

CSc 352

System Calls and Function Pointers

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System Calls

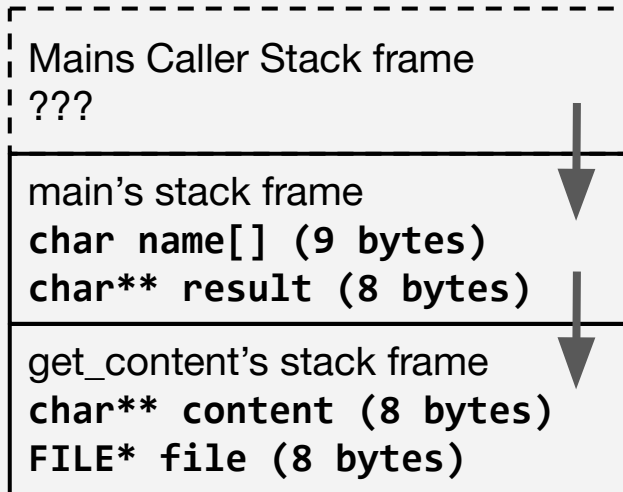
- There are some tasks that a “regular” user process does not have the privileges to do
 - Communicate with the hard drive / ssd
 - Communicating with the network hardware
 - Create a new process
- User programs can use **system calls** to request these things

The Stack

```
#include <stdio.h>

char** get_content(char* file_name) {
    char** content;
    FILE* file = fopen(file_name, "r");
    // Load file contents into content variable
    return content;
}

int main() {
    char name[] = "file.txt";
    char** result = get_content(name);
    // other stuff
    return 0;
}
```

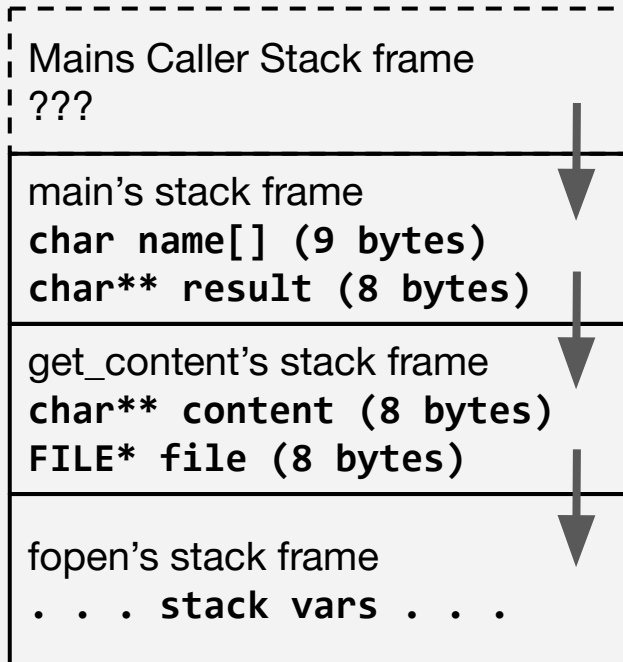


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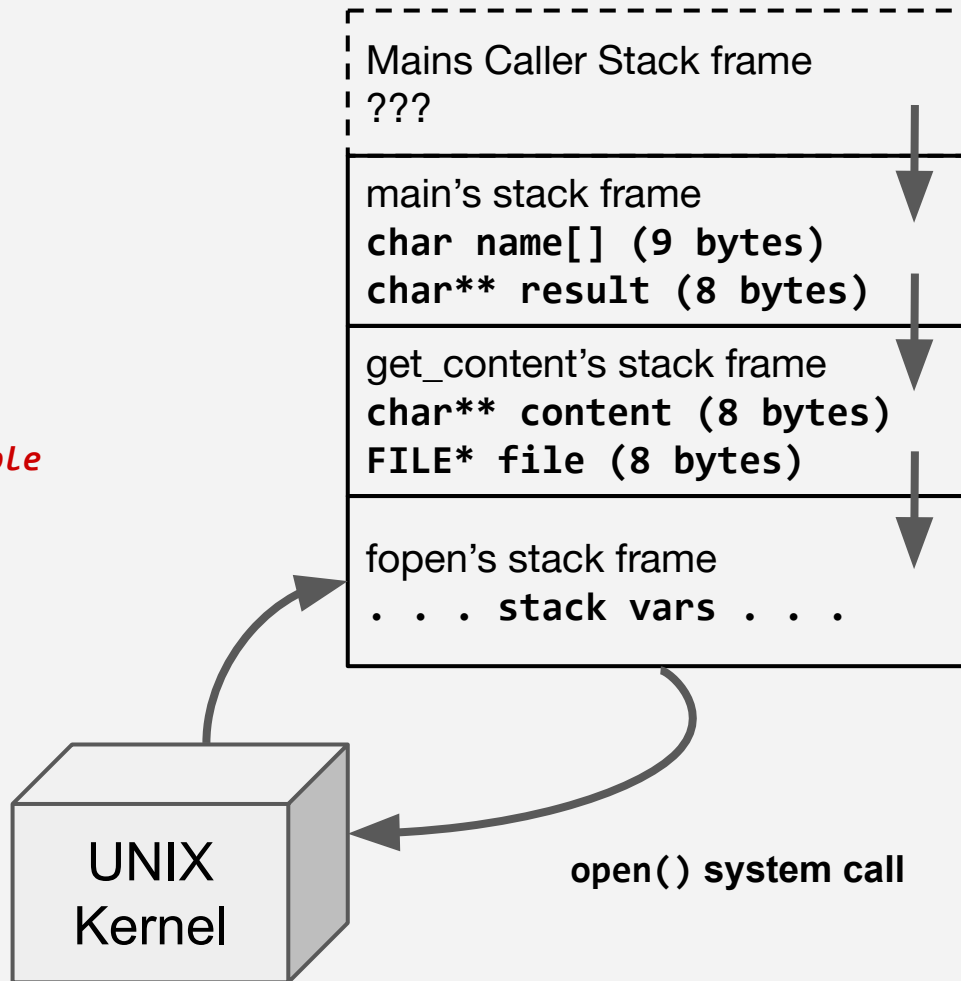


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System Calls

<https://www.cs.miami.edu/home/geoff/Courses/CSC521-04F/Content/UNIXProgramming/UNIXSystemCalls.shtml>

Many calls available

Generally, call these via library calls as intermediary / abstraction rather than directly

Library Functions Abstracting Sys Calls

- **fopen** is a standard library function, may invoke the **open** sys call
- **fscanf** is a standard library function, may invoke the **read** sys call
- **fclose** is a standard library function, may invoke the **close** sys call
- **printf** is a standard library function, may invoke the **write** sys call
-

Strace

the **strace** command can be used to see what system calls a process invokes

```
$ strace ./a.out 2> out
```

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

int main() {
    char buffer[256];
    FILE* test_file = fopen("test.txt", "r");
    while (fgets(buffer, 255, test_file) != NULL) {
        printf("LINE: %s\n", buffer);
    }
    fclose(test_file);
    return 0;
}
```


Strace

Go to your home directory

Use **strace** and determine what system call is used the most if you run `ls`

Function Pointers

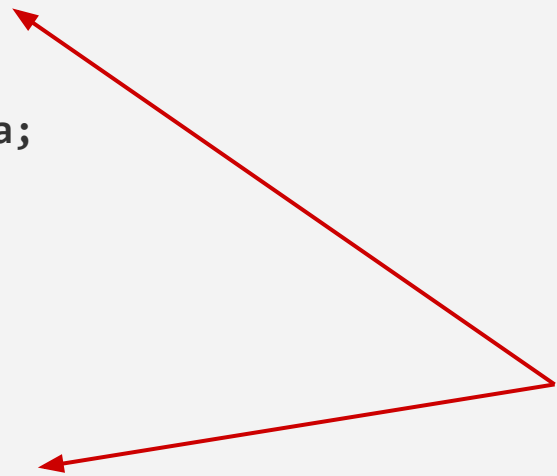
- Can call functions by their pointer (address), rather than by name
- Can store pointers to functions in variables!

Two Functions

```
int summation(int a) {  
    int result = 0;  
    while(a > 0) {  
        result = result + a;  
        a--;  
    }  
    return result;  
}
```

```
int factorial(int a) {  
    int result = 1;  
    while(a > 0) {  
        result = result * a;  
        a--;  
    }  
    return result;  
}
```

**Same return value,
same number of
parameters and
parameter types**



Function Pointers

```
int main(int argc, char** argv) {  
    int result = 0;  
    int (*action)(int);  
    int value = 5;  
  
    action = factorial;  
    if (argc >= 2 && argv[1][0] == 's') {  
        action = summation;  
    }  
  
    result = (*action)(value);  
    printf("%d\n", result);  
  
    return 0;  
}
```

**This is a function
pointer variable**

**Assigning a function
pointer variable**

**Call function via
pointer**

Object-Oriented

- In OO languages such as Python and Java, we can
 - Create classes, that define both **variables** and **functions**
 - Instantiates instances of classes (objects)
 - Call functions via an object with dot syntax

```
Car x = new Car();  
x.honkHorn();
```
 - Can avoid directly accessing the variables, use getters and setters, etc

Object-Oriented

```
public class Car {  
    private String color;  
    private String horn_sound;  
    private int horse_power;  
    private double latitude;  
    private double longitude;  
  
    public Car() { . . . }  
  
    public void honkHorn() { . . . }  
    public void showColor() { . . . }  
    public void move (double lat, double lng) { . . . }  
}
```

```
public static void main(String[] args) {  
    Car x = new Car();  
    x.honkHorn();  
}
```

Object-Oriented

Can we do something similar in C?

Object-Oriented

Can we do something similar in C?

Yes (but it's a bit uglier :)

Define a Struct with Functions

```
typedef struct Car {  
    char* color;  
    char* horn_sound;  
    int horse_power;  
    double latitude;  
    double longitude;  
    void (*honk_horn)(struct Car* this);  
    void (*show_color)(struct Car* this);  
    void (*move)(struct Car* this, double lat, double lng);  
} Car;
```

← “member variables”

← “methods”

Define the functions

```
void honk_horn(struct Car* this) {  
    if (this->horn_sound == NULL) {  
        printf("honk!\n");  
    } else {  
        printf("%s\n", this->horn_sound);  
    }  
}
```

```
void show_color(struct Car* this) {  
    if (this->color == NULL) {  
        printf("red\n");  
    } else {  
        printf("%s\n", this->color);  
    }  
}
```

```
void move(struct Car* this, double lat, double lng) {  
    this->latitude = lat;  
    this->longitude = lng;  
}
```

```
#define NEW_CAR(hp, lat, lng) \  
  (Car) {          \  
    NULL, NULL,   \  
    hp, lat, lng, \  
    honk_horn,    \  
    show_color,   \  
    move          \  
  };
```

Define a
“constructor”
with CPP

Use it!

```
int main(int argc, char** argv) {  
  
    Car plain = NEW_CAR(200, 0, 0);  
  
    plain.show_color(&plain);  
    plain.honk_horn(&plain);  
    plain.move(&plain, 1.0, 2.0);  
  
    return 0;  
}
```