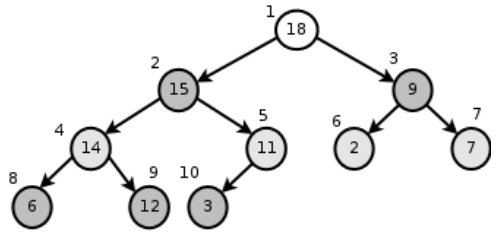
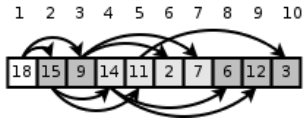
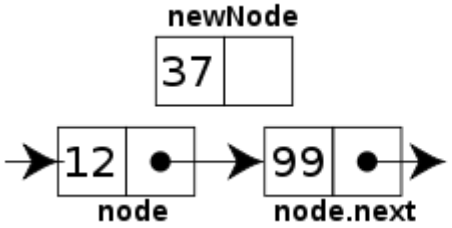
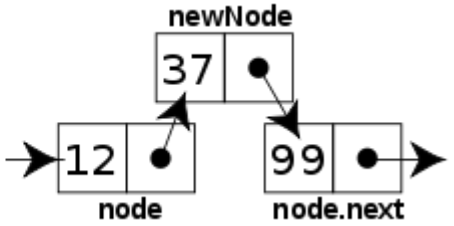




INSERTION-SORT(A)

		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	$n-1$





WELCOME TO CS 24!

Problem Solving with Computers-II

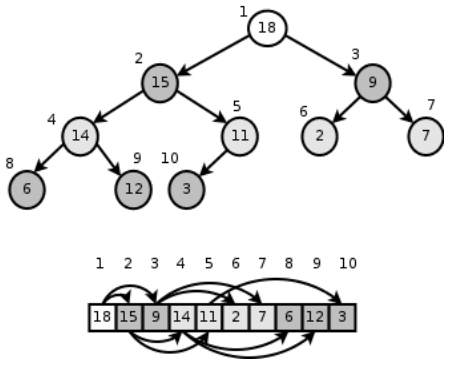
Instructor: Diba Mirza

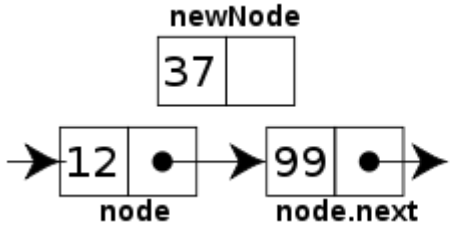
Read the syllabus. Know what's required. Know how to get help.

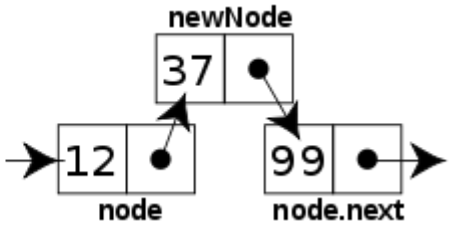
About this course

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
- Understand what goes on **under the hood of 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	$n-1$
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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

About the team

Instructor: Diba Mirza

- **TAs:** April Sanchez, Lucas Relic, Jiarui Zhu, Shichang Liu, Nawel Alioua, Bowen Zhang Vinothini Gunasekaran, Roman Aguilera
- **ULAs:** Lucas Nguyen, Vanessa Salgado
- **ULAs** in training: Julian Wong, Allison Huang

- Communication with staff via **Piazza**
- Lectures, sections, OH will be remote for the first two weeks
- Include [CS24] in the subject line of any email communication with me

Note: OH schedule may change after we switch to in person

** Ask questions about class examples, assignment questions, or other CS topics. **

Course Logistics

- Coure website: https://ucsb-cs24.github.io/w22
- If you have a section conflict, you may informally switch your section time. Post to the “section swap” thread on Piazza to announce the switch.
- NO MAKEUPS ON EXAMS!
- NO extensions on assignment deadlines. Keep track of due dates published on our class calendar: https://ucsb-cs24.github.io/w22/info/calendar/
- 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

iClicker Cloud

- Instructions to register for iclicker cloud for free are on Gauchospace
- Download the iclicker REEF app to participate in class

Required textbook

Zybook: CMPSC 24: Problem Solving with Computers II

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

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.

About you…

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

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 lectures

- I will not be a talking textbook
- I love interaction: Ask questions anytime over chat but wait for a few minutes for me to answer.
- I'll ask you questions too! Be ready to discuss and participate over chat and by responding to multiple choice questions (clicker cloud).
- Practice with the chat window:
  - What are looking forward to this quarter?
  - What questions do you have?

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

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
```

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