CSE 374 Lecture 13

Week 5
Typedefs, structs, data structures
Datatypes in C

- Void: a placeholder
- Numbers: int, short, long, double, float, ... (signed, unsigned)
- char: really a very short int (1 byte) interpreted as a printable character
- Pointers (T*): int, char, double, char*, ...
- Arrays (T[]): int arr[], char arr[], char* arr[], ...
  - Implicit promotion to pointer when passed as an argument to a function or returned from a function
- Booleans? Not defined in C
  - 0 or NULL is always considered "false" and anything else is true
- Advanced: Union T, Enum E, Function pointers
Typedef

Not really a new type - just creating an alias for an existing type

typedef <type> <name>;

In C, strings are "char*", but if I wanted to actually provide the name "string", I could!

typedef char* string;
int main(int argc, string *argv) {
  string s = "hello, world!";
  printf("%s\n", s);
}

Type-casting (*converting one type to another*)

- **Syntax:** \((t) \ e\) where \(t\) is a type and \(e\) is an expression (same as Java)
- **If** \(e\) **is a numeric type and** \(t\) **is a numeric type, this is a conversion**
  - To wider type, get same value
  - To narrower type, may not (will get mod)
  - From floating-point to integer, will round (may overflow)
  - From integer to floating-point, may round (but int to double is exact on most machines)

```c
main() {
    int sum = 17, count = 5;
    double mean;
    mean = (double) sum / count;
    printf("Value of mean : \%f\n", mean );
}
```
Implicit casting

- When necessary the compiler automatically converts from one type to another (more general) type
  - Promotes to integers, then to larger integers, then to floating point
  - During arithmetic
  - R-value converted to L-value

For details:
Pointer-casting

If $e$ has type $t_1^*$, then $(t_2^*)e$ is a (pointer) cast.

You still have the same pointer (index into the address space).

Nothing “happens” at run-time.

Just “getting around” the type system - can write any bits anywhere you want.

```c
void evil(int **p, int x) {
    int *q = (int*)p;
    *q = x;
}

void f(int **p) {
    evil(p, 345);
    **p = 17; // writes 17 to address 345 Best case - crash
}
```
Structs

- New datatypes
  - a record, containing one or more fields
  - Stored adjacently in memory
- Like Java class, except no methods
- Access a field S.f
- If S *Ps then Ps.f
  - shortcut S->f

```c
struct person_info {
    char * name;
    int age;
}
```
Struct-tags

Has type struct
person_info

‘Person_info’ is a struct
tag, not a type

Can use typedef to rename

```c
// struct person_info {
typedef struct person_info {
    char * name;
    int age;
} person_info;
// }
```
Parameters / Arguments

Reminder:

Function parameters initialized with a copy of corresponding argument

If the argument is a pointer, the parameter value will point to the same thing, of course

Arrays are passed as pointers (remember?)

(Demo: point.c)

Even with a struct a copy is created

Since this won’t change the original struct, it is more common to use a pointer to the struct

Avoids copying large objects

Allows manipulation of original object (can write functions like Java methods)

But, sometimes, want to pass-by-value. THINK!!
// A single list node that stores an integer as data.

typedef struct IntListNode {
    int data;
    struct IntListNode* next;
} IntListNode;

IntListNode* makeNode(int data, IntListNode* next) {
    IntListNode* n = (IntListNode*) malloc(sizeof(IntListNode));
    if (n) { // malloc might return null
        n->data = data;
        n->next = next;
    }
    return n;
}
typedef int int32; // use int32 for portability
typedef struct point { // type tag optional (sortof)
    int32 x, y;
} Point2d; // Point2d is synonym for struct
typedef Point2d * ptptr; // pointer to Point2D
Point2d p; // var declaration
ptptr ptlist; // declares pointer