Administrivia
- We have a new TA; he’ll start office hours next week
- I have homeworks back
  - Still one homework with no name – come claim it!
  - Cheating problem
- Midterm: how many of you have 3 next Thursday?

Agenda
- Recursion

How to calculate…
- What’s the sequence 1, 3, 6, 10, 15, 21, 28, 36…
  - Triangle numbers
  - How to do as loop?
  - How to do as addition on previous result?
    - Recursion!

A better example
- Simpler, you say?
- What’s the sequence 1, 1, 2, 3, 5, 8, …
  - Easy to define in terms of recursion, right?
  - How to iterate over this?
  - In other words, there are problems that are more intuitive recursively

Formalizing Recursion
- Recursive algorithms have the following properties
  - They call themselves
  - They call themselves to solve a smaller problem, and then work with the result
  - There’s a stopping condition, e.g., a call which is simple enough to solve explicitly
    - Generally avoid explicit loops
- Recursion’s advantages and disadvantages
  - Conceptually simpler
  - Less efficient than iteration

Some more examples
- FindMax
- Recursive binary search (p. 268)
- Divide-and-conquer approach
  - Take a big problem, split into smaller problems, solve separately
  - Very powerful methodology, works well with recursion
– Usually two recursive calls

8️⃣ **Towers of Hanoi**
- Three pegs
- Disks all on one peg
- Want to move it to third peg
- Second peg is a “work peg”
- Can’t move a disk until all smaller disks have been moved
- Basic intuition
  - Move the top disks from start to intermediate
  - Move the largest disk to destination
  - Move top disks from intermediate to destination

9️⃣ **Hanoi (II)**
- Three steps:
  - First, move pile from “from” to “inter”, using “to” as a work peg
  - Then, move disk from “from” to “to”
  - Then, move remainder of pile from “inter” to “to”, using “from” as a work peg
- This works because we don’t have to put things consecutively, just that larger disks must go on top of smaller disks
- Page 278 for code

10️⃣ **Next time**
- Today’s class is last one you need to know for midterm
- Mergesort and other sorts