Introduction

CSE 373
Data Structures
Winter 2006

Staff

- Instructor
  - Hal Perkins (perkins at cs.washington.edu)
- TA's
  - Gary Yngve (gyngve at cs.washington.edu)
  - Toby Roseman (tobyr at cs.washington.edu)
- Email is particularly good for short questions, setting up appointments, topics not suitable for class discussion list. Not so good for program debugging, grading questions, …

Web Page

- All info is on the web page for CSE 373
  (or at least will be once things are a bit further along…)
  - http://www.cs.washington.edu/373
  - also known as
    - http://www.cs.washington.edu/education/courses/373/06wi
- Look there for schedules, contact information, assignments, links to discussion boards and mailing lists, etc.

Office Hours

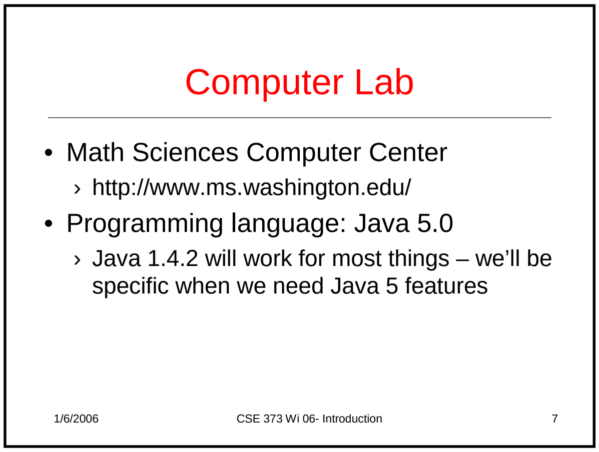
- Hal Perkins – 548 CSE (Allen Center)
  - MW after class + appointments
- Gary Yngve – tba
- Toby Roseman – tba

CSE 373 E-mail List

- If you are registered for the course you will be automatically registered. Otherwise, subscribe by going to the class web page
- E-mail list is used for posting important announcements by instructor and TAs
  - You are responsible for anything sent here

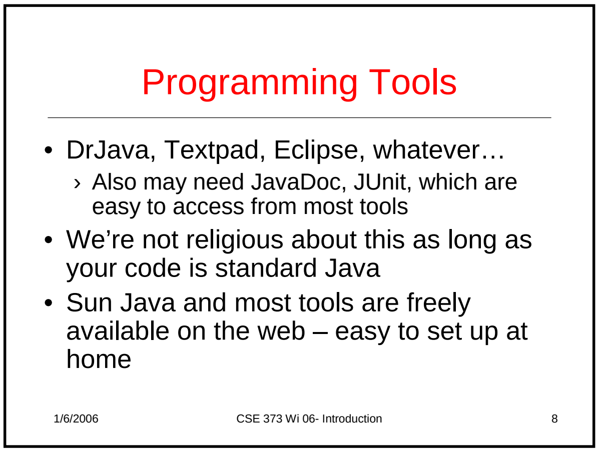
CSE 373 Discussion Board

- The course will have a Catalyst e-post message board
- Use
  - General discussion of class contents
  - Hints and ideas about assignments (but **not** detailed code or solutions)
  - Other topics related to the course



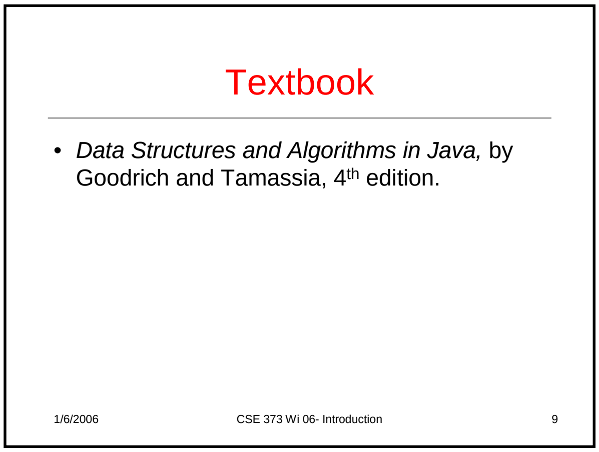
Computer Lab

- Math Sciences Computer Center
  - › http://www.ms.washington.edu/
- Programming language: Java 5.0
  - › Java 1.4.2 will work for most things – we'll be specific when we need Java 5 features



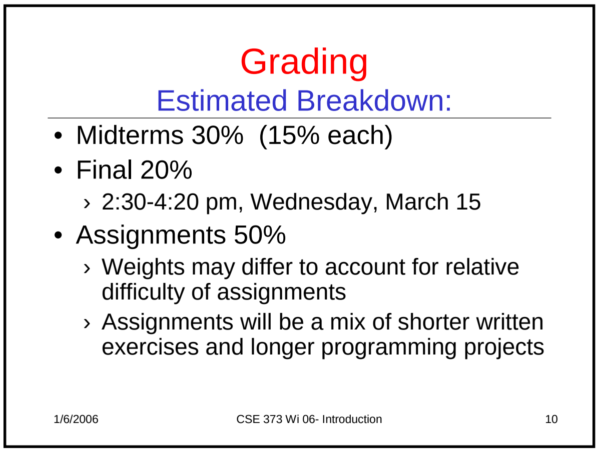
Programming Tools

- DrJava, Textpad, Eclipse, whatever…
  - › Also may need JavaDoc, JUnit, which are easy to access from most tools
- We're not religious about this as long as your code is standard Java
- Sun Java and most tools are freely available on the web – easy to set up at home



Textbook

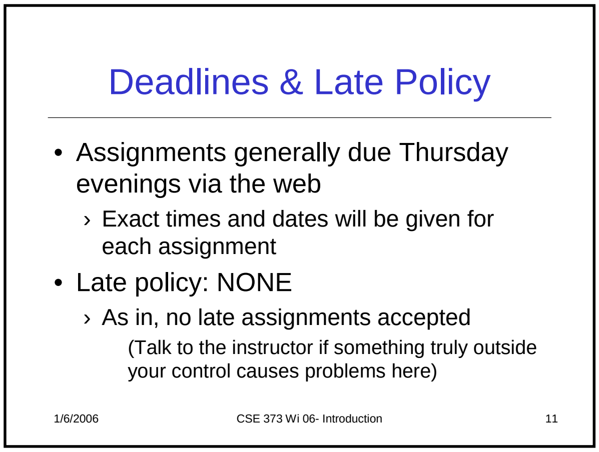
- *Data Structures and Algorithms in Java,* by Goodrich and Tamassia, 4th edition.



Grading

Estimated Breakdown:

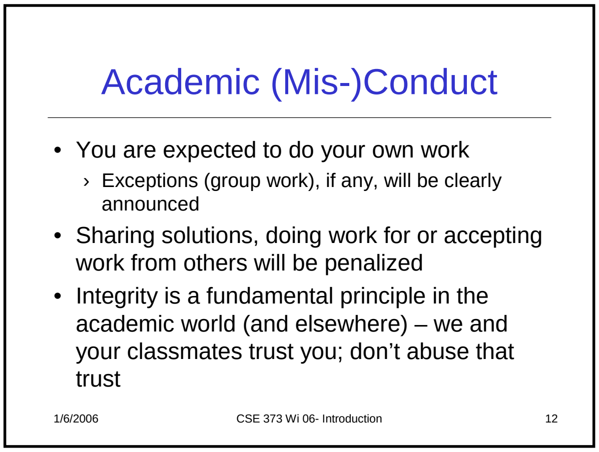
- Midterms 30% (15% each)
- Final 20%
  - › 2:30-4:20 pm, Wednesday, March 15
- Assignments 50%
  - › Weights may differ to account for relative difficulty of assignments
  - › Assignments will be a mix of shorter written exercises and longer programming projects



Deadlines & Late Policy

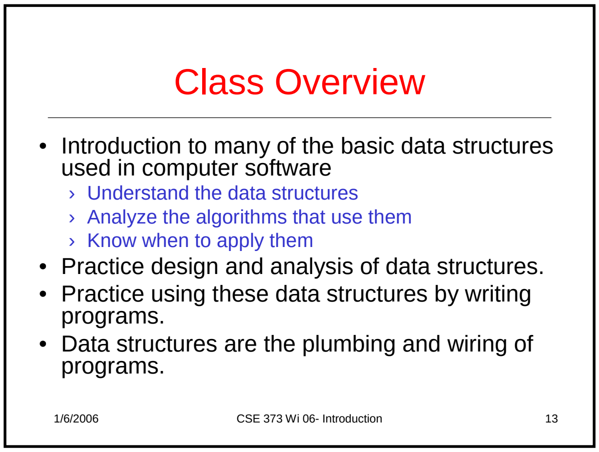
- Assignments generally due Thursday evenings via the web
  - › Exact times and dates will be given for each assignment
- Late policy: NONE
  - › As in, no late assignments accepted

    (Talk to the instructor if something truly outside your control causes problems here)



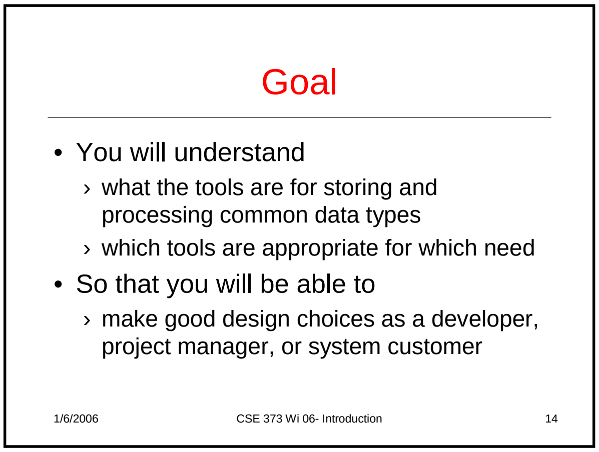
Academic (Mis-)Conduct

- You are expected to do your own work
  - › Exceptions (group work), if any, will be clearly announced
- Sharing solutions, doing work for or accepting work from others will be penalized
- Integrity is a fundamental principle in the academic world (and elsewhere) – we and your classmates trust you; don't abuse that trust



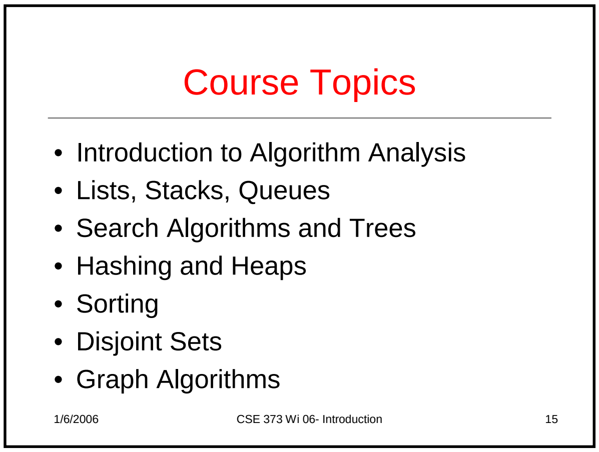
Class Overview

- Introduction to many of the basic data structures used in computer software
  - › Understand the data structures
  - › Analyze the algorithms that use them
  - › Know when to apply them
- Practice design and analysis of data structures.
- Practice using these data structures by writing programs.
- Data structures are the plumbing and wiring of programs.



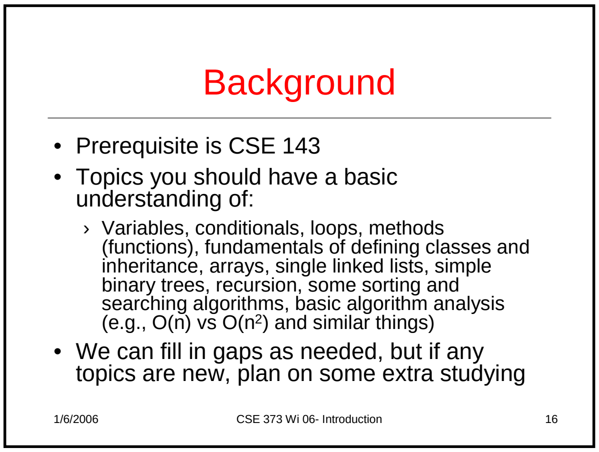
Goal

- You will understand
  - › what the tools are for storing and processing common data types
  - › which tools are appropriate for which need
- So that you will be able to
  - › make good design choices as a developer, project manager, or system customer



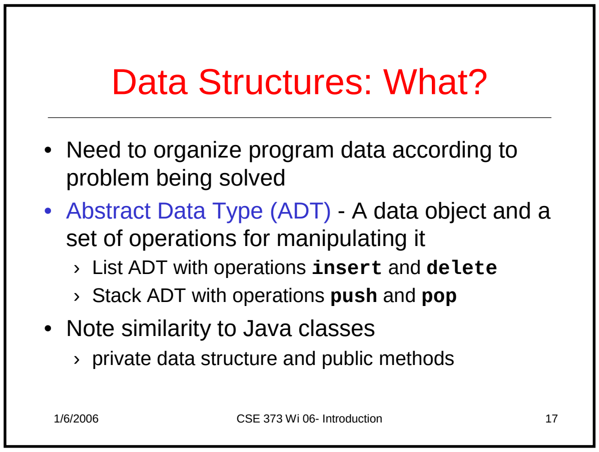
Course Topics

- Introduction to Algorithm Analysis
- Lists, Stacks, Queues
- Search Algorithms and Trees
- Hashing and Heaps
- Sorting
- Disjoint Sets
- Graph Algorithms



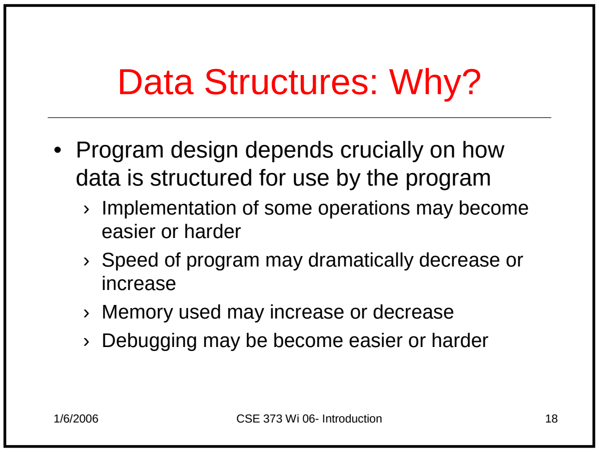
Background

- Prerequisite is CSE 143
- Topics you should have a basic understanding of:
  - › Variables, conditionals, loops, methods (functions), fundamentals of defining classes and inheritance, arrays, single linked lists, simple binary trees, recursion, some sorting and searching algorithms, basic algorithm analysis (e.g., O(n) vs O(n^2) and similar things)
- We can fill in gaps as needed, but if any topics are new, plan on some extra studying



Data Structures: What?

- Need to organize program data according to problem being solved
- Abstract Data Type (ADT) - A data object and a set of operations for manipulating it
  - › List ADT with operations **`insert`** and **`delete`**
  - › Stack ADT with operations **`push`** and **`pop`**
- Note similarity to Java classes
  - › private data structure and public methods



Data Structures: Why?

- Program design depends crucially on how data is structured for use by the program
  - › Implementation of some operations may become easier or harder
  - › Speed of program may dramatically decrease or increase
  - › Memory used may increase or decrease
  - › Debugging may be become easier or harder

Terminology

- Abstract Data Type (ADT)
  - Mathematical description of an object with set of operations on the object. Useful building block.
- Algorithm
  - A high level, language independent, description of a step-by-step process
- Data structure
  - A specific family of algorithms for implementing an abstract data type.
- Implementation of data structure
  - A specific implementation in a specific language

Algorithm Analysis: Why?

- Correctness:
  - Does the algorithm do what is intended.
- Performance:
  - What is the running time of the algorithm.
  - How much storage does it consume.
- Different algorithms may correctly solve a given task
  - Which should I use?

Iterative Algorithm for Sum

- Find the sum of the first **num** integers stored in an array **v**.

```
sum(v[ ]: integer array, num: integer): integer{
    temp_sum: integer ;
    temp_sum := 0;
    for i = 0 to num – 1 do
        temp_sum := v[i] + temp_sum;
    return temp_sum;
}
```

Note the use of pseudocode

Programming via Recursion

- Write a *recursive* function to find the sum of the first **num** integers stored in array **v**.

```
sum (v[ ]: integer array, num: integer): integer {
    if num = 0 then
        return 0                          } base case
    else
        return v[num-1] + sum(v,num-1);   } recursive case
}
```

Pseudocode

- In the lectures algorithms will (often) be presented in “pseudocode”.
  - Common in the computer science literature
  - Pseudocode is usually easily translated to real code.
  - Independent of particular programming language
  - Informal but precise: there is no “official” language definition for pseudocode

Algorithms vs Programs

- Proving correctness of an algorithm is very important
  - a well designed algorithm is guaranteed to work correctly and its performance can be estimated
- Proving correctness of a program (an implementation) is fraught with weird bugs
  - Abstract Data Types are a way to bridge the gap between mathematical algorithms and programs