CS106A: Programming Methodology
Mehran Sahami

- Childhood: Iran
- High School: San Diego
- Stanford University Ph.D. in Machine Learning
  (Before Machine Learning was cool)
- Spent a decade in tech industry before coming back as professor
  - Love of teaching is why I came back
• Took CS106A my freshman year at Stanford
  • It changed my life

• But it did not make me cut my mullet
  • It should have...
My parents are interesting folks

I originally concentrated in graphics and worked at Pixar

- Childhood: Nairobi, Kenya
- High School: Kuala Lumpur, Malaysia
- Stanford University Ph.D. in Neural Networks
- Research lab on AI for Social Good

The problem I really want to solve is to make high quality education more accessible
12 years ago to this day, I was sitting in your seats.
Head TA: Brahm Capoor
* Actually some of last year’s section leaders

Piech and Sahami, CS106A, Stanford University
Course mechanics
(This is a brief version.
Please read the handout for full details).
Prerequisite Test
Getting To Know You

• Assignment #0 on website ("Who are you?")

• Some initial responses (~125 responses so far)
  – Class is 60% women, 39% men, 1% prefer not to say
  – 4 students are former/current members of the armed forces
  – 15 students have founded socially-focused ventures
  – 1 student attacked by kangaroo when they were younger
  – "It is a really difficult time for my family right now, but I will still be trying my best in this class."

• Please be safe, compassionate, and kind. So will we.
Lectures and Sections

• Lectures MWF 1:30-2:20pm
  – Will be recorded (available on Canvas)
• Weekly 50-min section led by awesome section leaders (the backbone of the class!)
  – Section signups will be on class webpage (not Axess)
  – Signups begin on Thursday at 5pm and close Sunday at 5pm.
Office Hours

LaIR: evenings Sunday through Thursday (starting Sunday)

Piech and Sahami, CS106A, Stanford University
Grading Scale

Functionality and style grades for the assignments use the following scale:

++ A submission so good it “makes you weep”
+
++ Satisfies all requirements, with good functionality and style
✓
✓ Meets the requirements, but perhaps with small problems
✓— Has some somewhat serious problems
— Is worse than that, but shows real effort and understanding
—— Better than nothing

You are only competing against yourself.

Piech and Sahami, CS106A, Stanford University
Interactive Grading

One on one feedback from your section leader

• Chance for you to get more feedback than just a grade

• Opportunity to really develop “style” as a programmer
  • We’ll talk more about that soon

• This quarter, especially, we can put much more focus on learning rather than grading
What we will ask you to do

• 7 programming assignment 75%
  • Get more complicated as quarter progresses

• In-class diagnostic assessment (exam) 15%

• Section participation 10%

• Get 4 free “late days” (on assignments)
  • Each “late day” is a 24-hour period
  • Allows for turning in assignment late without penalty
  • After free late days are used, assignments penalized one grade bucket per day late
  • For extensions beyond free late days, contact Brahm (head TA)
Optional Contest
Online Text Books

Karel the Robot

Learns Python

Chris Piech and Eric Roberts
Department of Computer Science
Stanford University
January 2019

Get Started

Piech and Sahami, CS106A, Stanford University
Chapter 2: Programming Karel

The simplest style of Karel program uses text to specify a sequence of built-in commands that should be executed when the program is run. Consider the simple Karel program below. The text on the left is the program. The state of Karel's world is shown on the right:

```
# File: FirstKarel.py
#
# The FirstKarel program defines a "main" function with three commands. These commands cause
# Karel to move forward one block, pick up a beeper and then move ahead to the next corner.
from korel.stanfordkarel import *

def main():
    move()
pick_beeper()
    move()
```

Press the "Run" button to execute the program. Programs are typically written in a special application called an Integrated Development Environment (IDE) and most Karel programs are written in an IDE called PyCharm. Like an IDE, this reader has the ability to execute programs in order to help you see how things work as you learn.

The program is composed of several parts. The first part consists of the following lines:

```
# File: FirstKarel.py
#
```
Start Here

Are you an undergrad?

Yes → 5 Units

No

Hours per week = Units × 3

Average about 10 hours / week for assignments

Do you want to take CS106A for fewer units?

Yes → 3 Units or 4 Units

No
Are you in the right place?
What is CS106A?
“Computer science is no more about computers than astronomy is about telescopes, biology is about microscopes or chemistry is about beakers and test tubes. Science is not about tools, it is about how we use them and what we find out when we do.”

— Michael Fellows and Ian Parberry

“You must unlearn what you have learned”

— Yoda
Learning Goals

- Learn how to harness computing power to solve problems.
- To that end:
  - Explore fundamental techniques in computer programming.
  - Develop good software engineering style.
  - Gain familiarity with the Python programming language.
There are a lot of cool programs you may one day write
Pat Hanrahan, one of the founders of Pixar is a professor here. He just won the Turing Award – the Nobel Prize of Computer Science
Consumer Applications
Autonomous Surgery

(c) 2012 Intuitive Surgical, Inc.
Self-Driving Car
If only we could program self-driving cars...
Image Transformation
Data Visualization

Piech and Sahami, CS106A, Stanford University
Internet Applications

Chris Piech

Status: Chris is lecturing

Starting server on port 8000...
addProfile (name=Mehran) => success
addProfile (name=Chris) => success
addProfile (name=Chris) => Error: Database already contains Chris.
getStatus (name=Chris) => none
getStatus (name=Chris, status=teaching) => success
getStatus (name=Chris) => teaching
addFriend (name2=Mehran, name1=Chris) => success
getFriends (name=Chris) => [Mehran]
addProfile (name=Julie) => success
getStatus (name=Julie) => none
getFriends (name=Julie) => []
getStatus (name=Julie) => none
getFriends (name=Julie) => []
addFriend (name2=Chris, name1=Julie) => success
getStatus (name=Julie) => none
getStatus (name=Julie) => none
Art of Computer Science
Strive for Everyone to Succeed
Lets Get Started
Meet Karel the Robot

Good morning
Karel Speaks Python
Why Python?

1. Program language popularity

2. 

https://stackoverflow.blog/2017/09/06/incredible-growth-python/
Guido van Rossum
Karel’s World

1

2

3

1  2  3  4  5

North

South

West

East
Beepers
Knows Four Commands

move()

turn_left()

put_beeper()

pick_beeper()
move()
move()
`move()`
turn_left()
turn_left()
def turn_left():
    # Code for turning left goes here.
pick_beeper()
```python
def turn_left()
```
turn_left()
Make Sense?
First Challenge

---

PIECH AND SAHAMI, CS106A, STANFORD UNIVERSITY
First Challenge
Bird’s Eye View

Karel is facing East
Turn Left

Karel is facing North
Turn Left

Karel is facing West
Turn Left

Karel is facing South
Move
First Challenge

```
1 2 3 4 5
1  +  +  +   +   +
2  +  +  +   +   +
3  +  +  +   +   +
   +  +  +   +   +
```

Piech and Sahami, CS106A, Stanford University
First Challenge
Learn By Doing
def name():
    function statements

This adds a new command to Karels vocabulary
Anatomy of a Program

Import Packages

Program
Anatomy of a Program

Import Packages
Anatomy of a Program

- Import Packages
- main function
- helper functions
- start program

---

An example code snippet:

```python
def main():
    move()
    pick_beeper()
    move()
    turn_left()
    move()
    turn_right()
    move()
    put_beeper()
    move()

def turn_right():
    turn_left()
    turn_left()
    turn_left()
```

---

Example usage:

```
if __name__ == '__main__':
    run_karel_program()
```
def main():
    move()
    pick_beeper()
    move()
    turn_left()
    move()
    turn_right()
    move()
    put_beeper()
    move()

helper functions

start program

Anatomy of a Program

Import Packages
def main():
    move()
    pick_beeper()
    move()
    turn_left()
    move()
    turn_right()
    move()
    put_beeper()
    move()

def turn_right():
    turn_left()
    turn_left()
    turn_left()
    turn_left()
def main():
    move()
    pick_beeper()
    move()
    turn_left()
    move()
    turn_right()
    move()
    put_beeper()
    move()

def turn_right():
    turn_left()
    turn_left()
    turn_left()

if __name__ == '__main__':
    run_karel_program()
Anatomy of a Program

```
from karel.stanfordkarel import *

def main():
    move()
    pick_beeper()
    move()
    turn_left()
    move()
    turn_right()
    move()
    put_beeper()
    move()

def turn_right():
    turn_left()
    turn_left()
    turn_left()

if __name__ == '__main__':
    run_karel_program()
```
from karel.stanfordkarel import *

def main():
    move()
    pick_beeper()
    move()
    turn_left()
    move()
    turn_right()
    move()
    put_beeper()
    move()

def turn_right():
    turn_left()
    turn_left()
    turn_left()
    turn_left()

if __name__ == '__main__':
    run_karel_program()
from karel.stanfordkarel import *

def main():
    move()
    pick_beeper()
    move()
    turn_left()
    move()
    turn_right()
    move()
    put_beeper()
    move()

def turn_right():
    turn_left()
    turn_left()
    turn_left()
    turn_left()

if __name__ == "__main__":
    run_karel_program()
```python
from karel.stanfordkarel import *

def main():
    move()
    pick_beeper()
    move()
    turn_left()
    move()
    turn_right()
    move()
    put_beeper()
    move()

def turn_right():
    turn_left()
    turn_left()
    turn_left()
    turn_left()

if __name__ == "__main__":
    run_karel_program()
```

This line of code gives the **name** of the function (here, run)
from karel.stanfordkarel import *

def main():
    move()
    pick_beeper()
    move()
    turn_left()
    move()
    turn_right()
    move()
    put_beeper()
    move()

def turn_right():
    turn_left()
    turn_left()
    turn_left()
    turn_left()

if __name__ == "__main__":
    run_karel_program()
Anatomy of a Program

```python
from karel.stanfordkarel import *

def main():
    move()
    pick_beeper()
    move()
    turn_left()
    move()
    turn_right()
    move()
    put_beeper()
    move()

def turn_right():
    turn_left()
    turn_left()
    turn_left()
    turn_left()

if __name__ == "__main__":
    run_karel_program()
```

This is called a **code block**
from karel.stanfordkarel import *

def main():
    move()
pick_beeper()
    move()
    turn_left()
    move()
    turn_right()
    move()
    put_beeper()
    move()

def turn_right():
    turn_left()
    turn_left()
    turn_left()
    turn_left()

if __name__ == "__main__":
    run_karel_program()
from karel.stanfordkarel import *

def main():
    move()
    pick_beeper()
    move()
    turn_left()
    move()
    turn_right()
    move()
    put_beeper()
    move()

def turn_right():
    turn_left()
    turn_left()
    turn_left()
    turn_left()

if __name__ == "__main__":
    run_karel_program()
Why Study CS?
Joy of Building
Interdisciplinary
Closest Thing To Magic
Now is the Time
A machine learning algorithm performs **better than** the best dermatologists.

Developed this year, at Stanford.

Oh and Its Useful

1,000,000 more jobs than students by 2020

$500 billion opportunity

1.4 million computing jobs

400,000 computer science students
Everyone is Welcome
The End
The End?