

12. Problems involving loops and numbers

- a) Write the FizzBuzz program
- b) Print a table of Fahrenheit to Celsius conversions from -40 F to 100 F for every degree
- c) Modify the above program to add a header to your output
- d) Modify the above program to print temperatures from 100F to -40F

Calculate S in each of the following. First write the algorithm and then convert.

e) $S = 1 + 2 + 3 + \dots + 100$

Ans: 5050

f) $S = -1 - 2 - 3 - 4 \dots - 200$

Ans: -20100

g) $S = \frac{1}{2} + \frac{1}{3} + \dots + \frac{1}{100}$

Ans: 4.18737751

h) $S = 1^2 + 2^2 + 3^2 + \dots + 100^2$

Ans: 338350

i) $S = \frac{1}{2*3} + \frac{1}{3*4} + \frac{1}{4*5} + \dots + \frac{1}{99*100}$

Ans: 0.49

j) $S = \frac{1}{3*5} + \frac{1}{7*9} + \dots + \frac{1}{95*97}$

Ans: 0.10475

13. Changing the algorithm

Starting with the essential algorithm discussed above, change it in a way that solves a different problem as stated below:

- a) S is defined below. For $n = 1$, $S = 0.5$, $n = 2$, $S = 0.833$. As you add more terms, S increases. Calculate n for which S becomes larger than 4. First write the algorithm and then implement the code in C.

$$S = \frac{1}{2} + \frac{1}{3} + \dots + \frac{1}{n+1} \quad \text{Ans: } n = 83$$

- b) Evaluate S using $n = 100$ terms where

$$S = \sqrt{\left(6 * \left(1 + \frac{1}{2^2} + \frac{1}{3^2} + \frac{1}{4^2} + \frac{1}{5^2} + \dots + \frac{1}{n^2} \right) \right)}$$

- Calculate the value of n above if it is given that the above sum is equal to π to 6 decimal places.

14. Nested loops

Calculate S defined below. Do it in three steps: First write the algorithm, create a flow chart and finally implement it in C.

Ans: 6438750

Hint: Use two counters, one to keep track of columns as you go from left to right and the other to keep track of which row you are summing

$$\begin{aligned} S = & (1 * 1 + 1 * 2 + \dots + 1 * 50) \\ & + (2 * 1 + 2 * 2 + \dots + 2 * 50) \\ & + \dots \\ & + (100 * 1 + 100 * 2 + \dots + 100 * 50) \end{aligned}$$

More problems. These two problems should be solved using arrays.

a) Print all combinations of these three numbers: 1, 2, 3

123, 132, 213, ... and so on.

b) Multiply these two matrices. Hint: Use a multi-dimensional array.

$$\begin{pmatrix} 1 & 2 & 3 \\ 3 & 2 & 1 \\ 2 & 1 & 3 \end{pmatrix} \cdot \begin{pmatrix} 4 & 5 & 6 \\ 6 & 5 & 4 \\ 4 & 6 & 5 \end{pmatrix}$$

Ans:

$$\begin{pmatrix} 28 & 33 & 29 \\ 28 & 31 & 31 \\ 26 & 33 & 31 \end{pmatrix}$$

15. Problems involving manipulation of text

Note: Since the intent is to develop your own problem solving abilities, you are not allowed to use any built-in string manipulation functions from `string.h` (or `strings.h`)

- a) Given two strings: write a function that prints true if they are equal and false if they are not equal.
- b) Create a single variable named **myQuote** of the appropriate type that can hold the following sentence

***"Mr. Fay, is this going to be a battle of wits?"
"If it is," was the indifferent retort, "you have come unarmed!"***

- c) Write a function to find the length of the above string
Note: Do not use `strlen`
- d) Write a function to find the position at which the substring *"indifferent"* appears above.
- e) Create an array that contains positions of all commas i.e. *" , "* in the above sentence
- f) Create a substring of the above string that contains the following substring.

"you have come unarmed!"

Note that there is a quotation at the beginning but not at the end.

- g) Write a function to replace the word *indifferent* above with *nonchalant* in **myQuote**
- h) Make your code dynamic so that it works with any string. You will need to use **malloc**

- i) You have an array of strings. Create a new string, which is a concatenation of all the array elements.
 - a. Check that the length of individual strings when added equals the length of the final string
 - b. Make sure your program works with an array with no elements
- j) Given this string: "USA, Canada, Mexico, Bermuda, Grenada, Belize" -- create an array that contains these countries as its elements. Note: the comma is the separator
 - a. Make sure your program works when you add or remove countries from your string
 - b. Change your program so that the delimiter can be easily changed
- k) Modify the program above so it can understand countries separated by either a comma or a space or a period. "USA. Canada, Mexico, Bermuda Grenada, Belize"
- l) Change your program so that it can support any number of delimiters. Hint: Use an array to store your delimiters.

16. Miscellaneous problems

- a) Write a function to swap two integers. Do this in three different ways
 - a. Using a temp variable
 - b. Without using a temp variable
 - c. Using bit shift operators
- b) Write a function to find the nth power of an integer from first

principles e.g. 3^5

- c) Implement the Bubble Sort algorithm – first in the simple algorithmic language and then in C.
- d) Binary search
 - a. Read about binary search and write the algorithm in our simplified language
 - b. Write a program that creates a sorted array of N numbers
 - c. Now write a program to search for a specific number within your *sorted* array of numbers using binary search.
 - d. If the array has 1024 elements, approximately how many steps are needed before the search is complete?
 - e. What is the number of steps if the array has N elements?

17. Recursion

- a. Calculate factorial of a number using recursion
- b. Using recursion, solve each problem in the section Problems involving loops and numbers
- c. Reverse a string using recursion
- d. Write a recursive program to convert an alphanumeric such as “3.14159” to the appropriate numeric data type. If it has a decimal point but fits inside a float, use float else use double. If it is larger than a double, print an error. If there is no decimal point, use int or long or print an error message based on the logic explained earlier.