

CSCE 240: Advanced Programming Techniques

Lecture 2: Experience with Development Environments

PROF. BIPLAV SRIVASTAVA, AI INSTITUTE

11TH JANUARY 2024

Carolinian Creed: “I will practice personal and academic integrity.”

Credits: Some material reused with permission of Dr. Jeremy Lewis.
Others used as cited with thanks.

Organization of Lecture 2

- Introduction Section
 - Recap of Lecture 1
 - Communication platform: piazza or slack account
- Main Section
 - Review additional tasks: GitHub setup, Enhanced Hello World!
 - Concept: Pointers
 - Concept: Iteration
 - Numeric processing: Sorting .. E.g., Bubblesort, Quicksort
 - Team activity: code review, testing
- Concluding Section
 - About next lecture – Lecture 3
 - Ask me anything

Introduction Section

Recap of Lecture 1

- We (self –learned) / discussed course aims
 - Learn programming techniques
 - **C/C++ will be the “mother language”: everyone should know**
 - **Choose one or more languages to have multi-lingual learning: Java or Python preferred**
- Learn important programming concepts
- Learn in real-world setting, i.e., with others
- Solve real-world problems

Technology to Connect

- Communication platform – choices
 - Piazza: send messages and also answer/ collaborate with one another
 - Piazza: <https://piazza.com/sc/spring2024/csce240h>
 - Quick demo
 - *Slack: for clarifications, quick questions, connect, share files* [x]
- Email: for longer messages, planned discussions, important communication
- Blackboard: for virtual 1:1 meeting

Main Section

Review: GitHub

- GitHub basics
 - Sharing code, replicating others work
 - <https://docs.github.com/en/get-started/quickstart/hello-world>
- Course GitHub
 - <https://github.com/biplav-s/course-adv-proglang-s24>
- Share your private repo on “Students and Code Links” spreadsheet
 - Name the repo: CSCE240H-Spring2024-<your-first-name>. Example: CSCE240H-Spring2024-Bob
 - Additionally
 - Put a readme file (Readme.md) and give you full name
 - Create a sub-folder called “home-works”. Future home works will be here
 - Create a sub-folder called “project”. Your project will reside here.

Review: Enhanced Hello World

- C++, Java, Python

Crash Course on Computer Organization

- Architecture and Hardware
 - Components: memory, hard-disk, I/O, CPU
 - Working of a computer
- Programming level
 - Variables, locations and values
- Compilers/ Interpreters
 - Connecting program (software) to hardware

Concept: Pointers

- Pointers refer to accessing and manipulating location of variables
 - `a = 12` // variable is a, value is 12
 - `b = &a` // b has the address of a, i.e., 0 here. It is called a pointer
 - `c = a` // c has the value of a, i.e., 12
 - `d = *b` // will refer to a. That is, d will be equal to value pointed by b, i.e., 12

Variable	Location	Value
a	0	12
b	4	0
c	8	

Reference: <https://www.cplusplus.com/doc/tutorial/pointers/>

Pointers in Languages

- C++: fully supported
 - “A pointer is a variable that stores a memory address, for the purpose of acting as an alias to what is stored at that address.”
 - Pointer arithmetic
 - Arguments of functions can be passed by value or by pointers
- Java, Python: references
 - “A reference is a variable that refers to something else and can be used as an alias for that something else.”
 - When a variable is initialized to another variable, references are passed.
 - No pointer arithmetic by programmer

Reference:

- <https://nickmccullum.com/python-pointers/#why-dont-pointers-exist-in-python>
- <https://www.geeksforgeeks.org/is-there-any-concept-of-pointers-in-java/>

Code Samples

Locations:

- <https://github.com/biplav-s/course-adv-proglang/tree/main/sample-code/CandC%2B%2B>
- <https://github.com/biplav-s/course-adv-proglang-s23/tree/main/sample-code>
- <https://github.com/biplav-s/course-adv-proglang-s24>

Programming Exercise – C++

- Write a function, ***addNumbers()***, with two arguments containing numbers
 - Adds the two numbers
 - Returns the sum
- Write a function, ***addNumbersAtFirstLocation()***, with two arguments containing pointers to variables
 - Adds the two numbers
 - Updates the sum at the location of the first variable

Review With Peers

- Code walk through
 - Can one understand what the code is doing ?
 - Can one explain the code to someone else (non-coder) ?
 - Can one spot possible issues without running it?
- Unit testing
 - Does the program run as the coder wanted it to be (specification) ?
 - Does the program run as the instructor wanted it to be (requirement - customer) ?
 - Does the program terminate abruptly ?
 - Is there a hardcoding of directory ? Paths should be relative to code base directory.
 - Any special feature?

Coding Practices

Concept: Iteration

- For – number of iterations is known
 - **for**(initial condition; end condition; update action) {
 //body of the for loop
}
 - **for**(i = 0; i < 10; i++) {
 cout << i << endl; // print from 0 to 9
}
- While – number of iterations is unknown
 - **while**(condition) {
 // body of while loop
}
 - **while**(true) {
 ; // Do nothing -- infinite loop
}

Numeric Processing

- Problem: Sort numbers
 - **Requirement:** arrange a given sequence of numbers into a sorted (e.g., ascending order)
 - **Specification:**
 - Input: any sequence of numbers with $n=0$ or more integers
 - Output: a sequence of same length as input but where for $i=0..n-2$, $a[i] \leq a[i+1]$
 - Design
 - What functions to have?
 - Coding
 - Testing
 - Input is empty string
 - Input has one number
 - Input has two or more numbers
 - Input has all numbers of same value

Illustration: C++

- Usage of pointers
- Passing inputs and outputs is cumbersome
- Notice length of code

Illustration: Java

- Inputs passed as arguments
- Notice smaller length of code

Illustration: Python

- Inputs passed as arguments
- Notice smaller length of code

Discussion: Course Project

Course Project – Assembling of Prog. Assignments

- **Project:** Develop collaborative assistants (chatbots) that offer innovative and ethical solutions to real-world problems !
- **Methods:** Use programming techniques learnt in class, in your favorite language and at your (inspired) pace while getting exposure to AI issues
 - Collaborate with others only when it makes sense for larger results.
- **Reference:** Projects of previous courses
- **Theme for current course will be discussed later – welcome feedback to instructor**

Reference Spring 2022 Course Project – Assembling of Prog. Assignments

- **Project:** Develop collaborative assistants (chatbots) that offer innovative and ethical solutions to real-world problems ! *(Based on competition - <https://sites.google.com/view/casy-2-0-track1/contest>)*
- Specifically, **the project will be building a chatbot that can answer questions about a South Carolina member of state legislature from:**
<https://www.scstatehouse.gov/member.php?chamber=H>
 - Each student will choose a district (from 122 available).
 - Programming assignment programs will: (1) extract data from the district, (2) process it, (3) make content available in a command-line interface, (4) handle any user query and (5) report on interaction statistics.

Problem Scale

- Text and images
- Static and dynamic content; direct and indirect content
- Semi-structured and unstructured content

https://www.scstatehouse.gov/member.php?code=0372727228

Senate House Committee Postings and Reports Legislative Council Citizens' Interest Publications

Officers Standing Comm. Joint Comm. Email Meetings Calendars Journals Introductions Delegations Rules

House > Members of the House > Representative Gilda Cobb-Hunter

Representative Gilda Cobb-Hunter

Democrat - Orangeburg
District 66 - Orangeburg County - [Map](#)

Columbia Address
309C Blatt Bldg.
Columbia 29201

Home Address
4188 Five Chop Road
Orangeburg 29115

Business Phone (803) 734-2809

Home Phone (803) 531-1257
Business Phone (803) 534-2448

[Send message to Representative Cobb-Hunter](#)

Personal Information

- Social Work Administrator
- Residing at 4188 Five Chop Rd., Orangeburg
- Born November 5, 1952 in Gifford, Florida
- Daughter of Selvin, Sr. and the late Nina (Walker) Cobb
- Florida A & M University, B.S., 1973
- Florida State University, M.A., 1978
- South Carolina Board of Social Work Examiners, LISW, 1990
- August 30, 1975 married Terry Keith Hunter
- Member, Leadership South Carolina, Class of 1986
- House Minority Leader, 1997-00
- South Carolina Chapter of National Association of Social Workers
- South Carolina American Civil Liberties Union
- Branchville NAACP
- Orangeburg County Democratic Party
- National Committeewoman, Democratic National Committee
- President, National Black Caucus of State Legislators
- Joint Bond Review Committee
- Awarded Florida A & M University National Alumni Association 2014 Distinguished Alumnus Award

Committee Assignments

- Ways and Means, 1st V.C.

Sponsored Bills in the House

Primary Sponsor: ☒ Yes ☐ No

Search Session: 2021-2022 (124) Find Bills

Voting Record

Search Session: 2021-2022 (124) Find Votes

Service In Public Office

- House of Representatives, January 28, 1992 - Present

https://www.scstatehouse.gov/member.php?code=0088636353

Senate House Committee Postings and Reports Legislative Council Citizens' Interest Publications

Officers Standing Comm. Joint Comm. Email Meetings Calendars Journals Introductions Delegations Rules

House > Members of the House > Representative William H. Bailey

Representative William H. Bailey

Republican - Horry
District 104 - Horry County - [Map](#)

Columbia Address
420D Blatt Bldg.
Columbia 29201

Home Address
4487 Lake Circle
Little River 29566

Business Phone (803) 212-6918

Home Phone (843) 458-0844

[Send message to Representative Bailey](#)

Personal Information

- Retired Public Safety - Law Enforcement & Fire
- Residing at 4487 Lake Cir., Little River
- Born Dec. 4, 1962 in Conway
- Son of William W., Sr. and Katherine Gause
- Horry-Georgetown Technical College, A.D., 1999
- Coastal Carolina University, B.A., 2001
- Webster University, M.S., 2004
- Sept. 23, 1983 married Karen Elizabeth, 2 children, Anne Marie and Christopher
- City of North Myrtle Beach, Public Safety, Officer, 1990-04, Director, 2005-10
- FBI National Academy, 2003
- Horry County Airport Advisory Committee, 2004-10
- S.C. Supreme Court Task Force and Probate, 2009

Committee Assignments

- Interstate Cooperation, 2nd V.C.
- Judiciary

Sponsored Bills in the House

Primary Sponsor: ☒ Yes ☐ No

Search Session: 2021-2022 (124) Find Bills

Voting Record

Search Session: 2021-2022 (124) Find Votes

Discussion: Nature and Simplifications

- Once you select a district, the elected legislator is fixed.
- Some simplifications
 - Download local copy v/s web query
 - Handle static content first
 - Handle a subset of content
 - Have default handling for questions the chatbot does not understand
- Do project in a language you are most comfortable with
- Use all advanced programming concepts to simplify coding

Reference Spring 2023 Course Project – Assembling of Prog. Assignments

- **Project:** Develop collaborative assistants (chatbots) that offer useful information about diseases
- Specifically, use the CDC dataset on diseases at: <https://wwwnc.cdc.gov/travel/diseases>.
 - For polio, it is: <https://wwwnc.cdc.gov/travel/diseases/poliomyelitis>
 - Each student will choose two diseases (from 47 available).
 - Each student will also use data about the disease from WebMD. Example for polio - <https://www.webmd.com/children/what-is-polio>
 - Programming assignment programs will: (1) extract data about a disease from two sites, (2) process it, (3) make content available in a command-line interface, (4) handle any user query and (5) report on interaction statistics.

Discussion: Nature and Simplifications

- Once a user selected a disease, they could choose the disease's data sources whose locations were pre-determined .
 - Possibilities: WebMD (private) and CDC (public)
 - The information (answers) could be missing, overlapping or duplicate. A principle to combine content had to be defined by the student
- Some simplifications
 - Download local copy v/s web query
 - Handle static content first
 - Handle a subset of content
 - Have default handling for questions the chatbot does not understand
- The student could do project in a language you are most comfortable with
- Use all advanced programming concepts to simplify coding

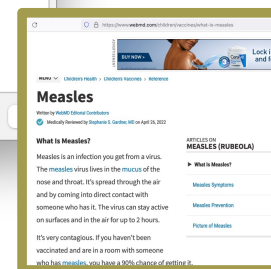
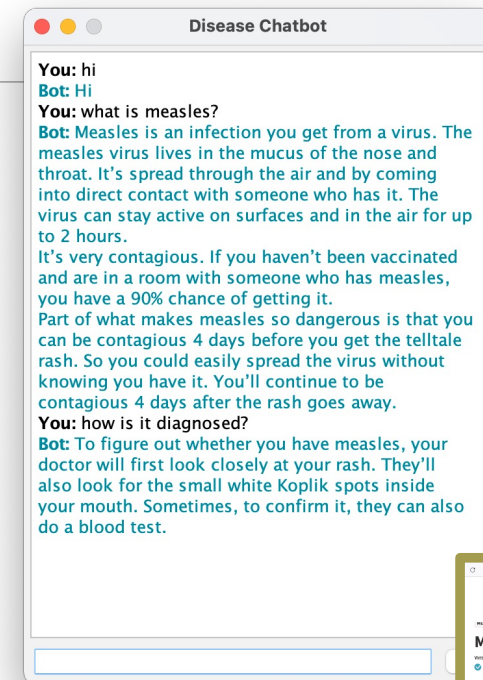
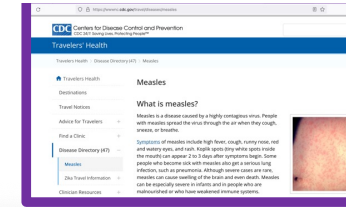
2023 Chatbot Created

PROGRAM SCOPE



- Diseases: The chatbot can support HIV, Scabies, Rabies, Rubella, Avian Flu, Malaria, Measles, Polio, and Mumps.
- Data Sources: CDC and WebMD articles for each of the diseases.
- Language: Java

Credits: CSCE 240 Spring 2024 students



2024 Project

- Choice 1: (Chatbot to) Recommend courses to students in a department for a semester
 - User: students
 - Data: course catalog, course description
 - Student choice: department and its courses
 - AI: recommendation, chatbot
- Choice 2: (Chatbot to) answer questions about airline compensation and flight delays
 - User: students
 - Data: airlines' policies, government regulations
 - Student choice: airline, countries of travel
 - AI: data cleaning and organization, chatbot
- Choice 3: ...

Concluding Section

Lecture 2: Concluding Comments

- We discussed the concepts of pointers and references
- We discussed the concept of iteration
 - For and while are most common
 - Others available (like do-while) but not that helpful in practice
- Looked at enhanced “Hello World”
- Looked at numeric processing – sorting
- Discussed projects

Additional Tasks

- Implement sorting in C++
- Implement sorting in another language (Java or Python)
- Add code on personal GitHub
- Update Instructor on slack

About Next Lecture – Lecture 3

Lecture 3: I/O

- Overview of streams, file processing
- Error handling
- Printing values