

## 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:

<a href="#">ada_float_array</a>	.....	7
<a href="#">ada_int_array</a>	.....	8





## Chapter 3

# File Index

### 3.1 File List

Here is a list of all files with brief descriptions:

<a href="#">Almog_Dynamic_Array.h</a>	
Header-only C macros that implement a simple dynamic array . . . . .	9
<a href="#">test.c</a> . . . . .	19



## 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

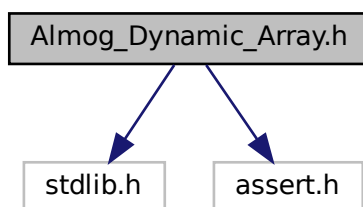
### 5.1 Almog\_Dynamic\_Array.h File Reference

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

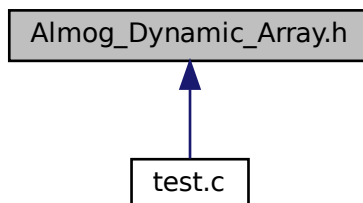
```
#include <stdlib.h>
```

```
#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_appand(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_appand` (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**

<i>type</i>	Element type stored in the array.
<i>header</i>	Lvalue of the header struct.
<i>value</i>	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**

<i>type</i>	Element type stored in the array (e.g., int).
<i>header</i>	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**

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

**Precondition**

$0 \leq \text{index} \leq \text{header.length}$ .

$\text{header.length} > 0$  if  $\text{index} == \text{header.length}$  (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_appand(type, (header), value); \
    } else { \
        ada_appand(type, (header), (header).elements[(index)]); \
        (header).elements[(index)] = value; \
    } \
} while (0)
```

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

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

**Parameters**

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

**Precondition**

$0 \leq \text{index} \leq \text{header.length}$ .

**Postcondition**

$\text{header.length}$  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**

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

**Precondition**

$0 \leq \text{index} < \text{header.length}$ .

**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**

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

**Precondition**

$0 \leq \text{index} < \text{header.length}$  and  $\text{header.length} > 0$ .

**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**

<i>type</i>	Element type stored in the array.
<i>header</i>	Lvalue of the header struct.
<i>new_capacity</i>	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

```

00001
00051 #ifndef ALMOG_DYNAMIC_ARRAY_H_
00052 #define ALMOG_DYNAMIC_ARRAY_H_
00053
00054
00061 #ifndef ADA_INIT_CAPACITY
00062 #define ADA_INIT_CAPACITY 10
00063 #endif /*ADA_INIT_CAPACITY*/
00064
00072 #ifndef ADA_MALLOC
00073 #include <stdlib.h>
00074 #define ADA_MALLOC malloc
00075 #endif /*ADA_MALLOC*/
00076
00077 #ifndef ADA_EXIT
00078 #include <stdlib.h>
00079 #define ADA_EXIT exit
00080 #endif /*ADA_EXIT*/
00081
00089 #ifndef ADA_REALLOC
00090 #include <stdlib.h>
00091 #define ADA_REALLOC realloc
00092 #endif /*ADA_REALLOC*/
00093
00101 #ifndef ADA_ASSERT
00102 #include <assert.h>
00103 #define ADA_ASSERT assert
00104 #endif /*ADA_ASSERT*/
00105
00106 /* typedef struct {
00107     size_t length;
00108     size_t capacity;
00109     int* elements;
00110 } ada_int_array; */
00111
00127 #define ada_init_array(type, header) do {
00128     (header).capacity = ADA_INIT_CAPACITY;
00129     (header).length = 0;
00130     (header).elements = (type *)ADA_MALLOC(sizeof(type) * (header).capacity);
00131     ADA_ASSERT((header).elements != NULL);
00132 } while (0)
00133
00150 #define ada_resize(type, header, new_capacity) do {
00151     type *ada_temp_pointer = (type *)ADA_REALLOC((void *)((header).elements),
00152     new_capacity*sizeof(type));
00153     if (ada_temp_pointer == NULL) {
00154         ADA_EXIT(1);
00155     }
00156     (header).elements = ada_temp_pointer;
00157     ADA_ASSERT((header).elements != NULL);
00158     (header).capacity = new_capacity;
00159 } while (0)
00176 #define ada_appand(type, header, value) do {
00177     if ((header).length >= (header).capacity) {
00178         ada_resize(type, (header), (int)((header).capacity + (header).capacity/2 + 1));
00179     }
00180     (header).elements[(header).length] = value;
00181     (header).length++;
00182 } while (0)
00183
00203 #define ada_insert(type, header, value, index) do {
00204     ADA_ASSERT((int)(index) >= 0);
00205     ADA_ASSERT((float)(index) - (int)(index) == 0);
00206     ada_appand(type, (header), (header).elements[(header).length-1]);
00207     for (int ada_for_loop_index = (header).length-2; ada_for_loop_index > (int)(index);
00208     ada_for_loop_index--) {
00209         (header).elements[ada_for_loop_index] = (header).elements [ada_for_loop_index-1];
00210     }
00211     (header).elements[(index)] = value;
00212 } while (0)

```

```

00212
00213
00229 #define ada_insert_unordered(type, header, value, index) do { \
00230     ADA_ASSERT((int)(index) >= 0); \
00231     ADA_ASSERT((float)(index) - (int)(index) == 0); \
00232     if ((size_t)(index) == (header).length) { \
00233         ada_appand(type, (header), value); \
00234     } else { \
00235         ada_appand(type, (header), (header).elements[(index)]); \
00236         (header).elements[(index)] = value; \
00237     } \
00238 } while (0)
00239
00253 #define ada_remove(type, header, index) do { \
00254     ADA_ASSERT((int)(index) >= 0); \
00255     ADA_ASSERT((float)(index) - (int)(index) == 0); \
00256     for (size_t ada_for_loop_index = (index); ada_for_loop_index < (header).length-1; \
00257         ada_for_loop_index++) { \
00258         (header).elements[ada_for_loop_index] = (header).elements[ada_for_loop_index+1]; \
00259     } \
00260     (header).length--; \
00261 } while (0)
00261
00274 #define ada_remove_unordered(type, header, index) do { \
00275     ADA_ASSERT((int)(index) >= 0); \
00276     ADA_ASSERT((float)(index) - (int)(index) == 0); \
00277     (header).elements[index] = (header).elements[(header).length-1]; \
00278     (header).length--; \
00279 } while (0)
00280
00281
00282 #endif /*ALMOG_DYNAMIC_ARRAY_H_*/

```

## 5.3 README.md File Reference

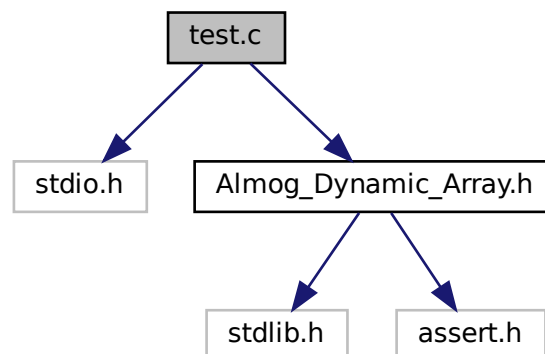
## 5.4 test.c File Reference

```

#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)
```

```
00047
00048 int main()
00049 {
00050     ada_int_array a;
00051
00052     ada_init_array(int, a);
00053
00054     for (int i = 0; i < 14; i++) {
00055         ada_appand(int, a, i);
00056     }
00057
00058     ADA_INT_PRINT(a);
00059
00060     ada_insert(int, a, 100, 1);
00061     ada_insert(int, a, 100, 1);
00062     ADA_INT_PRINT(a);
00063
00064
00065     ada_float_array b;
00066
00067     ada_init_array(float, b);
00068
00069     for (int i = 0; i < 69; i++) {
00070         ada_appand(float, b, i/2.0);
00071     }
00072
00073     ADA_FLOAT_PRINT(b);
00074
00075
00076     return 0;
00077 }
00078
```

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