

Enum, Typedef, Structures and Unions

CS 2022: Introduction to C

Instructor: Hussam Abu-Libdeh

Cornell University
(based on slides by Saikat Guha)

Fall 2009, Lecture 6

Numerical Types

- ▶ `int`: machine-dependent
- ▶ Standard integers
 - ▶ defined in `stdint.h` (`#include <stdint.h>`)
 - ▶ `int8_t`: 8-bits signed
 - ▶ `int16_t`: 16-bits signed
 - ▶ `int32_t`: 32-bits signed
 - ▶ `int64_t`: 64-bits signed
 - ▶ `uint8_t`, `uint32_t`, ...: unsigned
- ▶ Floating point numbers
 - ▶ `float`: 32-bits
 - ▶ `double`: 64-bits

Complex Types

- ▶ Enumerations
(user-defined weekday: `sunday`, `monday`, ...)
- ▶ Structures (user-defined combinations of other types)
- ▶ Unions (same data, multiple interpretations)
- ▶ Function pointers
- ▶ Arrays and Pointers of the above

Enumerations

```
enum days {mon, tue, wed, thu, fri, sat, sun};  
// Same as:  
// #define mon 0  
// #define tue 1  
// ...  
// #define sun 6
```

```
enum days {mon=3, tue=8, wed, thu, fri, sat, sun};  
// Same as:  
// #define mon 3  
// #define tue 8  
// ...  
// #define sun 13
```

Enumerations

```
enum days day;
// Same as:    int day;

for(day = mon; day <= sun; day++) {
    if (day == sun) {
        printf("Sun\n");
    } else {
        printf("day = %d\n", day);
    }
}
```

Enumerations

- ▶ Basically integers
- ▶ Can use in expressions like ints
- ▶ Makes code easier to read
- ▶ Cannot get string equiv.
- ▶ caution: `day++` will always add 1 even if enum values aren't contiguous.

Structures

```
struct mystruct {  
    char name[32];  
    int age;  
    char *addr;  
};
```

Structures

```
void foo(void) {
    struct mystruct person;           // uninitialized

    struct mystruct person2 = {      // initialization
        .name = {'f','o','o','\0'},
        .age = 22,
        .addr = NULL
    };

                                     // struct pointer
    struct mystruct *pptr =
        (struct mystruct *)malloc(sizeof(struct mystruct));

    ...
}
```


Structures

```
struct mystruct {  
    char name[32];  
    int age;  
    char *addr;  
};
```

...

```
person.age = 10;                // direct access  
person.addr = (char *)malloc(64);
```

```
pptr->age = 24;                 // indirect access  
strncpy(pptr->name, "foo", 32); // through pointer  
pptr->addr = NULL;
```

...

Structures

- ▶ Container for related data
- ▶ Chunks of memory; syntactic sugar for easy access.
- ▶ May have empty gaps between members
- ▶ Useful in creating data structures such as linked lists

Unions

```
union myunion {
    int x;
    struct {
        char b1;
        char b2;
        char b3;
        char b4;
    } b;
};

union myunion num;

num.x = 1000;
num.b.b1 = 5;
```

Unions

- ▶ Same memory space interpreted as multiple types
- ▶ Useful for plugins, slicing network packets etc.

Function Pointers

```
int min(int a, int b);
int max(int a, int b);

int foo(int do_min) {
    int (*func)(int,int);           // declaring func. ptr

    if (do_min)
        func = min;
    else
        func = max;

    return func(10,20);           // indirect call
}
```

Function Pointers

- ▶ Points to a function
- ▶ Has a *-type of the function it points to

Renaming Types

- ▶ Complex types inconvenient to write over and over
 - ▶ `(enum day *)malloc(sizeof(enum day))`
 - ▶ `(struct foo *)malloc(sizeof(struct foo))`
 - ▶ `(union bar *)malloc(sizeof(union bar))`
 - ▶ `(int (*)(int,int))((void *)min)`

Renaming Types

```
typedef long old type newtype
```

```
typedef enum day day_t;
```

```
typedef struct foo foo_t;
```

```
typedef int (fptr_t)(int,int);
```