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# *CSCE 240:* Advanced Programming Techniques
## Lecture 4: Input and Output, Formatting

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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 4

- Introduction Section
  - Recap of Lecture 3
- Main Section
  - Review home assignment #1: (FileBasedCalculator)
    - Peer activity: code review, testing
  - Concept: Handling mixed data types
  - Concept: Printing with formatting
- Concluding Section
  - About next lecture – Lecture 5
  - Ask me anything

# Introduction Section

# Recap of Lecture 3

- We discussed the concepts of data types, strings
- We discussed the concepts of streams and error handling
- We looked at programs in C++, Java and python on file handling
- Homework assignment - FileBasedCalculator

# Main Section

# 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.

# Peer Review: Homework Assignment #1

1. Go to spread sheet and on ”Homework Assignments - Peer Review” tab
2. Go to the row with your name
3. Peer review (10 mins)
    1. Enter roll number of person on your **LEFT** under “ID of code reviewer”
    2. Share code for the reviewer to see
    3. Reviewer: enter review (1-5)
    4. **Note**: negotiate – review code of neighbor or get own’s code reviewed
4. Peer test (10 mins)
    1. Enter roll number of person on your **RIGHT** under “ID of code tester”
    2. Share command line for the tester to see
    3. Tester: enter review (1-5)
    4. **Note**: negotiate – test code of neighbor or get own’s code tested

# Peer Reviewing Guideline (10 mins)

- Look out for
  - Can you understand what the code is doing ?
  - Can you explain the code to someone else (non-coder) ?
  - Can you 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
  - 1: code not available
  - 2: code with major issues
  - 3: code with minor issues
  - 4:
  - 5: no issues

# Peer Testing Guideline (10 mins)

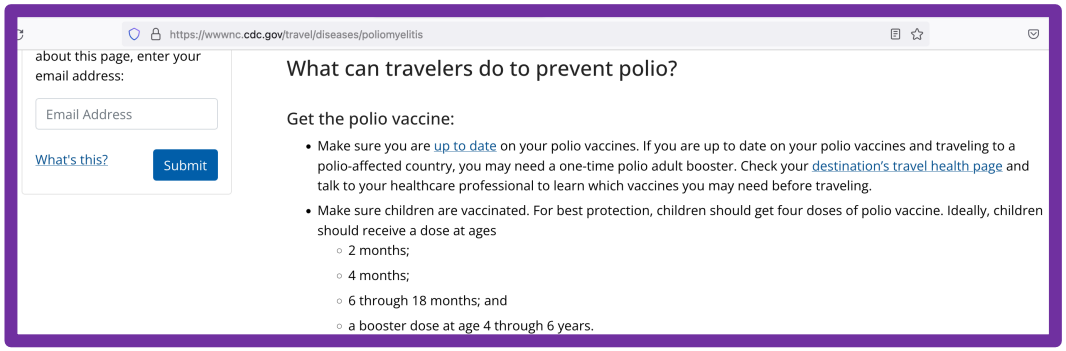
- Look out for
  - Does the program run as the coder wanted it to be (specification) ?
  - Does the program run as the instructor wanted it to be (requirement - customer) ?
  - Does the program terminate abruptly ?
  - Any special feature?
- What not to judge
  - Person writing the code
- Assign rating
  - 1: code not available
  - 2: code runs with major issues (abnormal termination, incomplete features)
  - 3: code runs with minor issues
  - 4:
  - 5: No issues

# Discussion

- Peer Code Reviewing
- Peer Testing

# Concept: Handling Mixed Types

Make sure children are vaccinated. For best protection, children should get four doses of polio vaccine. Ideally, children should receive a dose at ages 2 months;
•4 months;
•6 through 18 months; and
•a booster dose at age 4 through 6 years.




https://wwwnc.cdc.gov/travel/diseases/poliomyelitis

# Concept: Handling Mixed Types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# 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

# Mixed Data Types

- Examples:
  - Char, string, int, double on the same line
  - Char, string, int, float on different lines
  - Both
- Strategy
  - Read as characters/ strings  by line
  - Parse each line
- Assumption
  - Reader has idea of what data type is at a location
- *What if the reader cannot assume?*


https://www.scstatehouse.gov/member.php?chamber=H

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# Code Demo

- **Function:** demoReadMixedFile()
  - Once we have each word, we can convert to specific format based on our expectation of data type expected at that position
  - Github: https://github.com/biplav-s/course-adv-proglang/blob/main/sample-code/CandC%2B%2B/Class3and4_C%2B%2B_IO/src/Class3and4_C%2B%2B_IO.cpp

- Question: *What if the reader cannot assume?*

# Type Conversions

- Widening (promotion)

| From | To |
| --- | --- |
| Any `signed` or `unsigned` integral type except `long long` or `__int64` | `double` |
| `bool` or `char` | Any other built-in type |
| `short` or `wchar_t` | `int`, `long`, `long long` |
| `int`, `long` | `long long` |
| `float` | `double` |

- Narrowing conversions (coercion)

Reference and figure credit: https://docs.microsoft.com/en-us/cpp/cpp/type-conversions-and-type-safety-modern-cpp?view=msvc-170

# Discussion: Sorting of Characters

- Setting
  - Input: [‘a’, ‘z’, ‘i’]
  - Output: [‘a’, ‘i’, ‘z’]

- Question: can we reuse previous sorting program with minimal change?
  - If yes, how ?

# Concept: Formatted Printing

# Concept: Error Handling

%[flags][width][.precision][length]**specifier**

| *specifier* | Output | Example |
|---|---|---|
| d *or* i | Signed decimal integer | 392 |
| u | Unsigned decimal integer | 7235 |
| o | Unsigned octal | 610 |
| x | Unsigned hexadecimal integer | 7fa |
| X | Unsigned hexadecimal integer (uppercase) | 7FA |
| f | Decimal floating point, lowercase | 392.65 |
| F | Decimal floating point, uppercase | 392.65 |
| e | Scientific notation (mantissa/exponent), lowercase | 3.9265e+2 |
| E | Scientific notation (mantissa/exponent), uppercase | 3.9265E+2 |
| g | Use the shortest representation: %e or %f | 392.65 |
| G | Use the shortest representation: %E or %F | 392.65 |
| a | Hexadecimal floating point, lowercase | -0xc.90fep-2 |
| A | Hexadecimal floating point, uppercase | -0XC.90FEP-2 |
| c | Character | a |
| s | String of characters | sample |
| p | Pointer address | b8000000 |
| n | Nothing printed.<br>The corresponding argument must be a pointer to a signed int.<br>The number of characters written so far is stored in the pointed location. | |
| % | A % followed by another % character will write a single % to the stream. | % |

**Reference**: Content courtesy - https://www.cplusplus.com/reference/cstdio/printf/

# Code Demo

- **Function:** demoFormattedPrinting()
  - C's printf / sprintf allows fine-grained control and data type specific
  - Has inspired formatting support in other languages

# 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.

# Discussion: Nature and Simplifications

- Once you select a disease, the content is also fixed.
  - Enter selection in column F of spreadsheet
- 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

# Discussion: Chatbot Loop

- Input: from user (called utterance)
  - Problem specific query (i.e., about disease chosen)
  - Chitchat
  - Unrelated
- Output: from system (response)
  - Handle unrelated
  - Handle chitchat
  - Answer to query
- **Do it until user say over!**

Handling different data types

Show formatted content!

# Concluding Section

# Lecture 4: Concluding Comments

- We experienced peer review on home works
- Discussed the concepts of mixed types
- Discussed formatted printing

# About Next Lecture – Lecture 5

# Lecture 5: Memory Management

- Memory management
  - Dynamic object creation
  - Object destruction
- User defined types