

CSCE 240: Advanced Programming Techniques

Lecture 7: Object Oriented Concepts, UML

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 7

- Introduction Section
 - Recap of Lecture 6
- Main Section
 - Concept: UML
 - Concept: Object methods
 - Concept: Encapsulation and restriction to access
 - Background for project: Chatbots
- Concluding Section
 - About next lecture – Lecture 8
 - Ask me anything

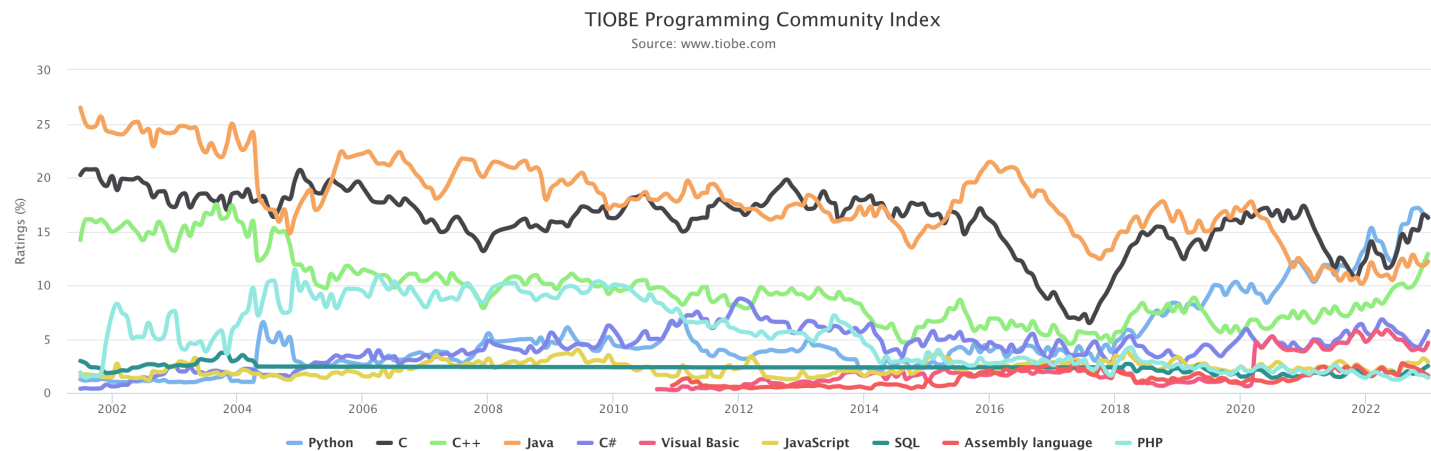
Introduction Section

Recap of Lecture 6

- We conducted peer review on home works #2
- Discussed objects v/s procedural view of problems
- Introduced Classes/ Objects

Programming Languages – Years Created

1957: Fortran
1958: LISP
1959: #COBOL
1964: BASIC
1972: C, SmallTalk
1978: SQL
1983: C++
1991: Python
1993: R
1995: PHP, Java & JS
2000: C#
2009: Go
2014: Swift



Source: <https://www.tiobe.com/tiobe-index/>

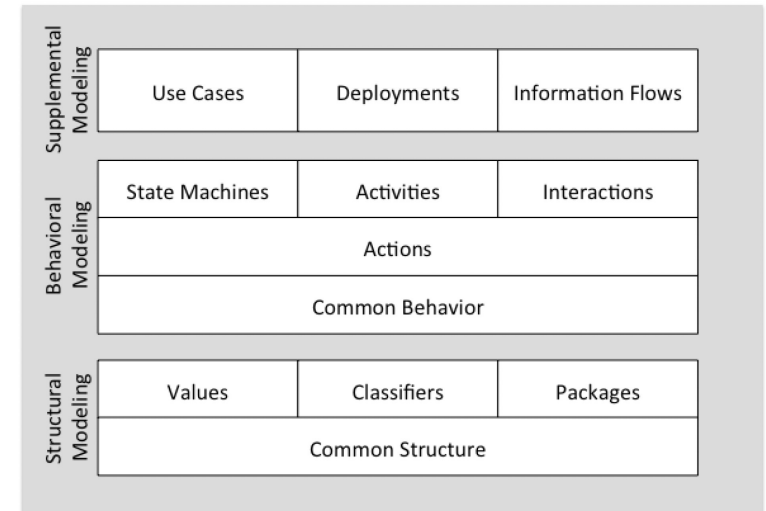
Source: <https://devskiller.com/history-of-programming-languages/>

Main Section

Concept: Unified Modeling Language (UML)

UML – What is it ?

- A visual, programming language independent, notation for communicating information about an Object-Oriented software's (static – structure, and dynamic - behavior) information
- Latest standard:
<https://www.omg.org/spec/UML/2.5.1/About-UML/>
- Standardized
 - Object Management Group (OMG) adopted in 1997
 - International Organization for Standardization (ISO) published UML as an approved standard in 2005



Semantic Areas of UML

Figure credit: UML 2.5.1 Specification

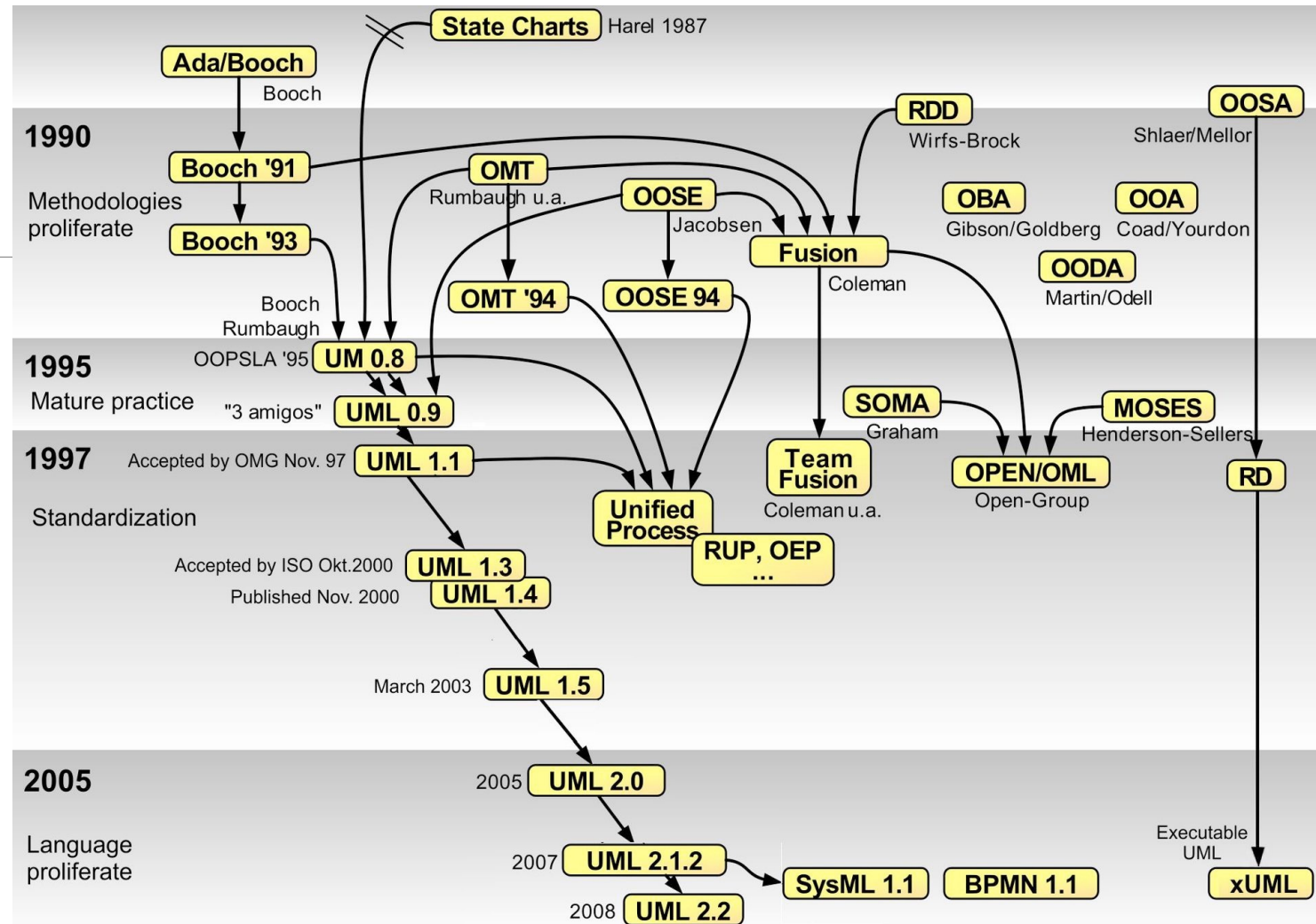
UML History

Rumbaugh, Jacobson and Booch lead the efforts

UML History

Figure credit:

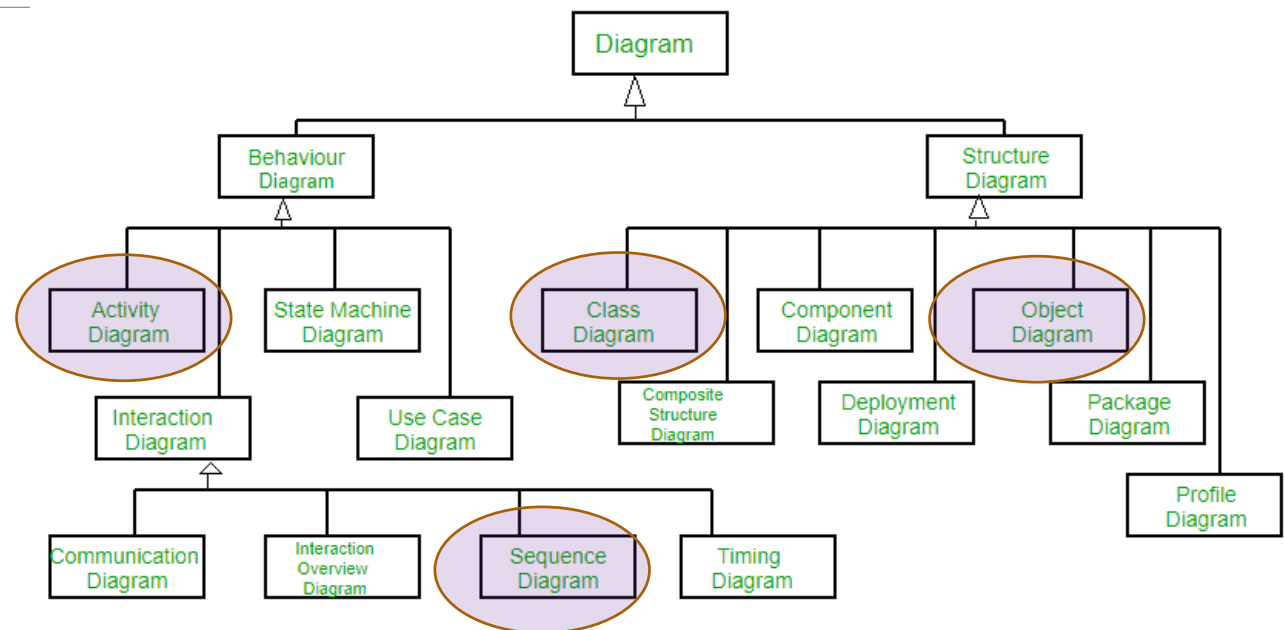
https://en.wikipedia.org/wiki/Unified_Modeling_Language



UML – Diagram Types

Most common types

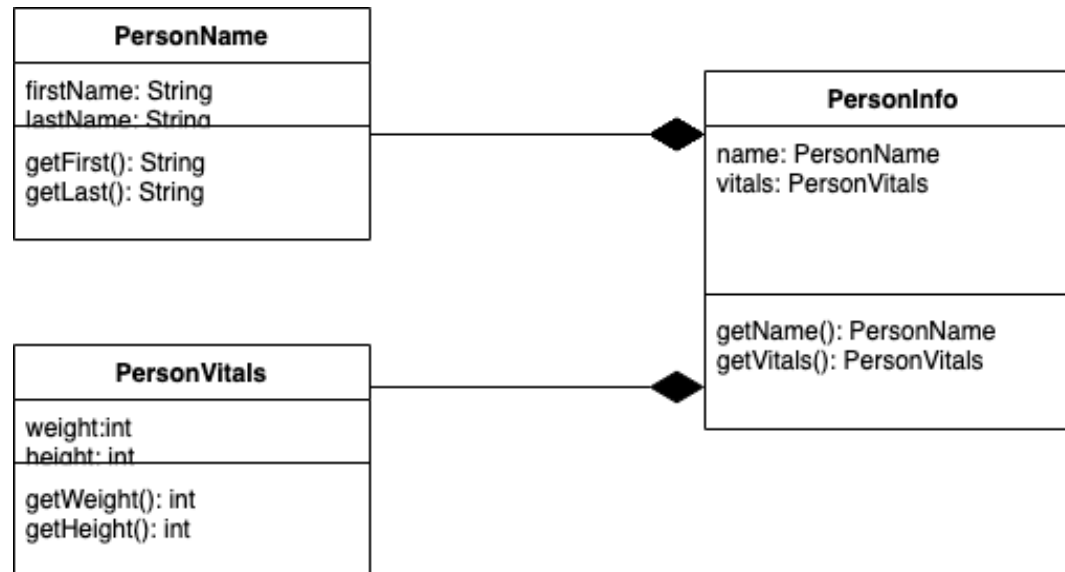
- Class and object diagrams
- Activity or sequence diagram



Types of Diagrams in UML 2.2

Figure credit: <https://www.geeksforgeeks.org/unified-modeling-language-uml-introduction/>

Example (Modified from Class 5/6)



Relationship Types

- Association: is related to
- Generalization: is a special type of
- Aggregation: is made up of, but can also exist independently
 - Example: Car and its wheels
- Composition: is made up of, but cannot exist independently
 - Example: Folder and its files

References:

1. UML 2.5.1 specs
2. Tutorial: <https://www.visual-paradigm.com/guide/uml-unified-modeling-language/uml-aggregation-vs-composition/>

Edit Example Class Diagram

- Using browser, go to: <https://app.diagrams.net/>
- Go to: File -> Open from -> Device -> and load file “Example.drawio”
 - File is at: <https://github.com/biplav-s/course-adv-proglang/tree/main/sample-code/UML/Class7-examples>
- Review and edit it
- You can save file or export the diagram in any supported format

Tools for UML

- Many free and paid tools are available
 - See a recent review: <https://www.gleek.io/blog/best-uml-tools.html>
- We will use diagrams.net (at <https://app.diagrams.net/>)

Concept: Encapsulation

Encapsulation

- Organize
 - All the information related to a concept together
 - All the methods related to manipulation of the information related to the concept
- Illustration
 - Simple relational number
 - Functions for
 - Accessing data members
 - Utility functions

Reference: <https://www.visual-paradigm.com/guide/uml-unified-modeling-language/uml-aggregation-vs-composition/>

Encapsulation – Access Restrictions

- Also called visibility rules, applies to both data members and functions
- Types
 - Public: any object can access
 - Protected: only object of same type or children can access
 - Private: only objects of same type can access
- **Demonstration:** SimpleRational

Code:

- <https://github.com/biplav-s/course-adv-proglang/blob/main/sample-code/CandC%2B%2B/Class7and8 C%2B%2B OO/src/implement/SimpleRelational.cpp>
- <https://github.com/biplav-s/course-adv-proglang/blob/main/sample-code/CandC%2B%2B/Class7and8 C%2B%2B OO/src/Class7and8 C%2B%2B OO.cpp>

Discussion - Example

- Class Name
 - Title: String // no one can access
 - FirstName: String // no one can access
 - MiddleName: String // no one can access
 - LastName: String // no one can access
 - Suffix: String // no one can access
 - NickName: String // only descendants can access
 - PreferredName: String // anyone can access

Discussion: Course Project

Course Project – Building and Assembling of Prog. Assignments in Health

- **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.

Core Programs Needed for Project

- Prog 1: extract data from the disease pages
- Prog 2: process it based on questions
- Prog 3: make content available in a command-line interface
- Prog 4: handle any user query and
- Prog 5: report statistics on interaction of a session, across session

Programming Assignment # 1

- Goal: extract data from the disease of choice
 - Language of choice: Any from the three (C++, Java, Python)
- Program should do the following:
 - Take disease as input
 - Read content about the disease
 - from the disease's URL from CDC and WebMD, OR
 - a local text version of the disease pages // Keep them as separate files with names <disease>-<source>.txt
 - Report statistics of content: lines, words, chars
 - Write content out in an output file formatted with indentation
- Code organization
 - Create a folder in your GitHub called "prog1-extractor"
 - Have sub-folders: src (or code), data, doc, test
 - Write a 1-page report in ./doc sub-folder
 - Send a confirmation that code is done to instructor, and update Google sheet

Chatbots - Background

- Conversation agents and interfaces (chatbots) are getting easy to build and deploy
 - Can be text-based or speech-based
 - Usually multi-modal (i.e, involving text, speech, vision, document, maps)
- Current chatbots typically interact with a single user at a time and conduct
 - Informal conversation, or
 - Task-oriented activities like answer a user's questions or provide recommendations

Demonstrations

- *Eliza*, <http://www.manifestation.com/neurotoys/eliza.php3>
- *Mitsuku*, <https://www.pandorabots.com/mitsuku/>

Chatbots and Their Complexity

- **Users:** 1 or more; stay same or change over time
- **Modality:** variety of input data
- **Data:** static, changes, e.g. sensor data
- **Personalization:** Language, communication style, ..
- **Form:** interface variety
- **Purpose:** what does it help with?
- **Domains:** scope

S.No.	Dimension	Variety
1	User	1, multiple
2	Modality	only conversation, only speech, multi-modal (with point, map, ...)
3	Data source	none, static, dynamic
4	Personalized	no, yes
5	Form	virtual agent, physical device, robot
6	Purpose	socialize, goal: information seeker, goal: action delegate
7	Domains	general, health, water, traffic, ...

Unique Characteristics of a Chatbot

(Decision Support Collaborative Assistant)

- Should be useful for a purpose
- Should be able to work with any user utterance (example: text for a text-based chatbot)
- Optional, but desirable
 - User should be able to refer to the history of conversation in utterance
 - Improves performance over time
 - Model the user (understand impact of system on human) and not harm her

Discussion: Nature and Simplifications

- Once you select a disease, the scope of answers is fixed.
- Some simplifications
 - **Download local copy** v/s web query
 - **Read 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

Suggested Scope is a Drastic Simplification

- **Users:** 1
- **Modality:** text
- **Data:** static (optionally: dynamic – voting history)
- **Personalization:** none
- **Form:** command line
- **Purpose:** information provider
- **Domain:** specific to representative and district

Concluding Section

Lecture 7: Concluding Comments

- We introduced UML – a language independent notation for communicating about OO software
- Looked at concept of encapsulation
- Discussed background of chatbot

About Next Lecture – Lecture 8

Lecture 8: Object Oriented Continued, UML Notations

- Code organization for OO project
- Larger OO examples
- Project – Prog assignment 1 discussion