

CSC
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Contents

1	Data Structure Index	1
1.1	Data Structures	1
2	File Index	3
2.1	File List	3
3	Data Structure Documentation	5
3.1	cvector Struct Reference	5
3.1.1	Field Documentation	5
3.1.1.1	capacity	5
3.1.1.2	data	5
3.1.1.3	size	5
4	File Documentation	7
4.1	/home/tamer/csc/src/csc.c File Reference	7
4.1.1	Detailed Description	8
4.1.2	Macro Definition Documentation	8
4.1.2.1	CSC_DEFINE_BUILTIN_CMP	8
4.1.3	Function Documentation	8
4.1.3.1	csc_error_str	8
4.1.3.2	csc_swap	9
4.2	/home/tamer/csc/src/csc.h File Reference	9
4.2.1	Detailed Description	11
4.2.2	Macro Definition Documentation	11
4.2.2.1	CSC_DECLARE_BUILTIN_CMP	11
4.2.2.2	CSC_MAX_ERROR_MSG_LEN	11
4.2.2.3	CSC_UNUSED	11
4.2.3	Typedef Documentation	11
4.2.3.1	csc_compare	11
4.2.3.2	CSCError	12
4.2.4	Enumeration Type Documentation	12
4.2.4.1	CSCError	12

4.2.5	Function Documentation	13
4.2.5.1	csc_error_str	13
4.2.5.2	csc_swap	13
4.3	/home/tamer/csc/src/cvector.c File Reference	13
4.3.1	Detailed Description	15
4.3.2	Function Documentation	15
4.3.2.1	csc_cvector_add	15
4.3.2.2	csc_cvector_at	15
4.3.2.3	csc_cvector_capacity	16
4.3.2.4	csc_cvector_create	16
4.3.2.5	csc_cvector_destroy	16
4.3.2.6	csc_cvector_empty	16
4.3.2.7	csc_cvector_find	17
4.3.2.8	csc_cvector_foreach	17
4.3.2.9	csc_cvector_reserve	17
4.3.2.10	csc_cvector_rm	18
4.3.2.11	csc_cvector_rm_at	18
4.3.2.12	csc_cvector_shrink_to_fit	18
4.3.2.13	csc_cvector_size	20
4.4	/home/tamer/csc/src/cvector.h File Reference	20
4.4.1	Detailed Description	22
4.4.2	Typedef Documentation	22
4.4.2.1	cvector	22
4.4.2.2	cvector_foreach	23
4.4.3	Function Documentation	23
4.4.3.1	csc_cvector_add	23
4.4.3.2	csc_cvector_at	23
4.4.3.3	csc_cvector_capacity	24
4.4.3.4	csc_cvector_create	24
4.4.3.5	csc_cvector_destroy	24
4.4.3.6	csc_cvector_empty	24
4.4.3.7	csc_cvector_find	25
4.4.3.8	csc_cvector_foreach	25
4.4.3.9	csc_cvector_reserve	25
4.4.3.10	csc_cvector_rm	26
4.4.3.11	csc_cvector_rm_at	26
4.4.3.12	csc_cvector_shrink_to_fit	26
4.4.3.13	csc_cvector_size	27

Chapter 1

Data Structure Index

1.1 Data Structures

Here are the data structures with brief descriptions:

cvector	5
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Chapter 2

File Index

2.1 File List

Here is a list of all documented files with brief descriptions:

/home/tamer/csc/src/ csc.c	
Implementation file for csc.h	7
/home/tamer/csc/src/ csc.h	
Main include file for the csc library	9
/home/tamer/csc/src/ cvector.c	
Implementation of the cvector structure	13
/home/tamer/csc/src/ cvector.h	
Interface of the cvector structure	20

Chapter 3

Data Structure Documentation

3.1 cvector Struct Reference

Data Fields

- void ** [data](#)
- size_t [size](#)
- size_t [capacity](#)

3.1.1 Field Documentation

3.1.1.1 size_t cvector::capacity

The number of elements the vector is capable of storing before needing to resize.

3.1.1.2 void** cvector::data

The internal data store of the vector.

3.1.1.3 size_t cvector::size

The number of elements currently in the vector.

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

- [/home/tamer/csc/src/cvector.c](#)

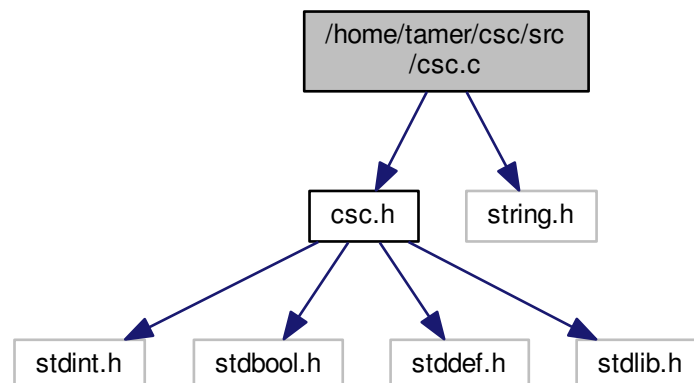
Chapter 4

File Documentation

4.1 /home/tamer/csc/src/csc.c File Reference

the implementation file for [csc.h](#).

```
#include "csc.h"  
#include <string.h>  
Include dependency graph for csc.c:
```



Macros

- `#define CSC_DEFINE_BUILTIN_CMP(type)`
implements a builtin type comparison function

Functions

- `void csc_swap (void **a, void **b)`
*generic swap function to swap two void**
- `void csc_error_str (CSCError e, char *buf, size_t len)`
returns a library-defined error string depending on the error.

4.1.1 Detailed Description

the implementation file for [csc.h](#).

Author

Tamer Aly

Date

27 Dec 2018

See Also

[csc.h](#)

4.1.2 Macro Definition Documentation

4.1.2.1 `#define CSC_DEFINE_BUILTIN_CMP(type)`

Value:

```
int csc_cmp_##type(const void* a, const void* b) \
{ \
    type vA = *(type*)a; \
    type vB = *(type*)b; \
    if (vA == vB) { return 0; } \
    else if (vA < vB) { return -1; } \
    else { return 1; } \
}
```

implements a builtin type comparison function

When defined with a type, this macro will implement the function signature that the `CSC_DECLARE_BUILTIN_CMP` defines. Note that the function signature **must** be declared first using `CSC_DECLARE_BUILTIN_CMP` in the header file.

See Also

[csc.h](#)

4.1.3 Function Documentation

4.1.3.1 `void csc_error_str (CSCErr e, char * buf, size_t len)`

returns a library-defined error string depending on the error.

This is a convenience function that populates `buf` of length `len` with a library-defined error message that depends on the value of `e`. It is recommended that `len` is *at least* [CSC_MAX_ERROR_MSG_LEN](#).

This function should ideally be used after a library call returning a [CSCErr](#) for a simple diagnostic error handling mechanism. For example:

```
CSCErr e = csc_some_func(args...);
if (e != E_NOERR) { // uh oh. An error.
    char buf[CSC_MAX_ERROR_MSG_LEN] = {0};
    csc_error_str(e, buf, CSC_MAX_ERROR_MSG_LEN);
    puts(buf);
}
```

Parameters

<i>e</i>	the error.
<i>buf</i>	the buffer to fill. Must be non-null .
<i>len</i>	the length of the buffer. Recommended to be \geq CSC_MAX_ERROR_MSG_LEN .

See Also

[CSC_MAX_ERROR_MSG_LEN](#)

4.1.3.2 void csc_swap (void ** a, void ** b)

generic swap function to swap two void*

This is a generic swap function to swap the provided elements.

Parameters

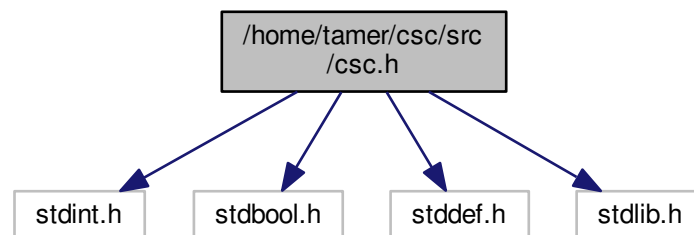
<i>a</i>	A is the first elem.
<i>b</i>	B is the second elem.

4.2 /home/tamer/csc/src/csc.h File Reference

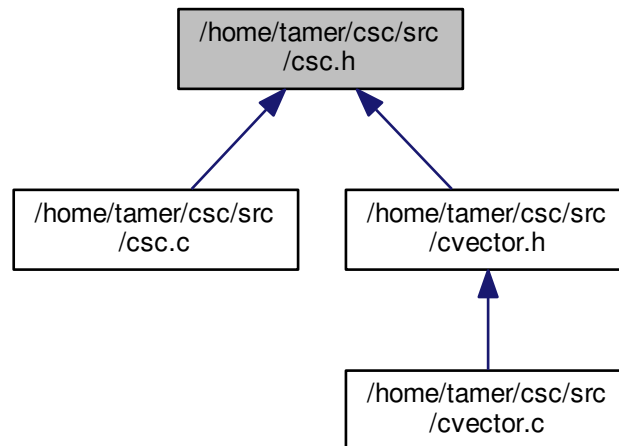
the main include file for the csc library.

```
#include <stdint.h>
#include <stdbool.h>
#include <stddef.h>
#include <stdlib.h>
```

Include dependency graph for csc.h:



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



Macros

- `#define CSC_UNUSED(x) (void)x`
macro that silences compiler warnings about unused function parameters.
- `#define CSC_DECLARE_BUILTIN_CMP(type) int csc_cmp_##type(const void* a, const void* b)`
convenience macro defining comparison functions for built in types.
- `#define CSC_MAX_ERROR_MSG_LEN 128`
the maximum message length a `CSCError` is guaranteed to generate.

Typedefs

- `typedef enum CSCError CSCError`
the list of errors that can be returned by the library.
- `typedef int(* csc_compare)(const void *a, const void *b)`
comparison function callback for comparing two elements

Enumerations

- `enum CSCError {`
`E_NOERR = 0, E_OUTOFMEM, E_OUTOFRANGE, E_INVALIDOPERATION,`
`E_ERR_N }`
the list of errors that can be returned by the library.

Functions

- `void csc_swap(void **a, void **b)`
generic swap function to swap two `void*`
- `void csc_error_str(CSCError e, char *buf, size_t len)`

returns a library-defined error string depending on the error.

- **CSC_DECLARE_BUILTIN_CMP** (int)

4.2.1 Detailed Description

the main include file for the csc library.

Author

Tamer Aly

Date

27 Dec 2018 This is the main include file that must be included alongside any other source and header combination for a particular data structure in the library. This file defines several helper functions that are used throughout the library.

4.2.2 Macro Definition Documentation

4.2.2.1 `#define CSC_DECLARE_BUILTIN_CMP(type) int csc_cmp_##type(const void* a, const void* b)`

convenience macro defining comparison functions for built in types.

This macro defines a comparison function for built-in C types.

For example, defining `CSC_DECLARE_BUILTIN_CMP(int)` would create the signature:

```
int csc_cmp_int(const void* a, const void* b);
```

Note that this macro only creates the signature of the function. See `csc.c` for how to implement the signature.

See Also

[CSC.C](#)

4.2.2.2 `#define CSC_MAX_ERROR_MSG_LEN 128`

the maximum message length a `CSCError` is guaranteed to generate.

See Also

[csc_error_str](#)

4.2.2.3 `#define CSC_UNUSED(x) (void)x`

macro that silences compiler warnings about unused function parameters.

This macro is used to silence compiler warnings about unused function parameters. Mostly, this is for unused context parameters in generic callback functions used internally by the library.

4.2.3 Typedef Documentation

4.2.3.1 `typedef int(* csc_compare)(const void *a, const void *b)`

comparison function callback for comparing two elements

This is a comparison function callback for comparing two elements that is used for routine functions like sorting or searching a generic container. When creating a custom comparison function for your type, the following protocol **must** be adhered to: a return value < 1 means a is less than b . a return value of > 1 means a is greater than b . a return value of 0 means a is equal to b .

As a convenience, the library provides comparison functions for all the C built in types.

Parameters

<i>a</i>	the first element
<i>b</i>	the second element

See Also

[CSC_DECLARE_BUILTIN_CMP](#)

4.2.3.2 typedef enum CSCErrors CSCErrors

the list of errors that can be returned by the library.

This enumeration defines all of the errors that can be returned by certain library calls. These errors can provide more diagnostic information than a simple true/false return. Whenever this error type is returned, a type of `CSCErrors : : E_NOERR` indicates a successful operation. Any other error, with the exception of `CSCErrors : : E_ERR_N`, indicates an error condition.

It is recommended that you check for this error code whenever possible:

```
CSCErrors e = csc_function(args...);
if (e != E_NOERR) {
    // handle the error by printing a simple diagnostic message.
    char buf[CSC_MAX_ERROR_MSG_LEN] = {0};
    csc_error_str(e, buf, CSC_MAX_ERROR_MSG_LEN);
    puts(buf);
}
```

See Also

[csc_error_str](#)

4.2.4 Enumeration Type Documentation

4.2.4.1 enum CSCErrors

the list of errors that can be returned by the library.

This enumeration defines all of the errors that can be returned by certain library calls. These errors can provide more diagnostic information than a simple true/false return. Whenever this error type is returned, a type of `CSCErrors : : E_NOERR` indicates a successful operation. Any other error, with the exception of `CSCErrors : : E_ERR_N`, indicates an error condition.

It is recommended that you check for this error code whenever possible:

```
CSCErrors e = csc_function(args...);
if (e != E_NOERR) {
    // handle the error by printing a simple diagnostic message.
    char buf[CSC_MAX_ERROR_MSG_LEN] = {0};
    csc_error_str(e, buf, CSC_MAX_ERROR_MSG_LEN);
    puts(buf);
}
```


See Also

[csc_error_str](#)

Enumerator

E_NOERR This indicates no errors occurred in the operation.**E_OUTOFMEM** This error indicates the operation failed since memory could not be allocated.**E_OUTOFRANGE** This error indicates that the operation failed due to accessing an out of range element. i.e. array index of -1.**E_INVALIDOPERATION** This error indicates that the operation failed because an invalid operation was attempted.**E_ERR_N** This is never returned by any function calls and can be ignored.

4.2.5 Function Documentation

4.2.5.1 void csc_error_str (CSCError e, char * buf, size_t len)

returns a library-defined error string depending on the error.

This is a convenience function that populates `buf` of length `len` with a library-defined error message that depends on the value of `e`. It is recommended that `len` is *at least* [CSC_MAX_ERROR_MSG_LEN](#).

This function should ideally be used after a library call returning a [CSCError](#) for a simple diagnostic error handling mechanism. For example:

```
CSCError e = csc_some_func(args...);
if (e != E_NOERR) { // uh oh. An error.
    char buf[CSC_MAX_ERROR_MSG_LEN] = {0};
    csc_error_str(e, buf, CSC_MAX_ERROR_MSG_LEN);
    puts(buf);
}
```

Parameters

<i>e</i>	the error.
<i>buf</i>	the buffer to fill. Must be non-null .
<i>len</i>	the length of the buffer. Recommended to be \geq CSC_MAX_ERROR_MSG_LEN .

See Also

[CSC_MAX_ERROR_MSG_LEN](#)

4.2.5.2 void csc_swap (void ** a, void ** b)

generic swap function to swap two `void*`

This is a generic swap function to swap the provided elements.

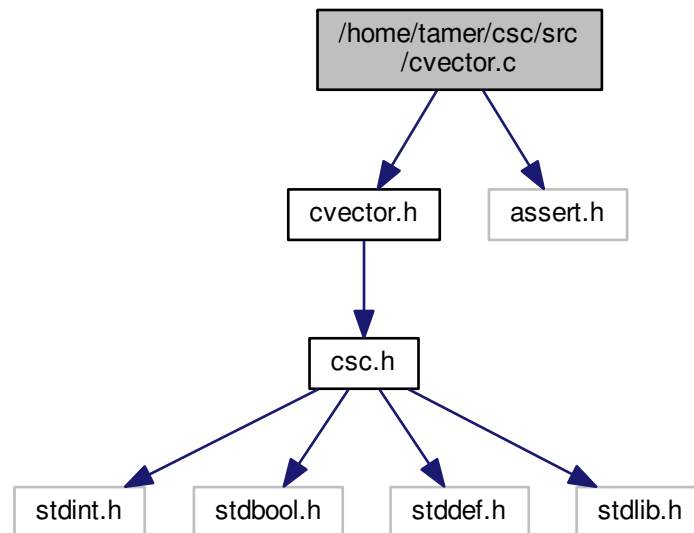
Parameters

<i>a</i>	A is the first elem.
<i>b</i>	B is the second elem.

4.3 /home/tamer/csc/src/cvector.c File Reference

contains the implementation of the `cvector` structure.

```
#include "cvector.h"
#include <assert.h>
Include dependency graph for cvector.c:
```



Data Structures

- struct `cvector`

Functions

- `cvector * csc_cvector_create ()`
cvector "constructor" function
- `size_t csc_cvector_size (const cvector *v)`
returns the size of the vector.
- `size_t csc_cvector_capacity (const cvector *v)`
returns the capacity of the vector.
- `void csc_cvector_destroy (cvector *v)`
cvector "destructor" function
- `void csc_cvector_foreach (cvector *v, cvector_foreach fn, void *context)`
applies the callback function to each element of the vector.
- `CSCError csc_cvector_add (cvector *v, void *elem)`
adds an element into the vector.
- `void * csc_cvector_at (const cvector *v, size_t idx)`
returns the element at the specified index.
- `void csc_cvector_rm (cvector *v, const void *elem, csc_compare cmp)`
removes an element from the vector.
- `CSCError csc_cvector_rm_at (cvector *v, size_t idx)`
removes the element at the specified 0-indexed index from the vector.

- void * `csc_cvector_find` (const `cvector` *v, const void *elem, `csc_compare` cmp)
finds the element in the specified vector.
- bool `csc_cvector_empty` (const `cvector` *v)
checks if the vector is empty.
- `CSCError` `csc_cvector_reserve` (`cvector` *v, `size_t` num_elems)
reserves memory for the specified number of elements in the vector.
- `CSCError` `csc_cvector_shrink_to_fit` (`cvector` *v)
shrinks the capacity to match the size of the vector.

4.3.1 Detailed Description

contains the implementation of the cvector structure.

Author

Tamer Aly

Date

27 Dec 2018

4.3.2 Function Documentation

4.3.2.1 `CSCError csc_cvector_add (cvector * v, void * elem)`

adds an element into the vector.

This function adds `elem` into the supplied vector. Note that `elem` **MUST** point to an element allocated on the heap.

Both `elem` and `v` are expected to be **non-null**. This means that `NULL` elements are **not** allowed.

Time Complexity: $O(1)$ best case, $O(n)$ worst case, $O(1)$ amortized.

Parameters

<code>v</code>	the vector.
<code>elem</code>	the element to add.

Returns

On success, `CSCError : : E_NOERR`. On memory allocation failure `CSCError : : E_OUTOFMEM`.

4.3.2.2 `void* csc_cvector_at (const cvector * v, size_t idx)`

returns the element at the specified index.

This function performs a range check to ensure that `idx` is less than the size of the vector.

All parameters are expected to be **non-null**.

Time Complexity: $O(1)$

Parameters

<i>v</i>	the vector.
<i>idx</i>	the index.

Returns

the element at that index in the vector or `NULL` if the index is out of range.

4.3.2.3 `size_t csc_cvector_capacity (const cvector * v)`

returns the capacity of the vector.

This function returns the number of elements the vector can hold before it needs to be resized.

All parameters are expected to be **non-null**.

Time Complexity: $O(1)$

Parameters

<i>v</i>	the vector.
----------	-------------

Returns

the capacity of the vector.

4.3.2.4 `cvector* csc_cvector_create ()`

cvector "constructor" function

This function is used to create a `cvector`. If the function is successful, the function returns a pointer to a `cvector` created on the heap. If unsuccessful, `NULL` is returned.

Returns

a pointer to a constructed `cvector`.

See Also

[csc_cvector_destroy](#)

4.3.2.5 `void csc_cvector_destroy (cvector * v)`

cvector "destructor" function

This function is used to clean up resources used by a `cvector` created via the [csc_cvector_create](#) function. This function must be called whenever a `cvector` is no longer used.

See Also

[csc_cvector_create](#)

4.3.2.6 `bool csc_cvector_empty (const cvector * v)`

checks if the vector is empty.

All parameters are expected to be **non-null**.

Time Complexity: $O(1)$

Parameters

<i>v</i>	the vector.
----------	-------------

Returns

`true` if the vector is empty. In other words, true if `csc_cvector_size(v) == 0`. Otherwise, `false`.

4.3.2.7 `void* csc_cvector_find (const cvector * v, const void * elem, csc_compare cmp)`

finds the element in the specified vector.

This function attempts to find `elem` using comparator `comp`.

All parameters are expected to be **non-null**.

Time Complexity: $O(1)$ best case, $O(n)$ average and worst case.

Parameters

<i>v</i>	the vector.
<i>elem</i>	the element to find.
<i>cmp</i>	the comparison function to use. See csc_compare for more details.

Returns

the element or `NULL` if the element couldn't be found.

4.3.2.8 `void csc_cvector_foreach (cvector * v, cvector_foreach fn, void * context)`

applies the callback function to each element of the vector.

This callback function defines an operation that will be applied to each element of the `cvector`. The user may pass in additional context using the `context` param or pass in `NULL` if not required.

Time Complexity: $O(n)$

Parameters

<i>v</i>	the vector.
<i>fn</i>	the callback function to apply to each element. See cvector_foreach .
<i>context</i>	user-defined data that will be applied to the callback. Can be <code>NULL</code> if unused.

See Also

[cvector_foreach](#)

4.3.2.9 `CSCError csc_cvector_reserve (cvector * v, size_t num_elems)`

reserves memory for the specified number of elements in the vector.

This functions reserves enough memory in the vector such that it is able to hold *at least* `num_elems` without needing to expand. If the number of elements that will be contained in the vector is known or can be estimated, you may be able to improve the performance of your application by allocating the memory for the elements up front using this function. As always with performance, your mileage may vary.

Note that memory truncation is **not** allowed. That is, if `num_elems` is $< \text{csc_cvector_size}(v)$, that is an error.

All parameters are expected to be **non-null**.

Time Complexity: OS-specific.

Parameters

<i>v</i>	the vector.
<i>num_elems</i>	the number of elements to allocate memory for.

Returns

On success `CSCError::E_NOERR`. If the requested size is less than the current size, `CSCError::E_INVALIDOPERATION`. If there is a memory error, `CSCError::E_OUTOFMEM`.

4.3.2.10 `void csc_cvector_rm (cvector * v, const void * elem, csc_compare cmp)`

removes an element from the vector.

This function removes `elem` from the supplied vector if it exists. In order to remove the element, the function must search for the element in the vector using the supplied `cmp` function.

All three parameters are expected to be **non-null**.

Time Complexity: $O(1)$ best case, $O(n)$ average and worst case.

Parameters

<i>v</i>	the vector.
<i>elem</i>	the element to remove.
<i>cmp</i>	the comparison function to use. See csc_compare for more details.

See Also

[csc_compare](#)
[csc_cvector_find](#)

4.3.2.11 `CSCError csc_cvector_rm_at (cvector * v, size_t idx)`

removes the element at the specified 0-indexed index from the vector.

This function the element at index `idx` from `v`.

All parameters are expected to be **non-null**.

Time Complexity: $O(1)$

Parameters

<i>v</i>	the vector.
<i>idx</i>	the index.

Returns

`CSCError::E_NOERR` or `CSCError::E_OUTOFRANGE` if the supplied index is out of range.

4.3.2.12 `CSCError csc_cvector_shrink_to_fit (cvector * v)`

shrinks the capacity to match the size of the vector.

After a call to this function, the following will be true:

```
csc_cvector_size(v) == csc_cvector_capacity(v);
```

This function may be useful in low-memory settings where the vector's capacity greatly exceeds the size and the extra memory won't be required.

All parameters are expected to be **non-null**.

Time Complexity: OS-specific.

Parameters

<code>v</code>	the vector.
----------------	-------------

Returns

On success `CSCError::E_NOERR`. If there is a memory error, `CSCError::E_OUTOFMEM`.

4.3.2.13 `size_t csc_cvector_size (const cvector * v)`

returns the size of the vector.

This function returns the number of elements currently in the vector.

All parameters are expected to be **non-null**.

Time Complexity: $O(1)$

Parameters

<code>v</code>	the vector.
----------------	-------------

Returns

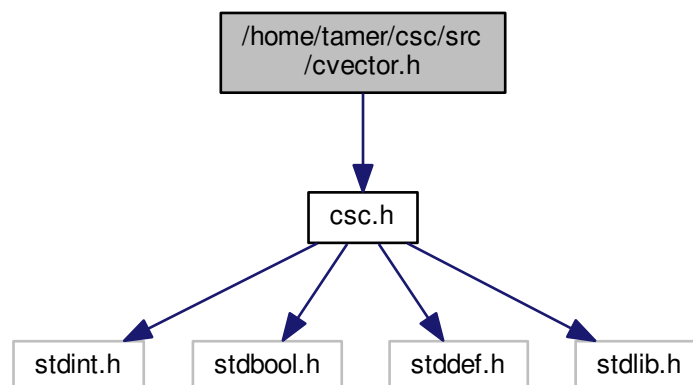
the size of the vector.

4.4 `/home/tamer/csc/src/cvector.h` File Reference

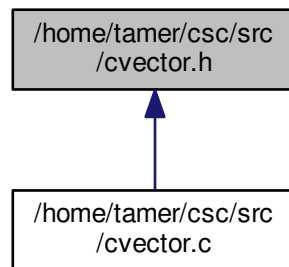
contains interface of the `cvector` structure.

```
#include "csc.h"
```

Include dependency graph for `cvector.h`:



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



Typedefs

- typedef struct `cvector` `cvector`
implementation of a generic dynamic array.
- typedef void(* `cvector_foreach`)(void *elem, void *context)
callback function for iterating the elements of a `cvector`.

Functions

- `cvector * csc_cvector_create` ()
cvector "constructor" function
- void `csc_cvector_destroy` (`cvector *v`)
cvector "destructor" function
- `CSCError csc_cvector_add` (`cvector *v`, void *elem)
adds an element into the vector.
- void `csc_cvector_rm` (`cvector *v`, const void *elem, `csc_compare` cmp)
removes an element from the vector.
- `CSCError csc_cvector_rm_at` (`cvector *v`, `size_t` idx)
removes the element at the specified 0-indexed index from the vector.
- void * `csc_cvector_find` (const `cvector *v`, const void *elem, `csc_compare` cmp)
finds the element in the specified vector.
- `size_t csc_cvector_size` (const `cvector *v`)
returns the size of the vector.
- `size_t csc_cvector_capacity` (const `cvector *v`)
returns the capacity of the vector.
- void `csc_cvector_foreach` (`cvector *v`, `cvector_foreach` fn, void *context)
applies the callback function to each element of the vector.
- void * `csc_cvector_at` (const `cvector *v`, `size_t` idx)
returns the element at the specified index.
- bool `csc_cvector_empty` (const `cvector *v`)
checks if the vector is empty.
- `CSCError csc_cvector_reserve` (`cvector *v`, `size_t` num_elems)
reserves memory for the specified number of elements in the vector.
- `CSCError csc_cvector_shrink_to_fit` (`cvector *v`)
shrinks the capacity to match the size of the vector.

4.4.1 Detailed Description

contains interface of the `cvector` structure.

Author

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Date

27 Dec 2018 Here is example code to get you started on using the `cvector`:

```
// for-each callback function signature
void print_elem(void* elem, void* context);

//
// somewhere in main....
//

// create a vector
cvector* v = csc_cvector_create();
if (v == NULL) {
    // couldn't create the vector.
}

// add some elements into the vector. Note that they must be on the heap and that the vector "owns" the
// element.
for (int i = 0; i < 10; i++) {
    int* x = malloc(sizeof(*x));
    if (x == NULL) {
        // couldn't allocate memory.
    }
    CSCError e = csc_cvector_add(v, x);
    if (e != E_NOERR) {
        // couldn't add the element.
    }
}

// get the size
size_t size = csc_cvector_size(v);

// print the elements "manually"
for (size_t i = 0; i < size; i++) {
    int* x = (int*) csc_cvector_at(v, i);
    printf("%d\n", *x);
}

// remove the 2nd element
CSCError e = csc_cvector_rm_at(v, 1);
if (e != E_NOERR) {
    // couldn't remove the element
}

// print the elements "functionally"
csc_cvector_foreach(v, print_elem, NULL);

// clean up resources
csc_cvector_destroy(v);

//
// somewhere outside of main...
//

// implement the callback
void print_elem(void* elem, void* context)
{
    CSC_UNUSED(context); // no need for context
    printf("%d\n", *(int*)elem);
}
```

4.4.2 Typedef Documentation

4.4.2.1 typedef struct cvector cvector

implementation of a generic dynamic array.

`cvector` implements a dynamic array that mimics `std::vector` from C++.

See Also

[csc_cvector_create](#)

4.4.2.2 typedef void(* cvector_foreach)(void *elem, void *context)

callback function for iterating the elements of a `cvector`.

This callback function defines an operation that will be applied to each element of the `cvector` by the `csc_cvector_foreach` function.

Parameters

<i>elem</i>	the element to process
<i>context</i>	user-defined data that can be passed into the function. Can be <code>NULL</code> if unused.

See Also

[csc_cvector_foreach](#)

4.4.3 Function Documentation

4.4.3.1 CSCErrors csc_cvector_add (cvector * v, void * elem)

adds an element into the vector.

This function adds `elem` into the supplied vector. Note that `elem` **MUST** point to an element allocated on the heap.

Both `elem` and `v` are expected to be **non-null**. This means that `NULL` elements are **not** allowed.

Time Complexity: $O(1)$ best case, $O(n)$ worst case, $O(1)$ amortized.

Parameters

<i>v</i>	the vector.
<i>elem</i>	the element to add.

Returns

On success, `CSCErrors : : E_NOERR`. On memory allocation failure `CSCErrors : : E_OUTOFMEM`.

4.4.3.2 void* csc_cvector_at (const cvector * v, size_t idx)

returns the element at the specified index.

This function performs a range check to ensure that `idx` is less than the size of the vector.

All parameters are expected to be **non-null**.

Time Complexity: $O(1)$

Parameters

<i>v</i>	the vector.
<i>idx</i>	the index.

Returns

the element at that index in the vector or `NULL` if the index is out of range.

4.4.3.3 `size_t csc_cvector_capacity (const cvector * v)`

returns the capacity of the vector.

This function returns the number of elements the vector can hold before it needs to be resized.

All parameters are expected to be **non-null**.

Time Complexity: $O(1)$

Parameters

<code>v</code>	the vector.
----------------	-------------

Returns

the capacity of the vector.

4.4.3.4 `cvector* csc_cvector_create ()`

cvector "constructor" function

This function is used to create a `cvector`. If the function is successful, the function returns a pointer to a `cvector` created on the heap. If unsuccessful, `NULL` is returned.

Returns

a pointer to a constructed `cvector`.

See Also

[csc_cvector_destroy](#)

4.4.3.5 `void csc_cvector_destroy (cvector * v)`

cvector "destructor" function

This function is used to clean up resources used by a `cvector` created via the [csc_cvector_create](#) function. This function must be called whenever a `cvector` is no longer used.

See Also

[csc_cvector_create](#)

4.4.3.6 `bool csc_cvector_empty (const cvector * v)`

checks if the vector is empty.

All parameters are expected to be **non-null**.

Time Complexity: $O(1)$

Parameters

<code>v</code>	the vector.
----------------	-------------

Returns

`true` if the vector is empty. In other words, true if `csc_cvector_size(v) == 0`. Otherwise, `false`.

4.4.3.7 void* `csc_cvector_find` (const `cvector` * *v*, const void * *elem*, `csc_compare` *cmp*)

finds the element in the specified vector.

This function attempts to find `elem` using comparator `comp`.

All parameters are expected to be **non-null**.

Time Complexity: $O(1)$ best case, $O(n)$ average and worst case.

Parameters

<i>v</i>	the vector.
<i>elem</i>	the element to find.
<i>cmp</i>	the comparison function to use. See csc_compare for more details.

Returns

the element or `NULL` if the element couldn't be found.

4.4.3.8 void `csc_cvector_foreach` (`cvector` * *v*, `cvector_foreach` *fn*, void * *context*)

applies the callback function to each element of the vector.

This callback function defines an operation that will be applied to each element of the `cvector`. The user may pass in additional context using the `context` param or pass in `NULL` if not required.

Time Complexity: $O(n)$

Parameters

<i>v</i>	the vector.
<i>fn</i>	the callback function to apply to each element. See cvector_foreach .
<i>context</i>	user-defined data that will be applied to the callback. Can be <code>NULL</code> if unused.

See Also

[cvector_foreach](#)

4.4.3.9 `CSCError` `csc_cvector_reserve` (`cvector` * *v*, `size_t` *num_elems*)

reserves memory for the specified number of elements in the vector.

This functions reserves enough memory in the vector such that it is able to hold *at least* `num_elems` without needing to expand. If the number of elements that will be contained in the vector is known or can be estimated, you may be able to improve the performance of your application by allocating the memory for the elements up front using this function. As always with performance, your mileage may vary.

Note that memory truncation is **not** allowed. That is, if `num_elems` is $< \text{csc_cvector_size}(v)$, that is an error.

All parameters are expected to be **non-null**.

Time Complexity: OS-specific.

Parameters

<i>v</i>	the vector.
----------	-------------

<i>num_elems</i>	the number of elements to allocate memory for.
------------------	--

Returns

On success `CSCError::E_NOERR`. If the requested size is less than the current size, `CSCError::E_INVALIDOPERATION`. If there is a memory error, `CSCError::E_OUTOFMEM`.

4.4.3.10 void csc_cvector_rm (cvector * v, const void * elem, csc_compare cmp)

removes an element from the vector.

This function removes `elem` from the supplied vector if it exists. In order to remove the element, the function must search for the element in the vector using the supplied `cmp` function.

All three parameters are expected to be **non-null**.

Time Complexity: $O(1)$ best case, $O(n)$ average and worst case.

Parameters

<i>v</i>	the vector.
<i>elem</i>	the element to remove.
<i>cmp</i>	the comparison function to use. See csc_compare for more details.

See Also

[csc_compare](#)
[csc_cvector_find](#)

4.4.3.11 CSCError csc_cvector_rm_at (cvector * v, size_t idx)

removes the element at the specified 0-indexed index from the vector.

This function the element at index `idx` from `v`.

All parameters are expected to be **non-null**.

Time Complexity: $O(1)$

Parameters

<i>v</i>	the vector.
<i>idx</i>	the index.

Returns

`CSCError::E_NOERR` or `CSCError::E_OUTOFRANGE` if the supplied index is out of range.

4.4.3.12 CSCError csc_cvector_shrink_to_fit (cvector * v)

shrinks the capacity to match the size of the vector.

After a call to this function, the following will be true:

```
csc_cvector_size(v) == csc_cvector_capacity(v);
```

This function may be useful in low-memory settings where the vector's capacity greatly exceeds the size and the extra memory won't be required.

All parameters are expected to be **non-null**.

Time Complexity: OS-specific.

Parameters

v	the vector.
-----	-------------

Returns

On success `CSCError : : E_NOERR`. If there is a memory error, `CSCError : : E_OUTOFMEM`.

4.4.3.13 `size_t csc_cvector_size (const cvector * v)`

returns the size of the vector.

This function returns the number of elements currently in the vector.

All parameters are expected to be **non-null**.

Time Complexity: $O(1)$

Parameters

v	the vector.
-----	-------------

Returns

the size of the vector.

Index

/home/tamer/csc/src/csc.c, [7](#)
/home/tamer/csc/src/csc.h, [9](#)
/home/tamer/csc/src/cvector.c, [13](#)
/home/tamer/csc/src/cvector.h, [20](#)

CSC_UNUSED

csc.h, [11](#)

CSCError

csc.h, [12](#)

capacity

cvector, [5](#)

csc.h

E_ERR_N, [13](#)

E_INVALIDOPERATION, [13](#)

E_NOERR, [13](#)

E_OUTOFMEM, [13](#)

E_OUTOFRANGE, [13](#)

csc.c

csc_error_str, [8](#)

csc_swap, [9](#)

csc.h

CSC_UNUSED, [11](#)

CSCError, [12](#)

csc_compare, [11](#)

csc_error_str, [13](#)

csc_swap, [13](#)

csc_compare

csc.h, [11](#)

csc_cvector_add

cvector.c, [15](#)

cvector.h, [23](#)

csc_cvector_at

cvector.c, [15](#)

cvector.h, [23](#)

csc_cvector_capacity

cvector.c, [16](#)

cvector.h, [23](#)

csc_cvector_create

cvector.c, [16](#)

cvector.h, [24](#)

csc_cvector_destroy

cvector.c, [16](#)

cvector.h, [24](#)

csc_cvector_empty

cvector.c, [16](#)

cvector.h, [24](#)

csc_cvector_find

cvector.c, [17](#)

cvector.h, [24](#)

csc_cvector_foreach

cvector.c, [17](#)

cvector.h, [25](#)

csc_cvector_reserve

cvector.c, [17](#)

cvector.h, [25](#)

csc_cvector_rm

cvector.c, [18](#)

cvector.h, [26](#)

csc_cvector_rm_at

cvector.c, [18](#)

cvector.h, [26](#)

csc_cvector_shrink_to_fit

cvector.c, [18](#)

cvector.h, [26](#)

csc_cvector_size

cvector.c, [20](#)

cvector.h, [27](#)

csc_error_str

csc.c, [8](#)

csc.h, [13](#)

csc_swap

csc.c, [9](#)

csc.h, [13](#)

cvector, [5](#)

capacity, [5](#)

cvector.h, [22](#)

data, [5](#)

size, [5](#)

cvector.c

csc_cvector_add, [15](#)

csc_cvector_at, [15](#)

csc_cvector_capacity, [16](#)

csc_cvector_create, [16](#)

csc_cvector_destroy, [16](#)

csc_cvector_empty, [16](#)

csc_cvector_find, [17](#)

csc_cvector_foreach, [17](#)

csc_cvector_reserve, [17](#)

csc_cvector_rm, [18](#)

csc_cvector_rm_at, [18](#)

csc_cvector_shrink_to_fit, [18](#)

csc_cvector_size, [20](#)

cvector.h

csc_cvector_add, [23](#)

csc_cvector_at, [23](#)

csc_cvector_capacity, [23](#)

csc_cvector_create, [24](#)

csc_cvector_destroy, [24](#)

csc_cvector_empty, [24](#)

- [csc_cvector_find](#), [24](#)
 - [csc_cvector_foreach](#), [25](#)
 - [csc_cvector_reserve](#), [25](#)
 - [csc_cvector_rm](#), [26](#)
 - [csc_cvector_rm_at](#), [26](#)
 - [csc_cvector_shrink_to_fit](#), [26](#)
 - [csc_cvector_size](#), [27](#)
 - [cvector](#), [22](#)
 - [cvector_foreach](#), [23](#)
- [cvector_foreach](#)
 - [cvector.h](#), [23](#)
- [data](#)
 - [cvector](#), [5](#)
- [E_ERR_N](#)
 - [csc.h](#), [13](#)
- [E_INVALIDOPERATION](#)
 - [csc.h](#), [13](#)
- [E_NOERR](#)
 - [csc.h](#), [13](#)
- [E_OUTOFMEM](#)
 - [csc.h](#), [13](#)
- [E_OUTOFRANGE](#)
 - [csc.h](#), [13](#)
- [size](#)
 - [cvector](#), [5](#)