

2020 年度 工学システム学類

プログラミング序論 B 【レポート課題 4】 ※演習の課題は別にあります。

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以下の設問 1),2)に回答せよ。解答スペースは自由に変更して構わない。

1) 「構造体」に関する以下の用語を説明せよ。

- 1) メンバ
- 2) アロー演算子

2) 4 個の要素 (int 型の変数) からなるデータの 2 番目に新しい要素を追加 (挿入) して 5 個の要素からなるデータにする処理を、「線形リスト」と「1 次元配列」のデータの構造で実装する場合、どちらの方が効率が良いか、具体的な処理手順を示しながら説明せよ。

【まずは、「1 x4 の配列」と「4 つの構造体を結んだ線形リスト」を用意し、各々の 2 番目の要素に新しい変数を挿入するために必要となる処理について、順に考えれば良い (図示すると分かりやすいと思います)】

1) Explain the following terms related to "structure."

- 1) member
- 2) arrow operator

2) Consider the process of adding (inserting) a new element to the second piece of data consisting of four elements (variables of type int) to make the data consist of five elements. Explain which data structure is more efficient, the "linear list" or the "one-dimensional array" data structure, with specific processing steps.

(See next page)

1)

- 1) The `struct` statement in C defines a new “data type” or structure with more than one “member”. Each element in that structure is called a member. This concept is very similar to instance variables in object-oriented programming.
- 2) The arrow operator (`->`) allows access to elements in structures. It is used with a pointer variable pointing to a structure. The left-hand side of an arrow operator must be a pointer variable (that points to a structure), and the right-hand side must be an appropriate member of the structure.

2)

A linked list would be more efficient in insertions.

Linked list (linear list):

- 1) Access the first node of the linked list
- 2) Allocate memory for the new node and give data
- 3) Copy the pointer for the first node to the new node
- 4) Change the pointer for the first node to the address of the new node

Array: (important: if the array already has length > 4 at declaration)

- 1) Iterate through the array backwards (from position 4 to 1)
- 2) At each position, shift the element to the right
- 3) Write the new data at position 1 (the second element)

It's not hard to see that the array requires many more operational steps, as it needs to move all the other elements by one to make room for the new inserted data. This is already under the assumption that the array has enough length at declaration to accommodate the new element. If the array was initialized with `length = 4`, in order to store 5 elements, you first need to create a new array of length 5 and copy each element of the old array to the new array, and then perform the steps up there.

In general, inserting a new element at the start of a linked list has a time complexity of $O(1)$, as it requires a constant amount of steps. However, inserting a new element into an array is $O(n)$, as you need to traverse through each element after the insertion position to make room for the insertion.