

stack-allocated array

```
int _main(int argc, char** strs) {
    char str[] = "abcde";

    printf("%s\n", str);
    printf("%c %d\n", str[0], str[0]); a 97
    printf("%c %d\n", str[5], str[5]); - 0
    printf("%d\n", sizeof(str));
}
```

%s - string %c - char

strs

main			
a 97	b 98	c 99	d 100
e 101	10	0	

1. C strings are char arrays

2. C strings are null-terminated
 \0

```
int main(int argc, char** strs) {
    char* str = calloc(56, sizeof(char));
    str[0] = 'a'; str[1] = 'b';
    str[2] = 'c'; str[3] = 'd';
    str[4] = 'e'; str[5] = '\0';

    printf("%s\n", str);
    printf("%c %d\n", str[0], str[0]);
    printf("%c %d\n", str[5], str[5]);
    printf("%d\n", sizeof(str));
}
```

heap-allocated array

strs

main	
@P	

@P

a	b	c	d
e	10		

```
char* make_string_of(char c, int count) {
    char str[count + 1];
    int index = 0;
    for(index = 0; index < count; index += 1) {
        str[index] = c;
    }
    str[count] = '\0';
    return str;
}
```

```
int main(int argc, char** strs) {
    char* fiveAs = make_string_of('a', 5);
    printf("Five As: %s\n", fiveAs);
    char* sixBs = make_string_of('b', 6);
    printf("Six Bs: %s\n", sixBs);
}
```

@P	m-s-o
str	a a a a
	a \0

printf

@M	m-s-o
str	b b b b
	b b \0

FA	main
SB	@P
	@M

UNDEFINED BEHAVIOR

- accessing local var after function returns
 - out-of-bounds access

```
char* make_string_of2(char c, int count) {
    char* str = calloc(count + 1, sizeof(char));
    int index = 0;
    for(index = 0; index < count; index += 1) {
        str[index] = c;
    }
    str[count] = '\0';
    return str;
}
```

```
int main(int argc, char** strs) {
    char* fiveAs = make_string_of2('a', 5);
    printf("Five As: %s\n", fiveAs);
    char* sixBs = make_string_of2('b', 6);
    printf("Six Bs: %s\n", sixBs);
}
```

free(fiveAs);
 free(sixBs);

how many times is calloc called?

m-s-o2	printf
@M	

FA	main
SB	@M
	@P

m-s-o2
@P

a a a a
a \0
:
b b b b
b b \0

free(pointer)

Takes a pointer (either interpretation – a struct reference or an array!) and tells calloc/malloc that the calloc()'ed space it refers to can be used again in the future. The pointer must not be used again after freeing it. free() should be called once for each time calloc() is used. Failing to free is called a **memory leak**.

A: 1
 B: 2
 C: 3

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

typedef struct AList {
    int* contents;
    int size;
    int capacity;
} AList;

AList* make_alist(int start_capacity) {

}

void expandCapacity(AList* alist) {

}

void add(AList* alist, int element) {

}

int get(AList* alist, int index) {

}

void print_alist(AList* alist) {
    int i = 0;
    for(i = 0; i < alist->size; i += 1) {
        printf("%d, ", alist->contents[i]);
    }
}

int main(int argc, char** args) {
    AList* a = make_alist(4);
    add(a, 5);
    add(a, 3);
    add(a, 1);
    printf("%d\n", get(a, 0));
    printf("%d\n", get(a, 1));
    printf("%d\n", get(a, 2));

    print_alist(a);

}
```

How many times is `calloc()` called in the `make_string2` example?

A: 1 B: 2

How much space is allocated for characters with `calloc()` in total in the `make_string2` example?

A: 11 chars B: 12 chars C: 13 chars D: Something else

A

```
AList* make_alist(int start_capacity) {
    AList* alist = calloc(start_capacity, sizeof(AList));
    int* contents = calloc(1, sizeof(int));
    alist->contents = contents;
    alist->size = 0;
    alist->capacity = start_capacity;
    return alist;
}
```

B

```
AList* make_alist(int start_capacity) {
    AList* alist = calloc(1, sizeof(AList*));
    int* contents = calloc(start_capacity, sizeof(int*));
    alist->contents = contents;
    alist->size = 0;
    alist->capacity = start_capacity;
    return alist;
}
```

C

```
AList* make_alist(int start_capacity) {
    AList* alist = calloc(1, sizeof(AList*));
    int* contents = calloc(start_capacity, sizeof(int));
    alist->contents = contents;
    alist->size = 0;
    alist->capacity = start_capacity;
    return alist;
}
```

D

```
AList* make_alist(int start_capacity) {
    AList* alist = calloc(1, sizeof(AList));
    int* contents = calloc(start_capacity, sizeof(int));
    alist->contents = contents;
    alist->size = 0;
    alist->capacity = start_capacity;
    return alist;
}
```

```
void add(AList* alist, int element) {
    if(alist.size >= alist.capacity) { expandCapacity(alist); }
    alist[alist->size] = element;
    alist->size += 1;
}
```

```
void add(AList* alist, int element) {
    if(this.size >= this.capacity) { expandCapacity(); }
    alist[alist->size] = element;
    alist->size += 1;
}
```

```
void add(AList* alist, int element) {
    if(alist->size >= alist->capacity) { expandCapacity(alist); }
    alist->contents[alist->size] = element;
    alist->size += 1;
}
```

```
void add(AList* alist, int element) {
    if(alist->size >= alist->capacity) { expandCapacity(alist); }
    alist->contents[alist->size] = element;
    alist->size += 1;
}
```