Welcome to CS106B!

Who's Here Today?

- Aero/Astro
- Anthropology
- Art Practice
- Bioengineering
- Biology
- Business
- Chemical Engineering
- Chemistry
- Civil/Environmental Engineering
- Creative Writing
- Data Science
- East Asian Studies
- Economics
- Education
- Electrical Engineering
- Energy Resources Engineering
- English
- Environmental Systems Engineering
- FemGen
- Genetics
- History
- Human Biology
- Immunology
- International Relations
- Law
- Materials Science
- Mechanical Engineering
- Microbiology and Immunology
- Middle Eastern Languages / Culture
- MS&E
- Physics
- Political Science
- Product Design
- Psychology
- Public Policy
- Spanish
- Statistics
- STS
- Symbolic Systems
- SymSys
- *Undeclared!*

Course Staff

Instructor: Keith Schwarz
(htiek@cs.stanford.edu)

Head TA: Kate Rydberg
(rydbergk@stanford.edu)

The CS106B Section Leaders
The CS106B Course Helpers

Course Website

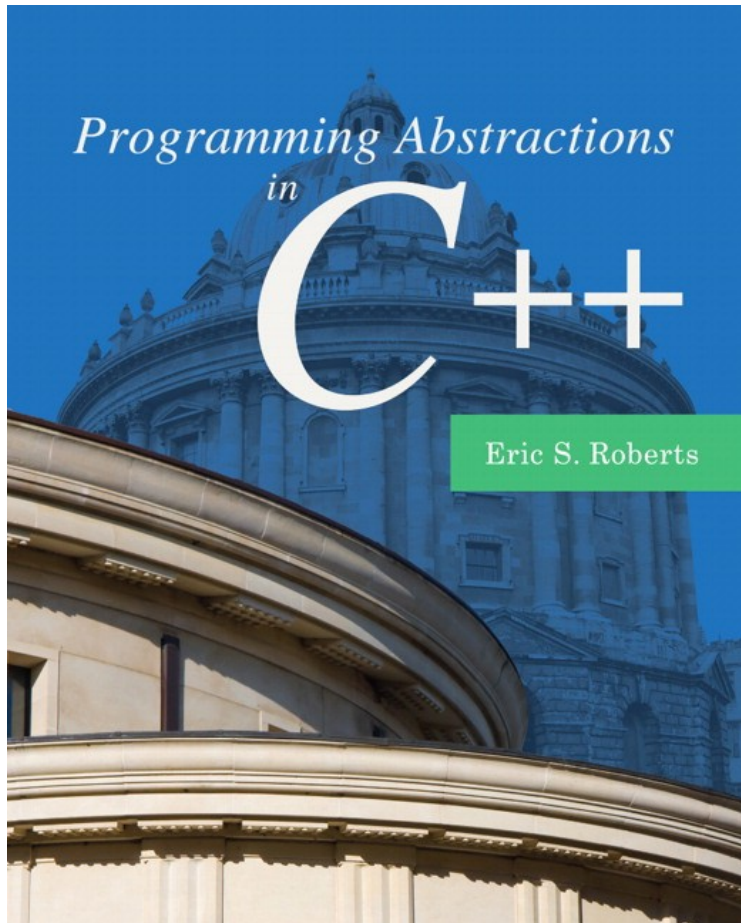**https://cs106b.stanford.edu**

Prerequisites

CS106A

(or equivalent)
(check out our course placement handout if you're unsure!)

Required Reading

- Available in the bookstore. Some copies are on reserve in the Engineering library.

- We do recommend picking up a copy of this book, since it provides a lot of useful extra background information.

Grading Policies

Grading Policies

■ 35% Assignments

Eight Assignments

(One intro assignment that goes out today, seven programming assignments)

Grading Policies

■ 35% Assignments
■ 25% Midterm Exam

Midterm Exam

Tuesday, February 19th
7PM – 10PM
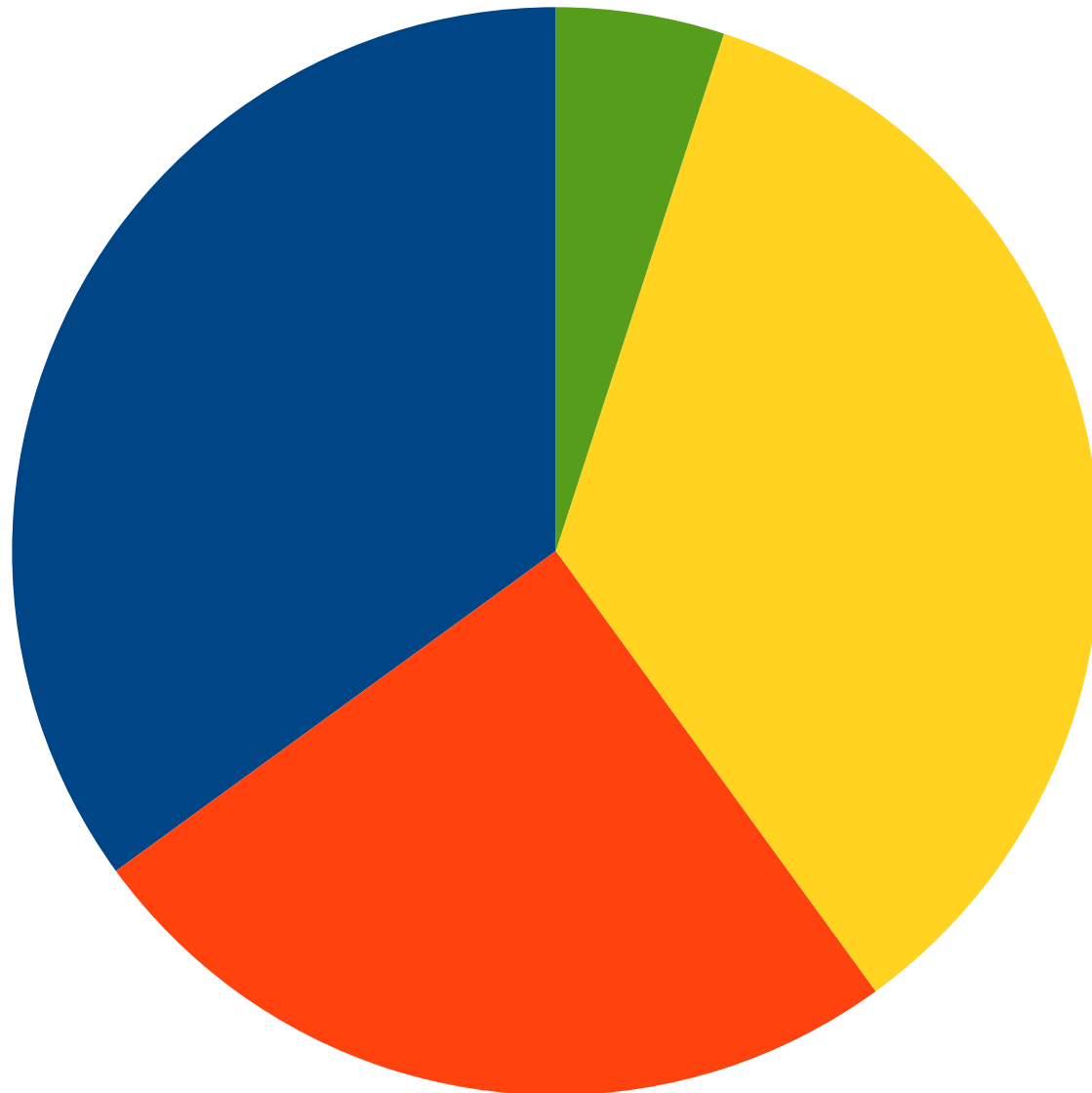Location TBA

Grading Policies

- 35% Assignments
- 25% Midterm Exam
- 35% Final Exam

Final Exam

Monday, March 18th
8:30AM – 11:30AM
No alternate exams except for OAE accommodations.

Grading Policies

- 35% Assignments
- 25% Midterm Exam
- 35% Final Exam
- 5% Section Participation

Discussion Sections

Weekly sections. Let's go talk about them!

Discussion Sections

- There are weekly discussion sections in CS106B. Section attendance is required.

- Sign up between Thursday, January 10th at 5:00PM and Sunday, January 13th at 5:00PM by visiting

  http://cs198.stanford.edu/section

- We don't look at Axess for section enrollments. Please make sure to sign up here even if you're already enrolled on Axess.

CS106S

- CS106S is an optional one-unit add-on course for CS106B that touches on applications of the material to civics, education, healthcare, and the like.

- This is "in addition to" rather than "instead of" regular section.e

How Many Units?

```
int numUnits(bool isGrad) {
    if (isGrad) {
        return randomInteger(3, 5); // 3 to 5
    } else {
        return 5;
    }
}
```

Getting Help

Getting Help

- LaIR Hours!
  - Sunday – Thursday, 7PM – 11PM
  - Held in the first floor of Tresidder Student Union.
  - LaIR hours start next week.
- Kate's Office Hours in Gates B02
  - Tuesdays and Thursdays, 1:30PM – 2:30PM.
- Keith's Office Hours in Gates 178
  - Tuesdays, 10:00AM – 12:00PM.
  - Stop on by! I'm happy to chat about just about anything.

What's Next in Computer Science?

Goals for this Course

- ***Learn how to model and solve complex problems with computers.***

- To that end:

  - Explore common abstractions for representing problems.

  - Harness recursion and understand how to think about problems recursively.

  - Quantitatively analyze different approaches for solving problems.

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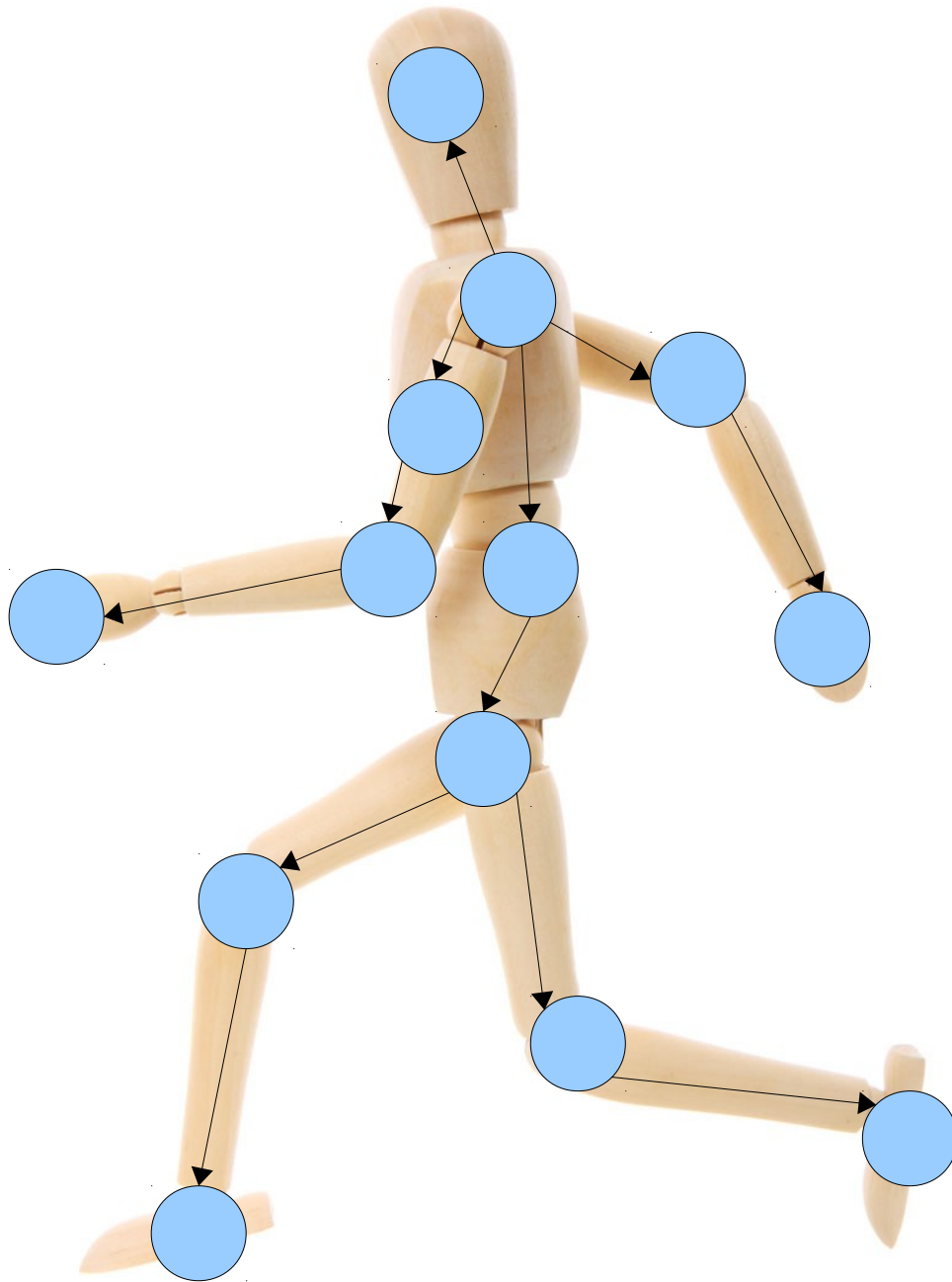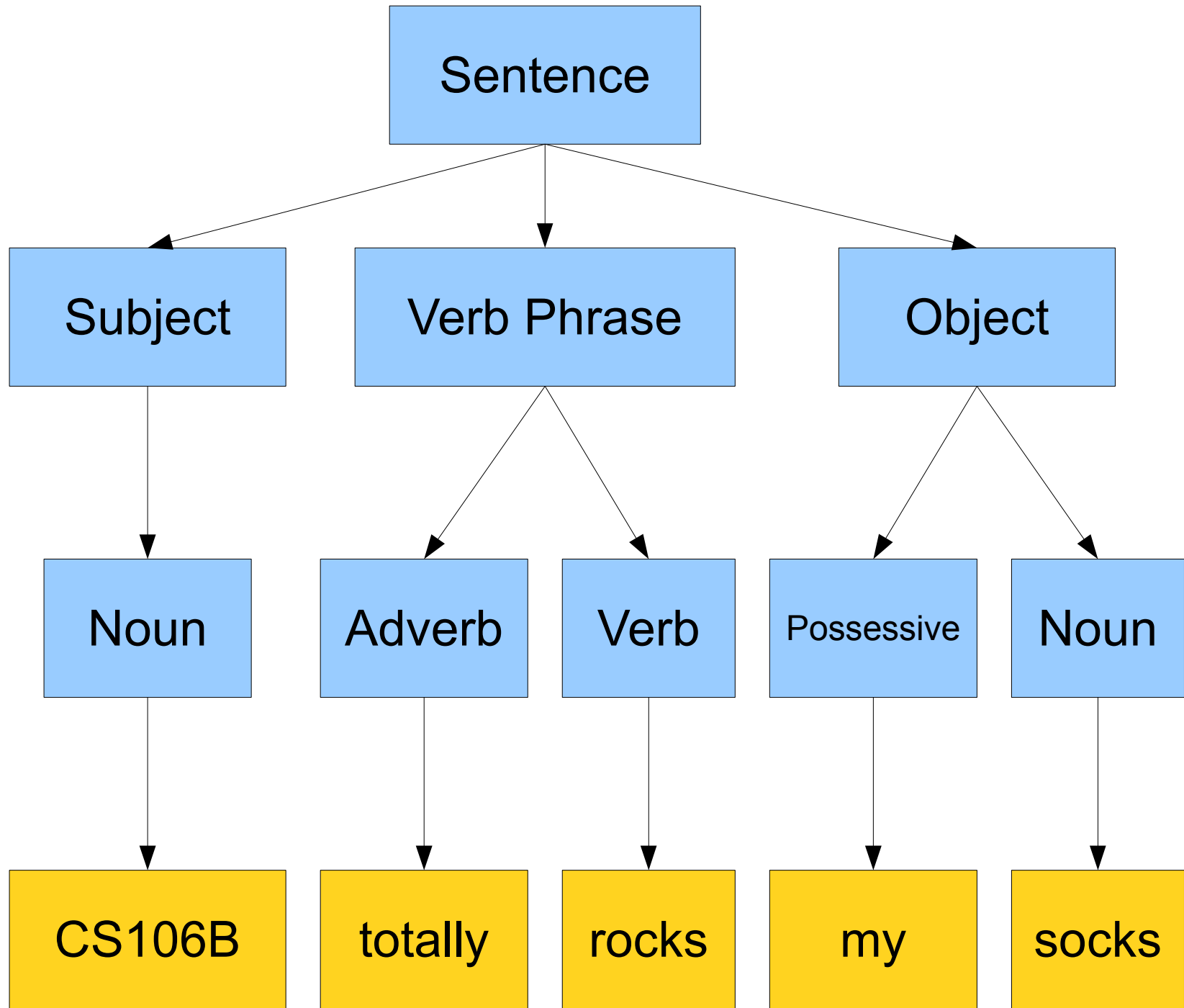
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```
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        │  Subject  │   │ Verb Phrase │   │  Object   │
        └───────────┘   └─────────────┘   └───────────┘
              │           ┌──────┴──────┐     ┌──────┴──────┐
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              ▼           ▼           ▼          ▼             ▼
        ┌───────────┐ ┌────────┐  ┌────────┐ ┌────────┐   ┌────────┐
        │  CS106B   │ │ totally│  │ rocks  │ │   my   │   │ socks  │
        └───────────┘ └────────┘  └────────┘ └────────┘   └────────┘
```

THE GOVERNMENT OF THE UNITED STATES

THE CONSTITUTION

LEGISLATIVE BRANCH

THE CONGRESS

SENATE HOUSE

- ARCHITECT OF THE CAPITOL
- UNITED STATES BOTANIC GARDEN
- GENERAL ACCOUNTING OFFICE
- GOVERNMENT PRINTING OFFICE
- LIBRARY OF CONGRESS
- CONGRESSIONAL BUDGET OFFICE

EXECUTIVE BRANCH

THE PRESIDENT

THE VICE PRESIDENT

EXECUTIVE OFFICE OF THE PRESIDENT

- WHITE HOUSE OFFICE
- OFFICE OF THE VICE PRESIDENT
- COUNCIL OF ECONOMIC ADVISERS
- COUNCIL ON ENVIRONMENTAL QUALITY
- NATIONAL SECURITY COUNCIL
- OFFICE OF ADMINISTRATION
- OFFICE OF MANAGEMENT AND BUDGET
- OFFICE OF NATIONAL DRUG CONTROL POLICY
- OFFICE OF POLICY DEVELOPMENT
- OFFICE OF SCIENCE AND TECHNOLOGY POLICY
- OFFICE OF THE U.S. TRADE REPRESENTATIVE

JUDICIAL BRANCH

THE SUPREME COURT OF THE UNITED STATES

- UNITED STATES COURTS OF APPEALS
- UNITED STATES DISTRICT COURTS
- TERRITORIAL COURTS
- UNITED STATES COURT OF INTERNATIONAL TRADE
- UNITED STATES COURT OF FEDERAL CLAIMS
- UNITED STATES COURT OF APPEALS FOR THE ARMED FORCES
- UNITED STATES TAX COURT
- UNITED STATES COURT OF APPEALS FOR VETERANS CLAIMS
- ADMINISTRATIVE OFFICE OF THE UNITED STATES COURTS
- FEDERAL JUDICIAL CENTER
- UNITED STATES SENTENCING COMMISSION

- DEPARTMENT OF AGRICULTURE
- DEPARTMENT OF COMMERCE
- DEPARTMENT OF DEFENSE
- DEPARTMENT OF EDUCATION
- DEPARTMENT OF ENERGY
- DEPARTMENT OF HEALTH AND HUMAN SERVICES
- DEPARTMENT OF HOMELAND SECURITY
- DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT

- DEPARTMENT OF THE INTERIOR
- DEPARTMENT OF JUSTICE
- DEPARTMENT OF LABOR
- DEPARTMENT OF STATE
- DEPARTMENT OF TRANSPORTATION
- DEPARTMENT OF THE TREASURY
- DEPARTMENT OF VETERANS AFFAIRS

### INDEPENDENT ESTABLISHMENTS AND GOVERNMENT CORPORATIONS

- AFRICAN DEVELOPMENT FOUNDATION
- CENTRAL INTELLIGENCE AGENCY
- COMMODITY FUTURES TRADING COMMISSION
- CONSUMER PRODUCT SAFETY COMMISSION
- CORPORATION FOR NATIONAL AND COMMUNITY SERVICE
- DEFENSE NUCLEAR FACILITIES SAFETY BOARD
- ENVIRONMENTAL PROTECTION AGENCY
- EQUAL EMPLOYMENT OPPORTUNITY COMMISSION
- EXPORT-IMPORT BANK OF THE U.S.
- FARM CREDIT ADMINISTRATION
- FEDERAL COMMUNICATIONS COMMISSION
- FEDERAL DEPOSIT INSURANCE CORPORATION
- FEDERAL ELECTION COMMISSION
- FEDERAL HOUSING FINANCE BOARD

- FEDERAL LABOR RELATIONS AUTHORITY
- FEDERAL MARITIME COMMISSION
- FEDERAL MEDIATION AND CONCILIATION SERVICE
- FEDERAL MINE SAFETY AND HEALTH REVIEW COMMISSION
- FEDERAL RESERVE SYSTEM
- FEDERAL RETIREMENT THRIFT INVESTMENT BOARD
- FEDERAL TRADE COMMISSION
- GENERAL SERVICES ADMINISTRATION
- INTER-AMERICAN FOUNDATION
- MERIT SYSTEMS PROTECTION BOARD
- NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
- NATIONAL ARCHIVES AND RECORDS ADMINISTRATION
- NATIONAL CAPITAL PLANNING COMMISSION
- NATIONAL CREDIT UNION ADMINISTRATION

- NATIONAL FOUNDATION ON THE ARTS AND THE HUMANITIES
- NATIONAL LABOR RELATIONS BOARD
- NATIONAL MEDIATION BOARD
- NATIONAL RAILROAD PASSENGER CORPORATION (AMTRAK)
- NATIONAL SCIENCE FOUNDATION
- NATIONAL TRANSPORTATION SAFETY BOARD
- NUCLEAR REGULATORY COMMISSION
- OCCUPATIONAL SAFETY AND HEALTH REVIEW COMMISSION
- OFFICE OF GOVERNMENT ETHICS
- OFFICE OF PERSONNEL MANAGEMENT
- OFFICE OF SPECIAL COUNSEL
- OVERSEAS PRIVATE INVESTMENT CORPORATION
- PEACE CORPS
- PENSION BENEFIT GUARANTY CORPORATION

- POSTAL RATE COMMISSION
- RAILROAD RETIREMENT BOARD
- SECURITIES AND EXCHANGE COMMISSION
- SELECTIVE SERVICE SYSTEM
- SMALL BUSINESS ADMINISTRATION
- SOCIAL SECURITY ADMINISTRATION
- TENNESSEE VALLEY AUTHORITY
- TRADE AND DEVELOPMENT AGENCY
- U.S. AGENCY FOR INTERNATIONAL DEVELOPMENT
- U.S. COMMISSION ON CIVIL RIGHTS
- U.S. INTERNATIONAL TRADE COMMISSION
- U.S. POSTAL SERVICE
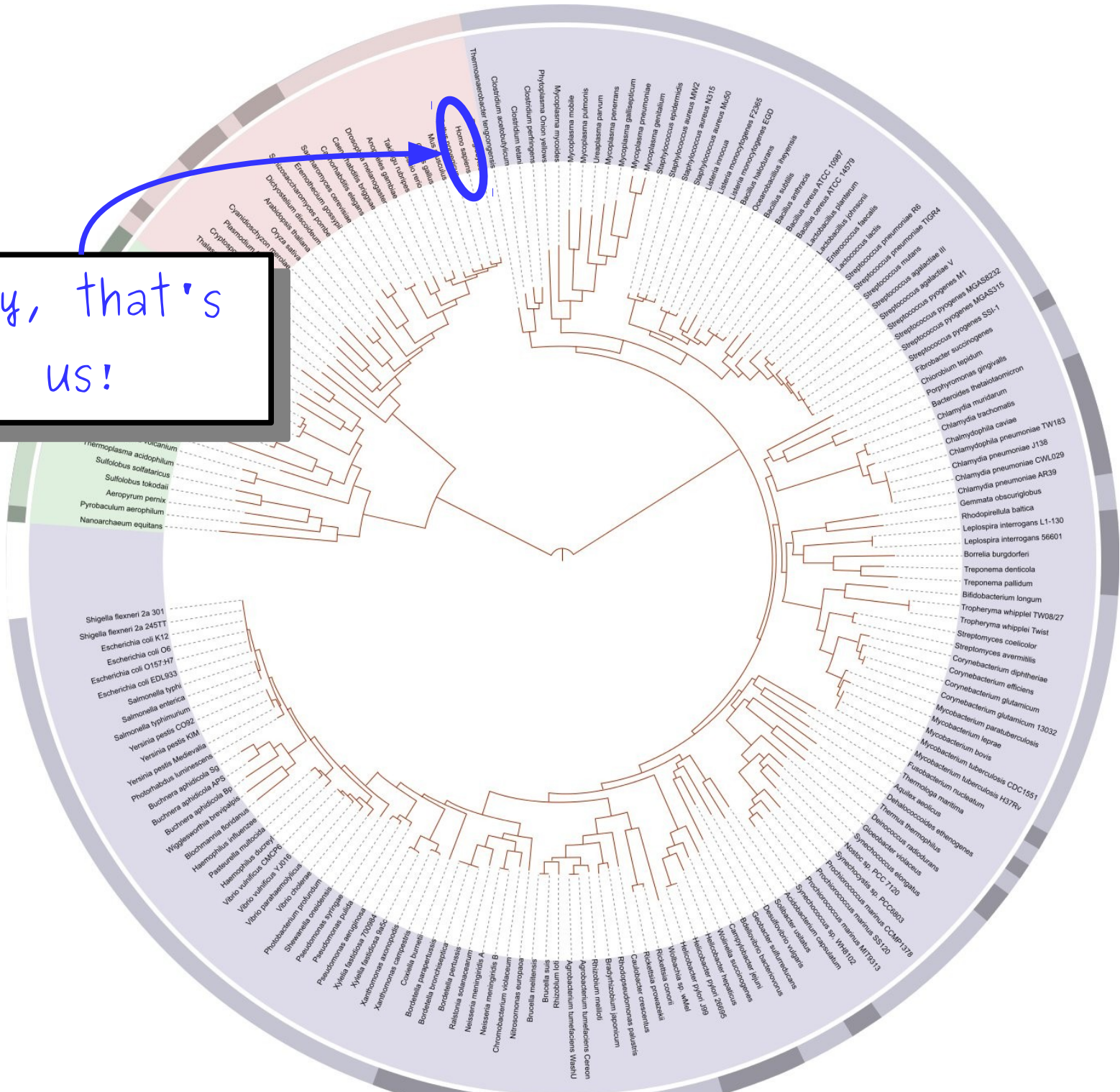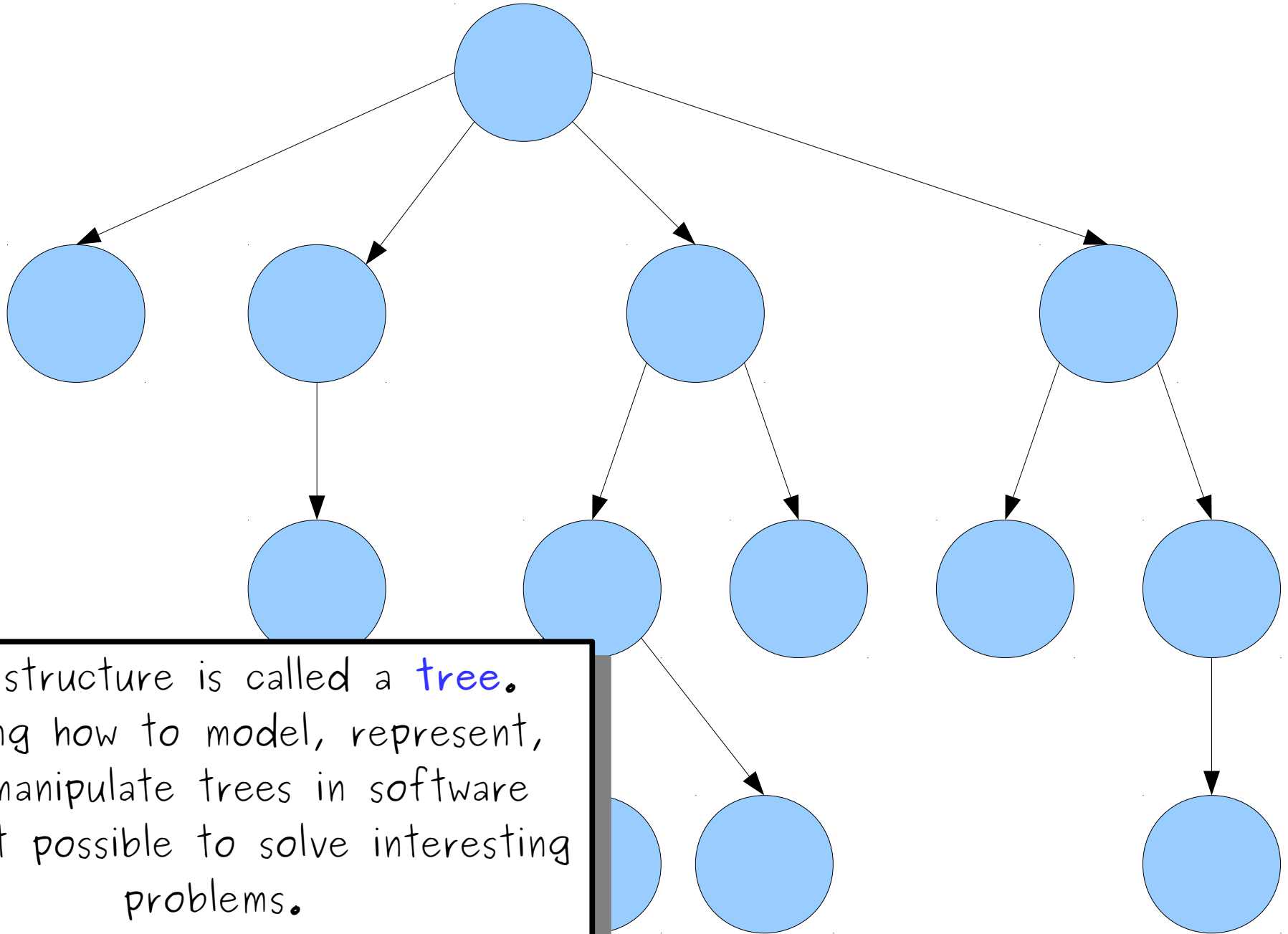
This structure is called a tree.
Knowing how to model, represent,
and manipulate trees in software
makes it possible to solve interesting
problems.

Building a vocabulary of *abstractions* makes it possible to represent and solve a wider class of problems.

How do we keep passwords secure
when servers are hacked all the time?
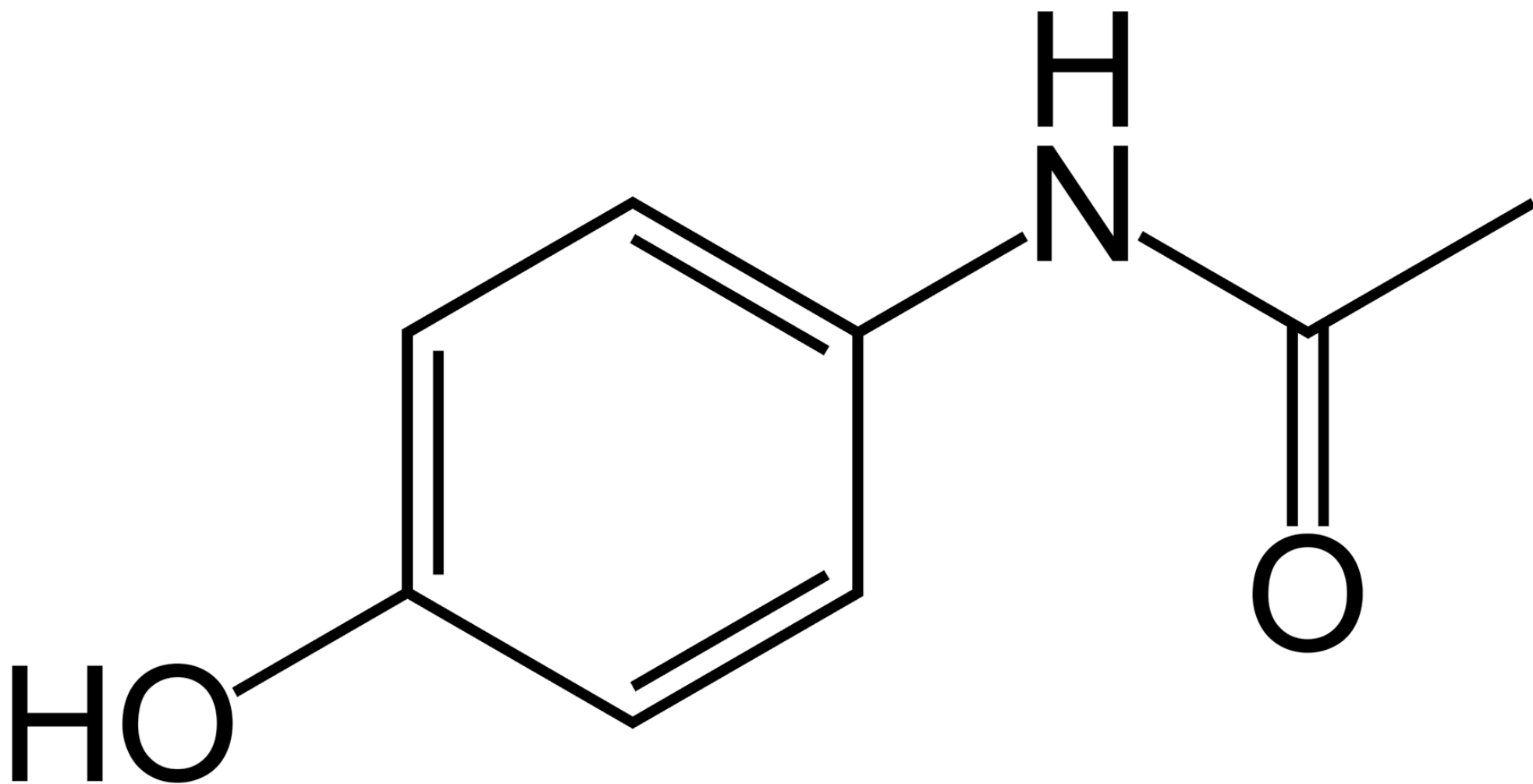
How do we quickly check whether a chemical has already been discovered?
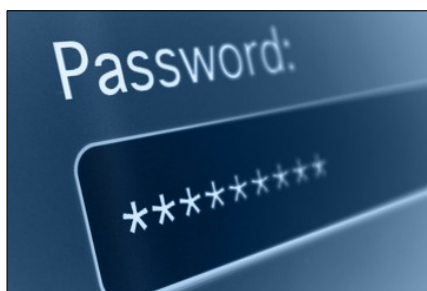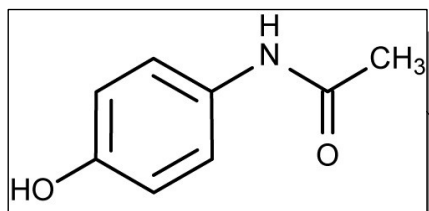
Hash Function

553872289012

224224651111

Inputs can be just about anything: strings, ID numbers, molecular shapes, passwords, etc.

Output is a seemingly random number that serves as a "fingerprint" of the input.

Building a vocabulary of ***abstractions*** makes it possible to represent and solve a wider class of problems.

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Creating Trees

A *recursive solution* is a solution that is defined in terms of itself.

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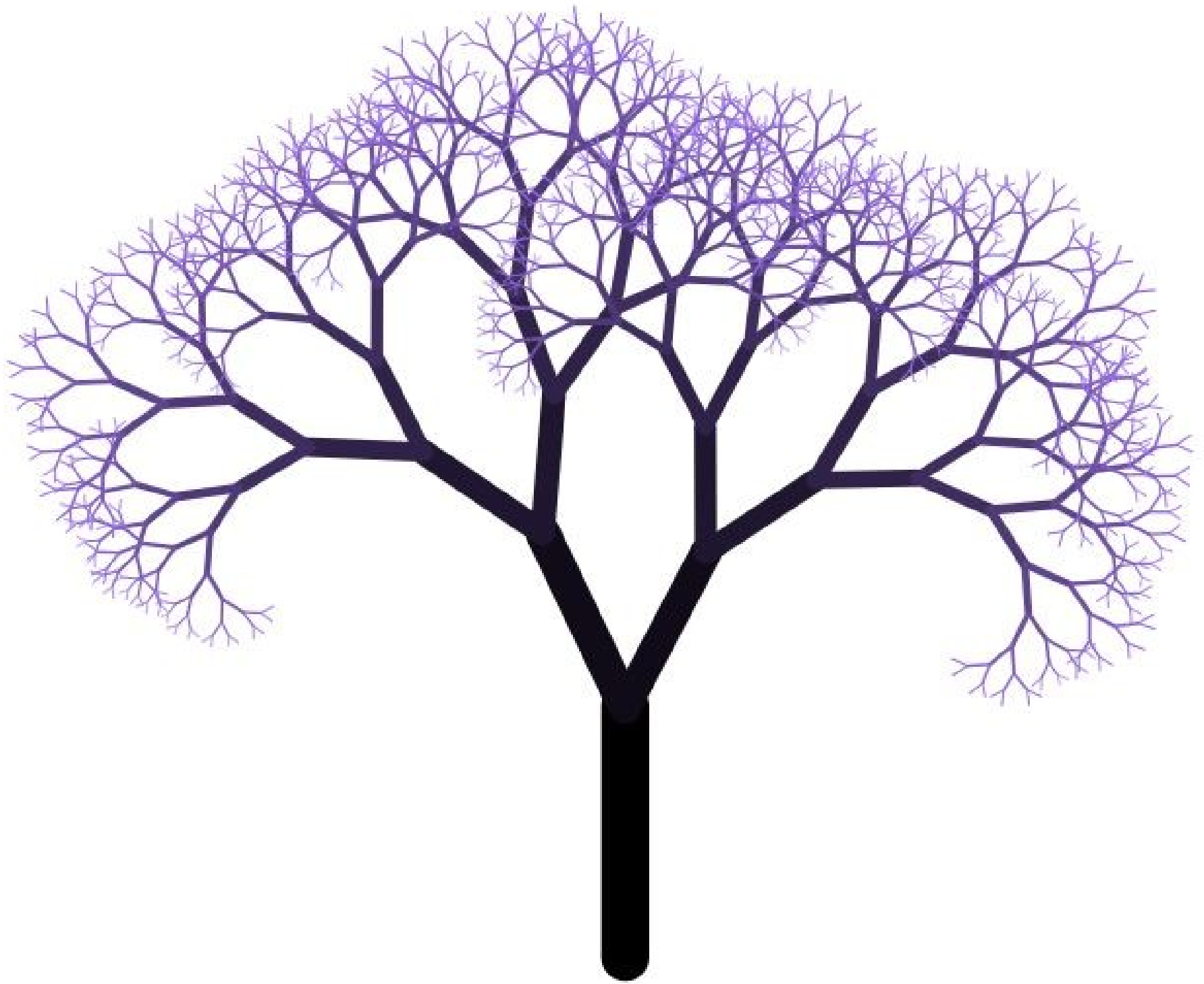
Goals for this Course

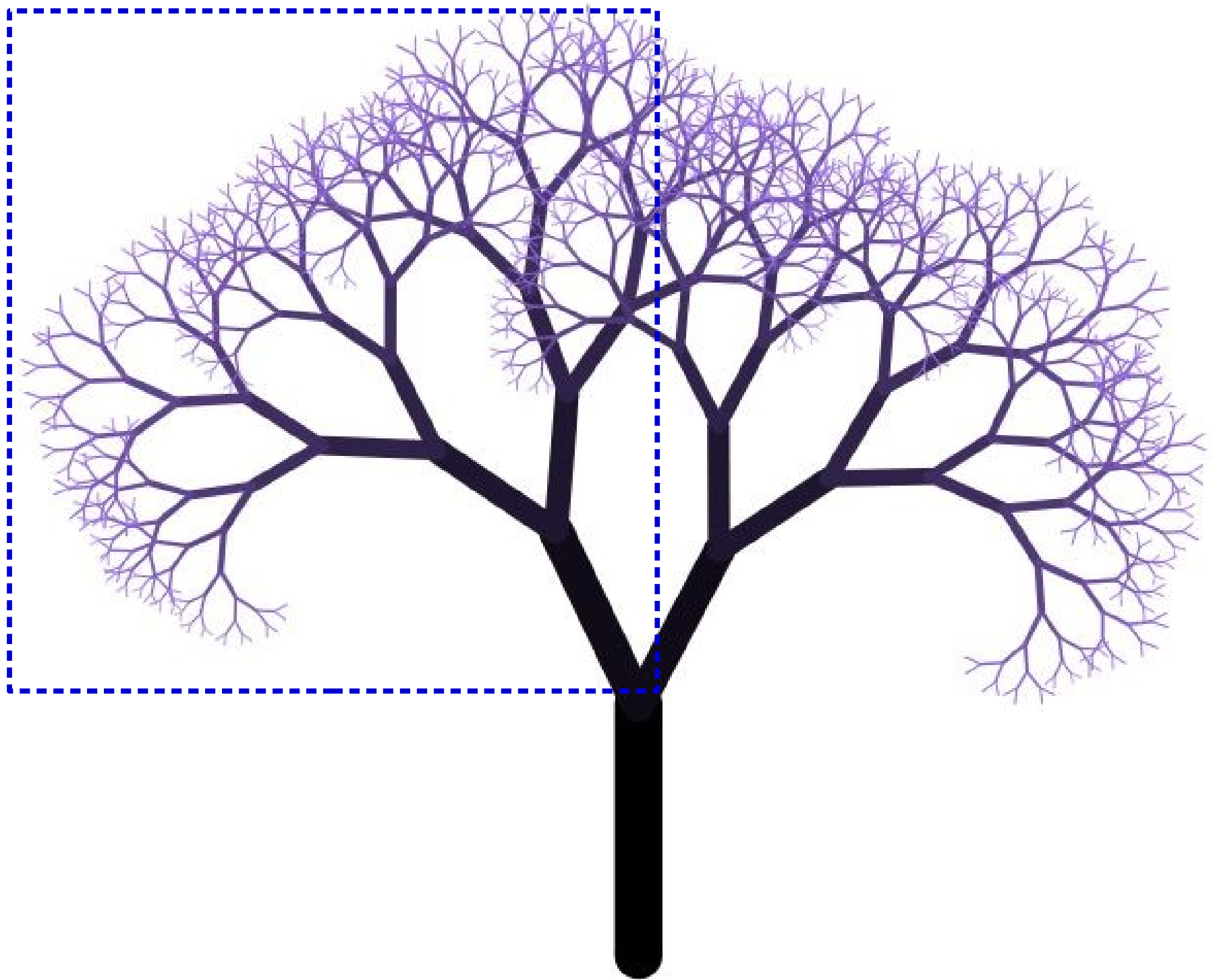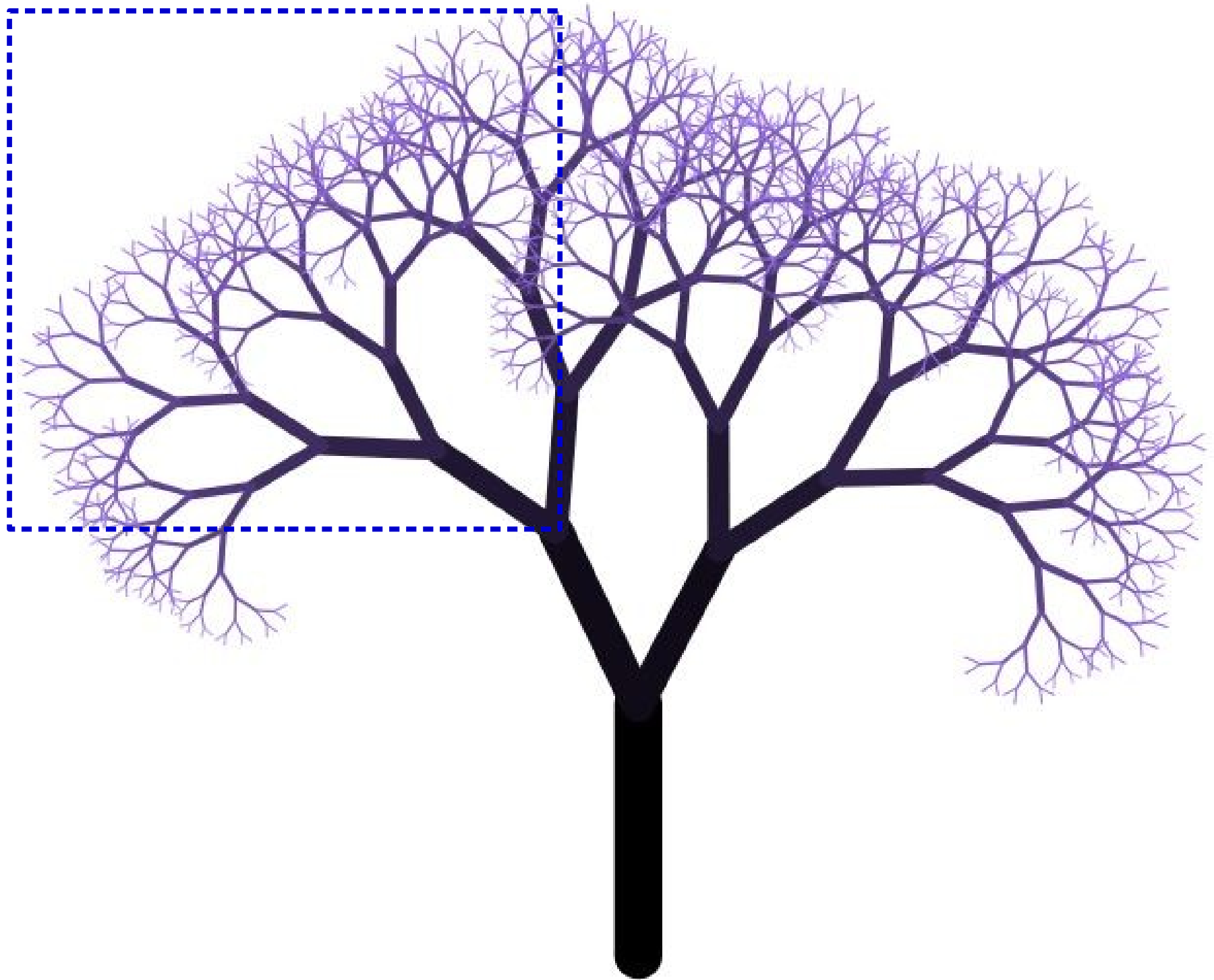*Learn how to model and solve complex problems with computers.*

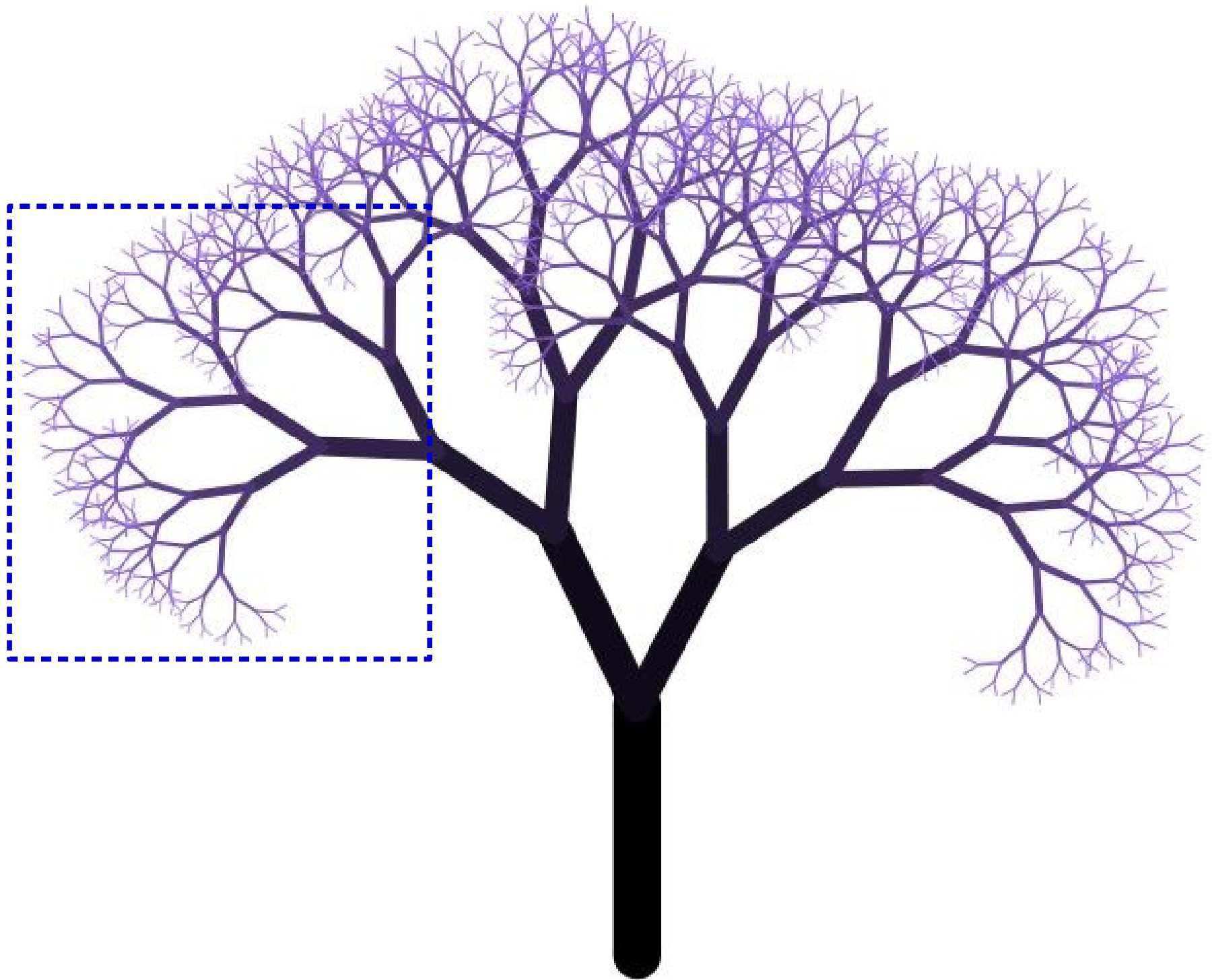To that end:

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- Human Biology
- Immunology
- International Relations
- Law
- Materials Science
- Mechanical Engineering
- Microbiology and Immunology
- Middle Eastern Languages / Culture
- MS&E
- Physics
- Political Science
- Product Design
- Psychology
- Public Policy
- Spanish
- Statistics
- STS
- Symbolic Systems
- SymSys
- *Undeclared!*

Speaking to the Computer

C++

What is C++?

- C++ is a programming language used to design complex, high-performance systems.

- C++ is an influential language. Java inherited much of its syntax from C++, and JavaScript retains many of its traits.

- There are many features of C++ that aren't present in Java / JavaScript / Python, and those features make it an attractive language for use in CS106B.

- C++ is a *huge* language that's undergone many revisions (it was invented in 1983; most recent version is C++17) and we won't be covering it in full depth. Take CS106L or CS110 for more!

```cpp
/* File: hello-world.cpp
 *
 * A canonical Hello, world! program
 * in C++.
 */

#include <iostream>
using namespace std;

int main() {
    cout << "Hello, world!" << endl;
    return 0;
}
```

```cpp
/* File: retain-evens.cpp
 *
 * A program to filter out odd numbers from a list.
 */
#include <iostream>
#include "vector.h"
using namespace std;

Vector<int> evensIn(Vector<int> values) {
    Vector<int> result;
    for (int i = 0; i < values.size(); i++) {
        if (values[i] % 2 == 0)
            result += values[i];
    }
    return result;
}

int main() {
    Vector<int> values = { 1, 2, 3, 4, 5 };

    for (int elem: evensIn(values)) {
        cout << elem << endl;
    }

    return 0;
}
```

Your Action Items

- Read Chapter 1 of *Programming Abstractions in C++* to learn more about the basics of C++ programming.

  - If you're coming from Java or JavaScript, much of this syntax will seem familiar, but there are some notable differences.

  - If you're coming from Python, it's pretty similar, but with lots of curly braces and semicolons.

- We'll begin writing C++ code in earnest on Wednesday.

Your Action Items

- ***Assignment 0: Welcome to CS106B*** is due this Friday at the start of class (11:30AM).
  - Starter files and assignment handout are up on the course website.
  - No programming involved, but you'll need to get your development environment set up.
- There's a bunch of documentation up on the course website. Please feel free to reach out to us if there's anything we can do to help out!

Your Action Items

- Some of the later assignments can be done in pairs.

  - Assignment 0 must be done individually. Everyone needs to have a working development environment and know how to work the debugger.

  - You may want to start thinking about who you'd like to work with, since you'll need to register for the same section as the person you'll be working with.

Next Time

- ***Welcome to C++!***

  - Defining functions.

  - Reference parameters.

  - Introduction to recursion.