location 1,6, requests a driver, and is willing
#to wait 15 units of time for pickup before he cancels
# The 15 is the rider's "patience"
1 RiderRequest Dan 1,1 6,6 15

#At time 10, Arnold exists
#Arnold is at location 3,3, requests a rider,
#and his car moves 2 units of distance per unit time
10 DriverRequest Arnold 3,3 2
```

Locations

- think of the riders and drivers existing on an x-y plane, so their locations are simplified compared to a real city
- there is a **Location** object to represent these locations in the simulation
- distance from one location to another is the vertical distance plus horizontal distance
- so, what is the distance from 1,1 to 6,6?

Other Events

besides **RiderRequest** and **DriverRequest** events, three other kinds of events can be generated during the simulation

Cancellation: cancels a waiting rider if they wait for pickup beyond their patience

Pickup: occurs when a driver picks up a rider

Dropoff: occurs when a driver drops-off a rider

event priorities

- each event has a priority, which is its timestamp
- events with smaller timestamps have higher priorities
- a priority queue is used to manage pending events

```
>>> pq = PriorityQueue()
>>> pq.add(Event(4))
>>> pq.add(Event(2))
>>> pq.add(Event(7))
>>> pq.remove().timestamp
2
```

Sample Text File: What Happens?

- What are all of the generated events?
- How long does Dan wait?
- What is Arnold's total distance traveled?
- What is Arnold's total distance traveled with a rider?
- Change Dan's patience from 15 to 10 — now what happens?

Dispatcher

- The dispatcher knows about the available drivers and riders
- It is also used to request a driver for a rider, request a rider for a driver, or cancel a rider request
- ... but wait, don't events already do this kind of thing?
  - No — events don't do anything on their own
  - They ask the dispatcher to perform appropriate actions
  - Dispatcher is part of the "business logic" to make things happen

Monitor

- OK — so we have all of these events happening
- And we're supposed to return statistics (average wait time of riders, etc.) when the simulation is over
- How?
  - We use the monitor!
  - The monitor is our bookkeeper, keeping track of relevant data from which we compute our stats

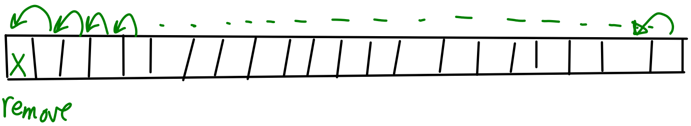
Monitor...

- The monitor has two important methods
  - `notify`: events call this method to have the monitor record an activity
  - `report`: produces stats about the activities that the monitor has remembered
    - Each stat is computed by a separate private helper function

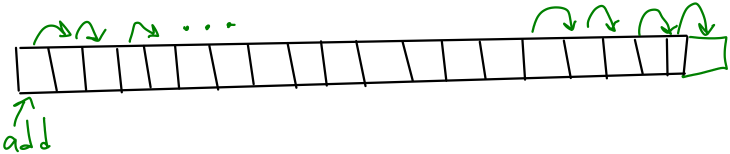
Events and Activities

- Why do we have **both** events and activities?
  - Events are used to move the simulation forward
    - They are active (cause things to happen)
  - Activities are used **only** in the monitor
    - They are passive (just used to record things)

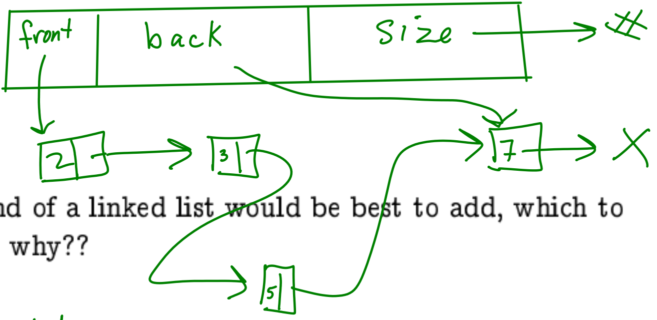
something linked lists do better than lists?



list-based Queue has a problem: adding or removing will be slow.



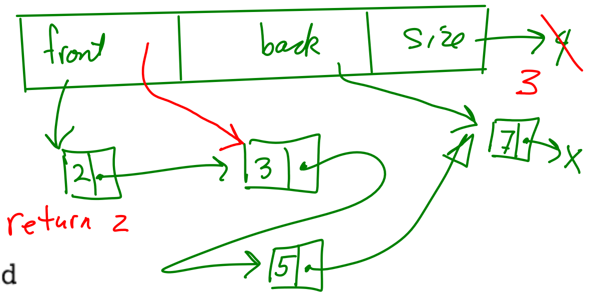
symmetry with linked list



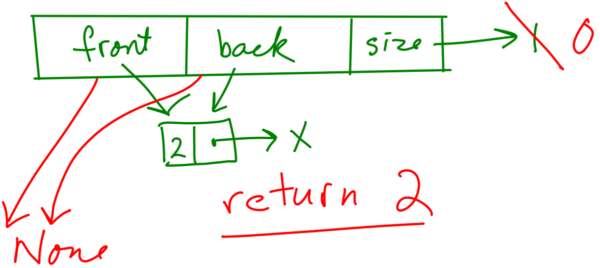
which end of a linked list would be best to add, which to remove? why??

delete at front since it is a lot easier to find front.next than the predecessor of back!

build pop_front



… already have append



revisit Queue API

add $\longleftrightarrow$ append
remove $\longleftrightarrow$ pop_front
is_empty $\longleftrightarrow$ size == 0

use an underlying LinkedList

revisit Stack API while we're at it

add $\longleftrightarrow$ prepend

remove $\longleftrightarrow$ pop_front

is_empty $\longleftrightarrow$ size == 0

also use an underlying LinkedList

they're all Containers

use different subclasses of
Container to compare performance

stress drive them through **container_cycle**, in container_timer.py:

- list-based Queue
- linked-list-based Queue
- list-based Stack
- linked-list-based Stack

what matters is the growth rate

as Queue grows in size, list-based-Queue bogs down impossibly ~~fast~~

slow

Python native list