CS 171: Introduction to Computer Science II

Department of Mathematics and Computer Science

Li Xiong

Today

- Meet everybody in class
- Course overview
- Course logistics
- Pre-test

Instructor and TA

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About Me

- Undergraduate teaching
  - CS170 Intro to CS I
  - CS171 Intro to CS II
  - CS377 Database systems
- Graduate teaching
  - CS550 Database systems
  - CS570 Data mining
  - CS573 Data privacy and security
- Research
  - data privacy and security
  - information integration and informatics

Meet everyone in class

- Group introduction (3-5 people)
- Introducing your group
  - Names
  - Your goals for the course
  - Something interesting about your group

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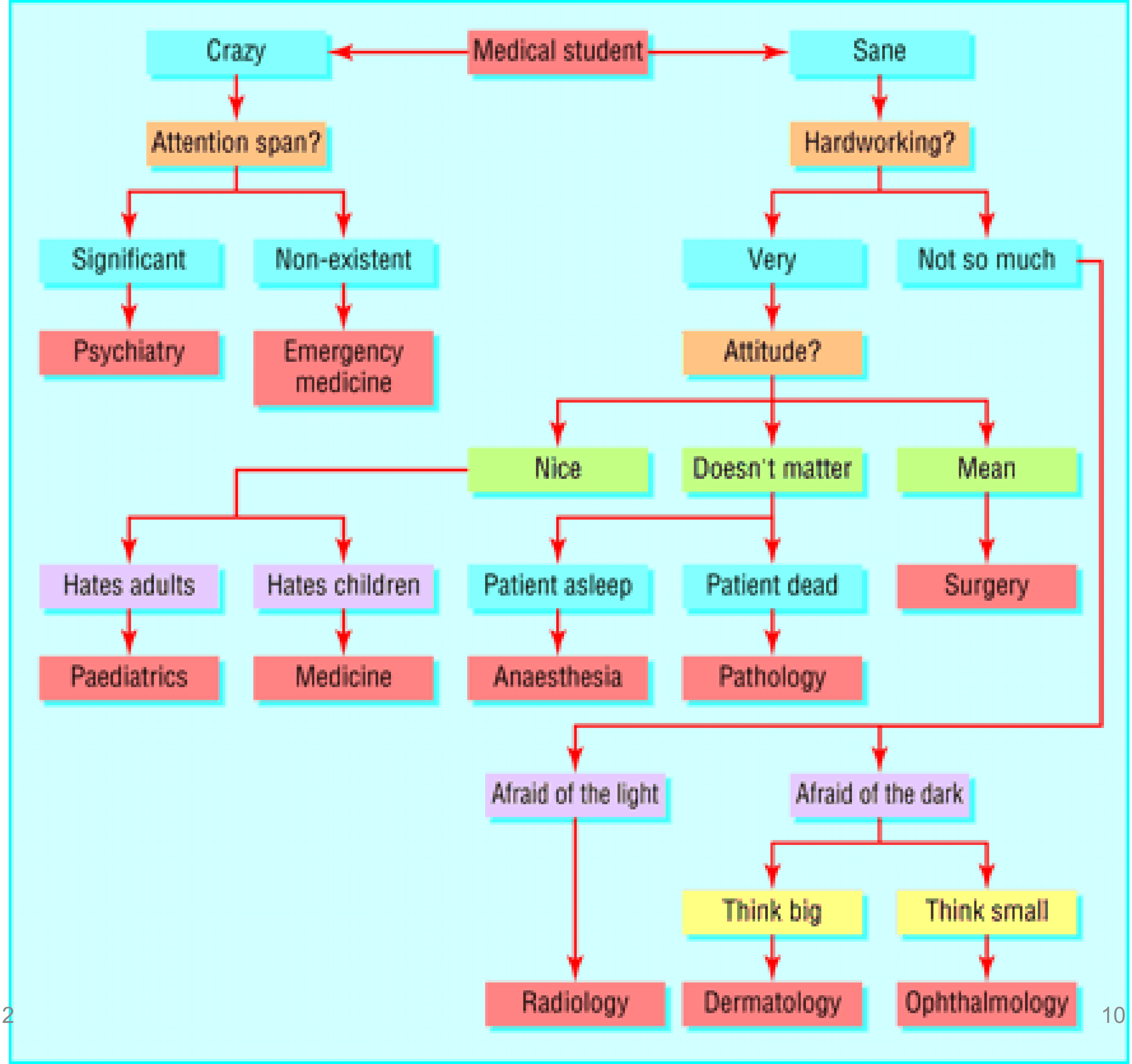
What the class is about

- A continuation of CS170
- Programming and problem solving, with applications
- Algorithms and algorithm analysis – methods to solve problems
- Data structures – methods to store information

What is an algorithm

- An algorithm is a method for solving a problem expressed as a sequence of steps that is suitable for execution by a computer (machine)
- Can be expressed in
  - natural languages
  - Flowcharts
  - Pseudocode
  - programming languages

…And that, in simple terms, is how you increase your ranking on search engines."



Crazy

Medical student

Sane

Attention span?

Hardworking?

Significant

Non-existent

Very

Not so much

Psychiatry

Emergency medicine

Attitude?

Nice

Doesn't matter

Mean

Hates adults

Hates children

Patient asleep

Patient dead

Surgery

Paediatrics

Medicine

Anaesthesia

Pathology

Afraid of the light

Afraid of the dark

Think big

Think small

Radiology

Dermatology

Ophthalmology

What is an algorithm: example

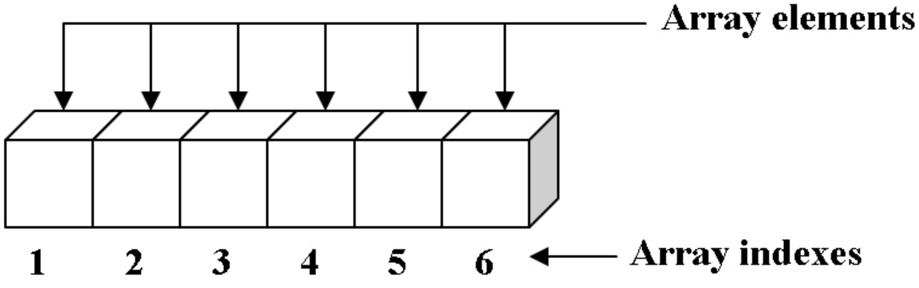
- Determine if a number n is a prime number (pseudocode and Java)

```
k = 2;
As long as k < n do
{ 1. Divide n by k
  2. If n is divisible by k, then return NO
  3. Otherwise, increase k by 1 }
return YES
```

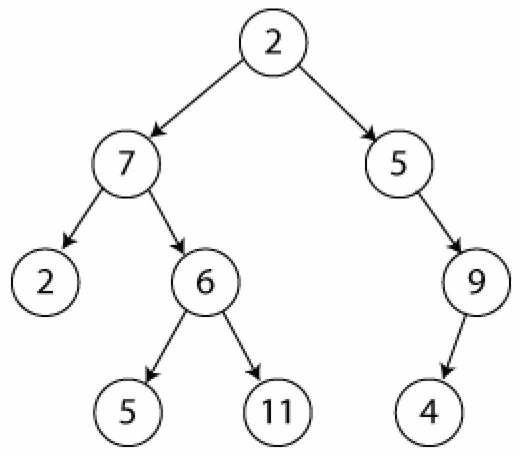
```
int k = 2;
while ( k++ < n ) {
    if ( n%k == 0) return false;
 }
return true;
```

What is a data structure

- A data structure is a way for organizing and accessing data
- Example data structures
  - Arrays
  - Trees, Graphs
- We will learn
  - Fundamental data structures and their operations
  - How to use Java's provided data structures
  - How to implement some of them
  - How to evaluate them and decide when to use what



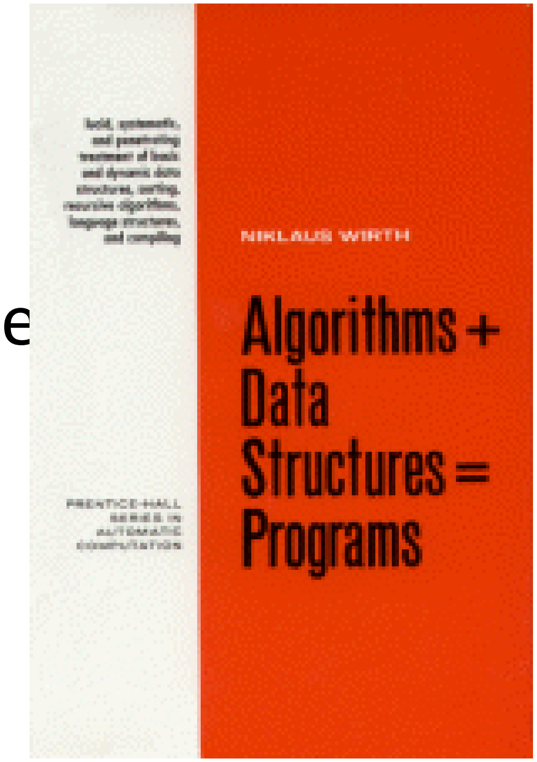
One-dimensional array with six elements



Tree with nine elements

Algorithms and data structures

- Algorithm + Data Structure = Program
  - An algorithm must use some data structure to store its information
  - An algorithm manipulates the data in the data structures in various ways
- To write a program
  - Design the data structures to store the information
  - Design the algorithm that uses the information to solve the problem
  - Implement the algorithm



bold, systematic, and penetrating treatment of basic and dynamic data structures, sorting, recursive algorithms, language structures, and compiling

NIKLAUS WIRTH

Algorithms + Data Structures = Programs

PRENTICE-HALL SERIES IN AUTOMATIC COMPUTATION

Algorithms and data structures

“ I will, in fact, claim that the difference between a bad programmer and a good one is whether he considers his code or his data structures more important. Bad programmers worry about the code. Good programmers worry about data structures and their relationships. ”

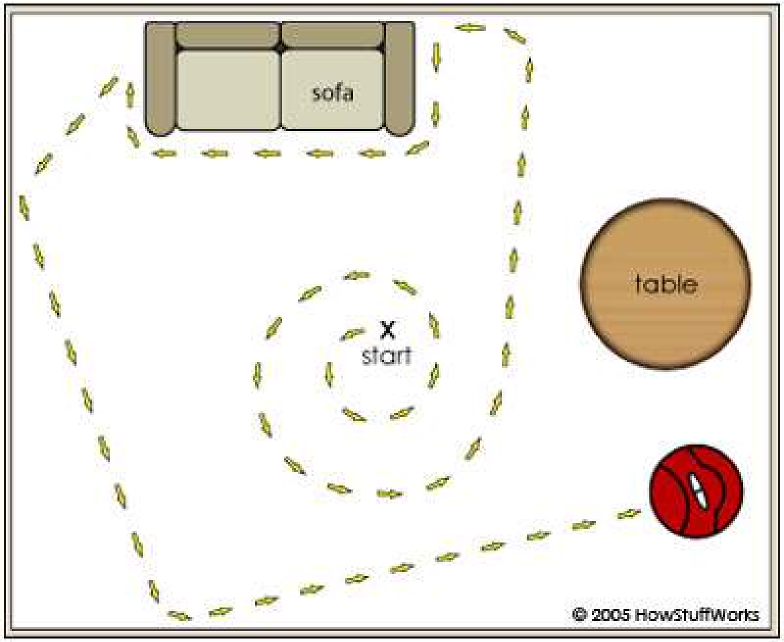
— Linus Torvalds (creator of Linux)

Good Algorithms and Data Structures

- Good algorithms and data structures are keys to write a good program for solving a problem
- Think about maintaining a phone directory or social network
  - A large number of records
  - Add/delete/modify records
  - Missing fields in records
  - Efficient search in a giant directory

Good algorithms and data structures

- Need ways to measure "goodness" of data structures and algorithms
- Algorithm analysis
  - Running analysis, Big-O notation
- Other goodness metrics: space usage, power



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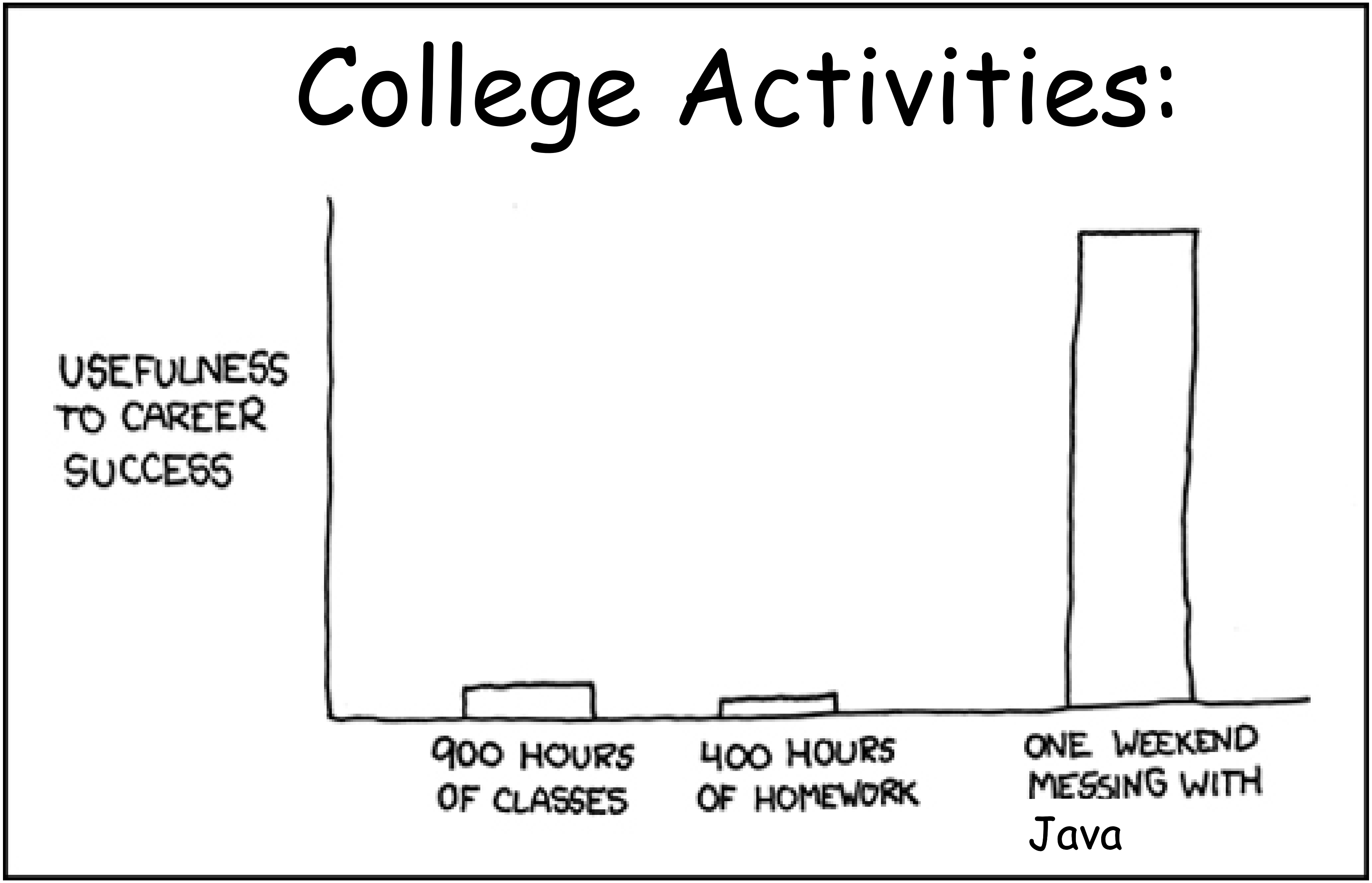
Course topics

- Data structures
  - Fundamental data structures: arrays, linked lists
  - Operations (algorithms that maintain and use the data structure): search, insertion, deletion, sort
  - Abstract data types (a data structure with its associated operations): stacks, queues, trees, hash tables, graphs
- Algorithms
  - Fundamental algorithms: sort, search, recursion
  - Algorithm analysis: runtime complexity, Big-O notation
- Programming
  - Java programming techniques
  - Applications: scientific, recreational, social networks, etc.

XKCD says it better



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Textbook

- Algorithms, 4th Edition, Sedgewick and Wayne
- Book site: http://algs4.cs.princeton.edu

Workload

- ~6 programming assignments (individual)
- 2 programming projects (team of up to 2 students)
- Assignment/project prep labs (not graded)
- Midterm and final exam
- Reading and quizzes

Grading

Programming assignments	30%
Programming projects	20%
Midterm	20%
Final	25%
Quizzes	5%

Policies

- Exams
  - All exams must be taken promptly at the required time.
  - Rescheduling midterm is possible if the request is made at least a week prior to the exam date
  - Final can not be rescheduled.
- Late assignment policy
  - Late assignment will be accepted within 3 days of the due date and penalized 10% per day. No extensions will be given.
  - 2 late assignment allowances, each can be used to turn in a single late assignment within 3 days of the due date without penalty.
- **Honor code**
  - College Honor Code and Departmental Policy
  - No collaboration is allowed on individual programming assignments.
  - Every program assignment must have the following comment included at the top of the file.

```
/*
THIS CODE IS MY OWN WORK, IT WAS WRITTEN WITHOUT CONSULTING
CODE WRITTEN BY OTHER STUDENTS. _Your_Name_Here_
*/
```

Study Strategy

- Come to class, think and participate
- Read the book or book site and play with the sample programs
- Come to office hours (TA and me)
- Start programming assignments early
- Think before program
- Enjoy and good luck!

Summary of Course Expectations

- This course will be **fun** and you will learn **a lot**, but expect to spend the **time and effort**:
  - To dig deeper into CS techniques and problem solving
  - To spend some sweat developing and debugging Java programs
- If you put in the effort, your reward will be a set of useful skills for other courses and the “real world”.
- Enjoy and good luck!

And now …

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