CS107, Lecture 5
More C Strings

Reading: K&R (1.6, 5.5, Appendix B3) or Essential
C section 3
Plan For Today

• Recap: String Operations
• Demo: Buffer Overflow and Valgrind
• Arrays of Strings
• Practice: Password Verification
• Pointers
• Announcements
• Strings in Memory
• Pointers to Strings
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C strings are arrays of characters, ending with a null-terminating character '\0'.

<table>
<thead>
<tr>
<th>index</th>
<th>value</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>'H'</td>
</tr>
<tr>
<td>1</td>
<td>'e'</td>
</tr>
<tr>
<td>2</td>
<td>'l'</td>
</tr>
<tr>
<td>3</td>
<td>'l'</td>
</tr>
<tr>
<td>4</td>
<td>'o'</td>
</tr>
<tr>
<td>5</td>
<td>','</td>
</tr>
<tr>
<td>6</td>
<td>'w'</td>
</tr>
<tr>
<td>7</td>
<td>'o'</td>
</tr>
<tr>
<td>8</td>
<td>'r'</td>
</tr>
<tr>
<td>9</td>
<td>'l'</td>
</tr>
<tr>
<td>10</td>
<td>'d'</td>
</tr>
<tr>
<td>11</td>
<td>'!'</td>
</tr>
<tr>
<td>12</td>
<td>'\0'</td>
</tr>
</tbody>
</table>

String operations use the null-terminating character to find the end of the string. E.g. `strlen` calculates string length by counting up the characters it sees before reaching a null-terminating character.
# Common string.h Functions

<table>
<thead>
<tr>
<th>Function</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>strlen(str)</code></td>
<td>returns the # of chars in a C string (before null-terminating character).</td>
</tr>
<tr>
<td><code>strcmp(str1, str2), strncmp(str1, str2, n)</code></td>
<td>compares two strings; returns 0 if identical, &lt;0 if <code>str1</code> comes before <code>str2</code> in alphabet, &gt;0 if <code>str1</code> comes after <code>str2</code> in alphabet. <code>strncmp</code> stops comparing after at most <code>n</code> characters.</td>
</tr>
<tr>
<td><code>strchr(str, ch)</code></td>
<td>character search: returns a pointer to the first occurrence of <code>ch</code> in <code>str</code>, or <code>NULL</code> if <code>ch</code> was not found in <code>str</code>. <code>strrchr</code> find the last occurrence.</td>
</tr>
<tr>
<td><code>strstr(haystack, needle)</code></td>
<td>string search: returns a pointer to the start of the first occurrence of <code>needle</code> in <code>haystack</code>, or <code>NULL</code> if <code>needle</code> was not found in <code>haystack</code>.</td>
</tr>
<tr>
<td><code>strcpy(dst, src),</code></td>
<td>copies characters in <code>src</code> to <code>dst</code>, including null-terminating character. Assumes enough space in <code>dst</code>. Strings must not overlap. <code>strncpy</code> stops after at most <code>n</code> chars, and does not add null-terminating char.</td>
</tr>
<tr>
<td><code>strcat(dst, src),</code></td>
<td>concatenate <code>src</code> onto the end of <code>dst</code>. <code>strncat</code> stops concatenating after at most <code>n</code> characters. Always adds a null-terminating character.</td>
</tr>
<tr>
<td><code>strspn(str, accept),</code></td>
<td><code>strspn</code> returns the length of the initial part of <code>str</code> which contains only characters in <code>accept</code>. <code>strcspn</code> returns the length of the initial part of <code>str</code> which does not contain any characters in <code>reject</code>.</td>
</tr>
<tr>
<td><code>strcspn(str, reject)</code></td>
<td></td>
</tr>
</tbody>
</table>
C Strings As Parameters

Regardless of how you created the string, when you pass a string as a parameter it is always passed as a `char *`. `char *` still lets you use bracket notation to access individual characters (*How? We’ll see later today!*).

```c
int doSomething(char *str) {
    char secondChar = str[1];
    ...
}
```

// can also write this, but it is really a pointer
int doSomething(char str[]) {
    ...
}
Buffer Overflows

• It is your responsibility to ensure that memory operations you perform don’t improperly read or write memory.
  • E.g. don’t copy a string into a space that is too small!
  • E.g. don’t ask for the string length of an uninitialized string!

• The Valgrind tool may be able to help track down memory-related issues.
  • See cs107.stanford.edu/resources/valgrind
  • We’ll talk about Valgrind more when we talk about dynamically-allocated memory.
Demo: Memory Errors
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Arrays of Strings

You can make an array of strings to group multiple strings together:

```c
char *stringArray[5]; // space to store 5 char *s
```

You can also use the following shorthand to initialize a string array:

```c
char *stringArray[] = {
    "my string 1",
    "my string 2",
    "my string 3"
};
```
Arrays of Strings

You can access each string using bracket syntax:

```c
printf("%s\n", stringArray[0]); // print out first string
```

When an array of strings is passed as a parameter, it is passed as a pointer to the first element of the string array. This is what `argv` is in `main`! This means you write the parameter type as:

```c
void myFunction(char **stringArray) {
// equivalent to this, but it is really a double pointer
void myFunction(char *stringArray[]) {
```
Write a function `verifyPassword` that accepts a candidate password and certain password criteria, and returns whether the password is valid.

```c
bool verifyPassword(char *password, char *validChars, char *badSubstrings[], int numBadSubstrings);
```

`password` is valid if it contains only letters in `validChars`, and does not contain any substrings in `badSubstrings`. 
void verifyPassword(char *password, char *validChars, char *badSubstrings[], int numBadSubstrings);

Example:

cchar *invalidSubstrings[] = { "1234" };  

bool valid = verifyPassword("1572", "0123456789", invalidSubstrings, 1);  // true
bool valid = verifyPassword("141234", "0123456789", invalidSubstrings, 1);  // false
Practice: Password Verification
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Pointers

• A *pointer* is a variable that stores a memory address.

• Because there is no pass-by-reference in C like in C++, pointers let us pass around the address of one instance of memory, instead of making many copies.

• One (8 byte) pointer can refer to any size memory location!

• Pointers are also essential for allocating memory on the heap, which we will cover later.

• Pointers also let us refer to memory generically, which we will cover later.
int x = 2;

// Make a pointer that stores the address of x.
// (& means "address of")
int *xPtr = &x;

// Dereference the pointer to get the data it points to.
// (*) means "dereference"
printf("%d", *xPtr);  // prints 2
A pointer is just a variable that stores a memory address!

```c
void myFunc(int *intPtr) {
    *intPtr = 3;
}

int main(int argc, char *argv[]) {
    int x = 2;
    myFunc(&x);
    printf("%d", x); // 3!
    ...
}
```
A pointer is just a variable that stores a memory address!

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}

int main(int argc, char *argv[]) {
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int main(int argc, char *argv[]) {
    int x = 2;
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    printf("%d", x); // 3!
    ...
}
```

<table>
<thead>
<tr>
<th>Address</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>0x105</td>
<td>2</td>
</tr>
</tbody>
</table>
A pointer is just a variable that stores a memory address!

```c
void myFunc(int *intPtr) {
    *intPtr = 3;
}

int main(int argc, char *argv[]) {
    int x = 2;
    myFunc(&x);
    printf("%d", x);  // 3!
    ...
}
```

![Address Value Table]

<table>
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</tr>
</thead>
<tbody>
<tr>
<td>...</td>
<td>...</td>
</tr>
<tr>
<td>x</td>
<td>0x105</td>
</tr>
<tr>
<td></td>
<td>2</td>
</tr>
</tbody>
</table>
A pointer is just a variable that stores a memory address!

```c
void myFunc(int *intPtr) {
    *intPtr = 3;
}

int main(int argc, char *argv[]) {
    int x = 2;
    myFunc(&x);
    printf("%d", x);  // 3!
    ...
}
```
A pointer is just a variable that stores a memory address!

```c
void myFunc(int *intPtr) {
    *intPtr = 3;
}

int main(int argc, char *argv[]) {
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A pointer is just a variable that stores a memory address!

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void myFunc(int *intPtr) {
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}

int main(int argc, char *argv[]) {
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A pointer is just a variable that stores a memory address!

```c
void myFunc(int *intPtr) {
    *intPtr = 3;
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int main(int argc, char *argv[]) {
    int x = 2;
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Pointers

A pointer is just a variable that stores a memory address!

```c
void myFunc(int *intPtr) {
    *intPtr = 3;
}

int main(int argc, char *argv[]) {
    int x = 2;
    myFunc(&x);
    printf("%d", x); // 3!
    ...
}
```

```
main()
<table>
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<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>x</td>
<td>0x105</td>
</tr>
<tr>
<td></td>
<td>3</td>
</tr>
</tbody>
</table>
```

...
Without pointers, we would make copies.

```c
void myFunc(int val) {
    val = 3;
}

int main(int argc, char *argv[]) {
    int x = 2;
    myFunc(x);
    printf("%d", x); // 2!
    ...
}
```
Without pointers, we would make copies.

```c
void myFunc(int val) {
    val = 3;
}

int main(int argc, char *argv[]) {
    int x = 2;
    myFunc(x);
    printf("%d", x);    // 2!
    ...
}
```
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```c
void myFunc(int val) {
    val = 3;
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int main(int argc, char *argv[]) {
    int x = 2;
    myFunc(x);
    printf("%d", x);  // 2!
    ...
}
```
Without pointers, we would make copies.

```c
void myFunc(int val) {
    val = 3;
}

int main(int argc, char *argv[]) {
    int x = 2;
    myFunc(x);
    printf("%d", x);  // 2!
    ...
}
```

---

**Address**

<table>
<thead>
<tr>
<th>Address</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>0x105</td>
<td>2</td>
</tr>
<tr>
<td>...</td>
<td></td>
</tr>
<tr>
<td>0xf0</td>
<td>2</td>
</tr>
<tr>
<td>...</td>
<td></td>
</tr>
</tbody>
</table>

---

**Stack**

`main()`

`myFunc()`

`myFunc()`

`main()`
Without pointers, we would make copies.

```c
void myFunc(int val) {
    val = 3;
}

int main(int argc, char *argv[]) {
    int x = 2;
    myFunc(x);
    printf("%d", x);    // 2!
    ...
}
```

**STACK**

<table>
<thead>
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</tr>
</thead>
<tbody>
<tr>
<td>...</td>
<td>...</td>
</tr>
<tr>
<td>x 0x105</td>
<td>2</td>
</tr>
<tr>
<td>...</td>
<td>...</td>
</tr>
<tr>
<td>val 0xf0</td>
<td>2</td>
</tr>
<tr>
<td>...</td>
<td>...</td>
</tr>
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</table>
Without pointers, we would make copies.

```c
void myFunc(int val) {
    val = 3;
}

int main(int argc, char *argv[]) {
    int x = 2;
    myFunc(x);
    printf("%d", x);     // 2!
    ...
}
```
Without pointers, we would make copies.

```c
void myFunc(int val) {
    val = 3;
}

int main(int argc, char *argv[]) {
    int x = 2;
    myFunc(x);
    printf("%d", x);  // 2!
    ...
}
```
Without pointers, we would make copies.

```c
void myFunc(int val) {
    val = 3;
}

int main(int argc, char *argv[]) {
    int x = 2;
    myFunc(x);
    printf("%d", x);    // 2!
    ...
}
```

<table>
<thead>
<tr>
<th>Address</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>main()</td>
<td>...</td>
</tr>
<tr>
<td>x</td>
<td>0x105</td>
</tr>
<tr>
<td></td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>...</td>
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</table>
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- Pointers

- **Announcements**
  - Strings in Memory
  - Pointers to Strings
Announcements

• Assignment 1 due Monday 1/21 11:59PM PST
  • Grace period until Wed. 1/23 11:59PM PST

• Lab 2: C strings practice

• Assignment 2 released at Assignment 1 due date
  • Due Mon. 1/28 11:59PM PST, grace period until Wed. 1/30 11:59PM PST
  • Programs using C strings
  • Style guide published on course website
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Character Arrays

When you declare an array of characters, contiguous memory is allocated on the stack to store the contents of the entire array.

```c
char str[6] = "apple";
```

The array variable (e.g. `str`) is not a pointer; it refers to the entire array contents. In fact, `sizeof` returns the size of the entire array!

```c
int arrayBytes = sizeof(str); // 6
```

(so then why do we need `strlen`? We’ll see soon!)

<table>
<thead>
<tr>
<th>Address</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>...</td>
<td>...</td>
</tr>
<tr>
<td>0x105</td>
<td>'0'</td>
</tr>
<tr>
<td>0x104</td>
<td>'e'</td>
</tr>
<tr>
<td>0x103</td>
<td>'l'</td>
</tr>
<tr>
<td>0x102</td>
<td>'p'</td>
</tr>
<tr>
<td>0x101</td>
<td>'p'</td>
</tr>
<tr>
<td>0x100</td>
<td>'a'</td>
</tr>
</tbody>
</table>

str
Character Arrays

An array variable refers to an entire block of memory. You cannot reassign an existing array to be equal to a new array.

```c
char str[6] = "apple";
char str2[8] = "apple 2";
str = str2;  // not allowed!
```

An array’s size cannot be changed once you create it; you must create another new array instead.
When you declare a char pointer equal to a string literal, the string literal is *not* stored on the stack. Instead, it’s stored in a special area of memory called the “Text segment”. You cannot modify memory in this segment.

```c
char *str = "hi";
```

The pointer variable (e.g. `str`) refers to the *address of the first character of the string in the text segment*. Since this variable is just a pointer, `sizeof` returns 8, no matter the total size of the string!

```c
int stringBytes = sizeof(str); // 8
```
A char * variable refers to a single character. You can reassign an existing char * pointer to be equal to another char * pointer.

```c
char *str = "apple";       // e.g. 0xff5
char *str2 = "apple 2";    // e.g. 0xfe2
str = str2;               // ok! Both store address 0xfe2
```
Arrays and Pointers

You can also make a pointer equal to an array; it will point to the first element in that array.

```c
int main(int argc, char *argv[]) {
    char str[6] = "apple";
    char *ptr = str;
    ...
}
```
Arrays and Pointers

You can also make a pointer equal to an array; it will point to the first element in that array.

```c
int main(int argc, char *argv[]) {
    char str[6] = "apple";
    char *ptr = str;

    // equivalent
    char *ptr = &str[0];

    // equivalent, but avoid
    char *ptr = &str;
    ...
}
```
When you do pointer arithmetic, you are adjusting the pointer by a certain *number of places* (e.g. characters).

```c
char *str = "apple"; // e.g. 0xff1
char *str2 = str + 1; // e.g. 0xff2
char *str3 = str + 3; // e.g. 0xff4

printf("%s", str); // apple
printf("%s", str2); // pple
printf("%s", str3); // le
```

<table>
<thead>
<tr>
<th>Address</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>0xff6</td>
<td>'\0'</td>
</tr>
<tr>
<td>0xff5</td>
<td>'e'</td>
</tr>
<tr>
<td>0xff4</td>
<td>'l'</td>
</tr>
<tr>
<td>0xff3</td>
<td>'p'</td>
</tr>
<tr>
<td>0xff2</td>
<td>'p'</td>
</tr>
<tr>
<td>0xff1</td>
<td>'a'</td>
</tr>
<tr>
<td></td>
<td>...</td>
</tr>
</tbody>
</table>
Pointer arithmetic does not add bytes. Instead, it adds the size of the type it points to.

// nums points to an int array
int *nums = ... // e.g. 0xfff1
int *nums2 = nums + 1; // e.g. 0xfff5
int *nums3 = nums + 3; // e.g. 0xfffd

printf("%d", *nums); // 52
printf("%d", *nums2); // 23
printf("%d", *nums3); // 34

STACK

<table>
<thead>
<tr>
<th>Address</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>0x1005</td>
<td>1</td>
</tr>
<tr>
<td>0x1001</td>
<td>16</td>
</tr>
<tr>
<td>0xffd</td>
<td>34</td>
</tr>
<tr>
<td>0xff9</td>
<td>12</td>
</tr>
<tr>
<td>0xff5</td>
<td>23</td>
</tr>
<tr>
<td>0xff1</td>
<td>52</td>
</tr>
<tr>
<td>...</td>
<td>...</td>
</tr>
</tbody>
</table>
When you use bracket notation with a pointer, you are actually performing pointer arithmetic and dereferencing:

```
char *str = "apple"; // e.g. 0xff1

// both of these add two places to str, // and then dereference to get the char there.
// E.g. get memory at 0xff3.
char thirdLetter = str[2];  // 'p'
char thirdLetter = *(str + 2);  // 'p'
```
Strings as Parameters

When you pass a `char *` string as a parameter, C makes a *copy* of the address stored in the `char *`, and passes it to the function. This means they both refer to the same memory location.

```c
void myFunc(char *myStr) {
    ...
}
```

```c
int main(int argc, char *argv[]) {
    char *str = "apple";
    myFunc(str);
    ...
}
```
When you pass a **char array** as a parameter, C makes a *copy of the address of the first array element*, and passes it (as a char *) to the function.

```c
void myFunc(char *myStr) {
    ...
}

int main(int argc, char *argv[]) {
    char str[6] = "apple";
    myFunc(str);
    ...
}
```
Strings as Parameters

When you pass a **char array** as a parameter, C makes a *copy of the address of the first array element*, and passes it (as a `char *`) to the function.

```c
void myFunc(char *myStr) {
    ...
}

int main(int argc, char *argv[]) {
    char str[6] = "apple";
    // equivalent
    char *arrPtr = str;
    myFunc(arrPtr);
    ...
}
```

![Address-Value Table](image)
Strings as Parameters

This means if you modify characters in `myFunc`, the changes will persist back in `main`!

```c
void myFunc(char *myStr) {
    myStr[4] = 'y';
}

int main(int argc, char *argv[]) {
    char str[6] = "apple";
    myFunc(str);
    printf("%s", str);  // apply ...
}
```

![Diagram showing memory addresses and values for variables str and myStr.]
Strings as Parameters

This means if you modify characters in `myFunc`, the changes will persist back in `main`!

```c
void myFunc(char *myStr) {
    myStr[4] = 'y';
}

int main(int argc, char *argv[]) {
    char str[6] = "apple";
    myFunc(str);
    printf("%s", str); // apply ...
}
```
This also means we can no longer get the full size of the array using `sizeof`, because now it is just a regular `char *` pointer.

```c
void myFunc(char *myStr) {
    int size = sizeof(myStr); // 8
}

int main(int argc, char *argv[]) {
    char str[6] = "apple";
    int size = sizeof(str); // 6
    myFunc(str);
    ...
}
```

### Address Value

<table>
<thead>
<tr>
<th>Address</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>0x100</td>
<td>'a'</td>
</tr>
<tr>
<td>0x101</td>
<td>'p'</td>
</tr>
<tr>
<td>0x102</td>
<td>'p'</td>
</tr>
<tr>
<td>0x103</td>
<td>'l'</td>
</tr>
<tr>
<td>0x104</td>
<td>'e'</td>
</tr>
<tr>
<td>0x105</td>
<td>'\0'</td>
</tr>
</tbody>
</table>

In the stack frame, `str` is stored at `0x100`. `myStr` is a pointer to the array `str`, so it is stored at `0xf`. The stack frame is shown with `main()`, `myFunc()`, and `...` indicating the continuation of the frame.
Strings and Memory

These memory behaviors explain why strings behave the way they do:

1. We can modify a string created as a `char[]` because its memory lives in our stack space.

2. We cannot modify a string created as a `char*` because its memory does not live in our stack space; it lives in the text segment.

3. We can set a `char*` equal to another value, because it is just a pointer.

4. We cannot set a `char[]` equal to another value, because it is not a pointer; it refers to the block of memory reserved for the original array.

5. If we change characters in a string passed to a function, these changes will persist outside of the function.

6. When we pass a char array as a parameter, we can no longer use `sizeof` to get its full size.
Demo: Strings and Memory
Plan For Today

• Recap: String Operations
• Demo: Buffer Overflow and Valgrind
• Arrays of Strings
• Practice: Password Verification
• Pointers
• Announcements
• Strings in Memory
• Pointers to Strings
Pointers to Strings

Sometimes, we would like to modify a string’s pointer itself, rather than just the characters it points to.

- Ex. Write a function `skipCSPrefix` that takes in a `char *` representing a class name, and modifies it to advance past the “CS” prefix, if any, in the string.

```c
char *myStr = "CS41";
skipCSPrefix(&myStr);
printf("%s\n", myStr); // 41
```
Pointers to Strings

void skipCSPrefix(char **strPtr) {
    char *prefix = strstr(*strPtr, "CS");
    if (prefix != NULL && prefix == *strPtr) {
        *strPtr += strlen("CS");
    }
}

int main(int argc, char *argv[]) {
    char *myStr = "CS41";
    skipCSPrefix(&myStr);
    printf("%s\n", myStr);  // 41
    return 0;
}

Address    Value
STACK main()          ...
...
void skipCSPrefix(char **strPtr) {
    char *prefix = strstr(*strPtr, "CS");
    if (prefix != NULL && prefix == *strPtr) {
        *strPtr += strlen("CS");
    }
}

int main(int argc, char *argv[]) {
    char *myStr = "CS41";
    skipCSPrefix(&myStr);
    printf("%s\n", myStr);  // 41
    return 0;
}
Pointers to Strings

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    char *prefix = strstr(*strPtr, "CS");
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int main(int argc, char *argv[]) {
    char *myStr = "CS41";
    skipCSPrefix(&myStr);
    printf("%s\n", myStr); // 41
    return 0;
}
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        *strPtr += strlen("CS");
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int main(int argc, char *argv[]) {
    char *myStr = "CS41";
    skipCSPrefix(&myStr);
    printf("%s\n", myStr); // 41
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int main(int argc, char *argv[]) {
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    printf("%s\n", myStr);  // 41
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        *strPtr += strlen("CS");
    }
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int main(int argc, char *argv[]) {
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    skipCSPrefix(&myStr);
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    char *prefix = strstr(*strPtr, "CS");
    if (prefix != NULL && prefix == *strPtr) {
        *strPtr += strlen("CS");
    }
}

int main(int argc, char *argv[]) {
    char *myStr = "CS41";
    skipCSPrefix(&myStr);
    printf("%s\n", myStr);  // 41
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}
### Pointers to Strings

```c
void skipCSPrefix(char **strPtr) {
    char *prefix = strstr(*strPtr, "CS");
    if (prefix != NULL && prefix == *strPtr) {
        *strPtr += strlen("CS");
    }
}

int main(int argc, char *argv[]) {
    char *myStr = "CS41";
    skipCSPrefix(&myStr);
    printf("%s\n", myStr);    // 41
    return 0;
}
```

<table>
<thead>
<tr>
<th>Address</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>0x105</td>
<td>myStr</td>
</tr>
<tr>
<td>0x11</td>
<td></td>
</tr>
<tr>
<td>0xf0</td>
<td></td>
</tr>
<tr>
<td>0xf</td>
<td></td>
</tr>
<tr>
<td>0x13</td>
<td>'\0'</td>
</tr>
<tr>
<td>0x12</td>
<td>'1'</td>
</tr>
<tr>
<td>0x11</td>
<td>'4'</td>
</tr>
<tr>
<td>0x10</td>
<td>'S'</td>
</tr>
<tr>
<td>0xf</td>
<td>'C'</td>
</tr>
</tbody>
</table>

The diagram shows the memory layout and the execution flow of the program. The `skipCSPrefix` function is called with a `char **` pointer, and it searches for the prefix "CS" in the string pointed to by `strPtr`. If found, it advances the pointer by the length of "CS". The `main` function initializes a string with "CS41", calls `skipCSPrefix`, and then prints the modified string "41".
void skipCSPrefix(char **strPtr) {
    char *prefix = strstr(*strPtr, "CS");
    if (prefix != NULL && prefix == *strPtr) {
        *strPtr += strlen("CS");
    }
}

int main(int argc, char *argv[]) {
    char *myStr = "CS41";
    skipCSPrefix(&myStr);
    printf("%s\n", myStr);  // 41
    return 0;
}
void skipCSPrefix(char **strPtr) {
    char *prefix = strstr(*strPtr, "CS");
    if (prefix != NULL && prefix == *strPtr) {
        *strPtr += strlen("CS");
    }
}

int main(int argc, char *argv[]) {
    char *myStr = "CS41";
    skipCSPrefix(&myStr);
    printf("%s\n", myStr);  // 41
    return 0;
}
Recap

- **Recap:** String Operations
- **Demo:** Buffer Overflow and Valgrind
- Arrays of Strings
- **Practice:** Password Verification
- Pointers
- **Announcements**
  - Strings in Memory
  - Pointers to Strings

**Next time:** Arrays and Pointers