AI INSTITUTE #AIISC
UNIVERSITY OF SOUTH CAROLINA

UNIVERSITY OF SOUTH CAROLINA

CSCE 240: Advanced Programming Techniques
Lecture 3: Input and Output

PROF. BIPLAV SRIVASTAVA, AI INSTITUTE

18TH JANUARY 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 3

- Introduction Section
  - Recap of Lecture 2
  - TA and SI Updates
- Main Section
  - Review additional tasks: Sorting of numbers
  - Concept: Data types
  - Concept: Strings
  - Concept: Streams, Input and Output
  - Concept: Error Handline
  - Numeric processing: Calculator
  - Team activity: code review, testing
- Concluding Section
  - About next lecture – Lecture 4
  - Ask me anything

Introduction Section

Recap of Lecture 2

- Introduced to TA (Teaching Assistant) and SI (Supplementary Instructor)
- We discussed concepts of pointers and iteration
- Looked at sorting of numbers in different languages

Updates from TA, SU

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

Main Section

Review: Sorting of Numbers

- C++, Java, Python

Concept: Data Types

Common C++ types

Type	Typical Bit Width	Typical Range
char	1byte	-127 to 127 or 0 to 255
unsigned char	1byte	0 to 255
signed char	1byte	-127 to 127
int	4bytes	-2147483648 to 2147483647
unsigned int	4bytes	0 to 4294967295
signed int	4bytes	-2147483648 to 2147483647
short int	2bytes	-32768 to 32767
unsigned short int	2bytes	0 to 65,535
signed short int	2bytes	-32768 to 32767
long int	8bytes	-2,147,483,648 to 2,147,483,647
signed long int	8bytes	same as long int
unsigned long int	8bytes	0 to 4,294,967,295
long long int	8bytes	-(2^63) to (2^63)-1
unsigned long long int	8bytes	0 to 18,446,744,073,709,551,615
float	4bytes	
double	8bytes	
long double	12bytes	
wchar_t	2 or 4 bytes	1 wide character

Credit and Reference: https://www.tutorialspoint.com/cplusplus/cpp_data_types.htm

Concept: Strings in Languages

- C: unsigned array of characters
  - Methods to copy, find length,…
  - Array operators
- C++: standard class
  - Methods to find length, compare
- Java: built-in data type
- Python: built-in data type; sequence of Unicode

Reference:

- Python: https://docs.python.org/3/library/stdtypes.html#textseq, https://docs.python.org/3/library/string.html

Concept: Streams, Input, Output

- **Streams**: an abstraction of end-point (file, terminal, string, web resource - source, destination) with characters in sequential order of any length.
- Input
  - cin: command line for input
  - ifstream: file for input
- Output
  - cout: command line for output
  - ofstream: file for output
- Both
  - fstream, sstream

- Pattern for using streams
  1. Open a stream
  2. Do operation (read, write or both)
  3. Close the stream

Reference:

- C++ IO classes - https://www.cplusplus.com/reference/iolibrary/, https://www.cprogramming.com/tutorial/c++-iostreams.html

Concept: Streams, Input, Output

- Pattern for using streams
  1. Open a stream
  2. Do operation (read, write or both)
  3. Close the stream

open (filename, mode);

`ios::in`	Open for input operations.
`ios::out`	Open for output operations.
`ios::binary`	Open in binary mode.
`ios::ate`	Set the initial position at the end of the file. If this flag is not set, the initial position is the beginning of the file.
`ios::app`	All output operations are performed at the end of the file, appending the content to the current content of the file.
`ios::trunc`	If the file is opened for output operations and it already existed, its previous content is deleted and replaced by the new one.

Reference:

- C++ IO classes - https://www.cplusplus.com/reference/iolibrary/, https://www.cprogramming.com/tutorial/c++-iostreams.html
- Table courtesy - https://www.cplusplus.com/doc/tutorial/files/

Concept: Error Handling

- Error is unavoidable. Think ahead.
- Good programs have stable behavior; they handle known and unknown situations
- Error can be tested on streams anytime.
  - bad(): Returns true if a reading or writing operation fails.
  - fail(): Returns true in the same cases as bad(), but also in the cases of a format.
  - eof(): Returns true if a file open for reading has reached the end.
  - good(): It is the most generic state flag returning false if any of the previous functions would return true.

Reference:

- Table courtesy - https://www.cplusplus.com/doc/tutorial/files/

Illustrate Concepts

- C++
  - Class3and4_C++_IO.cpp
  - Notice: code and data are in separate folders

Illustration: Java

- Notice the three libraries for input and output, respectively
- Notice try/ catch to handle errors

Illustration: Python

- File: L3_DemoReadWrite.py
- Main code is 3 lines: open, read/ write, close
- No data typing

Review C++ With Peers – In Class

- Code walk through
- Unit testing

Programming Home Work (#1) – C++

- Write a program called FileBasedCalculator.
  - It reads three lines from an input file (called input.txt): the operation to be done (add, subtract, multiply or divide), and two integer numbers.
  - It writes two lines to an output file (called output.txt). The first line says – ”The result of <operation> on <num1> and <num2> is below”. The second line has the result.
- Modify the program so that it can handle missing input file name.

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.

Discussion: Nature and Simplifications

- Once you select a district, the elected legislator 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

Concluding Section

Lecture 4: 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 – quick sort
- Discussed projects

Additional Tasks

- Implement sorting in C++
- Implement sorting in another language (Java or Python)
- Add code on personal GitHub
- Update TA/ Instructor on Piazza

About Next Lecture – Lecture 4

Lecture 4: I/O

- Handling mixed data types
- Error handling
- Printing values with formatting
- Will review Home Assignment-1 (FileBasedCalculator) in class