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CSCE 240: Advanced Programming Techniques
Lecture 20: Advanced Input/ Output, Operators

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 20

- Introduction Section
  - Recap of Lecture 19
  - TA and SI Updates
- Main Section
  - Concept: Buffering continued
  - Concept: Operator overloading
  - Task: Project – PA #4 due
- Concluding Section
  - About next lecture – Lecture 21
  - Ask me anything

Introduction Section

Recap of Lecture 19

- We reviewed HW 5
- We looked at pointers
  - Pointers and references
  - Pointer arrays
  - Pointer based swapping of numbers and user-defined types
- Checked on PA 4, due on Thursday (March 24, 2022)

Updates from TA, SU

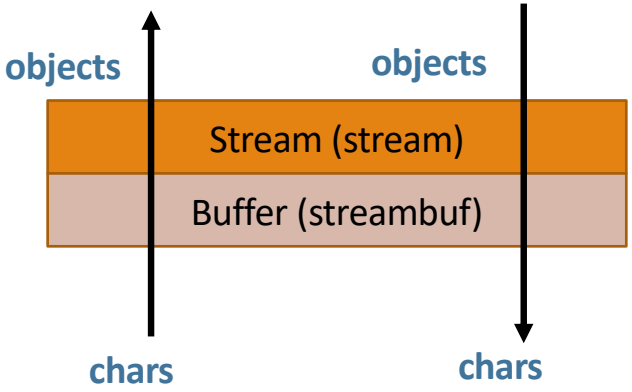
- TA update: Yuxiang Sun (Cherry)
- SI update: Blake Seekings

Main Section

Concept: Adv. I/O – Buffering (Continued)

Why Buffer Input or Output

- Computer has access to both memory (temporary storage) and disk (permanent storage)
- Properties
  - Faster to write data to memory than to disk.
  - Faster to write one block of N bytes to disk in a single operation than it is to write N bytes of data one byte at a time using N operations



- Developer has to be aware of
  - buffer size // impacts I/O performance or memory usage
  - Initial and last values // In case last chunk is less than buffer size
  - Clearing off of the buffer // Affects what is read/ written at the end; flush the values
- Buffered reading/ writing supported in most languages

Operations on Stream

- Position
  - **get**: position of the next character to be fetched into the sequence (extraction)
  - **put**: position of the next character to be deposited into the sequence (insertion)
- Operations
  - **seek**: move pointer with a given offset
  - **tell**: inform about the position of pointer

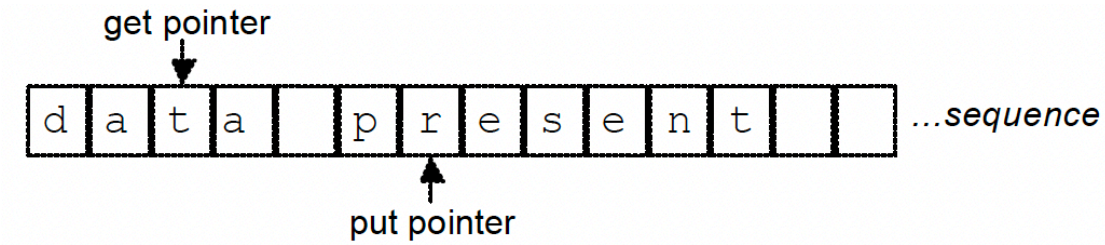


Image credit: C++ Essentials, Sharam Hekmat

Code Examples

- Steam write operations (option – 4)
- Reading and writing
  - with no buffering (option – 5)
  - with buffer size same as file length; extremely memory efficient (option – 6)

Discussion on Streams and Buffers

- Streams give a very convenient interface over I/O
  - Hides details of the physical systems (disks, displays, printer, string, web-connected resource)
  - But performance can be a challenge
- Buffers give a way to manage performance
  - Relies on differential speeds of access of I/O devices
  - Design issues about size of buffers, practical issues of initialization of content, flushing content (write situation)

Concept: Operator Overloading

Operator Overloading – What

- Overloading happens when we have multiple functions of the same name
  - Functions distinguished by signature, i.e., parameters and return types
  - Constructors are the common form of overloaded functions

- Operator overloading
  - When operators are overloaded
  - Examples: <<, >>, [], +, - , …

Operator Overloading - Why

- Commonly used with user defined types / classes
- Provide convenience to user, improve usability
- Avoid meaningless / error-prone behavior, especially when operator behavior is inherited due to class hierarchy

Example 1 – Strings

- Suppose you are working with text. Can be in any language.
  - You want to refer to strings and their relationships to each other
  - **Example**: combining two strings
- String representation:
  - Array of characters
- Operation
  - +, -, …

Example 2 – Point and Operations

- Suppose you are working in Geometry. Can be in any dimension.
  - You want to refer to points and their relationships with each other
  - **Example**: a point that is twice away from another point, with respect to a reference
- Point representation: 2-D: Cartesian Geometry
  - (x, y)
  - (angle, distance)
- Operation
  - +, -

Code example: (option > 6)

Class Exercise – 10 Mins

- Implement operators
  - * with a Point argument: multiples x and y of two points (self and argument) respectively, respectively
  - ^ with an int argument: multiples x and y of the point passed argument

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.

Core Programs Needed for Project

- Prog 1: extract data from the district **[prog1-extractor]**
- Prog 2: process it (extracted data) based on questions **[prog2processor]**
- Prog 3: make content available in a command-line interface **[prog3-ui]**
- **Prog 4: handle any user query [prog4-userintent2querymapper]**
- Prog 5: report statistics on interaction of a session, across session

Objective in Programming Assignment # 4:
Remove Requirement on User to Know Supported Queries!

- Until now, use needed to know what the program supports.
- **Can the system adapt rather than ask the user to adapt ?**

- **Approach Suggested**
  - Take user's utterance
  - Match to the closest supported query (six) and a confidence estimate
  - If confidence greater than a threshold
    - Run the query,
  - Otherwise
    - Ask user to re-phrase and ask again

- Program should do the following:
  - Run in an infinite loop until the user wants to quit
  - Handle any user response
    - **[#1]** User can quit by typing "Quit" or "quit" or just "q"
    - User can enter any other text and the program has to handle it. The program should write back what the user entered and say – "I do not know this information".
  - Handle known user query
    - **[#2]**"Tell me about the representative", "Tell me about the rep" => Personal Information (Type-I2)
    - **[#3]**"Where does the rep live" => Contact Information (Type-I1): Home Address
    - **[#4]**"How do I contact my rep " => Contact Information (Type-I1)
    - **[#5]**"What committees is my repo on" => Committee Assignments (Type-I3)
    - **[#6]**"Tell me everything" => *Give all information extracted*

Programming Assignment # 4

- Goal: **make an utterance to query** [Name: **prog4-userintent2querymapper**]

- Program may do the following:
  - Run in an infinite loop until the user wants to quit
  - Get a user utterance. We will call it u
  - See if u matches to supported queries in Q // 6 until now
    - Split u into words
    - For each query q in Q
      - Split q into words
      - Check how many words of u and w match
      - Compute a percentage of match
    - q_i: let this be the query with the highest match percentage
    - If q_i > 0.7 (a parameter),
      - Consider it to be the query. Inform user and execute; give information (result)
    - Else
      - Tell user cannot understand u. Rephrase and try again.

Optionally: consider edit distance

Programming Assignment # 4

- Code organization
  - Create a folder in your GitHub called "**prog4-userintent2querymapper**"
  - Have sub-folders: src (or code), data, doc, test
  - Write a 1-page report in ./doc sub-folder
  - Put a log of system interacting in ./test
  - Send a confirmation that code is done by updating Google sheet; optionally, send email to instructor and TA

- Use concepts learned in class
  - Exceptions

Concluding Section

Lecture 20: Concluding Comments

- We looked at buffering for inputs and outputs
- We looked at operator overloading
- Both useful across OO programming languages
- PA4 due

About Next Lecture – Lecture 21

Lecture 21: Advanced: Memory Mgmt

- Fixed memory
  - Vectors
  - Arrays
- Dynamic memory
  - List
  - User defined types
- Freeing memory
- PA 5 starts

17	**Mar 15 (Tu)**	**Testing strategies**	**Prog 4 - start**
18	Mar 17 (Th)	Advanced: Pointers	HW 5 due
19	Mar 22 (Tu)	Advanced: I/O	
20	Mar 24 (Th)	Advanced: Operator overloading	Prog 4 - end
21	Mar 29 (Tu)	Advanced: Memory Management	Prog 5 - start
22	Mar 31 (Th)	Advanced: Code efficiency	