

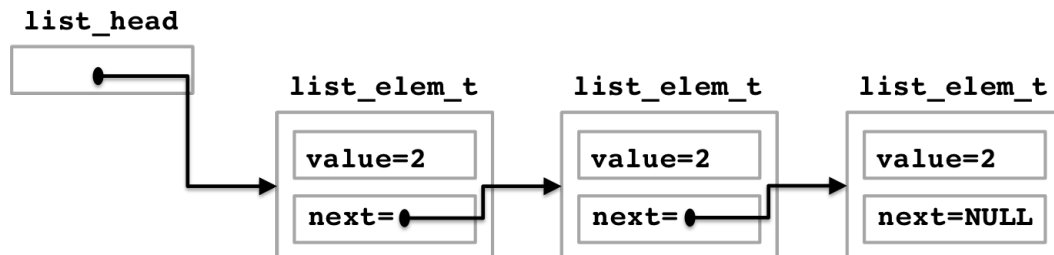
TP4: Linked lists

1 Getting started

The object of this lab is the implementation of linked lists in C language. The codes for this lab are in the directory `/share/l3info/CUnix/tp4` You can use the **Makefile** of TP3 for the compilation. The list type is represented using a `list_elem_t` structure whose definition is given as :

```
typedef struct s_list {  
    int    value;           //value of the element  
    struct s_list * next;   //pointer to the next element  
} list_elem_t;
```

This representation is illustrated in Fig.1 :



2 Implementation of linked lists

The file `list.c` provides the following functions (for a more detailed description, please refer to the source code of the `list.c` file).

- `list_elem_t * create_element (int val)`: creates a new element, whose field `next` is set to `NULL` and field `value` is set to the integer value `val` passed as a parameter. The function returns `NULL` on failure, otherwise the pointer to the new element.
- `void free_element (list_elem_t * l)`: frees the memory allocated to an element
- `int insert_head (list_elem_t ** l, int val)`: inserts an element at the head of the list (`* l` points to the head of the list). At the end of the execution, `* l` points to the new head of the list. The function returns 0 on success, -1 on failure.
- `int insert_tail (list_elem_t ** l, int val)`: inserts an element at the tail of the list (`* l` points to the head of the list). The function returns 0 on success, -1 on failure.

- **list_elem_t * find_element (list_elem_t * l, int pos):** returns the pointer to the position **pos** of the list (the first element is at position 0). The function returns this pointer on success, NULL on failure.
- **int remove_element (list_elem_t * * l, int val):** removes from the list the first element found in the list with a value equal to the value **val** passed as parameter. *** l** points to the head of the list. It frees the memory space dedicated to this element. The function returns 0 on success (an element with a value **val** has been found in the list), -1 on failure (no element with value **val** exists in the list)
- **void reverse_list (list_elem_t * * l):** modifies the list by reversing the order of its elements (the first becomes the last, the second the before last , etc.). We do not exchange the values of the elements, you have to manipulate the pointers.

3 Testing of linked lists

You also have a **test_list** test program located in the subdirectory **./bin**. To launch it, you just need to write **./bin/test_list**. This program allows (via keyboard commands) to add / remove items to/from the list. The operations over the list are summarized below :

- **‘h’** : insertion to the head of the list of a value given by the keyboard
- **‘t’** : insertion to the tail of the list of a value given by the keyboard
- **‘f’** : search (and display) the i^{th} element of the list
- **‘s’** : delete the first element equal to a given value
- **‘r’** : reverse the list
- **‘x’** : end of the program

The content of the list is displayed at the end of each operation in the form : [value_1] → [value_2] → ... → [value_n]

4 Exercise

Complete the **list.c** file to implement the functions of the linked lists and the **test_list.c** file which calls the corresponding functions. Take care the following remarks :

ATTENTION :

- Read the specification of each function (detailed in the **list.c** file) **BEFORE** starting coding!
- The implementation of each of these functions has to go through the list **only ONCE**, either directly or through the use of other functions.
- When manipulating a pointer of a structure, to access its fields we have to use the **‘→’** operator and not by the **‘.’** operator.
- Special care must be taken in the management of pointers. For example, you should always ensure that the variable **list_elem_t * l** is different from NULL before performing any operation, such as **l → next**.
- Make sure your sources compile without causing any warning messages!

- Be careful not to create a **"memory leak"**. Use Valgrind to verify your code!
- Check your program for correct operation in a non-interactive way by completing the target to the **makefile** called **test**. To do so, you have to use the input/output redirections of the **test_list** program and to use file **commands.txt** with all the commands to test your program.