UC Berkeley EECS
Lecturer
Michael Ball

Computational Structures in Data Science

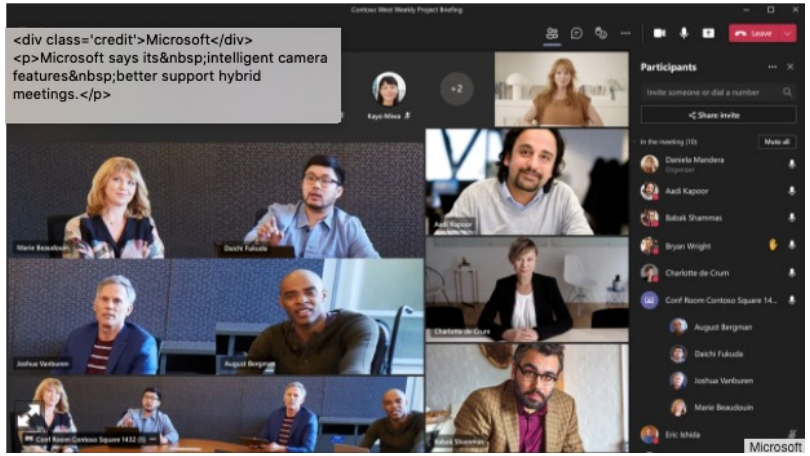
Week 4: HOFs

Head TA/Guest Lecturer
Shreya Kannan

Announcements

- LOST/Exam Prep Sections begin this week
- Please complete the daily screener!
- Some things on the horizon
  - HW 2 due this Friday, Sept 17
  - Maps scheduled to be released around Oct 1 (around a 2 week project)
- From Computer Science Mentors (CSM)
  - Sections start this week on Wednesday, mentor will email location soon if they haven't already
  - First 3 weeks are mandatory unless excused absence and if you are taking CSM for a unit, only 2 unexcused absences

Computing In the News: Building for a Hybrid Workspace



As businesses work to reopen office buildings, not all employees are keen on a return to the pre-pandemic status quo — forcing companies to adopt a "hybrid" approach to remote work. With some employees in the office, and others still at home, collaboration application and hardware vendors are now looking to support both in-office and remote workers.

Microsoft unveiled several new intelligent camera features for its Teams Rooms platform to better support hybrid meetings. Among the new capabilities is "active speaker tracking," which enables meeting room cameras to detect who is speaking in a conference room with several colleagues present. It does so by tracking audio, facial movements and hand gestures, allowing the camera to zoom in on the speaker. Additionally, each in-office participant can be placed in their own video pane, in the same way remote colleagues are presented, and facial recognition can identify participants and display their profile name. To help individuals in meeting rooms contribute more dynamically, Microsoft is updating companion mode in Teams mobile to give in-room attendees quick access to engagements features like chat, live reactions, and Microsoft Whiteboard.

Sources: https://www.computerworld.com/article/3632996/as-the-hybrid-workplace-emerges-microsoft-and-google-beef-up-video-tools.html, https://www.microsoft.com/en-us/microsoft-365/blog/2021/09/09/brace-yourselves-hybrid-work-is-hard-heres-how-microsoft-teams-and-office-365-can-help/

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Higher Order Functions: Returning a New Function

Learning Objectives

- Learn how to use and create higher order functions:
- Functions can be used as data
- Functions can accept a function as an argument
- **Functions can return a new function**

Review: What is a Higher Order Function?

- A function that takes in another function as an argument

OR

- **A function that returns a function as a result.**

Higher Order Functions

- **A function that returns (makes) a function**

```
1  def leq_maker(c):
2      def leq(val):
3          return val <= c
4      return leq
```

```
>>> leq_maker(3)
<function leq_maker.<locals>.leq at 0x1019d8c80>

>>> leq_maker(3)(4)
False

>>> [x for x in range(7) if leq_maker(3)(x)]
[0, 1, 2, 3]
```

Demo

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Computational Structures in Data Science

Environment Diagrams

Environment Diagrams

- Organizational tools that help you understand code
- **Terminology:**
  - **Frame:** keeps track of variable-to-value bindings, each function call has a frame
  - **Global Frame:** global for short, the starting frame of all python programs, doesn't correspond to a specific function
  - **Parent Frame:** The frame of where a function is defined (default parent frame is global)
  - **Frame number:** What we use to keep track of frames, f1, f2, f3, etc
  - **Variable** vs **Value**: x = 1. x is the **variable**, 1 is the **value**

Environment Diagrams Reminders

1. Always draw the global frame first
2. When evaluating assignments (lines with single equal), always evaluate right side first
3. When you CALL a function MAKE A NEW FRAME!
4. When assigning a primitive expression (number, boolean, string) write the value in the box
5. When assigning anything else (lists, functions, etc.), draw an arrow to the value
6. When calling a function, name the frame with the intrinsic name – the name of the function that variable points to
7. The parent frame of a function is the frame in which it was defined in (default parent frame is global)
8. If the value for a variable doesn't exist in the current frame, search in the parent frame

Demo

Example 1:

- Primitives and Functions: Environment Diagram Python Tutor: shorturl.at/guIVZ

Example 2:

- make_adder Higher Order Function: Environment Diagram Python Tutor Link: shorturl.at/jxE07

Example 1

```
a = "chipotle"
b = 5 > 3
c = 8

def foo(c):
    return c - 5

def bar():
    if b:
        a = "taco bell"

result1 = foo(10)
result2 = bar()
```

Example 2

```
def make_adder(n):
    def adder(k):
        return k + n
    return adder

n = 10
add_2 = make_adder(2)
x = add_2(5)
```

Environment Diagram Tips / Links

- NEVER draw an arrow from one variable to another.
- Useful Resources:
  - http://markmiyashita.com/cs61a/environment_diagrams/rules_of_environment_diagrams/
  - http://albertwu.org/cs61a/notes/environments.html