UMassAmherst | Manning College of Information & Computer Sciences

Programming Methodology

Lab 8: Observer and Streams

Wednesday, October 23rd, 2023

Weekly Lab Agenda

- Go over reminders/goals
- Review past material
- Work in groups of 2-3 to solve a few exercises
    - Please sit with your group from last week.
- Discussion leaders will walk around and answer questions
- Solutions to exercises will be reviewed as a class
- Attendance taken at the end

Reminders

- Download the starter code.
- Homework 5 is due tonight at 11:59pm
    - Come to office hours for help!
- The observables extra credit assignment has been released
    - Due Tuesday October 31st at midnight
- Complete the CATME Survey by next Friday November 3rd at midnight
- Midterm 2 is next week!
    - Start studying early.
    - Lab next week will be held as scheduled and attendance is required

Today's Goals

- Practice working with the observer pattern
- Practice working with streams

Observer Review

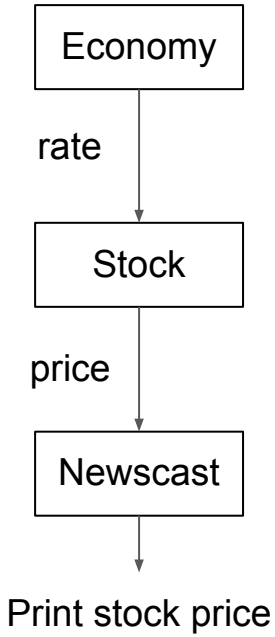
- What: A design pattern in which an observable subject automatically notifies dependent observers of any state changes
- Why: It's everywhere. E.g: GUI updates
- How: Reusable class

```
type Observer<T> = (x: T) => any;

class Observable<T> {
  private observers: Observer<T>[] = [];  // Maintain a list of observers

  subscribe(f: Observer<T>) {             // Add an observer to the list
    this.observers.push(f);
  }

  update(x: T) {                          // Notify each observer of update
    this.observers.forEach(f => f(x));
  }
}
```

Exercise 1

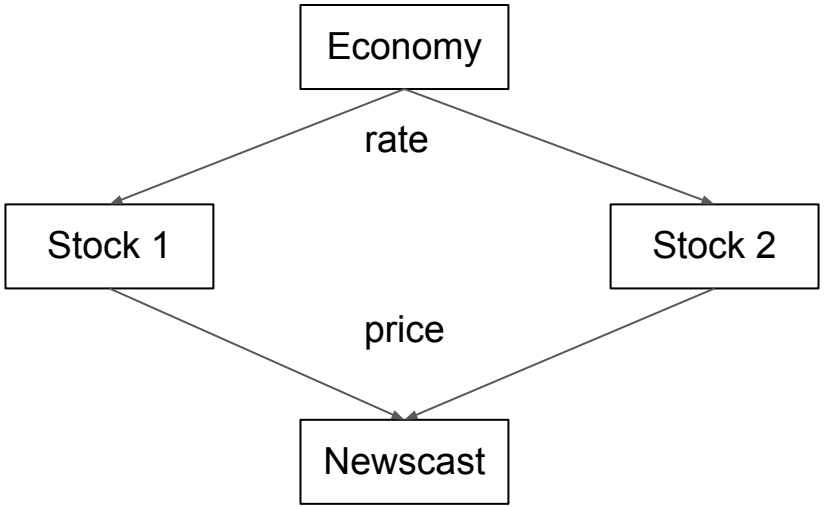
- Model the stock market with 3 classes. Make sure to test!

```
// Should be "observable"
class Economy /* possibly extends something */ {
    updateRate(rate: number): void {} // Notify whoever cares about the economy
}

// Should observe Economy's rate, and be "observable"
class Stock /* possibly extends something */ {
    constructor(name: string, base: number, price: number) {}
    updatePrice(rate: number): void {} // Update price = base * rate
}

//  Should observe and report Stock's price
class Newscast {
    constructor() {}
    report(name: string, price: number): void {
        console.log(`Stock ${name} has price ${price}.`)
    }
}
```



Exercise 2

- Add a function `observe(...stocks: Stock[])` to `Newscast` so that it can observe any number of input stocks
- Make `Newscast` be an Observable that updates subscribers with the tuple [stockName, stockPrice] of type [string, number] whenever it reports



Stream Review

- What: A sequence of data made available over time
- Why: Useful abstraction for the paradigm where there's limited random data access and each data record can only be seen once*. E.g: Data reading, signal processing
- How: We implemented stream as a lazily constructed list with memoized tail

```
interface Stream<T> {
  head: () => T;
  tail: () => Stream<T>;
  isEmpty: () => boolean;
  toString: () => string;
  map: <U>(f: (x: T) => U) => Stream<U>;
  filter: (f: (x: T) => boolean) => Stream<T>;
  reduce: <U>(f: (acc: U, e: T) => U, init: U) => Stream<U>; // This is new
}

reduce: (f, init) => snode(init, () => memoizedTail.get().reduce(f, f(init, head)))
```

Exercise 3: Maxima stream (in a previous exam!)

- Implement maxUpTo(s: Stream<number>): Stream<number>
- Input: A stream of numbers a1, a2, a3, ...,
- Output: A stream of maxima of numbers up to the current one:
  a1 => max(a1, a2) => max(a1, a2, a3) =>.... => sempty
- Example:
  Input stream: 1 => 4 => 3 => 2 => 5 => 1 => sempty
  Output stream: 1 => 4 => 4 => 4 => 5 => 5 => sempty