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# *CSCE 240:* Advanced Programming Techniques
# Lecture 2: Experience with Development Environments

PROF. BIPLAV SRIVASTAVA, AI INSTITUTE

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***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 variables 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/tree/main/sample-code

# 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] <= 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

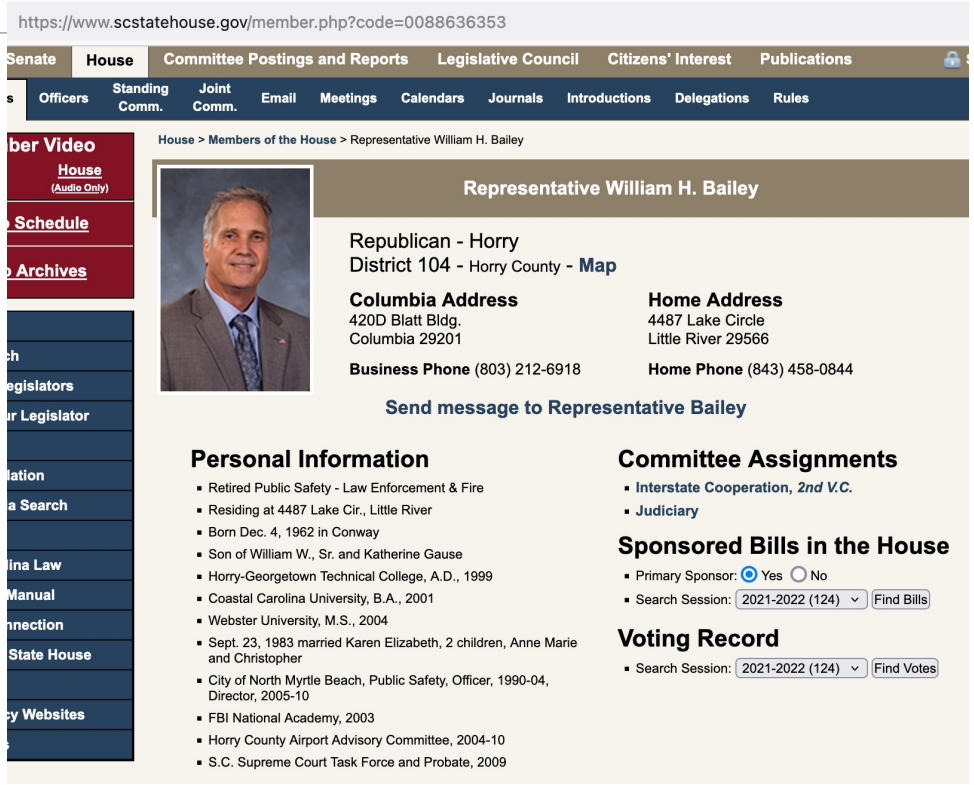
- **Project**: Develop collaborative assistants (chatbots) that offer innovative and ethical solutions to real-world problems !
- **Methods**: Use programming techniques learnt in class, in your favorite language and at your (inspired) pace while getting exposure to AI issues
  - Collaborate with others 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

# 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

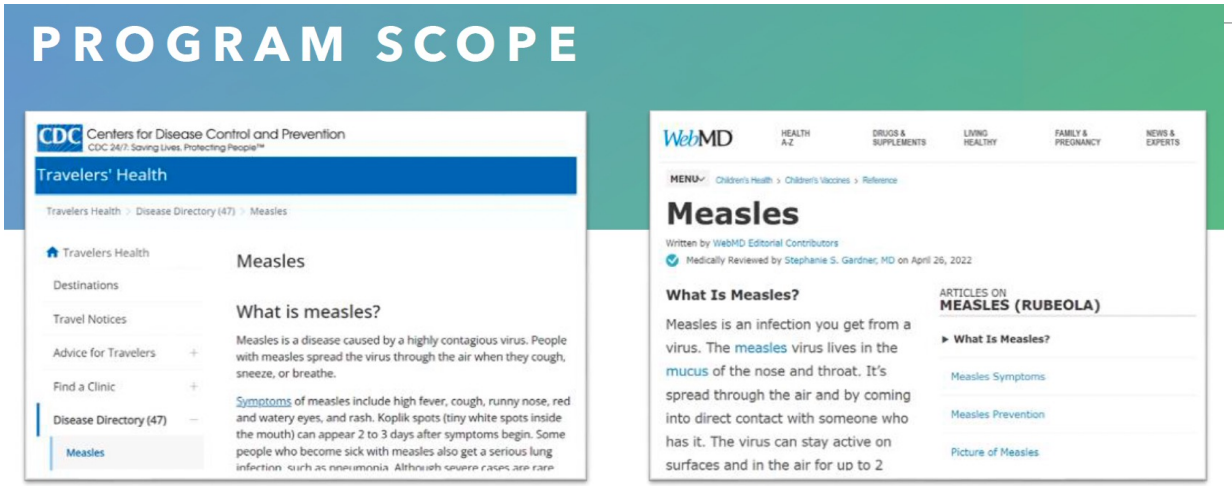
# Reference Spring 2023 Course Project – Assembling of Prog. Assignments

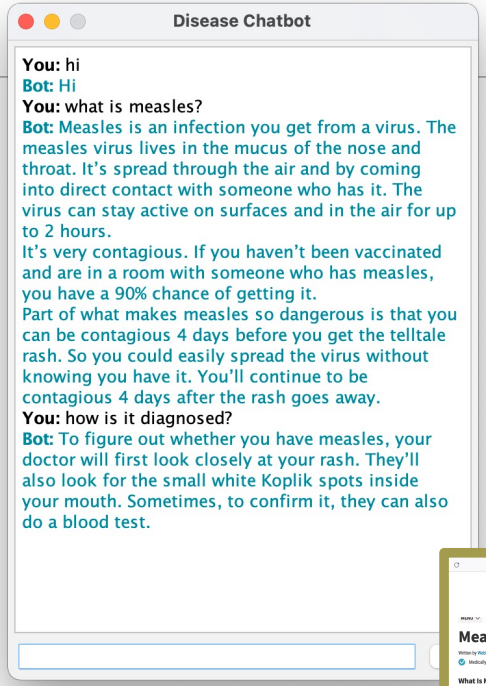
- **Project**: Develop collaborative assistants (chatbots) that offer useful information about diseases
- Specifically, use the CDC dataset on diseases at: https://wwwnc.cdc.gov/travel/diseases.
  - For polio, it is: https://wwwnc.cdc.gov/travel/diseases/poliomyelitis
  - Each student will choose two 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.

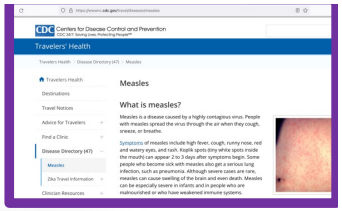
# Discussion: Nature and Simplifications

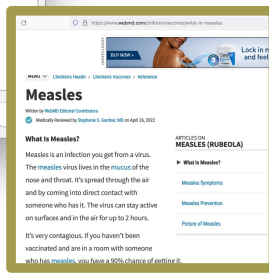
- Once a user selected a disease, they could choose the disease's data sources whose locations were pre-determined .
  - Possibilities: WebMD (private) and CDC (public)
  - The information (answers) could be missing, overlapping or duplicate. A principle to combine content had to be defined by the student
- 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





- 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