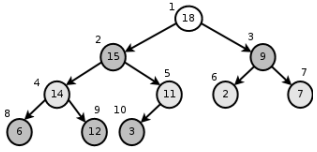
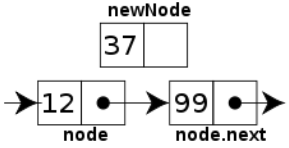
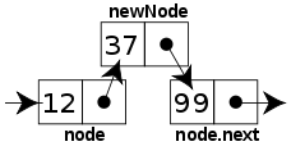



```
INSERTION-SORT(A)                          cost   times
1  for j = 2 to A.length                   c1     n
2      key = A[j]                          c2     n − 1
3      // Insert A[j] into the sorted
           sequence A[1 . . j − 1].        0      n − 1
4      i = j − 1                           c4     n − 1
5      while i > 0 and A[i] > key          c5     ∑_{j=2}^{n} t_j
6          A[i + 1] = A[i]                 c6     ∑_{j=2}^{n} (t_j − 1)
7          i = i − 1                       c7     ∑_{j=2}^{n} (t_j − 1)
8      A[i + 1] = key                      c8     n − 1
```





WELCOME TO CS 24!

Problem Solving with Computers-II

Read the syllabus. Know what's required. Know how to get help.

About me

- Diba Mirza (diba@ucsb.edu)
  - Assistant Teaching Professor, Computer Science
  - PhD (Computer Engineering, UCSD)

- Office hours (starting tomorrow 08/07):
  - TW: 3:30p - 5:00p Or by appointment
  - Location: HFH 1155

- Ways to reach me:
  - Piazza (highly recommended)
  - Email: Include [CS24] on the subject line

Getting help

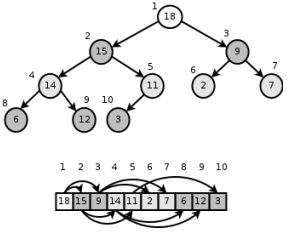
- TAs: Boyuan Feng, Yimeng Liu, Destinee Cheng
- TA hours are posted on the class website: https://ucsb-cs24.github.io/m19/info/schedule/
- Come to office hours and introduce yourself
- Setup a regular time to meet outside of section time with TAs
- Communicate with the staff in person and remotely on:

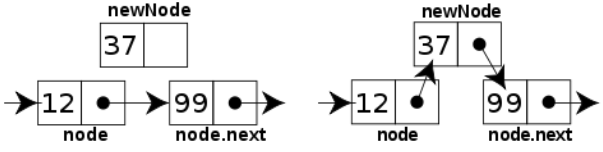
PIAZZA!

About this course

You will learn to:

- Design and implement **larger programs** that **run fast**
- Organize **data** in programs using **data structures**
- **Analyze** the **complexity** of your programs





INSERTION-SORT(A)	*cost*	*times*
1 **for** $j = 2$ **to** $A.length$	c_1	n
2 $key = A[j]$	c_2	$n-1$
3 // Insert $A[j]$ into the sorted sequence $A[1..j-1]$.	0	$n-1$
4 $i = j-1$	c_4	$n-1$
5 **while** $i > 0$ and $A[i] > key$	c_5	$\sum_{j=2}^{n} t_j$
6 $A[i+1] = A[i]$	c_6	$\sum_{j=2}^{n}(t_j-1)$
7 $i = i-1$	c_7	$\sum_{j=2}^{n}(t_j-1)$
8 $A[i+1] = key$	c_8	$n-1$

Data Structures and C++

Complexity Analysis

Course Logistics

- Coure website: https://ucsb-cs24.github.io/m19/
- Grading
  - Homeworks: 10%
  - Lab assignments: 15%
  - Programming assignments: 20%
  - Midterm Exams: 25%
  - Final Examination: 30%

- NO MAKEUPS ON EXAMS!

- You have 24 hour grace period to submit the labs. DO NOT contact the instructor or TAs for extensions unless you have a real emergency

- To complete the labs you need a college of engineering account. If you don't have one yet, send an email to help@engineering.ucsb.edu

iClickers: You must bring them

- Buy an iClicker at the Bookstore
- Bring your iclicker to class

Required textbook

- Michael Main and Walter Savitch. *Data Structures and Other Objects Using C++ (4th edition)*, Addison-Wesley, 2011.

Recommended textbook

- Problem Solving with C++, Walter Savitch, Edition 9

You must attend class and lab sections
You must prepare for class
You must participate in class

Clickers out – frequency AC

About you…

What is your familiarity/confidence with programming in C++?

A. Know nothing or almost nothing about it.
B. Used it a little, beginner level.
C. Some expertise, lots of gaps though.
D. Lots of expertise, a few gaps.
E. Know too much; I have no life.

About you…

What is your familiarity/confidence with using version control – git or subversion?

A. Know nothing or almost nothing about it.
B. Used it a little, beginner level.
C. Some expertise, lots of gaps though.
D. Lots of expertise, a few gaps.
E. Know too much; I have no life.

About you…

What is your familiarity/confidence with C++ memory-management?

A. Know nothing or almost nothing about it.
B. Used it a little, beginner level.
C. Some expertise, lots of gaps though.
D. Lots of expertise, a few gaps.
E. Know too much; I have no life.

Clickers, Peer Instruction, and PI Groups

- Find 1-2 students sitting near you. If you don't have any move.
- Introduce yourself.
- This is your initial PI group (at least for today)
- Discuss what you hope to get out of this class.

Procedural Programming

- Break down a problem into sub tasks (functions)
- Algorithm to bake a cake

    Preheat the oven to 350F

    Get the ingredients: 2 eggs, 1 cup flour, 1 cup milk

    Mix ingredients in a bowl

    Pour the mixture in a pan

    Place in the over for 30 minutes

Object Oriented Programming: A cake baking example

- Solution to a problem is a system of interacting **objects**
- An object has attributes and behavior
- What are the objects in this example?

1. Preheat the oven to 350F
2. Get the ingredients: 2 eggs, 1cup flour, 1 cup milk
3. Mix ingredients in a bowl
4. Pour the mixture in a pan
5. Place in the over for 30 minutes

Objects have attributes and behavior: A cake baking example

coded as member variables

coded as member functions

Object	Attributes	Behaviors
Oven	Size Temperature Number of racks	Turn on Turn off Set temperature
Bowl	Capacity Current amount	Pour into Pout out
Egg	Size	Crack Separate(white from yolk)

A class: pattern for describing similar objects

A generic pattern that is used to describe objects that have similar attributes and behaviors

e.g. a bowl and a pan may be described by the same class

```
class Dish{
     void pourIn( double amount);
     void pourOut(double amount);
     double capacity;
     double currentAmount;
};
```

Objects vs classes

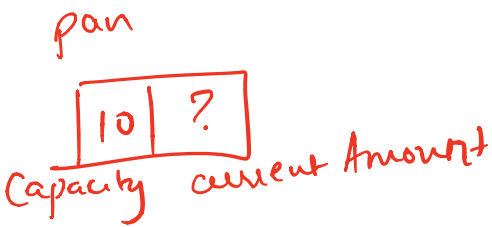
```
class Dish{
     void pourIn( double amount);
     void pourOut(double amount);
     double capacity;
     double currentAmount;
};
 //Creating objects of this class
```

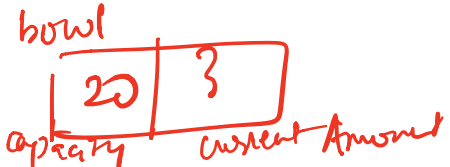
Dish pan;

Dish bowl;
pan.capacity = 10;
bowl.capacity = 20;

Each object has its own member variables

To access the member functions or variables use the dot operator





Concept: Classes describe objects

- Every object belongs to (is an instance of) a class
- An object may have fields, or variables
  - The class describes those fields
- An object may have methods
  - The class describes those methods
- A class is like a template, or cookie cutter

Concept: Classes are like Abstract Data Types

- An Abstract Data Type (ADT) bundles together:
  - some data, representing an object or "thing"
  - the operations on that data
- The operations defined by the ADT are the *only* operations permitted on its data
- ADT = classes + information hiding

```
class Dish{
public:
     void pourIn( double amount);
     void pourOut(double amount);
private:
     double capacity;
     double currentAmount;
};
```

Approximate Terminology

- instance = object
- field = instance variable
- method = function
- sending a message to an object = calling a function

Some advice on designing classes

- Always, *always* strive for a narrow interface
- Follow the principle of information hiding:
  - the caller should know as little as possible about how the method does its job
  - the method should know little or nothing about where or why it is being called
- Make as much as possible private
- Your class is responsible for it's own data; don't allow other classes to easily modify it!

What we have spoken about so far?

- Class = Data + Member Functions.
- Abstract Data Type = Class + information hiding
- How to activate member functions.
- But you still need to learn how to write the bodies of a class's methods.

Next time

- Implementing C++ classes
  - information hiding with access specifiers
  - Constructors