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void*. Why'd it have to be void*?

Week 5 Tuesday
Generics I

CS 107A, Spring 2022
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Starter Code

```
git clone /afs/ir/class/archive/cs/cs107a/cs107a.1226/WWW/exercises/generics1
```

Announcements

- Midterm is next Tuesday
  - Date/Time: Tuesday, May 3rd, 7pm-9pm
  - Locations: 420-040 and STLC 111
  - See more info on the CS 107 website
  - If you have a conflict, email Nick by Wed
- assign4 schedule
- CS 107A Midterm Review Session next Sunday, time/location TBD
  - Practice Exam released later

Unix Tip Spotlight

- Exiting gdb, ssh sessions, terminals
  - <CTRL+D>: send EOF to the current program
  - Causes gdb, ssh, shells, etc to quit

Agenda

- `void*`
- `struct pair`

void*

What is a `void*`?

- A `int*` is a pointer to 1+ values of type ____
- A `char**` is a pointer to 1+ values of type ____
- A `struct foo*` is a pointer to 1+ values of type ____
- A `void**` is a pointer to 1+ values of type ____
- A `void*` is a pointer to 1+ values of type ____

What is a `void*`?

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- A `void*` is a pointer to 1+ values of type ____

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- A `void**` is a pointer to 1+ values of type `void*`
- A `void*` is a pointer to 1+ values of type ____

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- A `char**` is a pointer to 1+ values of type `char*`
- A `struct foo*` is a pointer to 1+ values of type `struct foo`
- A `void**` is a pointer to 1+ values of type `void*`
- A `void*` is a pointer to 1+ values of type `void???`

What is a `void*`?

- A `int*` is a pointer to 1+ values of type `int`
- A `char**` is a pointer to 1+ values of type `char*`
- A `struct foo*` is a pointer to 1+ values of type `struct foo`
- A `void**` is a pointer to 1+ values of type `void*`
- A `void*` is a pointer to 1+ values of type `void???`
  - But there is no such thing as a value of type `void`!

What is a `void*`?

- Values of type `void*` are pointers to something, but it's not specified what it is ("it's a `void`, but that doesn't exist!")
- We use them when we don't want to commit to specifying what the pointer points to while writing code e.g. for generics
  - But when the function is actually run, something real like an `int` is being pointed to

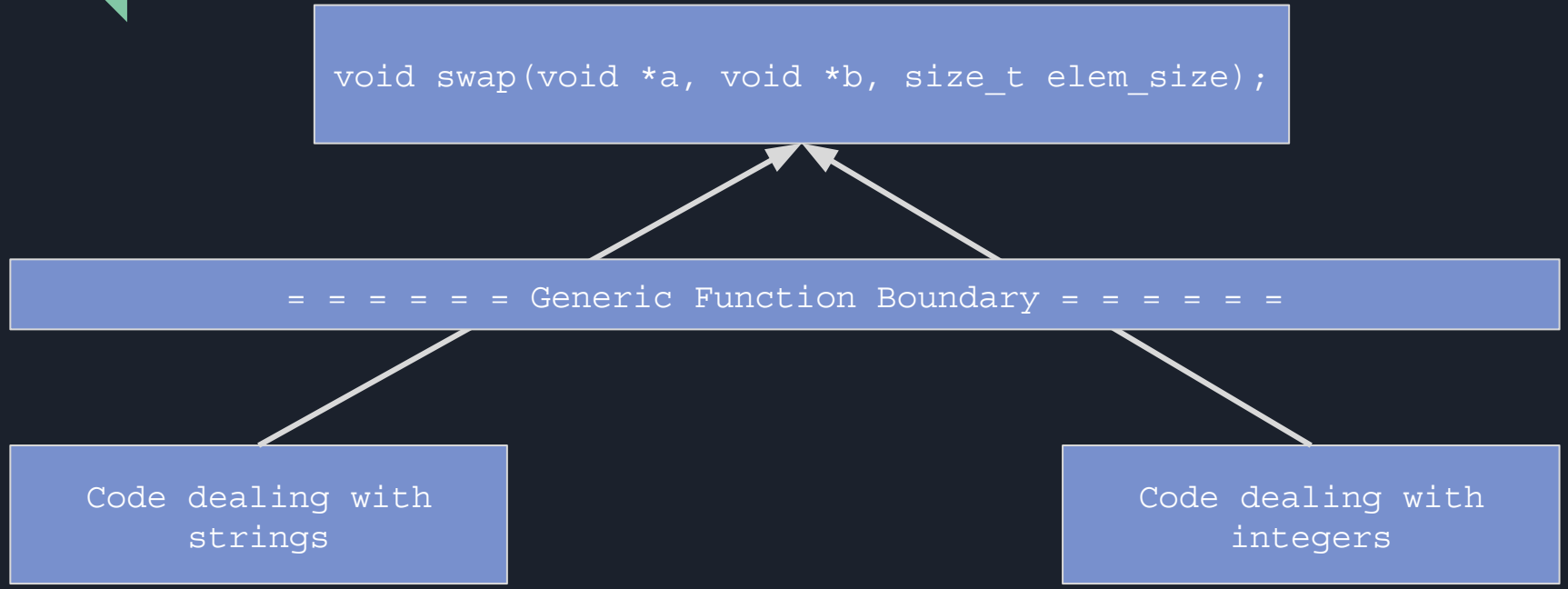
```
void qsort(void *base, size_t nmemb, size_t size,
           int (*compar)(const void *, const void *));
```

What can't you do with `void*`?

- You can't do anything that gets what it points to
  - You cannot dereference it e.g. `*ptr`
  - You cannot index into it e.g. `ptr[0]`
- You can't do pointer arithmetic, since that requires the size of what it points to e.g. `ptr + 3`
  - But you can cast to something else first, like `(char*)ptr + 3`
- The below is illegal and does not compile!

```
void get_3rd_elem(void *arr, size_t n) {
  return arr[2];
}
```

Generic Functions



Generic Functions

Code here can only assume it's working on pointers to something!

```
void swap(void *a, void *b, size_t elem_size);
```

= = = = = = Generic Function Boundary = = = = = =

Code dealing with strings

Code dealing with integers

Code here can assume it's working with strings!

Code here can assume it's working with ints!

What can you actually do with `void*`?

- If given nothing:
  - You can't really do anything
- If given `elem_size`:
  - You can copy elements
    - `void *memcpy(void *dest, const void *src, size_t n);`
    - `void *memmove(void *dest, const void *src, size_t n);`
  - You can get a pointer to a later element, where `i < num_elems`
    - `(char*)ptr + i*elem_size`
- If given a function pointer that operates on the `void*`, can use that

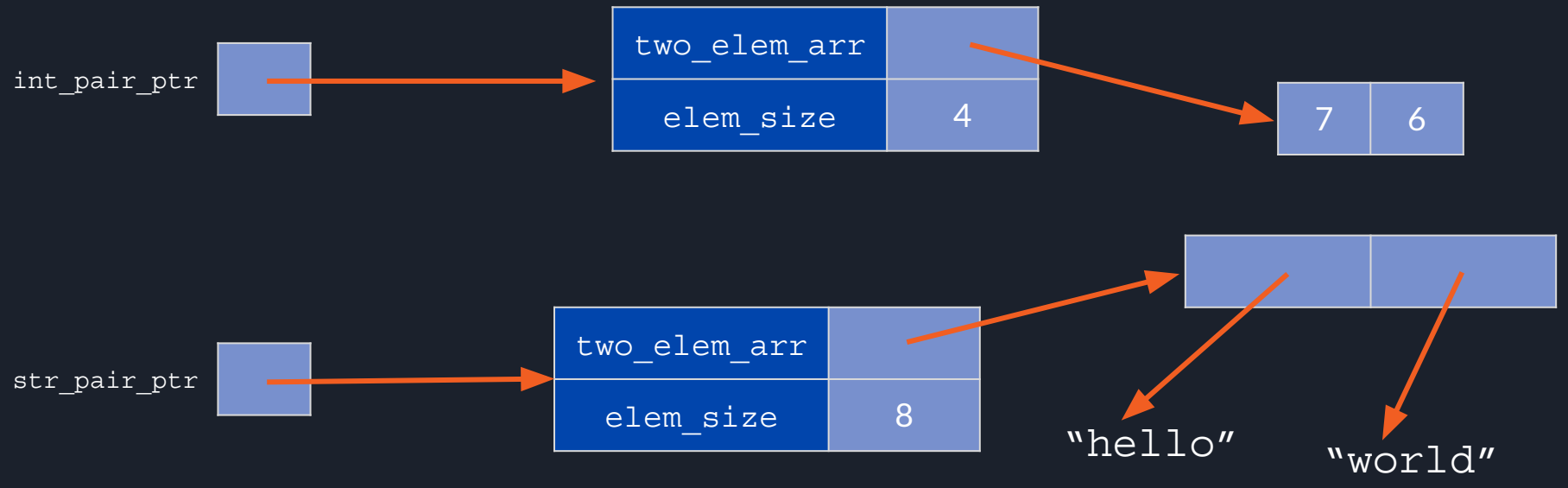
struct pair

struct pair on the stack

```
struct pair {
  void *two_elem_arr;
  size_t elem_size;
};
```

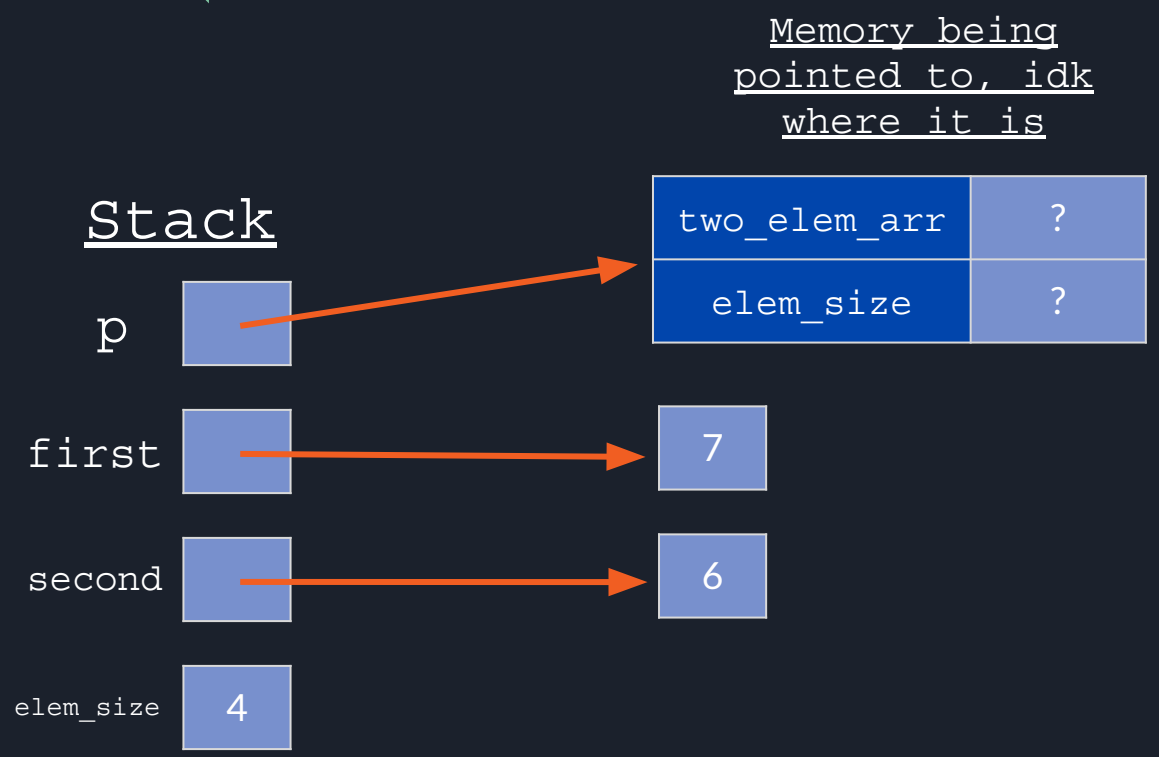
struct pair on the heap

```
struct pair {
    void *two_elem_arr;
    size_t elem_size;
};
```



pair_create initial

```
struct pair {
    void *two_elem_arr;
    size_t elem_size;
};
```



pair_create final

```
struct pair {
    void *two_elem_arr;
    size_t elem_size;
};
```