Memory and C Programming

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What is Memory?

What is Memory?

- I can’t recall…

I remember now:

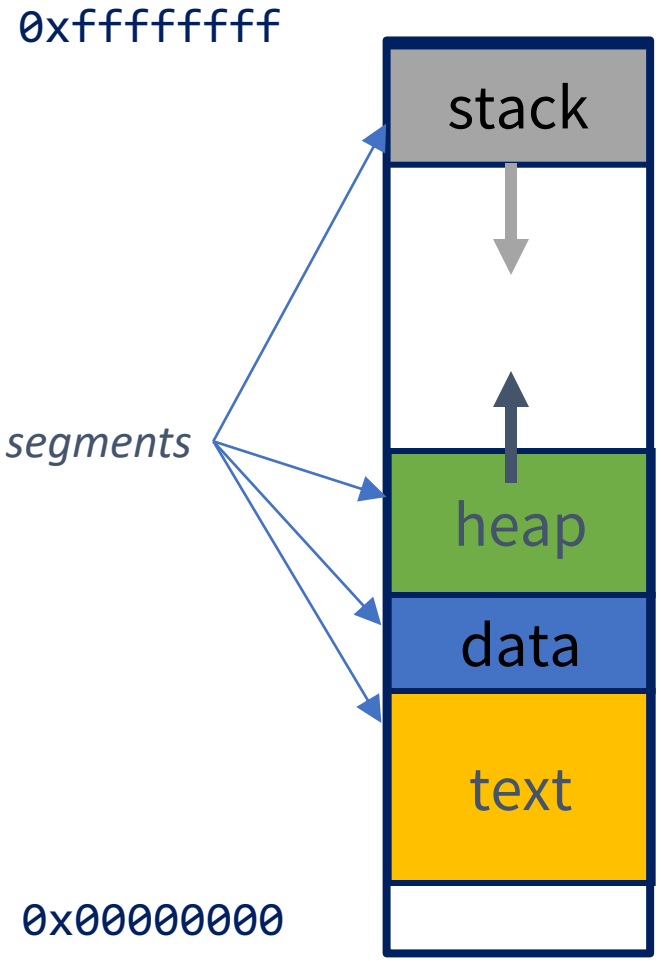
- Memory is an array of bytes
- An index into this array is called an ”address”
- A variable holding an address is called a “pointer”

Types of memory

- Code: machine instructions (read-only)
- Read-only data (string constants etc.)
- Global variables
- Heap: dynamically allocated memory
- Stack

You can store your data in global variables, on the heap, or on the stack

Logical view of process memory



call stack

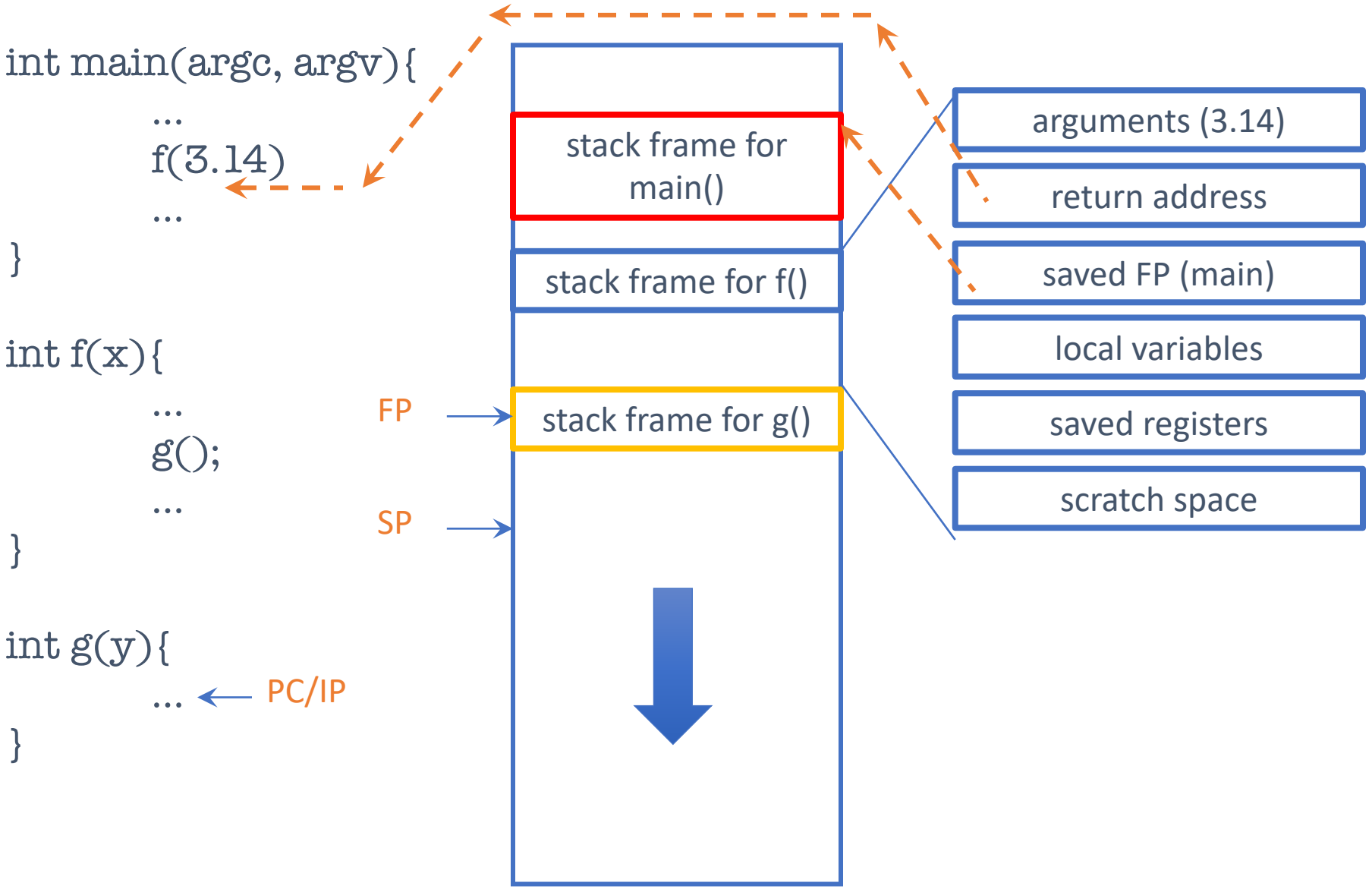
heap used for memory allocation (malloc)

data segment contains global variables

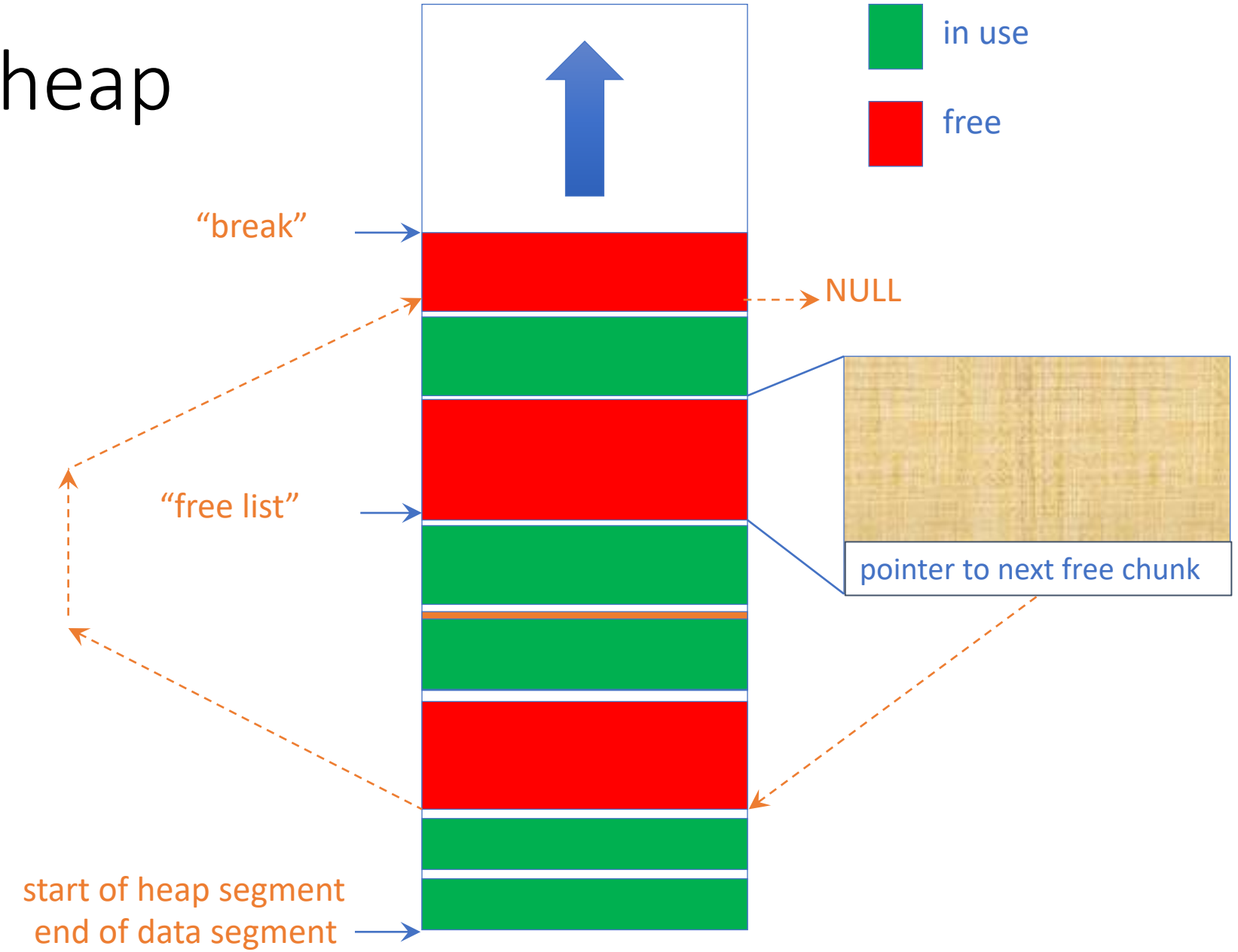
read-only text segment contains code and constants

How many bits in an address for this CPU?
Why is address 0 not mapped?

Review: stack (aka call stack)



Review: heap


in use
free
"break"
NULL
"free list"
pointer to next free chunk
start of heap segment
end of data segment

Three types of data memory

	Global	Heap	Stack
allocated	at start of process	using malloc()	at start of function call
initial state	as specified or 0 otherwise	junk	as specified or junk otherwise
released	at end of process	using free()	at end of function call

C Programming

- Like Java programming, but
  - no garbage collection
  - no type safety
  - no object-orientation, polymorphism, container types, …
- Instead:
  - ”structs”
  - pointers
  - malloc/free

Hello World

```
int main()
{
        printf(“Hello World\n”);
        return 0;
}
```

Structs

```
struct square
{
        int width, height;
};

typedef struct square square_t;
```

Pointers

```
void f()
{
        square_t sq1, sq2;          // on the stack!
        square_t* ptr = &sq1;       // a pointer

        ptr->width = 300;

        …
```

malloc/free

```
void f()
{
        square_t* ptr = malloc( sizeof(square_t) );

        ptr->width = 300;
        …
        free(ptr);
        …
```

Project P0

- Implement a queue *and* a test program
- Has to be done by each student individually
  - by next Friday 6pm, so you have one week
- Tar file with instructions (README file) on CMS