CSc 352

C Programming
Arrays

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Arrays

In C, an array can be thought of as a pointer to a chunk of memory. More specifically, a chunk of memory that is sequential, with a size that is **N * T** where **N** is the number of slots in the array (length) and **T** is the size of the type of the array.

If **char = 1** byte and **int = 4** bytes, then:

```
// name is a ptr to 5 contiguous bytes
char name [5] = "zach";
// numbers is a ptr to 28 contiguous bytes
int numbers[7] = {1, 2, 3, 4, 5, 6, 7};
```

Arrays

```
// name is a “ptr” to 5 contiguous bytes
char name [5] = "zach";
// numbers is a “ptr” to 28 contiguous bytes
// if an int is 4 bytes
int numbers[7] = {1, 2, 3, 4, 5, 6, 7};
int * numbers_2 = numbers;

printf("%p %p %p\n", name, numbers, numbers_2);
printf("%ld %ld\n", sizeof(name), sizeof(numbers));
```

```c
int numbers[7] = {50, 100, 150, 200, 250, 200, 250};
// Code A
for (int i = 0 ; i < 7; i++) {
  printf("element %d is: %d\n", i, numbers[i]);
}
// Code B
for (int i = 0 ; i < 7; i++) {
  printf("element %d is: %d\n", i, *(numbers + i) );
}
// Code C
for (int i = 0 ; i < 7; i++) {
  printf("element %d is: %d\n", i, *numbers++ );
}
```

What is the difference between these codes?

Arrays

- Can do math on pointers!
- Especially useful when dealing with arrays, iterations, offsets

```
char x[4] = {'z', 'r', 't', 'v'};
long y[4] = {100, 200, 300, 400};
char * x2 = x + 1;
long * y2 = y + 2;
printf("%c and %ld", *x2, *y2);
```

```
char char_var = '\0';
int  int_var = 0;
long long_var = 0;
char * char_ptr = &char_var;
int  * int_ptr = &int_var;
long * long_ptr = &long_var;

long one, two;

one = (long) char_ptr; two = (long) (char_ptr+1);
printf("two minus one: %ld\n", two - one);

one = (long) int_ptr; two = (long) (int_ptr+1);
printf("two minus one: %ld\n", two - one);

one = (long) long_ptr; two = (long) (long_ptr+1);
printf("two minus one: %ld\n", two - one);
```

What will print?

```
int values[10] = {0, 50, 100, 150, 200,
                  250, 300, 350, 400, 450};
 int i = 0;
 while (i < 5) {
   int a = *(values+i) + *(values+9-i);
   printf("%d ", a);
   i += 1;
 }
 printf("\n");
```

What will print?

```c
void another (int array[]) {
  long size = sizeof(array);
  printf("size: %ld\n", size);
}

int main() {
  int values[10] = {0, 50, 100, 150, 200,
                    250, 300, 350, 400, 450};
  long size = sizeof(values);
  printf("size: %ld\n", size);
  another(values);
  return 0;
}
```

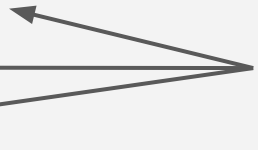
What will happen?

(without -Wall -Werror)

scanf and fgets with pointers

Remember lines such as these?

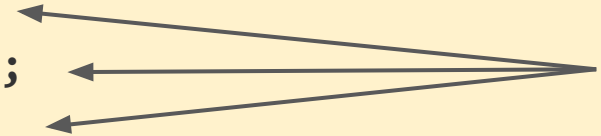
```
int x = 0;
char buffer[32];
fgets(buffer, 31, stdin)
scanf("%31s", buffer)
scanf("%d", &x)
```



Providing the fgets / scanf functions a *pointer* to the memory location to store the input value

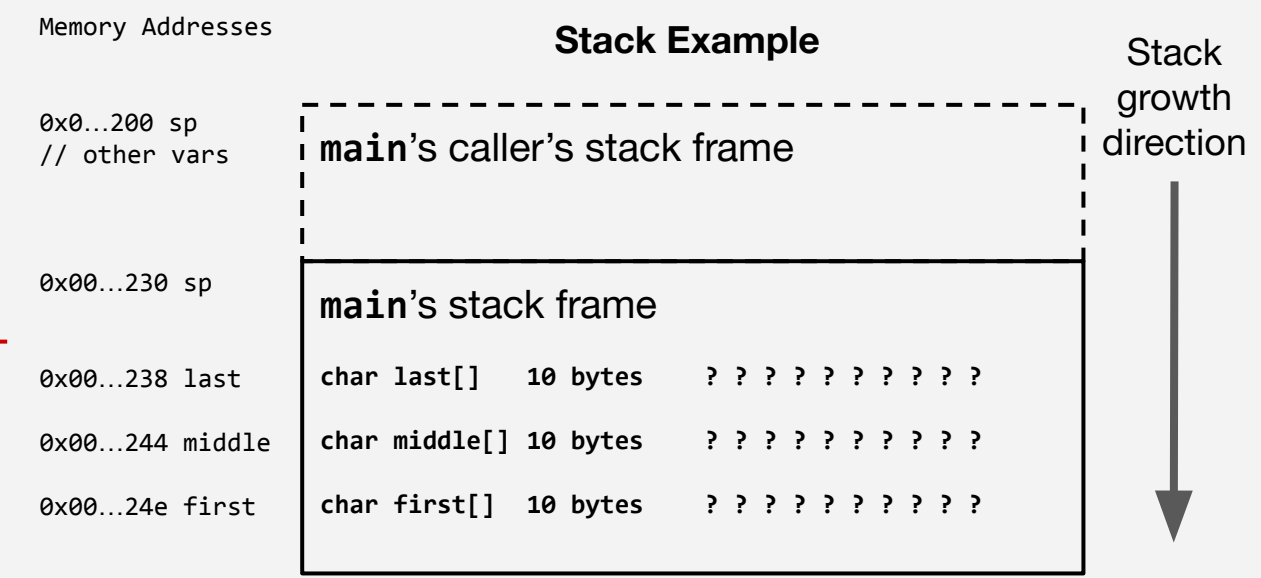
What is wrong with this code? What might happen?

```
char last[10];
char middle[10];
char first[10];
printf("first name:\n");
scanf("%s", first);
printf("middle name:\n");
scanf("%s", middle);
printf("last name:\n");
scanf("%s", last);
printf("%s %s %s", first, middle, last);
```

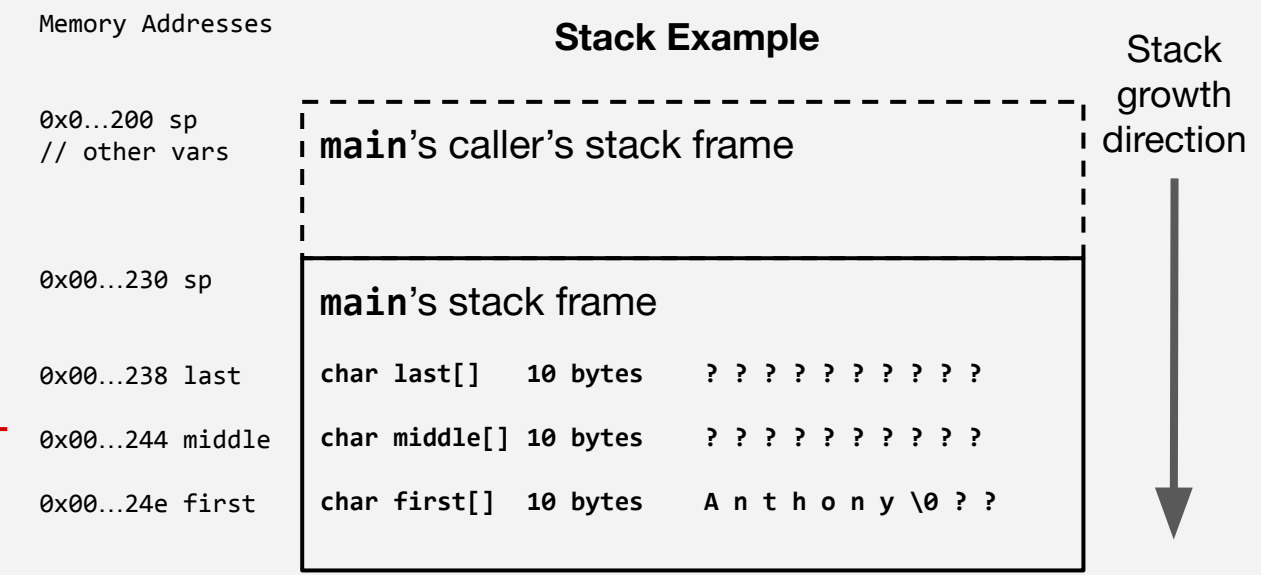


Assume that these three arrays are allocated in sequence in space on the stack (10 bytes, then the next 10, then the next 10)

```
void main() {
    char last[10];
    char middle[10];
    char first[10];
    printf("first name:\n");
    scanf("%s", first);
    printf("middle name:\n");
    scanf("%s", middle);
    printf("last name:\n");
    scanf("%s", last);
    printf("%s %s %s", first, middle, last);
   return 0;
}
```

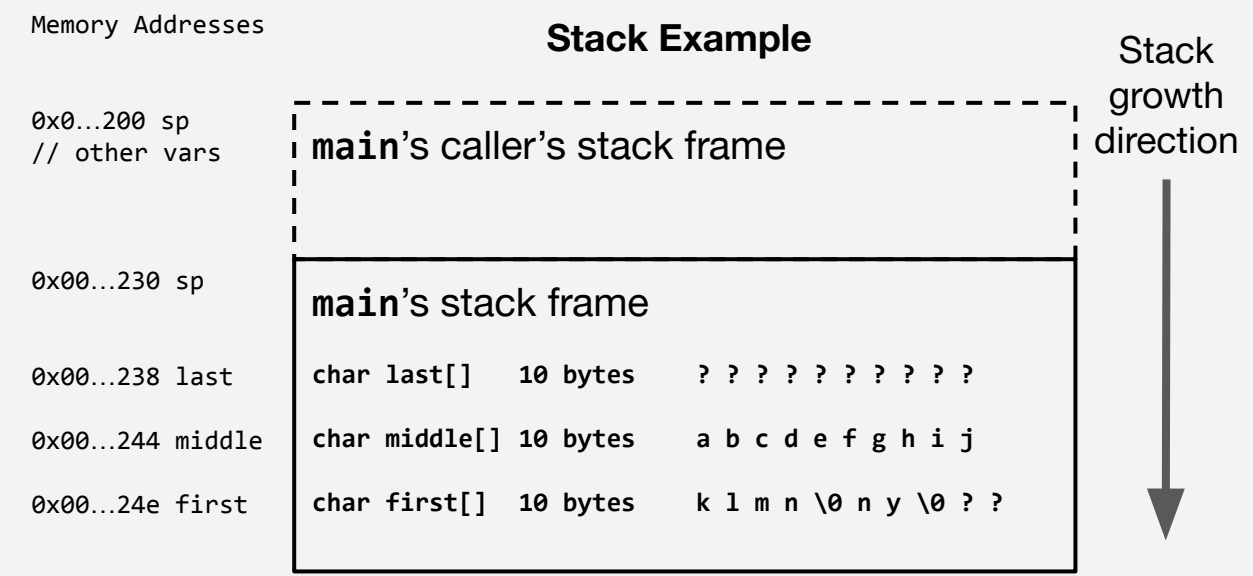


```c
void main() {
    char last[10];
    char middle[10];
    char first[10];
    printf("first name:\n");
    scanf("%s", first);
    printf("middle name:\n");
    scanf("%s", middle);
    printf("last name:\n");
    scanf("%s", last);
    printf("%s %s %s", first, middle, last);
   return 0;
}
```



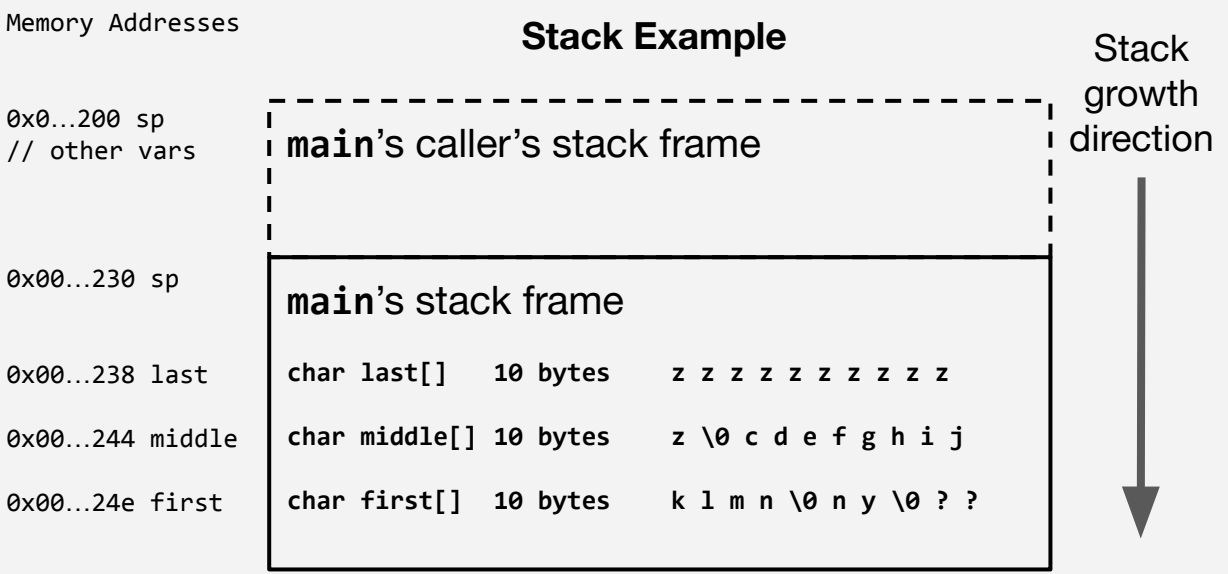
Input provided: **Anthony**

```c
void main() {
    char last[10];
    char middle[10];
    char first[10];
    printf("first name:\n");
    scanf("%s", first);
    printf("middle name:\n");
    scanf("%s", middle);
    printf("last name:\n");
    scanf("%s", last);
    printf("%s %s %s", first, middle, last);
   return 0;
}
```



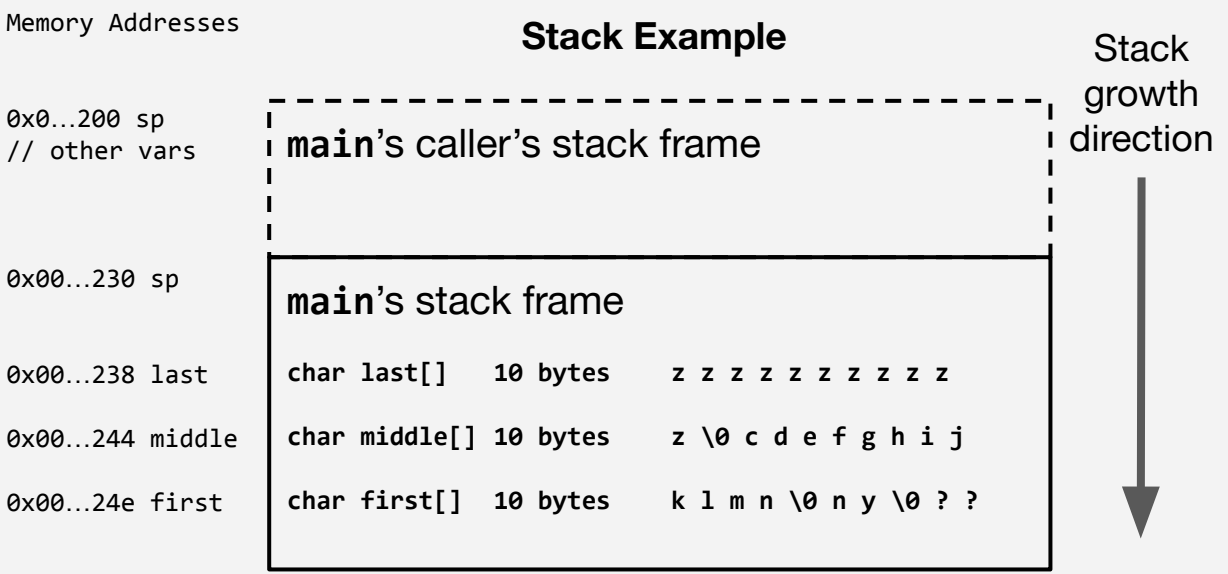
Input provided: **abcdefghijklmn**

```
void main() {
    char last[10];
    char middle[10];
    char first[10];
    printf("first name:\n");
    scanf("%s", first);
    printf("middle name:\n");
    scanf("%s", middle);
    printf("last name:\n");
    scanf("%s", last);
    printf("%s %s %s", first, middle, last);
   return 0;
}
```



Input provided: **zzzzzzzzzz**

```c
void main() {
    char last[10];
    char middle[10];
    char first[10];
    printf("first name:\n");
    scanf("%s", first);
    printf("middle name:\n");
    scanf("%s", middle);
    printf("last name:\n");
    scanf("%s", last);
    printf("%s %s %s", first, middle, last);
   return 0;
}
```



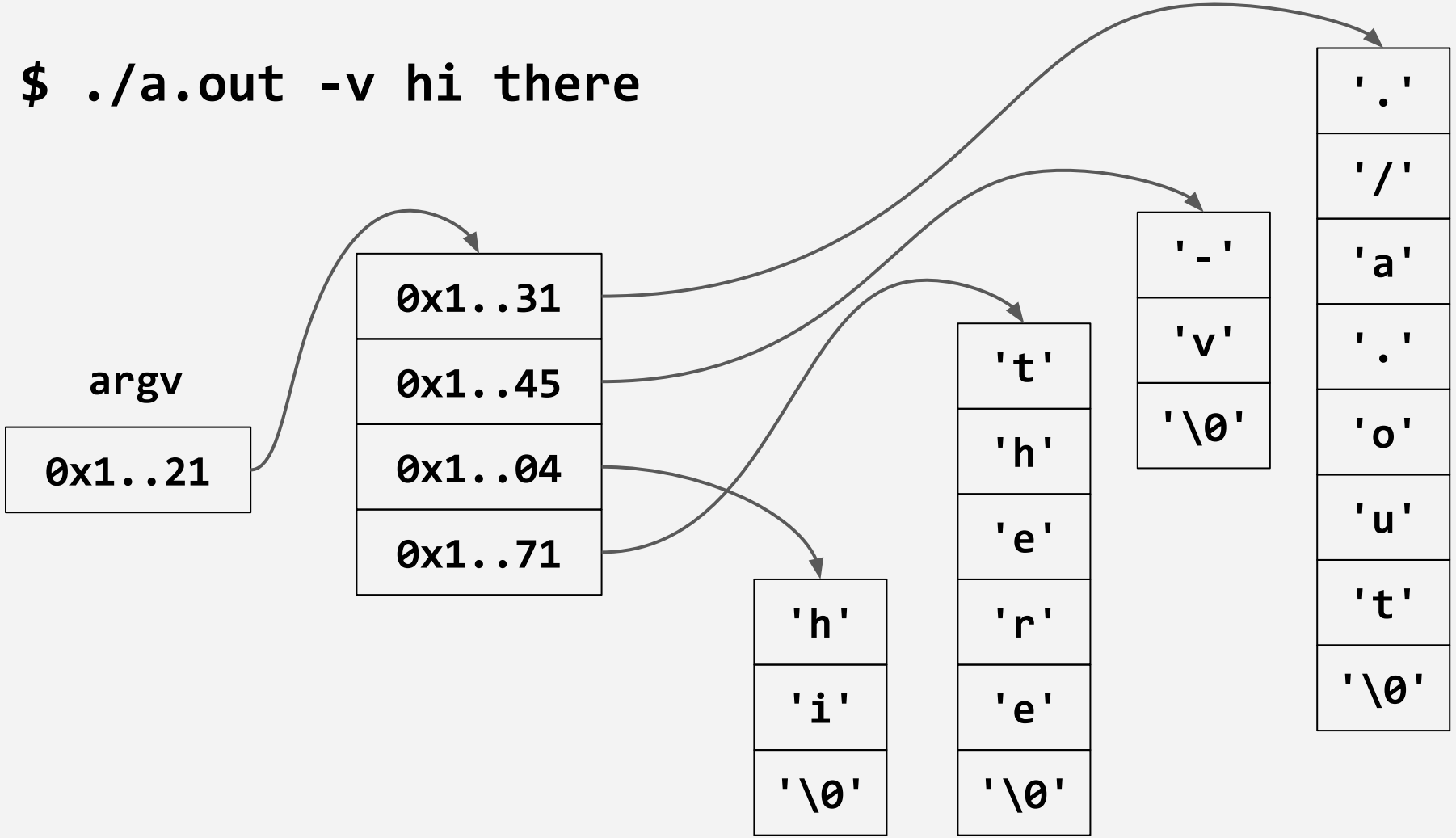
Prints: **`klmn z zzzzzzzzzz`**

The args array

```
int main() {
    . . . .
}
```

```
int main(int argc, char * argv[]) {
    . . . .
}
```

This can be thought of as:
“A pointer to an array of pointers, each of which points to a sequence of characters”


$ ./a.out -v hi there
argv
0x1..21
0x1..31
0x1..45
0x1..04
0x1..71
'h'
'i'
'\0'
't'
'h'
'e'
'r'
'e'
'\0'
'-'
'v'
'\0'
'.'
'/'
'a'
'.'
'o'
'u'
't'
'\0'