CSCE 240: Advanced Programming Techniques (Honors)
Lecture 1: Introduction

PROF. BIPLAV SRIVASTAVA, AI INSTITUTE

9TH 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 1

- Introduction Section
  - Instructor introduction and course logistics
- Main Section
  - Programming and languages
  - Course Logistics: Housekeeping, topics, evaluation, teaching philosophy
  - Getting Started: Programming platform setup - Getting started for the “Hello World !” program, for C/C++, and optionally, Java and Python
  - Additional Task: Github, for code sharing
- Concluding Section
  - About next lecture – Lecture 2
  - Ask me anything

Introduction Section

BIPLAV SRIVASTAVA

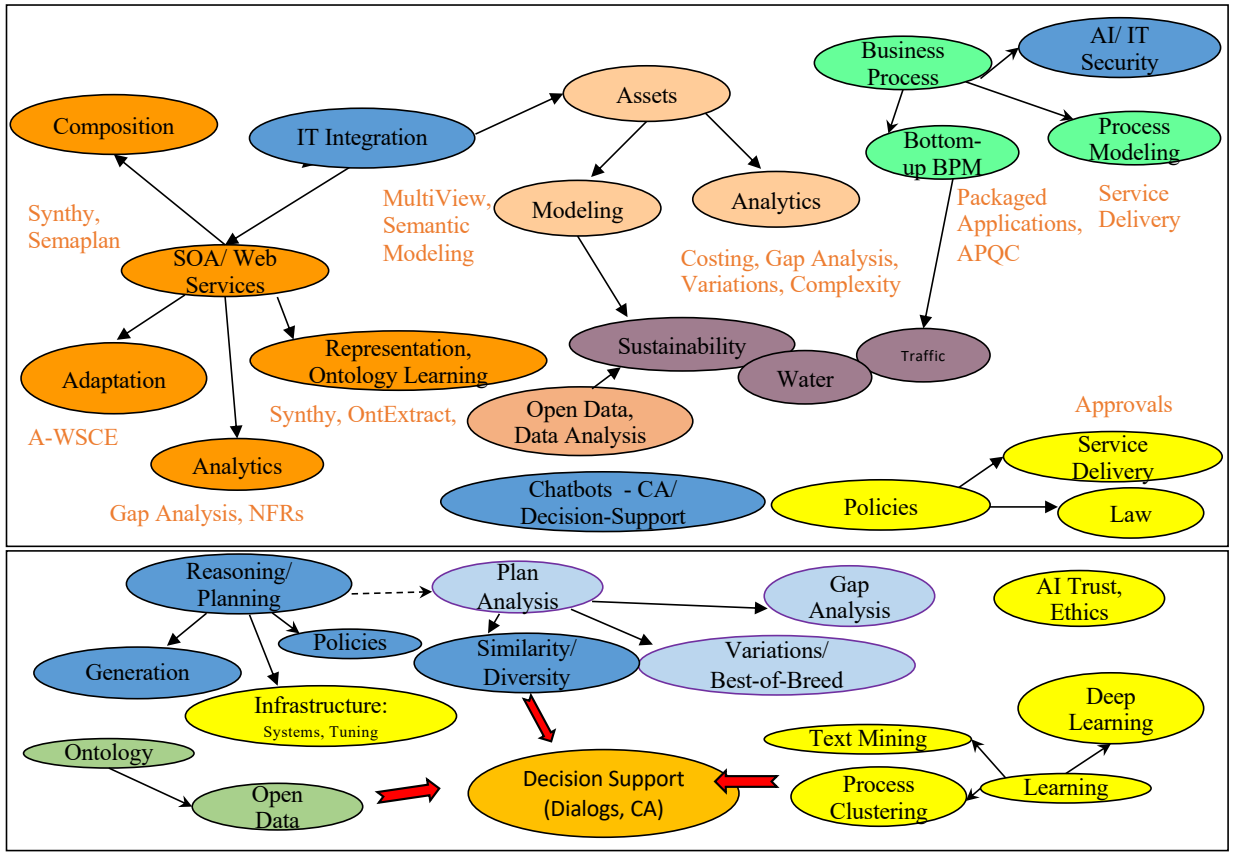
Research Snapshot (1989-2024)

Keywords: AI, Services, Sustainability

Current Research Focus: Theory (Neuro-symbolic), **Usability** (Trust Rating, RCTs), **Smart Cities** (Energy, Water, Health)

The Space of AI Applications Explored

The Space of AI Techniques Used

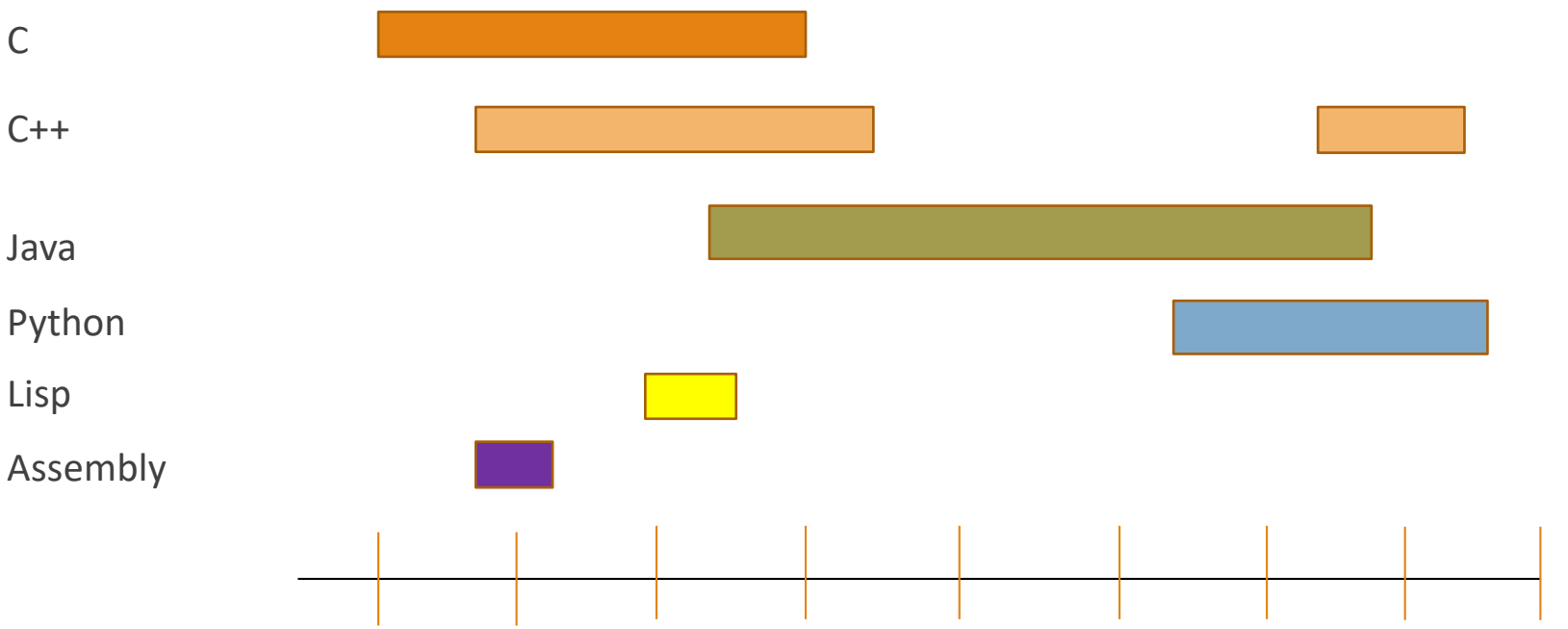


Details: https://sites.google.com/site/biplavsrivastava/

AI4Society: https://ai4society.github.io/projects/

Keywords: AI, Services, Sustainability
Papers: 200+ refereed; 5,900+ references
Patents: 72 (US issued); 4 sole inventions

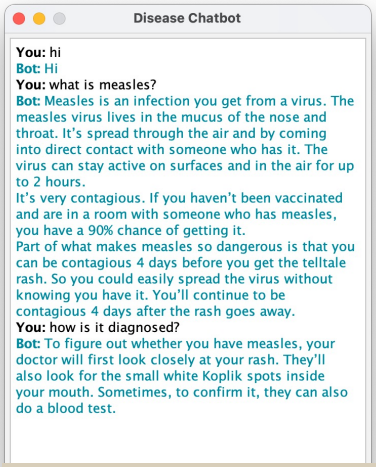
Personal Programming Language Journey* (35+ years)



*Excluded: Javascript, Prolog, …

Develop a Vibrant Research Culture Around AI

Students building chatbots
in Adv. Prog. Tech. class
in C++, Java and Python
(Elected Reps, Spring 2022;
Diseases, Spring 2023)



System Image Credit:
Christine Steege, CSCE240(H), Spring 2023

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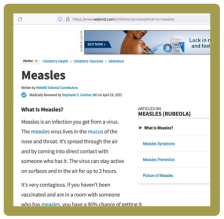

WebMD

- Thoroughness in work
- Clarity in communication
- Pro-active focus to complete an effort
- Comfortable working with others: social yet focused

Classes offered: AI, Trusted AI, Special Topics – Open Data, Planning, Chatbots; Adv. Prog. Tech. (CSCE 240), Comp. Proc. of Nat. Lang./NLP (CSCE 771)

http://casy.cse.sc.edu/kite

KITE: An Unsupervised, Effective and Inclusive Approach for Textual Content Exploration

Chatbots built for: governance (IJCAI 2016), astronomy (AAAI 2018 best demo award), water (AAAI 2018), smart room (ICAPS 2018 demo runner up, IJCAI 2018), career planning (commercial product), market intelligence (AAAI 2020 deployed AI award), dialogs for information retrieval (ICAPS 2021), fairness assessment (AAAI 2021), computer games (AAAI 2022), generalized planning (IJCAI 2023), transportation, set recommendation (teaming, meals) and health.

https://ai4society.github.io/demos/

About the Honors Program, Students

- Honors program expectations
- Students quick survey about programming experience

Main Section

Programming and Languages

Programming – Why and What's New

Why

- Control a system (hardware, software). With
  - Performance – effective, efficient
  - Robustness – e.g., handle variation in inputs
  - Maintenance – manage change in system easily
  - Cost – low
- Changes in programming languages and systems happen continuously

What's New

- Mainstream programming
  - Focus on maintenance and low cost
  - Python, Java
- Specialized programming (e.g., military, games, IoT)
  - Focus on performance
  - C++/C, Assembly
- Automatic programming - new
  - Code generation (Github CoPilot, ChatGPT)

Programming – How You Approach Coding

- Software engineering
  - Requirements
  - Specification
  - Design
  - Coding
  - Testing
- Development in teams
- Communication with all stakeholders
- Meeting project objectives

Languages – How You Conduct Coding

- Language choice
  - Coding convention
  - Code organization
  - Tool choices
  - Coding process
  - Syntax
  - Testing process
- Code maintenance
  - Releases
  - Bug fixing

Getting started for:

The “Hello World !” program

Course Logistics

Administrative Information

- HNRS: Advanced Programming Tech. CSCE240-(H)SPRING-2024
- Meeting Time: TuTh 8:30—9:45 AM
- Class methods
  - In-class: Swearingen Engr Ctr | Room 2A19
  - Material available afterwards on Blackboard (hence, Asynchronous Online)
- Websites
  - Course: Code and slides - https://github.com/biplav-s/course-adv-proglang-s24/
    Details: https://sites.google.com/site/biplavsrivastava/teaching/prog-csce-240-spring-2024-advanced-programming-techniques

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CSCE 240 - Advanced Programming Techniques (3 Credits)
Pointers; memory management; advanced programming language structures: operator overloading, iterators, multiple inheritance, polymorphism, templates, virtual functions; Unix programming environment.
Prerequisites: CSCE 215, C or better in CSCE 146.

Learning Objectives

- Develop language-independent understanding of programming concepts by being exposed to multiple languages (C++, Java, Python)
- Independently design and implement programs in multiple language of choices (C++, Java or Python based on choice) in a Unix environment
- Demonstrate mastery of pointers, iterators, memory management including object creation and destruction, and parameter passing in C++
- Demonstrate mastery of object-oriented programming concepts including: inheritance, polymorphism, operator overloading, template functions and classes, and the use of STL containers.
- Develop object-oriented models using UML
- Able to work in programming teams with code review and walk throughs
- Solve practical problems that matter

Books and Resources: C/C++

- C/C++
  - **(Authoritative)** Brian Kerninghan and Dennis Ritchie, The C Programming Language, https://en.wikipedia.org/wiki/The_C_Programming_Language
  - **(Authoritative)** Bjarne Stroustrup
    - The Annotated C++ manual, https://www.stroustrup.com/arm.html
    - The C++ Programming Language (4th Edition), Addison-Wesley ISBN 978-0321563842. May 2013, https://www.stroustrup.com/C++.html
  - Walter Savitch, Absolute C++ 6th ed., Pearson, 2016
  - Free books
    - C++ Essentials, Sharam Hekmat, https://freecomputerbooks.com/Cpp-Essentials.html
    - Fundamentals of C++ Programming , by Richard L. Halterman https://archive.org/details/2018FundamentalsOfCppProgramming/page/n333/mode/2up
    - C++ Today, https://www.jetbrains.com/cpp/cpp-today-oreilly/

Books and Resources: Java, Python

- Java
  - **(Authoritative)** The Java Programming Language, 4th Edition 4th Edition by Ken Arnold, James Gosling, David Holmes, ISBN-13: 978-0321349804
  - Effective Java - 3rd Edition, by Joshua Bloch, ISBN-13: 978-0134685991
  - Free books
    - Essential Java, by Krzysztof Kowalczyk (HTML), https://www.programming-books.io/essential/java/
    - Teach Yourself Java in 21 days, https://cs.cmu.edu/afs/cs.cmu.edu/user/gchen/www/download/java/LearnJava.pdf
- Python
  - **(Authoritative)** https://docs.python.org/3/tutorial/
  - Free books
    - Fundamentals of Python Programming, Richard L. Halterman, https://freecomputerbooks.com/Fundamentals-of-Python-Programming-by-Richard-Halterman.html
    - Think Python, Allen Downey, https://greenteapress.com/wp/think-python-2e/

Topics to Cover

- Input and output
- Pointers
- Iterators
- Memory management including object creation and destruction
- Parameter passing
- Object-oriented programming concepts including: inheritance, polymorphism, operator overloading, template functions and classes, and the use of STL (standard template library) containers.
- Develop / communicate object-oriented models using UML

Teaching Philosophy and Evaluation

- Learning under controlled, supervised environment ("spoon feeding")
  - Nature
    - Going by topics
    - Assessment by strict rubrics
      - Home work
      - Quizzes
  - Pros: easy to follow by students (especially by non-serious ones)
  - Cons: problems are disparate, mundane
- **Freedom with responsibility**
  - Nature
    - Solving meaningful societal problems; applying concepts learnt
    - Freedom to choose language, concepts and algorithms
    - Assessment by impact and effort
      - Projects
  - Pros: learn concepts by doing, better job prospects
  - Cons: pro-active effort needed by everyone, rubrics on non-common tasks are harder to understand

Home Work

- Home works will be testing content taught in class

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.

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.

Code Sharing and Review

- All code will be put on student's personal GitHub account in a repository named: **csce-240-h-spring2024-programs**
- Repository will be shared with instructor (GitHub: biplav-s) and TA.
- Homework assignments will be peer-reviewed in class. Not graded but class activity (doing home assignments, peer reviewing and testing) will count towards overall grade
- Programing assignments and project will be reviewed by TA and instructor only; select projects will be shared with class with students' permission

Student Assessment

A = [900-1000]
B+ = [850-899]
B = [800-849]
C+ = [750-799]
C = [700-749]
D+ = [650-699]
D = [600-649]
F = [0-599]

Tests	1000 points
• Course Project: programming assign.(5) and report, in-class presentation	600 points
• Class Participation and Home Works (~5)	200 points
• Quizzes and Exams	200 points
Total	1000 points

Coding Platform Setup

C/ C++ - Setup

- Using native command line
  - https://www.tutorialspoint.com/cprogramming/c_environment_setup.htm

- Using IDE
  - Eclipse: https://www.softwaretestinghelp.com/eclipse-for-cpp/
  - VisualStudio Code: https://code.visualstudio.com/

Java - Setup

- Using native command line
  - https://www.tutorialspoint.com/java/java_environment_setup.htm

- Using IDE
  - Eclipse: https://courses.cs.washington.edu/courses/cse373/18au/resources/eclipse-setup.html
  - VisualStudio Code: https://code.visualstudio.com/

Python - Setup

- Using native command line
  - https://wiki.python.org/moin/BeginnersGuide/Download

- Using IDE
  - Eclipse: https://www.ics.uci.edu/~pattis/common/handouts/introtopythonineclipse/
  - PyCharm: https://www.jetbrains.com/help/pycharm/quick-start-guide.html
  - VisualStudio Code: https://code.visualstudio.com/

Topics, Home Work, Project

Additional Tasks

- Setup GitHub repository
- Extend “Hello World” programs to read an argument from command line, concatenate to “Hello World” and print it

Concluding Section

Lecture 1: Concluding Comments

- We discussed course aims
  - Learn programming techniques
  - C/C++ will be the “mother language”
  - Choose one or more languages to have multi-lingual learning
- Learn important programming concepts
- Learn in real-world setting, i.e., with others
- Solve real-world problems

About Next Lecture – Lecture 2

Lecture 2: Experience with Development Environments

- Review Hello World
- Implement Read/ Write
- Implement sorting of numbers
- Peer code review and testing