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CSCE 240: Advanced Programming Techniques
Lecture 8: Object Oriented Concepts - Inheritance

PROF. BIPLAV SRIVASTAVA, AI INSTITUTE

8TH FEBRUARY 2022

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 9

- Introduction Section
  - Recap of Lecture 8
  - TA and SI Updates
- Main Section
  - Concept: Inheritance
  - Discussion: Home work #3 – due in Class 10
  - Discussion: Prog. Assignment #2 and Project discussion
- Concluding Section
  - About next lecture – Lecture 10
  - Ask me anything

Introduction Section

Recap of Lecture 8

- We relooked at relationships between classes
- We discussed code organization – header and implementation files, when to separate
- We discussed programming assignment (PA) #1 due that day

Updates from TA, SU

- TA update: Yuxiang Sun (Cherry)
- SI update: Blake Seekings

Main Section

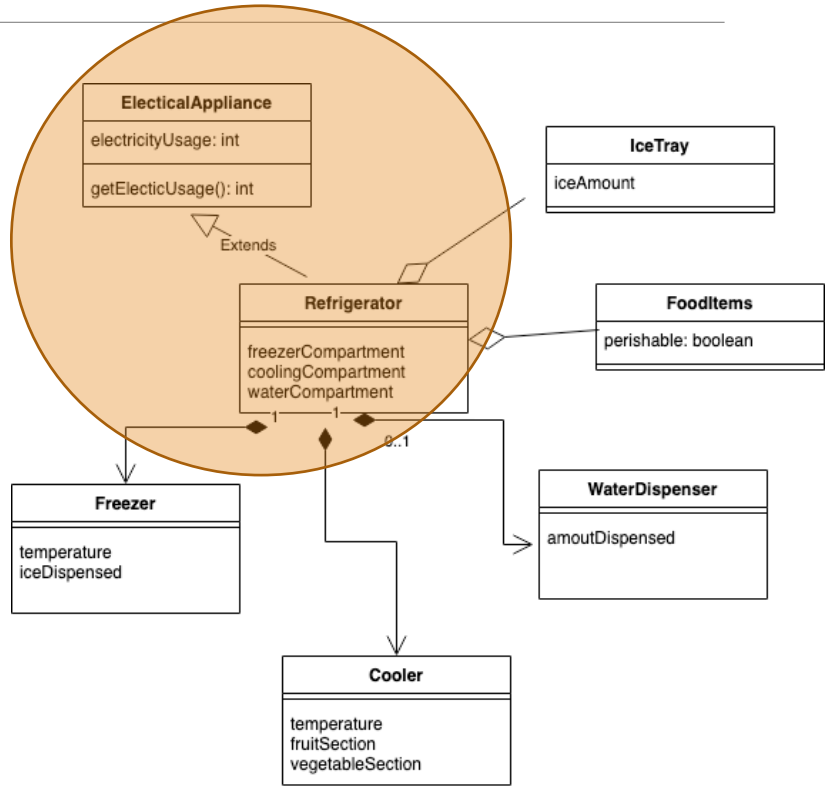
Concept: Inheritance

What is Inheritance ?

- A class “inheriting” or reusing **characteristics** from another, existing class
- Synonyms: subclassing, specialization, derived
- Analogy: child inheriting from a parent
  - “Course-CSCE-240” sub-class of “Course-Undergraduate”
  - “USA” specialization of “Country”
- What are characteristics
  - Data members
    - Enrollment, timing, syllabus: course domain
    - Capital, head-of-state, currency: country domain
  - Functions manipulating the data members

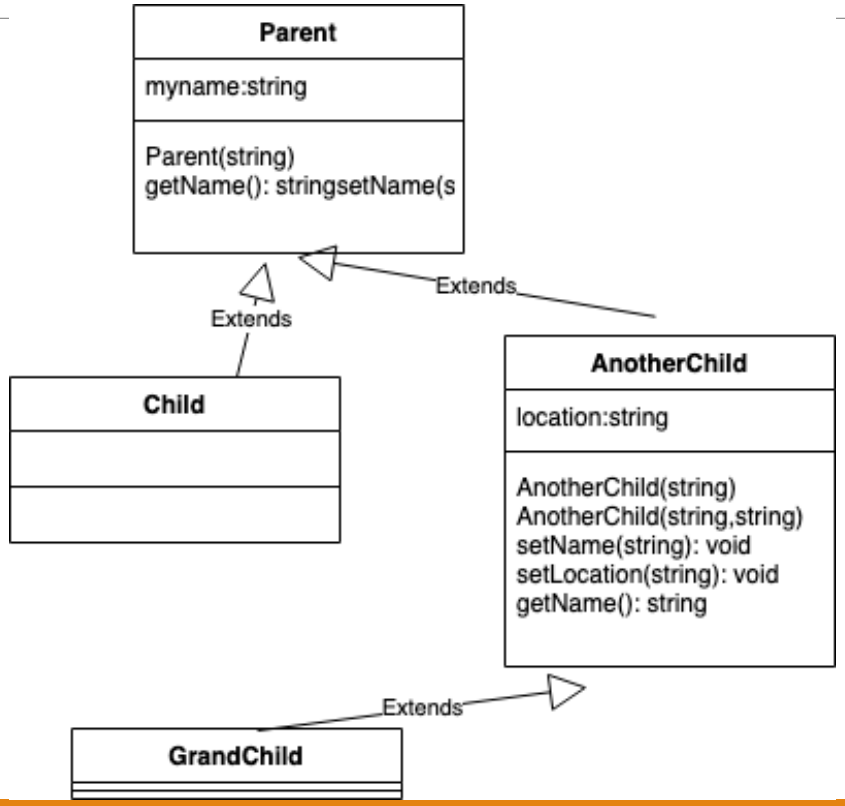
Why Use Inheritance ?

- Promote reuse
- Make code understandable, improve maintainability
- Promote security and data integrity
- Improve testing
- Improve code development productivity



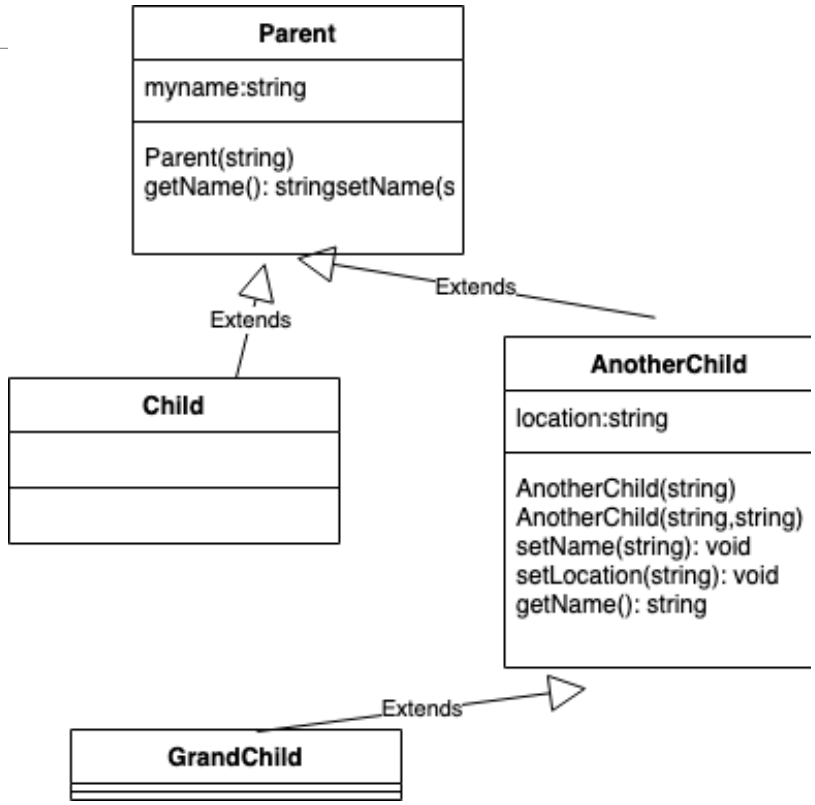
How to Use Inheritance ?

- Language independent syntax
- Illustration
  - 4 classes
  - 2 data members: myname, location
  - Access restrictions: private, protected, public



Notes on Inheritance

- Code for classes Child and GrandChild are minimal
  - Code reuse happens by default
- A child can override the behavior of its parent



Home Work 3

Due Thursday, Feb 10, 2022

Programming Home Work (#3) – C++

Home Work #2

- Write a program called GeometricPropertyCalculator.
  - The program reads an input file (called input.txt). Each line in the file contains dimensions of a geometric shape – rectangle, shape and triangle. Specifically:
    - For rectangle, it contains – RECTANGLE <length-in-cm> <breadth-in-cm>
    - For circle, it contains – CIRCLE <radius-in-cm>
    - For triangle, it contains – TRIANGLE <side-1-in-cm> <side-2-in-cm> <side-3-in-cm>
  - The user specifies the property to calculate as argument to the program: 1 for AREA and 2 for PERIMETER
  - The program writes output lines to an output file (called output.txt) for each shape that it reads and the property – AREA or PERIMETER.
    - For example, for RECTANGLE and property as AREA, the program should write – RECTANGLE AREA <calculated value>
  - Write GeometricPropertyCalculator in C++
    - It should support RECTANGLE, CIRCLE and TRIANGLE
    - It should support properties AREA and PERIMETER
    - If there is insufficient information, the program should give an error. E.g. TRIANGLE AREA "Not enough information to calculate"

Home Work #3

- Build a program called **OOGeometricPropertyCalculator**
  - Your new code will do the same as Home Work#2 but with OO design
  - It will have 4 classes: Shape – the parent, and its three children - Rectangle, Circle and Traingle
  - Shape will have three members: **area**, **perimeter** and **errorMessage**; and at least three functions getArea(), getPerimeter() and getErrorMessage().
  - In your code, there will be a utility file (OOGeometricPropertyCalculator.cpp) with main() and will call the classes and functions. You can choose to have one or more files for the classes.
    (E.g, For the 4 classes, 4 headers + 4 .cpp files).
  - You will also draw UML class diagrams for it
- Functionality Reminder
  - The user specifies the property to calculate as argument to the program: 1 for AREA and 2 for PERIMETER
  - The program writes output lines to an output file (called output.txt) for each shape that it reads and the property – AREA or PERIMETER.

Programming Home Work (#3) – C++

- Code guidelines for the OO code you will write
  - Have sub-directories in your folder
    - src sub-folder, (or code) for code
    - data sub-folder, for input.txt and output.txt
    - doc sub-folder, for documentation on what the code does or sample output.

- In documentation
  - **Have a UML class diagram for the classes**
  - Observe how long was the code earlier and now. If you have to add a new functionality (like getVertices() to get all the vertices in a shape), how easy or hard will it be in HW2 code or HW3 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 ! *(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.

PA: Code Reviewing Rubric Used

- Look out for
  - 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?
    - Are the variables initialized ?
    - Are files closed?
    - Is their unnecessary code bloat ?
- What not to judge
  - Usage of language features, unless they are inappropriate

Assign rating (out of 100 -/+)
- -100: code not available
- -80: code with major issues
- -60: code with minor issues
- -20:
- 0: (full marks): no issues
- +20: special features

PA: Code Testing Rubric Used

- Look out for
  - 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?
- What not to judge
  - Length of documentation. It can just be short and accurate.
  - Person writing the code

Assign rating (out of 100 -/+)
- -100: code not available
- -80: code with major issues (e.g., abnormal termination, incomplete features)
- -60: code with minor issues
- -20:
- (full marks): no issues
- +20: special features

Core Programs Needed for Project

- Prog 1: extract data from the district
- **Prog 2: process it (extracted data) 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 # 2

- Goal: **process extracted text based on questions**
  - Language of choice: Any from the three (C++, Java, Python)
- Program should do the following:
  - Take input from a local file with whose content is obtained from Prog#1 (when district name given as input)
  - Given an information type as input, the program will return its content
    - Examples: Contact Information, personal information, voting records
    - Input type can be given as command line argument.
      Examples:
      - prog2processor –t “Contact Information”
      - prog2processor –t “Contact Information:name” // Get person’s name
  - For demonstrating that your program works, have a file called “test_output.txt” showing the set of supported commandline options and output in the doc folder.
- Code organization
  - Create a folder in your GitHub called “prog2-processor”
  - 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 TA, and update Google sheet

- Contact Information (Type-I1)
  - Name
  - Region
  - Addresses: Columbia, Home
  - Phone: Business, Home
- Personal Information (Type-I2)
- Committee Assignments (Type-I3)
- Sponsored Bills in the House (Type-I4)
- Voting Record (Type-I5)
- **Service in Public Office (Type-I6)**

Example: Representative Information

Input:

prog2processor –t “Contact Information:name” // Get person’s name

Output:

Terry Alexander

- Contact Information (Type-I1)
- Personal Information (Type-I2)
- Committee Assignments (Type-I3)
- Sponsored Bills in the House (Type-I4)
- Voting Record (Type-I5)
- **Service in Public Office (Type-I6)**

Representative Terry Alexander

Democrat - Florence
District 59 - Darlington & Florence Counties - **Map**

Columbia Address
314C Blatt Bldg.
Columbia 29201

Home Address
1646 Harris Court
Florence 29501

Business Phone (803) 734-3004

Home Phone (843) 665-7321

Send message to Representative Alexander

Personal Information

- Education Consultant & Pastor
- Residing at 1646 Harris Court, Florence
- Born January 23, 1955 in Florence
- Son of the late James and Adell Alexander
- Durham Business College, A.D., 1976
- Francis Marion University, B.A., 1991
- Howard University School of Divinity, M. Div., 1998
- Married to Starlee Davis Alexander, 2 children, Terrell McClain and Matthew
- Pastor, Wayside Chapel Baptist Church
- Career Development Consultant
- Adjunct Professor of Religion, Limestone College
- Pee Dee Regional Council of Governments
- Past President, Habitat for Humanity, Board of Directors
- Charter member, The Florence Breakfast Rotary Club
- Past President, Boys and Girls Club of Florence
- Boy Scouts of the Pee Dee Executive Boards
- Florence Branch, NAACP, past President
- Mercy Medicine Board
- Pee Dee Chapter American Red Cross
- 100 Black Men of the Pee Dee
- Kappa Alpha Psi Fraternity, Inc.
- Francis Marion Society
- National Association of County Officials
- National Association of Black County Officials
- South Carolina Association of Black County Officials
- South Carolina Association of Guidance Counselors
- South Carolina Alliance of Black Educators

Committee Assignments

- **Education and Public Works, *2nd V.C.***
- **Regulations and Admin. Procedures**

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

- Florence County Council, 1990-06, District Number 3
- House of Representatives, 2007 - Present

Discussion

Concluding Section

Lecture 9: Concluding Comments

- We looked at inheritance relationship among classes
- Home Work #3 – due Feb 10
- Prog. Assignment #2 - due Feb 22

About Next Lecture – Lecture 10

Lecture 10: Object Oriented - Polymorphism

- OO – Polymorphism.
- Home work 3 will be peer reviewed in class

8	**Feb 3 (Th)**	**Code org (C++)**	**Prog 1 - end**
9	Feb 8 (Tu)	OO – inheritance	Prog 2 - start
10	Feb 10 (Th)	OO - polymorphism	HW 3 due
11	Feb 15 (Tu)	In class test	Quiz 1 – In class