Lecture 9

CIS 208

Friday, February 11,2005

Test 1

- Friday, February 25th
- Wednesday: Review
- Email me questions/topics to cover.

Pointer practice

```
int j =3, k=5, *p = &j, *q = &j,*r;
double x;
```

p == &j	1
**&p	3
r =&x	illegal
7 * *p / *q +7	14
*(r = &k) *= *p	15

Null Pointers

- Have a value of 0

```
int *p;
p =0;
p = NULL; //pre-defined macro.
```

- Means the pointer is inactive

void pointers

- Generic pointer type
- can be used as gateways
- don’t have to cast

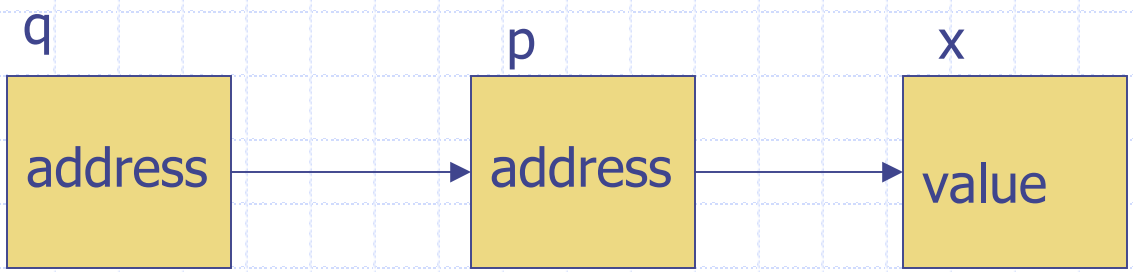
```
void *foo() { . . .}
int *p = foo();
char *q = foo();
```

Misc. Pointer stuff

- Can’t point to register variables
  - register int v; &v;
- Can’t point to constants
  - &3
- Can’t point to ordinary expressions
  - &(k+99);

Pointer to Pointer

- Called Multiple indirection



**q *p x

**q == *(*q)

```
#include <stdio.h>
void main(void) {
int x, *p, **q;
x =10;
p = &x;
q = &p;

printf("%d",**q);
}
```

Arrays of pointers

- argv is an example
- int *x[10]; // creates array of 10 pointers
- rules the same as before
  - x[2] = &var
  - *x[2] returns value from that pointer

Multidimensional pointers

```
ch[][];

**ch == ch[0][0];
**(ch +1) == ch[1][0];
*(*ch +1) == ch[0][1];
*(*(ch+1)+1) == ch[1][1];
```

Really messy, best leave it alone

Using argv as pointer

main(int argc, char *argv[]) ==
main(int argc, char **argv)

*argv == first string in the array.
**argv == first character;

++argv := moves to next string.

```
#include <stdio.h>
int main(int argc, char **argv) {
char **p = argv+1;
while (*p) puts(*p++);
return 0;
}

int main(int argc, char **argv) {
++argv;
while (*argv) puts(*argv++);
return 0;}
```

```
int main(int argc, char **argv) {
char *p;
int j;

for (j = 1; j < argc; ++j){
    p = argv[j];
    puts(p);}
return 0;
```

Call by reference

- pass pointers as arguments

```
void foo(int *p) { }

int x = 3; *q = &x;
foo(&x);
foo(q);
```

foo has access to x

q != p. Separate pointers to same location

Dynamic Memory

- allocate memory on the fly
- array size doesn’t have to hard coded
- Useful in data structures
- No constructors in C

malloc & calloc

- in stdlib.h
- will allocate memory chunk
- returns pointer to start of chunk

void *calloc(size_t num, size_t size)

- initializes allocated memory to 0
- num is number of desired elements
- size is the number of bytes per element
  - char = 1, int = 2-4, etc

void *malloc(size_t size)

- does NOT initialize memory.
- Is faster.
- size is the total bytes to be allocated
- malloc(n * bytes)

sizes???

- Vary from machine to machine
- Not fair to make you memorize them
- C makes it easy

malloc

- wanna allocate 10 int array?

```
int *p;
p = (int *) malloc(400); // int is 4 bytes
```

sizeof operator

- returns size of input type

```
sizeof(char)
sizeof(int)

int *p;
sizeof(p);
```

Back to malloc

- void *malloc(size_t size)

- size = number of elements * size of elements
  = n * sizeof(type)

array of 10 ints:

```
int *p = malloc(10 * sizeof(int));
```

array of 15 floats:

```
float *p = malloc(15 * sizeof(float));
```

Malloc/Calloc

- Returns 0 if error
  - Not enough memory error is common

```
int *p;
if (!(p = (int *) calloc(10,sizeof(int))))
        printf("out of memory");
```

Drip Drip Drip

```
int *p;
p = (int *)malloc(10 * sizeof(p));
//do some stuff here

p = (int *) malloc(20 * sizeof(p));
```

????

Memory Leaks

- Operating system usually deals after program execution
- Problem for big programs
- Must find a way to get used memory back

void free(void *ptr)

- in stdlib.h
- frees up chunk pointed to by ptr

- destroys all info in chunk

free(void *ptr)

- IMPORTANT!!!!!

Only give pointers that were allocated with either malloc or calloc

Do this or else. Seriously. ptr must be exact pointer place given in allocate function

free

```
int *p;
p = (int *)malloc(10 * sizeof(p));
//do some stuff
free(p); // p must still point to old address
p = (int *) malloc(10 * sizeof(p));
```