

C Structs, and more



CS 2130: Computer Systems and Organization 1

October 31, 2022

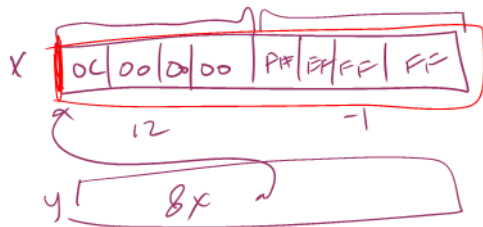
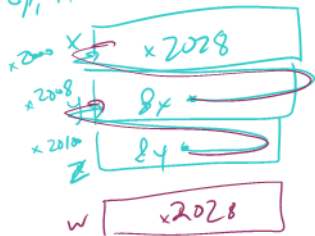
Announcements

- Homework 7 due Wednesday at 11pm
- Exam 2 Friday - Bring questions on Wednesday!

Quiz Review

last an 1-4

C, 78, 1



$z = \downarrow$
 $FF\ FF\ FF\ FF\ \underline{00\ 00\ 00\ 00}$

$$\text{int} * k = y + 1 \rightarrow x2000 + 4 = x2004$$

Structures

`struct` - Structures in C

- Act like Java classes, but no methods and all public fields
- Stores fields adjacently in memory (but may have padding)
- Compiler determines padding, use `sizeof()` to get size
- Name of the resulting type includes word `struct`

```
struct foo {  
    long a;  
    int b;  
    short c;  
    char d;  
};
```

```
struct foo x;  
x.b = 123;  
x.c = 4;
```

Structure Literals

```
struct a {  
    int b;  
    double c;  
};
```

/* Both of the following initialize b to 0 and c to 1.0 */

```
struct a x = { 0, 1.0 };  
struct a y = { .b = 0, .c = 1.0 };
```

typedef

`typedef` - give new names to any type!

- Fairly common to see several names for same data type to convey intent
- Ex: `unsigned long` may be `size_t` when used in sizes
- Examples:

```
typedef int Integer;
```

```
Integer x = 4;
```

```
typedef double ** dpp;
```

- Used with *anonymous structs*:

```
typedef struct { int x; double y; } foo;
```

```
foo z = { 42, 17.4 };
```

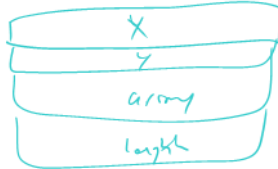
baz y = {

}; ←

typedef foo baz;

Struct Example

```
typedef struct {  
    long x;  
    long y;  
    long *array;  
    long length;  
} foo;
```



Struct Example

```
long sum2(foo *arg) {  
    long ans = arg->x;  
    for(long i = 0; i < arg->length; i += 1)  
        ans += arg->y * arg->array[i];  
    return ans;  
}
```

```
sum2:  
    movq    (%rdi), %rax  
    movq    24(%rdi), %r8  
    testq   %r8, %r8  
    jle    .LBB1_3  
    movq    8(%rdi), %rdx  
    movq    16(%rdi), %rsi  
    xorl    %edi, %edi  
.LBB1_2:  
    movq    (%rsi,%rdi,8), %rcx  
    imulq   %rdx, %rcx  
    addq    %rcx, %rax  
    incq    %rdi  
    cmpq    %rdi, %r8  
    jne    .LBB1_2  
.LBB1_3:  
    retq
```


Struct Example

```
long sum1(foo arg) {
    long ans = arg.x;
    for(long i = 0; i < arg.length; i += 1)
        ans += arg.y * arg.array[i];
    return ans;
}
```

```
sum1:
    movq    8(%rsp), %rax
    movq    32(%rsp), %r8
    testq   %r8, %r8
    jle    LBB0_3
    movq    16(%rsp), %rdx
    movq    24(%rsp), %rsi
    xorl    %edi, %edi
.LBB0_2:
    movq    (%rsi,%rdi,8), %rcx
    imulq   %rdx, %rcx
    addq    %rcx, %rax
    incq    %rdi
    cmpq    %rdi, %r8
    jne    .LBB0_2
.LBB0_3:
    retq
```