MP1 Overview Session

CS 240 - The University of Illinois

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Goals

In this MP, you will get comfortable with programming in C and learn how to:

- work with strings, memory allocation, pointers
- create data structures
- read files
- manipulate data at the bit- and byte-level

Programming in C

Memory Allocation in C

- *void* malloc (size_t size)* - allocate heap memory
- *void* calloc (size_t num, size_t size)* - allocate heap memory and initialize all bits to zero
- *sizeof()* - return the size of the object or the type
  - E.g. *sizeof(char) == 1*
- *void free (void* ptr)* - deallocate previously allocated memory

String in C

A string in C is a sequence of characters with a terminating null byte

- There is no string type in C (*string s;* ❌)
- A C-string is represented by a character pointer
  - *char s[3] = “HI”;*

H	*I*	*\0*

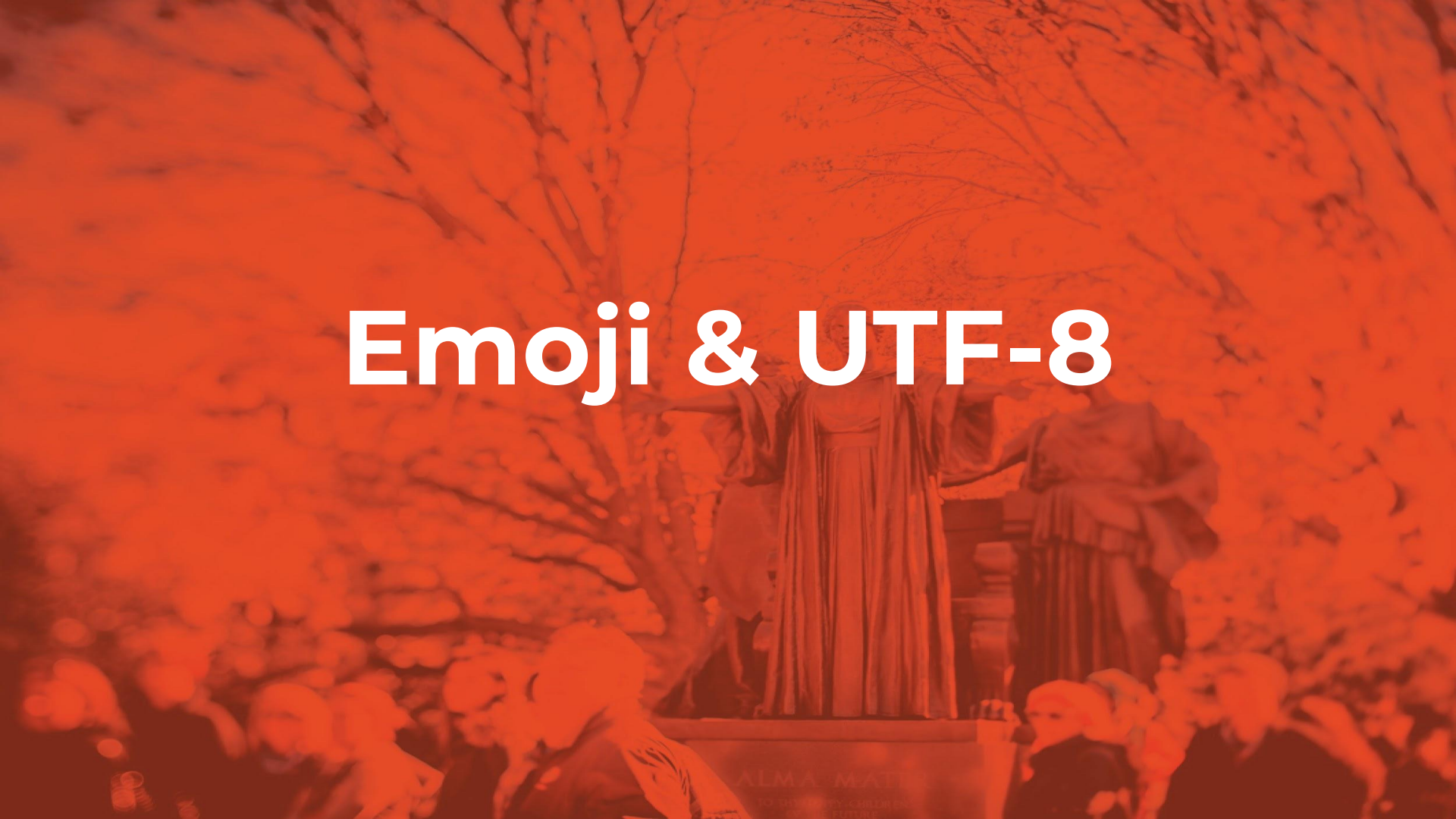
- Useful functions: *strlen*, *strcpy / strncpy*, *strcmp / strncmp*, *strcat / strncat*

Working with File in C

Useful functions:

- *fopen*, *fclose* - open/close a file
- *fread*, *fwrite* - read from/write to file
- *fseek* - set the position of the file pointer
- *ftell* - return the current position of the file pointer

Remember to check for errors!



Emoji & UTF-8

UTF-8

- Unicode Transformation Format
- Variable-length character encoding
- Encode character using 1 - 4 bytes
- Can encode a lot more characters than ASCII
- In this MP, you will work with UTF-8 encoded string and manipulate data at byte-level

Emoji

In UTF-8, an emoji is encoded using either 3 bytes (*U+203C* - *U+3299*) or 4 bytes (*U+1F000* - *U+1FAFF*)

For this MP, we will only consider emojis in the inclusive range of *U+1F000* to *U+1FAFF*

For example, 💙 (U+*1F499*) has the byte sequence *0xF0 0x9F 0x92 0x99*

MP - Part 1

Simple Emoji Functions

Implement six functions in *emoji.c*:

- *emoji_favorite* - return your favorite emoji
  - “💙”
  - “*\u1F499*”
  - “*\xF0\x9F\x92\x99*”

Simple Emoji Functions

Implement six functions in *emoji.c*:

- *emoji_count* - count the number of emojis in a UTF-8 string

Simple Emoji Functions

Implement six functions in *emoji.c*:

- *emoji_random_alloc* - generate a random emoji
  - rand() for generating random number
  - allocate heap memory for the emoji
  - make sure to return a valid C-string

Simple Emoji Functions

Implement six functions in *emoji.c*:

- *emoji_invertChar* - invert an emoji
  - invert only the first character in the string
  - invert 😊 to some sad face
  - invert five more emojis of your choice

Simple Emoji Functions

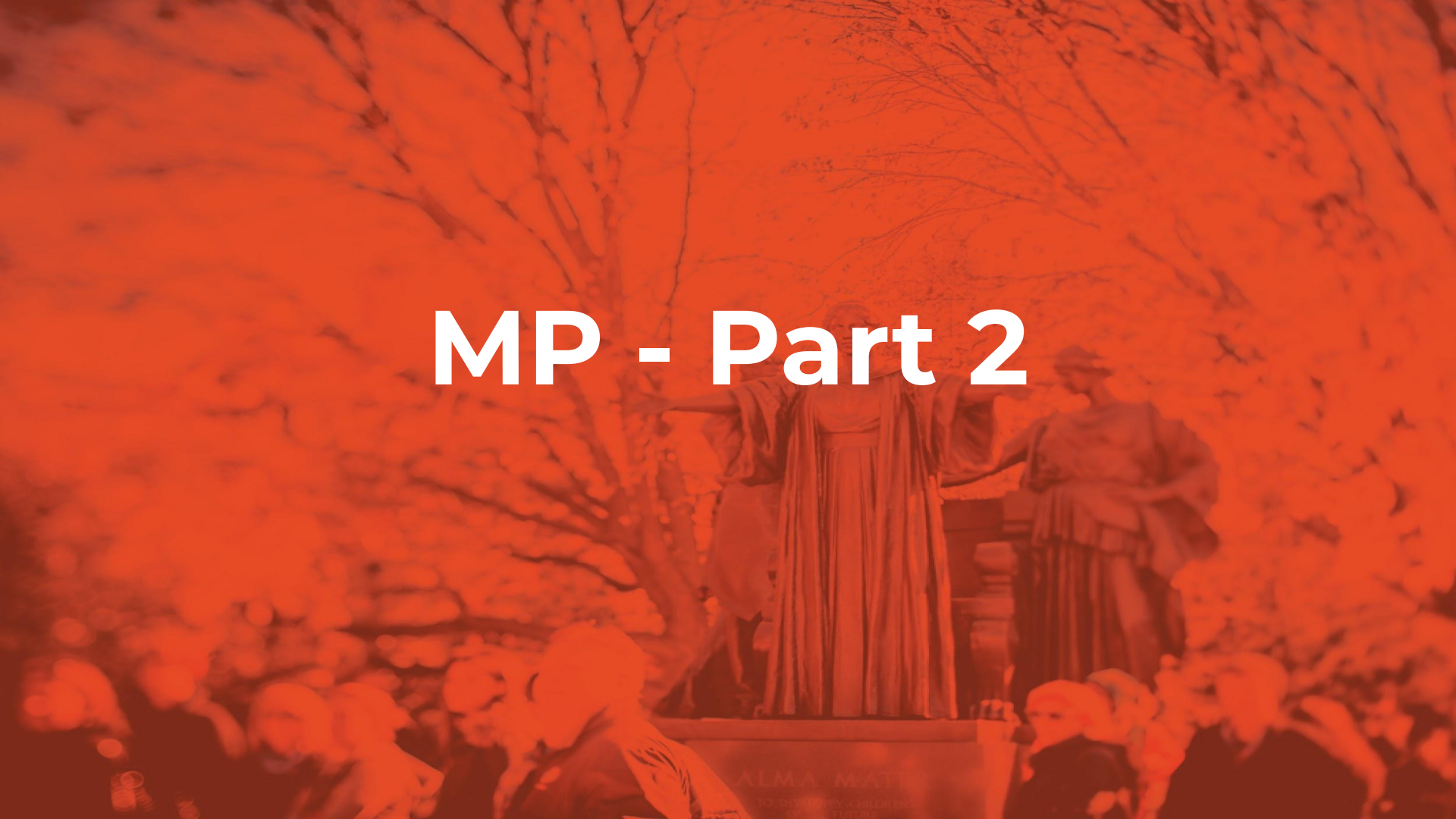
Implement six functions in *emoji.c*:

- *emoji_invertAll* - invert all the emojis in a string using *emoji_invertChar*

Simple Emoji Functions

Implement six functions in *emoji.c*:

- *emoji_invertFile_alloc* - read the contents of a file, invert all the emojis, and return the inverted string



MP - Part 2

An Emoji Translator

Implement four functions in *emoji-translate.c*:

- *emoji_init* - initialize an *emoji_t* object
  - add any member variables an *emoji_t* object might have in *emoji-translate.h*

An Emoji Translator

Implement four functions in *emoji-translate.c*:

- *emoji_add_translation* - add a translation to the *emoji_t* object
  - E.g. “😊” → “happy”

An Emoji Translator

Implement four functions in *emoji-translate.c*:

- *emoji_translate_file_alloc* - translate the content of a file using all the translation rules added so far
  - when multiple rules match, choose the one with the longest emoji string
  - E.g. “😊😊” → “very happy” >> “😊” → “happy”

An Emoji Translator

Implement four functions in *emoji-translate.c*:

- *emoji_destroy* - destroy an *emoji_t* object and deallocate any memory associated with the object

An Emoji Translator

Example Usage

```
emoji_t emoji;
emoji_init(&emoji);

emoji_add_translation(&emoji, "❤️", "heart");

// The file on disk contains: "I ❤️💙 Illinois!"
unsigned char *translation = emoji_translate_file_alloc(&emoji, "tests/txt/simple.txt");

// Translation Output: "I heart💙 Illinois!"
printf("%s\n");

emoji_destroy(&emoji);
```

Memory Correctness

Your code need to run “valgrind clean”:

- Zero memory error, no memory leak
- *free()* any memory allocated with *malloc/calloc*
- *fclose()* any file opened with *fopen*