COMP1511: Structs, Pointers to Structs

Session 2, 2018

Recap: `typedef`

We can use the keyword `typedef` to give a name to a type:

```
typedef double real;
```

This means variables can be declared as **numeric** but they will actually be of type **double**.

Do not overuse typedef - it can make programs harder to read, e.g.:

```
typedef int andrew;

andrew main(void) {
    andrew i,j;
    ....
```

Recap: Using typedef to make programs portable

Suppose have a program that does floating-point calculations.
If we use a typedef'ed name for all variable, e.g.:

```
typedef double real;

real matrix[1000][1000][1000];

real my_atanh(real x) {
    real u = (1.0 - x)/(1.0 + x);
    return -0.5 * log(u);
}
```

If we move to a platform with little RAM, we can save memory (and lose precision) by changing the typedef:

```
typedef float real;
```

Recap: `structs`

- We have seen simple types e.g. **int, char, double**
  - variables of these types hold single values
- We have seen a compound type: arrays
  - array variables hold multiple values
  - arrays are homogenous - every array element is the same type
  - array element selected using integer index
  - array size can be determined at runtime
- Another compound type: structs
  - structs hold multiple values (fields)
  - struct are heterogeneous - fields can be differenttype
  - struct field selected using name
  - struct fields fixed

Recap: `structs - example`

If we define a struct that holds COMP1511 student details:

```
#define MAX_NAME 64
#define N_LABS 10

struct student {
    int zid;
    char name[64];
    double lab_marks[N_LABS]
    double assignment1_mark;
    double assignment2_mark;
}
```

We can declare an arry to hold the details of all students:

```
struct student comp1511_students[900];
```

Recap: combining structs and typedef

Common to use typedef to give name to a struct type.

```
struct student {
    int zid;
    char name[64];
    double lab_marks[N_LABS]
    double assignment1_mark;
    double assignment2_mark;
}

typedef struct student student_t;

student_details_t comp1511_students[900];
```

Programmer often use convention to separate type names
e.g. **_t** suffix.

Recap: Assigning `structs`

Unlike arrays, it is possible to copy all components of a structure in a single assignment:

```
struct student_details student1, student2;
...
student2 = student1;
```

It is *not* possible to compare all components with a single comparison:

```
if (student1 == student2) // NOT allowed!
```

If you want to compare two structures, you need to write a function to compare them component-by-component and decide whether they are "the same".

Recap: `structs` and functions

A structure can be passed as a parameter to a function:

```
void print_student(student_t student) {
    printf("%s z%d\n", d.name, d.zid);
}
```

Unlike arrays, a copy will be made of the entire structure, and only this copy will be passed to the function.

Unlike arrays, a function can return a struct:

```
student_t read_student_from_file(char filename[]) {
    ....
}
```

Pointers to `structs`

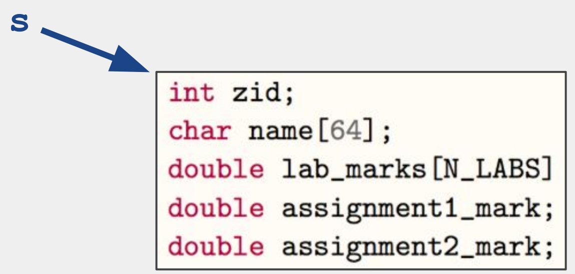
If a function needs to modify a structs field or if we want to avoid the inefficiency of copying the entire struct, we can instead pass a *pointer* to the struct as a parameter:

```c
int scan_zid(student *s) {
return scanf("%d", &((*s).zid));
}
```

The "arrow" operator is more readable :

```c
int scan_zid(student *s) {
return scanf("%d", &(s->zid));
}
```

If **s** is a pointer to a struct **s->field** is equivalent to **(*s).field**



```c
int zid;
char name[64];
double lab_marks[N_LABS]
double assignment1_mark;
double assignment2_mark;
```

```c
(*s).zid = 1234567;
(*s).lab_marks[2]=7;
strcpy((*s).name, "John")
… …
```

Alternatively,

```c
s->zid = 1234567;
s->lab_marks[2]=7;
strcpy(s->name, "John")
```

Nested Structures

One structure can be nested inside another

```
typedef struct date     Date;
typedef struct time     Time;
typedef struct speeding Speeding;
```

```
struct date {
   int day, month, year;
};
struct time {
   int hour, minute;
};
struct speeding {
   Date   date;
   Time   time;
   double speed;
   char   plate[MAX_PLATE];
};
```