Almog Dynamic Array

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Chapter 1

README

Works with structs. For example:

```
typedef struct {
    size_t length;
    size_t capacity;
    int* elements;
} ada_int_array;
```

Chapter 2

Class Index

2.1 Class List

Here are the classes, structs, unions and interfaces with brief descriptions:

Chapter 3

File Index

3.1 File List

Here is a list of all files with brief descriptions:

Chapter 4

Class Documentation

4.1 ada_float_array Struct Reference

Public Attributes

- size_t length
- size_t capacity
- float ∗ elements

4.1.1 Detailed Description

Definition at line 10 of file test.c.

4.1.2 Member Data Documentation

4.1.2.1 capacity

```
size_t ada_float_array::capacity
```

Definition at line 12 of file test.c.

Referenced by print_float_ada().

4.1.2.2 elements

```
float∗ ada_float_array::elements
```

Definition at line 13 of file test.c.

Referenced by print_float_ada().

4.1.2.3 length

```
size_t ada_float_array::length
```

Definition at line 11 of file test.c.

Referenced by print_float_ada().

The documentation for this struct was generated from the following file:

- test.c

4.2 ada_int_array Struct Reference

Public Attributes

- size_t length
- size_t capacity
- int ∗ elements

4.2.1 Detailed Description

Definition at line 4 of file test.c.

4.2.2 Member Data Documentation

4.2.2.1 capacity

```
size_t ada_int_array::capacity
```

Definition at line 6 of file test.c.

Referenced by print_int_ada().

4.2.2.2 elements

```
int* ada_int_array::elements
```

Definition at line 7 of file test.c.

Referenced by print_int_ada().

4.2.2.3 length

```
size_t ada_int_array::length
```

Definition at line 5 of file test.c.

Referenced by print_int_ada().

The documentation for this struct was generated from the following file:

- test.c

Chapter 5

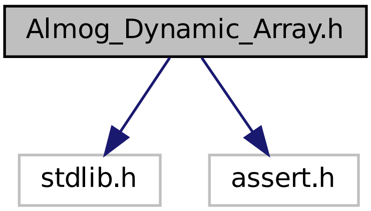
File Documentation

5.1 Almog_Dynamic_Array.h File Reference

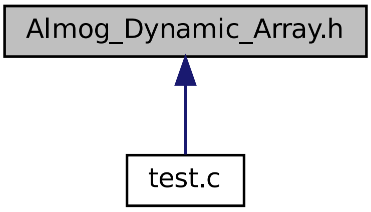
Header-only C macros that implement a simple dynamic array.

```
#include <stdlib.h>
#include <assert.h>
```

Include dependency graph for Almog_Dynamic_Array.h:



This graph shows which files directly or indirectly include this file:



Macros

- #define ADA_INIT_CAPACITY 10

  Default initial capacity used by ada_init_array.
- #define ADA_MALLOC malloc

  Allocation function used by this header (defaults to malloc).
- #define ADA_EXIT exit
- #define ADA_REALLOC realloc

  Reallocation function used by this header (defaults to realloc).
- #define ADA_ASSERT assert

  Assertion macro used by this header (defaults to assert).
- #define ada_init_array(type, header)

  Initialize an array header and allocate its initial storage.
- #define ada_resize(type, header, new_capacity)

  Resize the underlying storage to hold new_capacity elements.
- #define ada_append(type, header, value)

  Append a value to the end of the array, growing if necessary.
- #define ada_insert(type, header, value, index)

  Insert value at position index, preserving order (O(n)).
- #define ada_insert_unordered(type, header, value, index)

  Insert value at index without preserving order (O(1) amortized).
- #define ada_remove(type, header, index)

  Remove element at index, preserving order (O(n)).
- #define ada_remove_unordered(type, header, index)

  Remove element at index by moving the last element into its place (O(1)); order is not preserved.

5.1.1 Detailed Description

Header-only C macros that implement a simple dynamic array.

This header provides a minimal, macro-based dynamic array for POD-like types. The array "header" is a user-defined struct with three fields:

- size_t length; current number of elements
- size_t capacity; allocated capacity (in elements)
- T∗ elements; pointer to contiguous storage of elements (type T)

How to use: 1) Define a header struct with length/capacity/elements fields. 2) Initialize it with ada_init_array(T, header). 3) Modify it with ada_append (append), ada_insert, remove variants, etc. 4) When done, free(header.elements) (or your custom deallocator).

Customization:

- Define ADA_MALLOC, ADA_REALLOC, and ADA_ASSERT before including this header to override allocation and assertion behavior.

Complexity (n = number of elements):

- Append: amortized O(1)

- Ordered insert/remove: O(n)
- Unordered insert/remove: O(1)

Notes and limitations:

- These are macros; arguments may be evaluated multiple times. Pass only simple lvalues (no side effects).
- Index checks rely on ADA_ASSERT; with NDEBUG they may be compiled out.
- ada_resize exits the process (exit(1)) if reallocation fails.
- ada_insert reads header.elements[header.length - 1] internally; inserting into an empty array via ada_insert is undefined behavior. Use ada_append or ada_insert_unordered for that case.
- No automatic shrinking; you may call ada_resize manually.

Example: typedef struct { size_t length; size_t capacity; int∗ elements; } ada_int_array;

ada_int_array arr; ada_init_array(int, arr); ada_append(int, arr, 42); ada_insert(int, arr, 7, 0); // requires arr.length > 0 ada_remove(int, arr, 1); free(arr.elements);

Definition in file Almog_Dynamic_Array.h.

5.1.2 Macro Definition Documentation

5.1.2.1 ada_append

```
#define ada_append(
                type,
                header,
                value )
```

Value:

```
    do {                                                 \
    if ((header).length >= (header).capacity) {                                         \
        ada_resize(type, (header), (int)((header).capacity + (header).capacity/2 + 1));    \
    }                                                                                 \
    (header).elements[(header).length] = value;                                         \
    (header).length++;                                                                \
} while (0)
```

Append a value to the end of the array, growing if necessary.

Parameters

type	Element type stored in the array.
header	Lvalue of the header struct.
value	Value to append.

Postcondition

header.length is incremented by 1; the last element equals value.

Note

Growth factor is (int)(header.capacity ∗ 1.5). Because of truncation, very small capacities may not grow (e.g., from 1 to 1). With the default INIT_CAPACITY=10 this is typically not an issue unless you manually shrink capacity. Ensure growth always increases capacity by at least 1 if you customize this macro.

Definition at line 176 of file Almog_Dynamic_Array.h.

5.1.2.2 ADA_ASSERT

```
#define ADA_ASSERT assert
```

Assertion macro used by this header (defaults to assert).

Define ADA_ASSERT before including this file to override. When NDEBUG is defined, standard assert() is disabled.

Definition at line 103 of file Almog_Dynamic_Array.h.

5.1.2.3 ADA_EXIT

```
#define ADA_EXIT exit
```

Definition at line 79 of file Almog_Dynamic_Array.h.

5.1.2.4 ada_init_array

```
#define ada_init_array(
            type,
            header )
```

Value:

```
        do {                                                   \
        (header).capacity = ADA_INIT_CAPACITY;                                               \
        (header).length = 0;                                                           \
        (header).elements = (type *)ADA_MALLOC(sizeof(type) * (header).capacity);   \
        ADA_ASSERT((header).elements != NULL);                                         \
    } while (0)
```

Initialize an array header and allocate its initial storage.

Parameters

type	Element type stored in the array (e.g., int).
header	Lvalue of the header struct containing fields: length, capacity, and elements.

Precondition

header is a modifiable lvalue; header.elements is uninitialized or ignored and will be overwritten.

Postcondition

header.length == 0, header.capacity == INIT_CAPACITY, header.elements != NULL (or ADA_ASSERT fails).

Note

Allocation uses ADA_MALLOC and is checked via ADA_ASSERT.

Definition at line 127 of file Almog_Dynamic_Array.h.

5.1.2.5 ADA_INIT_CAPACITY

```
#define ADA_INIT_CAPACITY 10
```

Default initial capacity used by ada_init_array.

You may override this by defining ADA_INIT_CAPACITY before including this file.

Definition at line 62 of file Almog_Dynamic_Array.h.

5.1.2.6 ada_insert

```
#define ada_insert(
                type,
                header,
                value,
                index )
```

Value:

```
    do {                                                          \
     ADA_ASSERT((int)(index) >= 0);
          \
     ADA_ASSERT((float)(index) - (int)(index) == 0);
          \
     ada_append(type, (header), (header).elements[(header).length-1]);
               \
     for (int ada_for_loop_index = (header).length-2; ada_for_loop_index > (int)(index);
        ada_for_loop_index--) {   \
         (header).elements[ada_for_loop_index] = (header).elements [ada_for_loop_index-1];
             \
     }
          \
     (header).elements[(index)] = value;
            \
} while (0)
```

Insert value at position index, preserving order (O(n)).

Parameters

type	Element type stored in the array.
header	Lvalue of the header struct.
value	Value to insert.
index	Destination index in the range [0, header.length].

Precondition

> 0 <= index <= header.length.
>
> header.length > 0 if index == header.length (this macro reads the last element internally). For inserting into an empty array, use ada_appand or ada_insert_unordered.

Postcondition

> Element is inserted at index; subsequent elements are shifted right; header.length is incremented by 1.

Note

> This macro asserts index is non-negative and an integer value using ADA_ASSERT. No explicit upper-bound assert is performed.

Definition at line 203 of file Almog_Dynamic_Array.h.

5.1.2.7 ada_insert_unordered

```
#define ada_insert_unordered(
                type,
                header,
                value,
                index )
```

Value:

```
    do {   \
    ADA_ASSERT((int)(index) >= 0);                              \
    ADA_ASSERT((float)(index) - (int)(index) == 0);             \
    if ((size_t)(index) == (header).length) {                     \
        ada_append(type, (header), value);                        \
    } else {                                                    \
        ada_append(type, (header), (header).elements[(index)]);     \
        (header).elements[(index)] = value;                       \
    }                                                           \
} while (0)
```

Insert value at index without preserving order (O(1) amortized).

If index == header.length, this behaves like an append. Otherwise, the current element at index is moved to the end, and value is written at index.

Parameters

type	Element type stored in the array.
header	Lvalue of the header struct.
value	Value to insert.
index	Index in the range [0, header.length].

Precondition

0 <= index <= header.length.

Postcondition

header.length is incremented by 1; array order is not preserved.

Definition at line 229 of file Almog_Dynamic_Array.h.

5.1.2.8 ADA_MALLOC

```
#define ADA_MALLOC malloc
```

Allocation function used by this header (defaults to malloc).

Define ADA_MALLOC to a compatible allocator before including this file to override the default.

Definition at line 74 of file Almog_Dynamic_Array.h.

5.1.2.9 ADA_REALLOC

```
#define ADA_REALLOC realloc
```

Reallocation function used by this header (defaults to realloc).

Define ADA_REALLOC to a compatible reallocator before including this file to override the default.

Definition at line 91 of file Almog_Dynamic_Array.h.

5.1.2.10 ada_remove

```
#define ada_remove(
                type,
                header,
                index )
```

Value:

```
    do {                                                                    \
    ADA_ASSERT((int)(index) >= 0);
       \
    ADA_ASSERT((float)(index) - (int)(index) == 0);
       \
    for (size_t ada_for_loop_index = (index); ada_for_loop_index < (header).length-1; ada_for_loop_index++)
       { \
        (header).elements[ada_for_loop_index] = (header).elements[ada_for_loop_index+1];
          \
    }
       \
    (header).length--;
        \
} while (0)
```

Remove element at index, preserving order (O(n)).

Parameters

type	Element type stored in the array.
header	Lvalue of the header struct.
index	Index in the range [0, header.length - 1].

Precondition

0 <= index < header.length.

Postcondition

header.length is decremented by 1; subsequent elements are shifted left by one position. The element beyond the new length is left uninitialized.

Definition at line 253 of file Almog_Dynamic_Array.h.

5.1.2.11 ada_remove_unordered

```
#define ada_remove_unordered(
              type,
              header,
              index )
```

Value:

```
    do {           \
    ADA_ASSERT((int)(index) >= 0);                              \
    ADA_ASSERT((float)(index) - (int)(index) == 0);             \
    (header).elements[index] = (header).elements[(header).length-1];  \
    (header).length--;                                            \
} while (0)
```

Remove element at index by moving the last element into its place (O(1)); order is not preserved.

Parameters

type	Element type stored in the array.
header	Lvalue of the header struct.
index	Index in the range [0, header.length - 1].

Precondition

0 <= index < header.length and header.length > 0.

Postcondition

header.length is decremented by 1; array order is not preserved.

Definition at line 274 of file Almog_Dynamic_Array.h.

5.1.2.12 ada_resize

```
#define ada_resize(
                type,
                header,
                new_capacity )
```

Value:

```
        do {                                                            \
        type *ada_temp_pointer = (type *)ADA_REALLOC((void *)((header).elements),
       new_capacity*sizeof(type)); \
        if (ada_temp_pointer == NULL) {
       \
            ADA_EXIT(1);
          \
        }
       \
        (header).elements = ada_temp_pointer;
        \
        ADA_ASSERT((header).elements != NULL);
        \
        (header).capacity = new_capacity;
        \
    } while (0)
```

Resize the underlying storage to hold new_capacity elements.

Parameters

type	Element type stored in the array.
header	Lvalue of the header struct.
new_capacity	New capacity in number of elements.

Precondition

> new_capacity >= header.length (otherwise elements beyond new_capacity are lost and length will not be adjusted).

Postcondition

> header.capacity == new_capacity and header.elements points to a block large enough for new_capacity elements.

Warning

> On allocation failure, this macro calls ADA_EXIT(1).

Note

> Reallocation uses ADA_REALLOC and is also checked via ADA_ASSERT.

Definition at line 150 of file Almog_Dynamic_Array.h.

5.2 Almog_Dynamic_Array.h

```
#ifndef ALMOG_DYNAMIC_ARRAY_H_
#define ALMOG_DYNAMIC_ARRAY_H_


#ifndef ADA_INIT_CAPACITY
#define ADA_INIT_CAPACITY 10
#endif /*ADA_INIT_CAPACITY*/

#ifndef ADA_MALLOC
#include <stdlib.h>
#define ADA_MALLOC malloc
#endif /*ADA_MALLOC*/

#ifndef ADA_EXIT
#include <stdlib.h>
#define ADA_EXIT exit
#endif /*ADA_EXIT*/

#ifndef ADA_REALLOC
#include <stdlib.h>
#define ADA_REALLOC realloc
#endif /*ADA_REALLOC*/

#ifndef ADA_ASSERT
#include <assert.h>
#define ADA_ASSERT assert
#endif /*ADA_ASSERT*/

/* typedef struct {
    size_t length;
    size_t capacity;
    int* elements;
} ada_int_array; */

#define ada_init_array(type, header) do {                                   \
        (header).capacity = ADA_INIT_CAPACITY;                                    \
        (header).length = 0;                                                  \
        (header).elements = (type *)ADA_MALLOC(sizeof(type) * (header).capacity);   \
        ADA_ASSERT((header).elements != NULL);                                \
    } while (0)

#define ada_resize(type, header, new_capacity) do {
      \
        type *ada_temp_pointer = (type *)ADA_REALLOC((void *)((header).elements),
 new_capacity*sizeof(type)); \
        if (ada_temp_pointer == NULL) {
      \
            ADA_EXIT(1);
          \
        }
      \
        (header).elements = ada_temp_pointer;
        \
        ADA_ASSERT((header).elements != NULL);
        \
        (header).capacity = new_capacity;
        \
    } while (0)

#define ada_append(type, header, value) do {                                        \
        if ((header).length >= (header).capacity) {                                    \
            ada_resize(type, (header), (int)((header).capacity + (header).capacity/2 + 1));   \
        }                                                                           \
        (header).elements[(header).length] = value;                                     \
        (header).length++;                                                            \
    } while (0)

#define ada_insert(type, header, value, index) do {
          \
    ADA_ASSERT((int)(index) >= 0);
          \
    ADA_ASSERT((float)(index) - (int)(index) == 0);
          \
    ada_append(type, (header), (header).elements[(header).length-1]);
                \
    for (int ada_for_loop_index = (header).length-2; ada_for_loop_index > (int)(index);
 ada_for_loop_index--) {   \
        (header).elements[ada_for_loop_index] = (header).elements [ada_for_loop_index-1];
              \
    }
          \
    (header).elements[(index)] = value;
            \
} while (0)
```

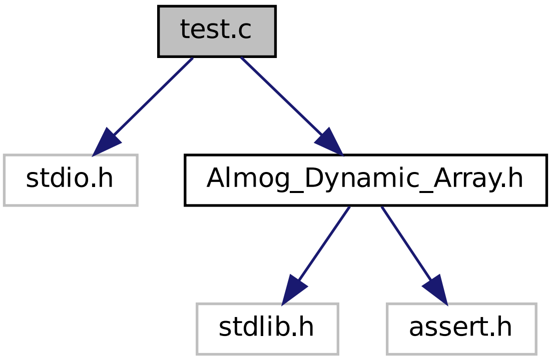
```



#define ada_insert_unordered(type, header, value, index) do {   \
    ADA_ASSERT((int)(index) >= 0);                              \
    ADA_ASSERT((float)(index) - (int)(index) == 0);             \
    if ((size_t)(index) == (header).length) {                    \
        ada_append(type, (header), value);                       \
    } else {                                                    \
        ada_append(type, (header), (header).elements[(index)]);     \
        (header).elements[(index)] = value;                      \
    }                                                           \
} while (0)

#define ada_remove(type, header, index) do {                                            \
    ADA_ASSERT((int)(index) >= 0);                                                      \
    ADA_ASSERT((float)(index) - (int)(index) == 0);                                     \
    for (size_t ada_for_loop_index = (index); ada_for_loop_index < (header).length-1; ada_for_loop_index++) { \
        (header).elements[ada_for_loop_index] = (header).elements[ada_for_loop_index+1];   \
    }                                                                                   \
    (header).length--;                                                                  \
} while (0)

#define ada_remove_unordered(type, header, index) do {          \
    ADA_ASSERT((int)(index) >= 0);                              \
    ADA_ASSERT((float)(index) - (int)(index) == 0);             \
    (header).elements[index] = (header).elements[(header).length-1];  \
    (header).length--;                                           \
} while (0)


#endif /*ALMOG_DYNAMIC_ARRAY_H_*/
```

5.3 README.md File Reference

5.4 test.c File Reference

```
#include <stdio.h>
#include "Almog_Dynamic_Array.h"
```

Include dependency graph for test.c:



Classes

- struct ada_int_array
- struct ada_float_array

Macros

- #define ADA_INT_PRINT(ada) print_int_ada(ada, #ada)
- #define ADA_FLOAT_PRINT(ada) print_float_ada(ada, #ada)

Functions

- void print_int_ada (ada_int_array ada, char ∗name)
- void print_float_ada (ada_float_array ada, char ∗name)
- int main ()

5.4.1 Macro Definition Documentation

5.4.1.1 ADA_FLOAT_PRINT

```
#define ADA_FLOAT_PRINT(
              ada ) print_float_ada(ada, #ada)
```

Definition at line 46 of file test.c.

5.4.1.2 ADA_INT_PRINT

```
#define ADA_INT_PRINT(
              ada ) print_int_ada(ada, #ada)
```

Definition at line 30 of file test.c.

5.4.2 Function Documentation

5.4.2.1 main()

```
int main ( )
```

Definition at line 48 of file test.c.

References ada_appand, ADA_FLOAT_PRINT, ada_init_array, ada_insert, and ADA_INT_PRINT.

5.4.2.2 print_float_ada()

```
void print_float_ada (
             ada_float_array ada,
             char * name )
```

Definition at line 32 of file test.c.

References ada_float_array::capacity, ada_float_array::elements, and ada_float_array::length.

5.4.2.3 print_int_ada()

```
void print_int_ada (
             ada_int_array ada,
             char * name )
```

Definition at line 16 of file test.c.

References ada_int_array::capacity, ada_int_array::elements, and ada_int_array::length.

5.5 test.c

```
00001 #include <stdio.h>
00002 #include "Almog_Dynamic_Array.h"
00003
00004 typedef struct {
00005     size_t length;
00006     size_t capacity;
00007     int* elements;
00008 } ada_int_array;
00009
00010 typedef struct {
00011     size_t length;
00012     size_t capacity;
00013     float* elements;
00014 } ada_float_array;
00015
00016 void print_int_ada(ada_int_array ada, char *name)
00017 {
00018     printf("%s\n", name);
00019     printf("capacity: %zu\n", ada.capacity);
00020     printf("length: %zu\n[", ada.length);
00021     if (ada.length == 0) {
00022         printf("]\n\n");
00023         return;
00024     }
00025     for (size_t i = 0; i < ada.length - 1; i++) {
00026         printf("%d, ", ada.elements[i]);
00027     }
00028     printf("%d]\n\n", ada.elements[ada.length - 1]);
00029 }
00030 #define ADA_INT_PRINT(ada) print_int_ada(ada, #ada)
00031
00032 void print_float_ada(ada_float_array ada, char *name)
00033 {
00034     printf("%s\n", name);
00035     printf("capacity: %zu\n", ada.capacity);
00036     printf("length: %zu\n[", ada.length);
00037     if (ada.length == 0) {
00038         printf("]\n\n");
00039         return;
00040     }
00041     for (size_t i = 0; i < ada.length - 1; i++) {
00042         printf("%g, ", ada.elements[i]);
00043     }
00044     printf("%g]\n\n", ada.elements[ada.length - 1]);
00045 }
00046 #define ADA_FLOAT_PRINT(ada) print_float_ada(ada, #ada)
```

```
int main()
{
    ada_int_array a;

    ada_init_array(int, a);

    for (int i = 0; i < 14; i++) {
        ada_append(int, a, i);
    }

    ADA_INT_PRINT(a);

    ada_insert(int, a, 100, 1);
    ada_insert(int, a, 100, 1);
    ADA_INT_PRINT(a);


    ada_float_array b;

    ada_init_array(float, b);

    for (int i = 0; i < 69; i++) {
        ada_append(float, b, i/2.0);
    }

    ADA_FLOAT_PRINT(b);


    return 0;
}
```

Index