

## Studio Session on C++ Data: Variables and Basic Types

These studio exercises are intended to gain familiarity with basic C++ data concepts and techniques, some of which may be somewhat familiar from your previous programming experience, and to cover a few details specific to C++ (and especially the C++11 standard) that may not be obvious at first glance.

Students who are more familiar with the material are encouraged to help those who are less familiar with it and asking questions of your instructors and teaching assistants during the studio sessions is highly encouraged as well.

Please record your answers you work through the following exercises. After you have finished, please submit your answers to the required exercises and to any of the enrichment exercises you completed to Blackboard or our OJ system (if applicable).

The enrichment exercises are optional but are a good way to dig into the material a little deeper, especially if you breeze through the required ones.

### PART I: REQUIRED EXERCISES

1. Visual Studio 2022 Community and create a new Console App project (for example, named **DataStudio** or something similar that identifies which studio this is for). Change the signature of the main function to be **int main (int argc, char \* argv[])** and add a line that prints out **argv[0]** (position 0 of **argv**, so named because it holds the program's arguments vector) to **cout** (the standard output stream). Add any necessary precompiler and compiler directives, build your project, and fix any remaining warnings or errors. Once the program builds correctly open a console window as you did in the previous studio, change to the directory where the executable program for the project was created, and run it. As the answer to this exercise please say (1) what output the program produced, and (2) what that tells you about what is always contained in position 0 of a program's arguments vector.
2. In your main function, declare a pointer to const character (of type **const char \***) as the loop variable of a for loop, and using only pointer operators like ++ and \* (i.e., without using the square bracket array indexing operator []) do the following: (1) initialize the pointer to point to the first character of **argv[0]**; (2) at each new position test whether the pointer still points to a non-zero character (anything other than '\0') and if so print out the character at that position and then an end of line; and (3) after each step move the pointer to the next character position in the program name, using the ++ operator on the pointer, until the end of the string is reached. As the answer to this exercise give what your program printed.
3. What happens if you try to repeat exercise 2 using a reference instead of a pointer? Please give three ways in which references differ from pointers in C++ and say which one of those three explains what happens when you try to use a reference that way in C++, as the answer to this exercise.
4. Repeat exercise 2 using the **auto** keyword instead of **const char \*** to declare the pointer variable. Build and run your program, and as the answer to this exercise please indicate whether you observed any difference in how the program behaved for this exercise, compared to how it behaved in exercise 2 (and if you did see any differences what they were).
5. Again without using array indexing operators, modify your solution to exercise 4 so that instead of only iterating through the characters in the program name, it iterates through all the characters of all the

strings that were passed as arguments to the program. As the answer to this exercise, please identify all the pointer operators (not array operators) that you used and describe briefly what each one does.

PART II: ENRICHMENT EXERCISE (optional, feel free to skip some and do ones that interest you)

6. Repeat exercise 4 using **decltype** in place of **auto** (but still initialize the pointer variable). Build and run your program. Then, try the same thing without initializing the variable. As the answer to this question please indicate what you observed in each of those cases.