



0x17. C - Doubly linked lists

C

Algorithm

Data structure

👤 By: Julien Barbier

⚙️ Weight: 1

📅 Project over - took place from Dec 8, 2022 6:00 AM to Dec 9, 2022 6:00 AM

☑️ An auto review will be launched at the deadline

In a nutshell...

- **Auto QA review:** 98.0/98 mandatory & 16.0/16 optional
- **Altogether: 200.0%**
 - Mandatory: 100.0%
 - Optional: 100.0%
 - Calculation: $100.0\% + (100.0\% * 100.0\%) == 200.0\%$

h o l e e ↓ N e # e o l r r A l Y A e . , N > > . e o h >

Resources

Read or watch:

- What is a Doubly Linked List (/rltoken/C5_IRM981SVn8oA8RP3gag)

Learning Objectives

At the end of this project, you are expected to be able to explain to anyone (/rltoken/OABh2M07w5kdsh9gRx1XwA), **without the help of Google**:

General

- What is a doubly linked list



- How to use doubly linked lists
- (/). Start to look for the right source of information without too much help



Copyright - Plagiarism

- You are tasked to come up with solutions for the tasks below yourself to meet with the above learning objectives.
- You will not be able to meet the objectives of this or any following project by copying and pasting someone else's work.
- You are not allowed to publish any content of this project.
- Any form of plagiarism is strictly forbidden and will result in removal from the program.

Requirements

General

- Allowed editors: `vi`, `vim`, `emacs`
- All your files will be interpreted/compiled on Ubuntu 20.04 LTS using python3 (version 3.8.5)
- All your files should end with a new line
- A `README.md` file, at the root of the folder of the project is mandatory
- Your code should use the `Betty` style. It will be checked using `betty-style.pl` (<https://github.com/holbertonschool/Betty/blob/master/betty-style.pl>) and `betty-doc.pl` (<https://github.com/holbertonschool/Betty/blob/master/betty-doc.pl>)
- You are not allowed to use global variables
- No more than 5 functions per file
- The only C standard library functions allowed are `malloc`, `free`, `printf` and `exit`
- In the following examples, the `main.c` files are shown as examples. You can use them to test your functions, but you don't have to push them to your repo (if you do we won't take them into account). We will use our own `main.c` files at compilation. Our `main.c` files might be different from the one shown in the examples
- The prototypes of all your functions should be included in your header file called `lists.h`
- Don't forget to push your header file
- All your header files should be include guarded

More Info

Please use this data structure for this project:



```

/**
 * struct dlistint_s - doubly linked list
 * @n: integer
 * @prev: points to the previous node
 * @next: points to the next node
 *
 * Description: doubly linked list node structure
 *
 */
typedef struct dlistint_s
{
    int n;
    struct dlistint_s *prev;
    struct dlistint_s *next;
} dlistint_t;

```

Quiz questions

Great! You've completed the quiz successfully! Keep going! ([Hide quiz](#))

Question #0

In a doubly linked list, what's the "head" of a linked list?

- ☐ It's the node with the pointer to the next equals to NULL
- ☒ It's the node with the pointer to the previous equals to NULL

Question #1

In a doubly linked list, what are possible directions to traverse it? (select all possible answers)

- ☒ Forward
- ☒ Backward

Tasks

0. Print list

mandatory

Score: 100.0% (Checks completed: 100.0%)



Write a function that prints all the elements of a `dlistint_t` list.

(/)

- Prototype: `size_t print_dlistint(const dlistint_t *h);`
- Return: the number of nodes
- Format: see example

```
julien@ubuntu:~/0x17. Doubly linked lists$ cat 0-main.c
#include <stdlib.h>
#include <string.h>
#include <stdio.h>
#include "lists.h"

/**
 * main - check the code
 *
 * Return: Always EXIT_SUCCESS.
 */
int main(void)
{
    dlistint_t *head;
    dlistint_t *new;
    dlistint_t hello = {8, NULL, NULL};
    size_t n;

    head = &hello;
    new = malloc(sizeof(dlistint_t));
    if (new == NULL)
    {
        dprintf(2, "Error: Can't malloc\n");
        return (EXIT_FAILURE);
    }
    new->n = 9;
    head->prev = new;
    new->next = head;
    new->prev = NULL;
    head = new;
    n = print_dlistint(head);
    printf("-> %lu elements\n", n);
    free(new);
    return (EXIT_SUCCESS);
}
julien@ubuntu:~/0x17. Doubly linked lists$ gcc -Wall -pedantic -Werror -Wextra -std=
gnu89 0-main.c 0-print_dlistint.c -o a
julien@ubuntu:~/0x17. Doubly linked lists$ ./a
9
8
-> 2 elements
julien@ubuntu:~/0x17. Doubly linked lists$
```

Repo:

- GitHub repository: [alx-low_level_programming](#)



- Directory: 0x17-doubly_linked_lists
- (/). File: 0-print_dlistint.c

☑ Done!

Help

Check your code

>_ Get a sandbox

QA Review

1. List length

mandatory

Score: 100.0% (*Checks completed: 100.0%*)

Write a function that returns the number of elements in a linked `dlistint_t` list.

- Prototype: `size_t dlistint_len(const dlistint_t *h);`



```

julien@ubuntu:~/0x17. Doubly linked lists$ cat 1-main.c
#include <stdlib.h>
#include <string.h>
#include <stdio.h>
#include "lists.h"

/**
 * main - check the code
 *
 * Return: Always EXIT_SUCCESS.
 */
int main(void)
{
    dlistint_t *head;
    dlistint_t *new;
    dlistint_t hello = {8, NULL, NULL};
    size_t n;

    head = &hello;
    new = malloc(sizeof(dlistint_t));
    if (new == NULL)
    {
        dprintf(2, "Error: Can't malloc\n");
        return (EXIT_FAILURE);
    }
    new->n = 9;
    head->prev = new;
    new->next = head;
    new->prev = NULL;
    head = new;
    n = dlistint_len(head);
    printf("-> %lu elements\n", n);
    free(new);
    return (EXIT_SUCCESS);
}
julien@ubuntu:~/0x17. Doubly linked lists$ gcc -Wall -pedantic -Werror -Wextra -std=
gnu89 1-main.c 1-dlistint_len.c -o b
julien@ubuntu:~/0x17. Doubly linked lists$ ./b
-> 2 elements
julien@ubuntu:~/0x17. Doubly linked lists$

```

Repo:

- GitHub repository: alx-low_level_programming
- Directory: 0x17-doubly_linked_lists
- File: 1-dlistint_len.c

✓ Done!

Help

Check your code

>_ Get a sandbox

QA Review



2(A) Add node

mandatory

Score: 100.0% (Checks completed: 100.0%)

Write a function that adds a new node at the beginning of a `dlistint_t` list.

- Prototype: `dlistint_t *add_dnodeint(dlistint_t **head, const int n);`
- Return: the address of the new element, or `NULL` if it failed

```
julien@ubuntu:~/0x17. Doubly linked lists$ cat 2-main.c
#include <stdlib.h>
#include <string.h>
#include <stdio.h>
#include "lists.h"

/**
 * main - check the code
 *
 * Return: Always EXIT_SUCCESS.
 */
int main(void)
{
    dlistint_t *head;

    head = NULL;
    add_dnodeint(&head, 0);
    add_dnodeint(&head, 1);
    add_dnodeint(&head, 2);
    add_dnodeint(&head, 3);
    add_dnodeint(&head, 4);
    add_dnodeint(&head, 98);
    add_dnodeint(&head, 402);
    add_dnodeint(&head, 1024);
    print_dlistint(head);
    return (EXIT_SUCCESS);
}
julien@ubuntu:~/0x17. Doubly linked lists$ gcc -Wall -pedantic -Werror -Wextra -std=
gnu89 2-main.c 2-add_dnodeint.c 0-print_dlistint.c -o c
julien@ubuntu:~/0x17. Doubly linked lists$ ./c
1024
402
98
4
3
2
1
0
julien@ubuntu:~/0x17. Doubly linked lists$
```

Repo:



- GitHub repository: alx-low_level_programming
- (/). Directory: 0x17-doubly_linked_lists
- File: 2-add_dnodeint.c

✓ Done!

Help

Check your code

>_ Get a sandbox

QA Review

3. Add node at the end

mandatory

Score: 100.0% (Checks completed: 100.0%)

Write a function that adds a new node at the end of a `dlistint_t` list.

- Prototype: `dlistint_t *add_dnodeint_end(dlistint_t **head, const int n);`
- Return: the address of the new element, or `NULL` if it failed




```

julien@ubuntu:~/0x17. Doubly linked lists$ cat 3-main.c
#include <stdlib.h>
#include <string.h>
#include <stdio.h>
#include "lists.h"

/**
 * main - check the code
 *
 * Return: Always EXIT_SUCCESS.
 */
int main(void)
{
    dlistint_t *head;

    head = NULL;
    add_dnodeint_end(&head, 0);
    add_dnodeint_end(&head, 1);
    add_dnodeint_end(&head, 2);
    add_dnodeint_end(&head, 3);
    add_dnodeint_end(&head, 4);
    add_dnodeint_end(&head, 98);
    add_dnodeint_end(&head, 402);
    add_dnodeint_end(&head, 1024);
    print_dlistint(head);
    return (EXIT_SUCCESS);
}
julien@ubuntu:~/0x17. Doubly linked lists$ gcc -Wall -pedantic -Werror -Wextra -std=
gnu89 3-main.c 3-add_dnodeint_end.c 0-print_dlistint.c -o d
julien@ubuntu:~/0x17. Doubly linked lists$ ./d
0
1
2
3
4
98
402
1024
julien@ubuntu:~/0x17. Doubly linked lists$

```

Repo:

- GitHub repository: `alx-low_level_programming`
- Directory: `0x17-doubly_linked_lists`
- File: `3-add_dnodeint_end.c`

☒ Done!

Help

Check your code

>_ Get a sandbox

QA Review



4. Free list (/)

mandatory

Score: 100.0% (*Checks completed: 100.0%*)

Write a function that frees a `dlistint_t` list.

- Prototype: `void free_dlistint(dlistint_t *head);`



01 julien@ubuntu:~/0x17. Doubly linked lists\$ cat 4-main.c

```
#include <stdlib.h>
#include <string.h>
#include <stdio.h>
#include "lists.h"

/**
 * main - check the code
 *
 * Return: Always EXIT_SUCCESS.
 */
int main(void)
{
    dlistint_t *head;

    head = NULL;
    add_dnodeint_end(&head, 0);
    add_dnodeint_end(&head, 1);
    add_dnodeint_end(&head, 2);
    add_dnodeint_end(&head, 3);
    add_dnodeint_end(&head, 4);
    add_dnodeint_end(&head, 98);
    add_dnodeint_end(&head, 402);
    add_dnodeint_end(&head, 1024);
    print_dlistint(head);
    free_dlistint(head);
    head = NULL;
    return (EXIT_SUCCESS);
}
```

julien@ubuntu:~/0x17. Doubly linked lists\$ gcc -Wall -pedantic -Werror -Wextra -std=gnu89 4-main.c 3-add_dnodeint_end.c 0-print_dlistint.c 4-free_dlistint.c -o e

julien@ubuntu:~/0x17. Doubly linked lists\$ valgrind ./e

==4197== Memcheck, a memory error detector

==4197== Copyright (C) 2002-2015, and GNU GPL'd, by Julian Seward et al.

==4197== Using Valgrind-3.11.0 and LibVEX; rerun with -h for copyright info

==4197== Command: ./e

==4197==

0

1

2

3

4

98

402

1024

==4197==

==4197== HEAP SUMMARY:

==4197== in use at exit: 0 bytes in 0 blocks

==4197== total heap usage: 9 allocs, 9 frees, 1,216 bytes allocated

==4197==

==4197== All heap blocks were freed -- no leaks are possible

==4197==

==4197== For counts of detected and suppressed errors, rerun with: -v



```
==4197== ERROR SUMMARY: 0 errors from 0 contexts (suppressed: 0 from 0)
alien@ubuntu:~/0x17. Doubly linked lists$
```



Repo:

- GitHub repository: alx-low_level_programming
- Directory: 0x17-doubly_linked_lists
- File: 4-free_dlistint.c

✓ Done!

Help

Check your code

>_ Get a sandbox

QA Review

5. Get node at index

mandatory

Score: 100.0% (Checks completed: 100.0%)

Write a function that returns the nth node of a `dlistint_t` linked list.

- Prototype: `dlistint_t *get_dnodeint_at_index(dlistint_t *head, unsigned int index);`
- where `index` is the index of the node, starting from 0
- if the node does not exist, return `NULL`



```

julien@ubuntu:~/0x17. Doubly linked lists$ cat 5-main.c
#include <stdlib.h>
#include <string.h>
#include <stdio.h>
#include "lists.h"

/**
 * main - check the code
 *
 * Return: Always EXIT_SUCCESS.
 */
int main(void)
{
    dlistint_t *head;
    dlistint_t *node;

    head = NULL;
    add_dnodeint_end(&head, 0);
    add_dnodeint_end(&head, 1);
    add_dnodeint_end(&head, 2);
    add_dnodeint_end(&head, 3);
    add_dnodeint_end(&head, 4);
    add_dnodeint_end(&head, 98);
    add_dnodeint_end(&head, 402);
    add_dnodeint_end(&head, 1024);
    print_dlistint(head);
    node = get_dnodeint_at_index(head, 5);
    printf("%d\n", node->n);
    free_dlistint(head);
    head = NULL;
    return (EXIT_SUCCESS);
}
julien@ubuntu:~/0x17. Doubly linked lists$ gcc -Wall -pedantic -Werror -Wextra -std=
gnu89 5-main.c 3-add_dnodeint_end.c 0-print_dlistint.c 4-free_dlistint.c 5-get_dnode
int.c -o h
julien@ubuntu:~/0x17. Doubly linked lists$ ./h
0
1
2
3
4
98
402
1024
98
julien@ubuntu:~/0x17. Doubly linked lists$

```

Repo:

- GitHub repository: [alx-low_level_programming](#)
- Directory: [0x17-doubly_linked_lists](#)
- File: [5-get_dnodeint.c](#)





✓ Done!

Help

Check your code

>_ Get a sandbox

QA Review



6. Sum list

mandatory

Score: 100.0% (*Checks completed: 100.0%*)

Write a function that returns the sum of all the data (n) of a `dlistint_t` linked list.

- Prototype: `int sum_dlistint(dlistint_t *head);`
- if the list is empty, return 0



```

julien@ubuntu:~/0x17. Doubly linked lists$ cat 6-main.c
#include <stdlib.h>
#include <string.h>
#include <stdio.h>
#include "lists.h"

/**
 * main - check the code
 *
 * Return: Always EXIT_SUCCESS.
 */
int main(void)
{
    dlistint_t *head;
    int sum;

    head = NULL;
    add_dnodeint_end(&head, 0);
    add_dnodeint_end(&head, 1);
    add_dnodeint_end(&head, 2);
    add_dnodeint_end(&head, 3);
    add_dnodeint_end(&head, 4);
    add_dnodeint_end(&head, 98);
    add_dnodeint_end(&head, 402);
    add_dnodeint_end(&head, 1024);
    sum = sum_dlistint(head);
    printf("sum = %d\n", sum);
    free_dlistint(head);
    head = NULL;
    return (EXIT_SUCCESS);
}
julien@ubuntu:~/0x17. Doubly linked lists$ gcc -Wall -pedantic -Werror -Wextra 6-main.c -std=gnu89 3-add_dnodeint_end.c 4-free_dlistint.c 6-sum_dlistint.c -o i
julien@ubuntu:~/0x17. Doubly linked lists$ ./i
sum = 1534
julien@ubuntu:~/0x17. Doubly linked lists$

```

Repo:

- GitHub repository: alx-low_level_programming
- Directory: 0x17-doubly_linked_lists
- File: 6-sum_dlistint.c

☒ Done!

Help

Check your code

>_ Get a sandbox

QA Review

7. Insert at index





Write a function that inserts a new node at a given position.

- Prototype: `dlistint_t *insert_dnodeint_at_index(dlistint_t **h, unsigned int idx, int n);`
- where `idx` is the index of the list where the new node should be added. Index starts at 0
- Returns: the address of the new node, or `NULL` if it failed
- if it is not possible to add the new node at index `idx`, do not add the new node and return `NULL`

Your files `2-add_dnodeint.c` and `3-add_dnodeint_end.c` will be compiled during the correction



julien@ubuntu:~/0x17. Doubly linked lists\$ cat 7-main.c

```
#include <stdlib.h>
#include <string.h>
#include <stdio.h>
#include "lists.h"

/**
 * main - check the code
 *
 * Return: Always EXIT_SUCCESS.
 */
int main(void)
{
    dlistint_t *head;

    head = NULL;
    add_dnodeint_end(&head, 0);
    add_dnodeint_end(&head, 1);
    add_dnodeint_end(&head, 2);
    add_dnodeint_end(&head, 3);
    add_dnodeint_end(&head, 4);
    add_dnodeint_end(&head, 98);
    add_dnodeint_end(&head, 402);
    add_dnodeint_end(&head, 1024);
    print_dlistint(head);
    printf("-----\n");
    insert_dnodeint_at_index(&head, 5, 4096);
    print_dlistint(head);
    free_dlistint(head);
    head = NULL;
    return (EXIT_SUCCESS);
}
```

julien@ubuntu:~/0x17. Doubly linked lists\$ gcc -Wall -pedantic -Werror -Wextra -std=gnu89 7-main.c 2-add_dnodeint.c 3-add_dnodeint_end.c 0-print_dlistint.c 4-free_dlistint.c 7-insert_dnodeint.c -o j

julien@ubuntu:~/0x17. Doubly linked lists\$./j

0
1
2
3
4
98
402
1024

0
1
2
3
4
4096
98
402



1024

alien@ubuntu:~/0x17. Doubly linked lists\$



Repo:

- GitHub repository: alx-low_level_programming
- Directory: 0x17-doubly_linked_lists
- File: 7-insert_dnodeint.c, 2-add_dnodeint.c, 3-add_dnodeint_end.c

✓ Done!

Help

Check your code

>_ Get a sandbox

QA Review

8. Delete at index

mandatory

Score: 100.0% (Checks completed: 100.0%)

Write a function that deletes the node at index `index` of a `dlistint_t` linked list.

- Prototype: `int delete_dnodeint_at_index(dlistint_t **head, unsigned int index);`
- where `index` is the index of the node that should be deleted. Index starts at 0
- Returns: 1 if it succeeded, -1 if it failed



```
julien@ubuntu:~/0x17. Doubly linked lists$ cat 8-main.c
```

[illegible]

```

delete_dnodeint_at_index(&head, 0);
(/) printf("-----\n");
delete_dnodeint_at_index(&head, 0);
printf("-----\n");
delete_dnodeint_at_index(&head, 0);
printf("-----\n");
delete_dnodeint_at_index(&head, 0);
printf("-----\n");
delete_dnodeint_at_index(&head, 0);
printf("-----\n");
delete_dnodeint_at_index(&head, 0);
printf("-----\n");
delete_dnodeint_at_index(&head, 0);
printf("-----\n");
delete_dnodeint_at_index(&head, 0);
print_dlistint(head);
return (0);
}

```

```

julien@ubuntu:~/0x17. Doubly linked lists$ gcc -Wall -pedantic -Werror -Wextra -std=
gnu89 8-main.c 3-add_dnodeint_end.c 0-print_dlistint.c 4-free_dlistint.c 8-delete_dn
odeint.c -o k

```

```

julien@ubuntu:~/0x17. Doubly linked lists$ ./k

```

```

0
1
2
3
4
98
402
1024
-----
0
1
2
3
4
402
1024
-----
1
2
3
4
402
1024
-----
2
3
4
402
1024
-----
3
4
402
1024

```



(4)

402

1024

402

1024

1024

julien@ubuntu:~/0x17. Doubly linked lists\$



Repo:

- GitHub repository: alx-low_level_programming
- Directory: 0x17-doubly_linked_lists
- File: 8-delete_dnodeint.c

☒ Done!

Help

Check your code

>_ Get a sandbox

QA Review

9. Crackme4

#advanced

Score: 100.0% (Checks completed: 100.0%)

Find the password for crackme4 (<https://github.com/holbertonschool/0x17.c>).

- Save the password in the file 100-password
- Your file should contain the exact password, no new line, no extra space
- Hint: The program prints "OK" when the password is correct

Repo:

- GitHub repository: alx-low_level_programming
- Directory: 0x17-doubly_linked_lists
- File: 100-password





Done!

Help

Check your code

>_ Get a sandbox

QA Review

10. Palindromes

#advanced

Score: 100.0% (Checks completed: 100.0%)

A palindromic number reads the same both ways. The largest palindrome made from the product of two 2-digit numbers is $9009 = 91 \times 99$.

Find the largest palindrome made from the product of two 3-digit numbers.

- Save the result in the file `102-result`
- Your file should contain the exact result, no new line, no extra space

Repo:

- GitHub repository: `alx-low_level_programming`
- Directory: `0x17-doubly_linked_lists`
- File: `102-result`



Done!

Help

Check your code

>_ Get a sandbox

QA Review

11. crackme5

#advanced

Score: 100.0% (Checks completed: 100.0%)

Write a keygen for crackme5 (<https://github.com/holbertonschool/0x17.c>).

- Usage of the crackme: `./crackme5 username key`
- The crackme will segfault if you do not enter the correct key for the user
- Usage for your keygen: `./keygen5 username`
- Your keygen should print a valid key for the username

```
julien@ubuntu:~/0x17$ gcc -Wall -pedantic -Werror -Wextra -std=gnu89 103-keygen.c -o keygen5
julien@ubuntu:~/0x17$ ./crackme5 julien javascript
Segmentation fault (core dumped)
julien@ubuntu:~/0x17$ ./crackme5 julien `./keygen5 julien`
Congrats!
julien@ubuntu:~/0x17$
```



Repo:

- GitHub repository: alx-low_level_programming
- Directory: 0x17-doubly_linked_lists
- File: 103-keygen.c

☒ Done!

Help

Check your code

>_ Get a sandbox

QA Review

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