CSc 352

C Programming
Arguments, Functions, Boolean

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Announcements

- Expect some changes to the readings / schedule
- Don’t forget: 3 dropped pop quizzes
- PA 3
- Test your programs thoroughly, and don’t rely too heavily on gradescope

`int x;` versus `int x = 0;`

Command line args

- Recall: Many programs can have ***command-line arguments***
- Common way to enable/disable settings, send information, give file names to a process that you want to start
- Three types

Flag

A boolean option that begins with a dash (enable/disable feature)

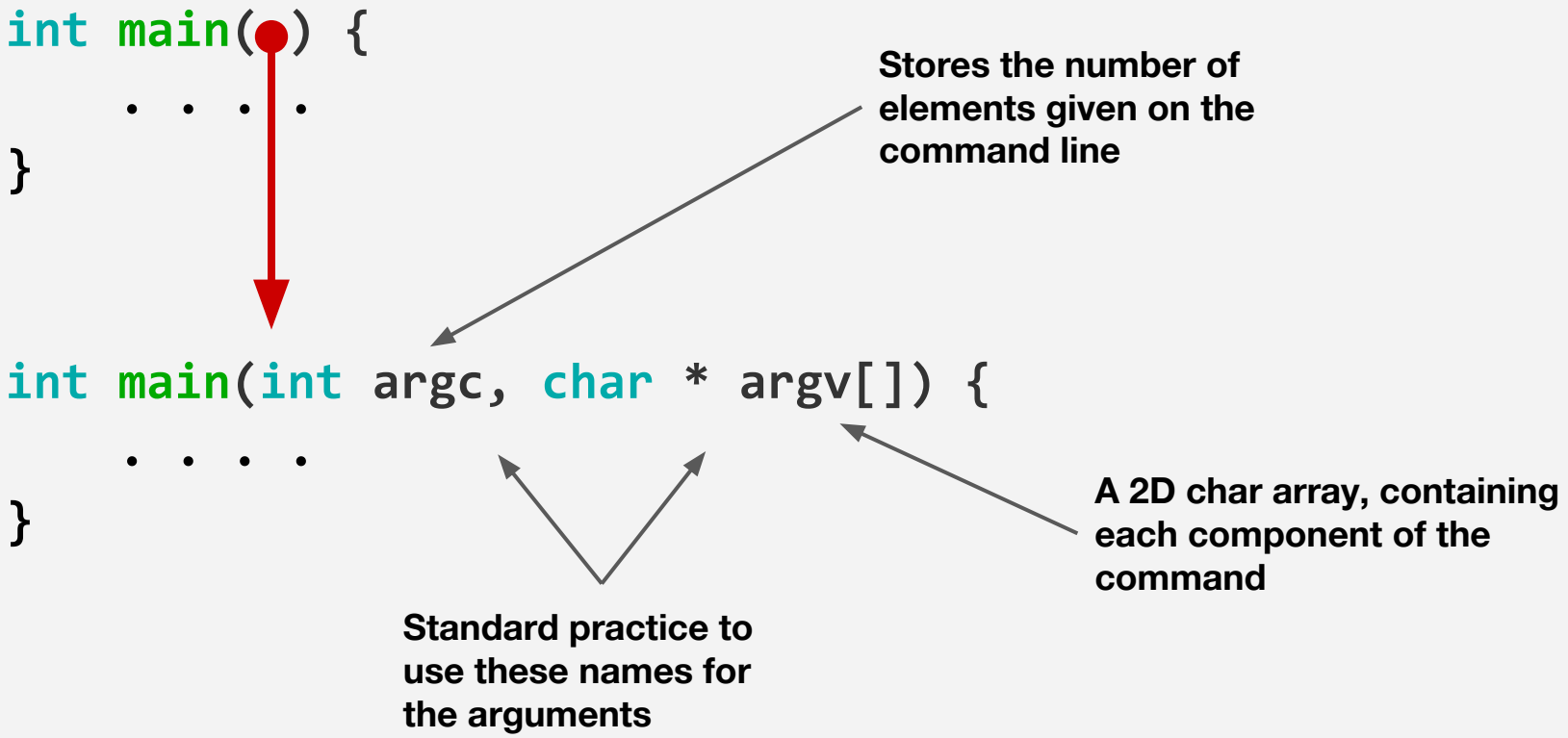
Named argument

A flag, with a value following

Positional argument

An argument with no flag

How to “get” these in a C program?



What will this print?

```c
#include <stdio.h>

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

  for (int i = 0; i < argc; i++) {
    printf("element %d: %s\n", i, argv[i]);
  }

  return 0;
}
```

```
$ ./a.out -v hi there
```

```c
#include <stdio.h>
#include <stdbool.h>
#include <string.h>
int main(int argc, char * argv[]) {
  bool help_enabled = false, case_enabled = false;
  for (int i = 0; i < argc; i++) {
    if (strcmp(argv[i], "-h") == 0) {
      help_enabled = true;
    } else if (strcmp(argv[i], "-c") == 0) {
      case_enabled = true;
    }
  }
  if (help_enabled) {
    printf("A help message\n");
    return 0;
  }
  if (case_enabled) {
    // run some code
  }
  // The rest of your main function....
  return 0;
}
```

How to implement a flag argument in C

```c
#include <stdio.h>
#include <stdbool.h>
#include <string.h>
int main(int argc, char * argv[]) {
  bool help_enabled = false, case_enabled = false;
  for (int i = 0; i < argc; i++) {
    if (strcmp(argv[i], "-h") == 0) {
      help_enabled = true;
    } else if (strcmp(argv[i], "-c") == 0) {
      case_enabled = true;
    }
  }
  if (help_enabled) {
    printf("A help message\n");
    return 0;
  }
  if (case_enabled) {
    // run some code
  }
  // The rest of your main function....
  return 0;
}
```

What's the deal with these files that end in .h?

C11 does support a bool type, *if* you use stdbool.h

What is strcmp? How do I know which functions I can and should use?

Functions

- The basic premise of function declaration, definition, calling, etc is similar to Java and Python
- Will discuss today - some nuances to understand here
- There are no *methods* in C, but there are a bunch of functions a part of the ***C Standard Library*** that we can leverage
- Let’s look at defining our own functions, then investigate the standard library

```c
#include <stdio.h>

int greater(int a, int b) {
  if (a > b) { return a; }
  return b;
}

void custom_printf(char text[]) {
  printf("LOOK! %s\n", text);
}

int main(int argc, char * argv[]) {
  int z = greater(250, 300);
  printf("%d\n", z);
  custom_printf("output");
  return 0;
}
```

A program with multiple functions

```c
#include <stdio.h>

int main(int argc, char * argv[]) {
  int z = greater(250, 300);
  printf("%d\n", z);
  custom_printf("output");
  return 0;
}

int greater(int a, int b) {
  if (a > b) { return a; }
  return b;
}

void custom_printf(char text[]) {
  printf("LOOK! %s\n", text);
}
```

What does this do?

```c
#include <stdio.h>

int greater(int a, int b);
void custom_printf(char text[]);

int main(int argc, char * argv[]) {
  int z = greater(250, 300);
  printf("%d\n", z);
  custom_printf("output");
  return 0;
}

int greater(int a, int b) {
  if (a > b) { return a; }
  return b;
}

void custom_printf(char text[]) {
  printf("LOOK! %s\n", text);
}
```

Can solve with a function prototype

Activity

```c
#include <stdio.h>

char[] get_a_string() {
  char content[50];
  printf("Please enter a string:\n");
  scanf("%49s", content);
  return content;
}

int main(int argc, char * argv[]) {
  char[] input;
  input = get_a_string();
  printf("characters: %s\n", input);
  return 0;
}
```

What will this print out?

```c
#include <stdio.h>

char[] get_a_string() {
  char content[50];
  printf("Please enter a string:\n");
  scanf("%49s", content);
  return content;
}

int main(int argc, char * argv[]) {
  char[] input;
  input = get_a_string();
  printf("characters: %s\n", input);
  return 0;
}
```

You cannot just return a char[ ] from a function

You *can* do something similar if you use pointers a memory allocation, which we have not gotten to yet

```
test.c:3:5: error: expected identifier or ‘(’ before ‘[’ token
    3 | char[] get_a_string() {
      |
```

C standard library header files

- A library that you can assume should be installed and available on a UNIX system that supports C (most systems!)
- https://en.wikipedia.org/wiki/C_standard_library#Header_files

Where are these files?
What do they look like?

```
$ locate stdbool.h

$ echo '#include <stdbool.h>' | cpp -H -o /dev/null 2>&1 | head -n1
```

https://stackoverflow.com/questions/13079650/how-can-i-find-the-header-files-of-the-c-programming-language-in-linux

Boolean Type

- As you can see, booleans work in C11
- . . . . but NOT as a built-in part of the language syntax, as something that must be included from the standard library
- You are allowed to use though

Where is it?

Where does the compiler get **limits.h** from. . . .

1. On lectura?
2. On your computer? (if applicable)

.h and .c files

- For large code projects in C, code is organized into .c and .h files
  - ***Dot C*** files: Where the ***implementation*** live
  - ***Dot H*** files: Where the ***declarations / prototypes*** live
- For libraries, put the code in .h and the function prototypes in .h
- In one of the future PAs you'll be tasked with writing a library as a part of it

printing.h

```c
/**
 * print an integer
 */
void print_int(int x);

/**
 * print an float
 */
void print_float(float x);
. . . .
```

printing.c

```c
#include "printing.h"

void print_int(int x) {
  printf("%d\n", x);
}

void print_float(float x) {
  printf("%f\n", x);
}
. . . .
```

```
$  gcc -Wall -Werror -std=c11 -c printing.c
$  gcc -Wall -Werror -std=c11 -o test test.c printing.o
```

Recursion

- Recursion works in C too
- Keep in mind the stack
- In the future, we will do some diagramming of the stack (and heap!) but that is for another time

Number of Coins

Write a program that:

- Accepts an amount of USD cents as a command-line positional arg
- Computes the min number of coins (pennies, nickels, dimes, quarters) needed to represent this amount
- ***NO loops***

```
$ ./a.out 15
Minimum coins needed: 2
$ ./a.out 51
Minimum coins needed: 3
$ ./a.out 104
Minimum coins needed: 8
$ ./a.out 2
Minimum coins needed: 2
```

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

int change(int amount) {
  // Base cases
  if (amount == 1 || amount == 5 || amount == 10 || amount == 25) {
    return 1;
  }
  if (amount > 25) {
    return 1 + change(amount - 25); // Quarter
  } else if (amount > 10) {
    return 1 + change(amount - 10); // Dime
  } else if (amount > 5) {
    return 1 + change(amount - 5); // Nickel
  } else {
    return 1 + change(amount - 1); // Penny
  }
}

int main(int argc, char** argv) {
  int x = atoi(argv[1]);
  int number_of_coins = change(x);
  printf("Minimum coins needed: %d\n", number_of_coins);
  return 0;
}
```

Topics to cover

- Function calls
  - ~~prototypes~~
  - ~~.h and .c~~
  - ~~The standard library~~
  - ~~Recursion~~
  - The stack, *basic* ELF layout
- ~~Cmd line arguments~~
- ~~Booleans~~
- Pass
- Statements, Expressions, Side-effects, r-values / l-values
- Arrays