

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)

```
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:

<https://www.oreilly.com/library/view/c-in-a/0596006977/ch04.html>

Pointer-casting

If `e` has type `t1*`, then `(t2*) 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.

```
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`

```
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

```
struct person_info {  
    char * name;  
  
    int age;  
}
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Can use typedef to rename

```
typedef struct person_info person_info;
```

```
struct person_info {
```

```
    char * name;
```

```
    int age;
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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!!

Linked Lists



Points to
the List

Last node doesn't
point to next

// 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;  
}
```

Linked Lists



Points to
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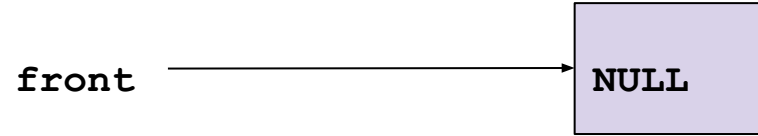
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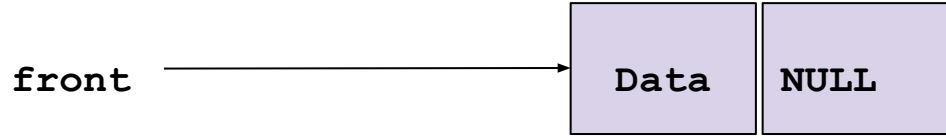
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    }  
    return n;  
}
```

Linked Lists



```
IntListNode* fromArray(int* array, int length) {  
    IntListNode* front = NULL;  
    for (int i = length - 1; i >= 0; i--) {  
        front = makeNode(array[i], front); }  
    return front;  
}
```

Linked Lists



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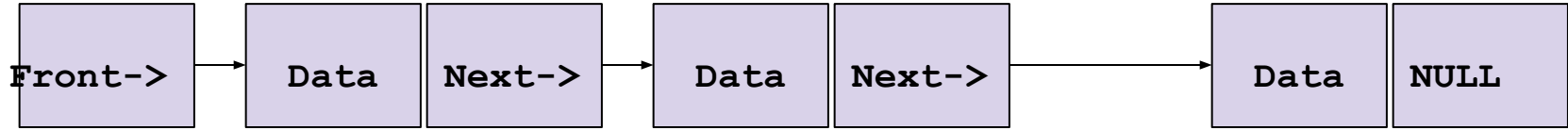
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    }  
    return n;  
}
```

Typedef struct ex.

```
typedef int int32; // use int32 for portability
typedef struct point { // type tag optional (sortof)
    int32 x, y;
} Point2d; // Point2d is synonym for struct point
typedef Point2d * ptptr; // pointer to Point2D
Point2d p; // var declaration
ptptr ptlist; // declares pointer
```