Chapter 9

Monday, January 01, 2007
9:30 PM

9.1 Pointers

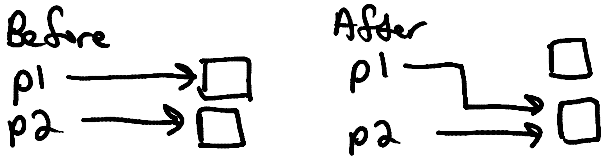
pointer - memory address of variable
tells where variable is, not its name
call-by-ref a form of pointer

to declare
cannot use integer even though addr is num
must say it is a pointer of x type
int *p
place asterisk in front of name

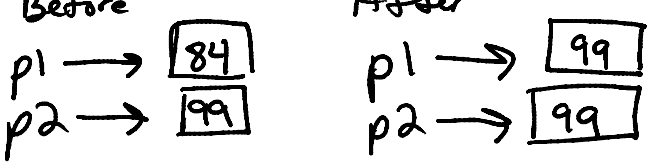
accessing
*p - value of addr pointed to by p
p - addr pointed to by p

assignment
p = &v get addr of v, store in p
*p = 42 store 42 in addr pointed to
* is dereferencing operator
& is "address-of" (referencing) operator
p1 = p2 works when both are pointers
*p1 = *p2 assign values, not addrs
Example:

p1 = p2



*p1 = *p2



Creating new memory chunks

allocate memory from computer

"anonymous" because has no name, just pointer

```
int *p1;
p1 = new int;
```

also called dynamic variables

new is C++ method of allocating

C uses function calls

if not enough mem, program will terminate

Example

```
int *p1, *p2;
p1 = new int;
*p1 = 42;
p2 = p1;
*p2 = 53;
p1 = new int;
*p1 = 88;
```

Can also call constructors

```
p1 = new int (17)
```

sets value of mem chunk to 17

Memory Management

"freestore" - mem that can be allocated

can be exhausted by too many news

free dynamic vars no longer used w/ delete

```
delete p
```

also important to delete before assigning pointer a new addr, mem leak

dangling pointer — pointer has no addr after delete is called

do not use *p

Static vs Dynamic Variables

dynamic - created by new
allocated / freed while program is running

ordinary vars are not static however
static is special keyword
we will return to its concept w/ classes

call ordinary vars "automatic vars"
they are a subset of dynamic vars that are created / deleted by the restrictions of their scope

Using typedef

typedef is a sort of alias
can be used for any datatype
Example:

```
typedef int* IntPtr;
IntPtr p;
```

helps avoid accidently forgetting *

```
int *p1, p2;  // p2 normal int
int* p1, p2;  // p2 normal int
int *p1, *p2; // correct
IntPtr p1, p2;  // correct
```

Syntax:

```
typedef <known-type> <alias>;
```

9.2 Dynamic Arrays

size determined while program is running
instead of when written like Ch 7

an array var is actually a pointer
[size] tells how much mem to alloc

[size] tells how much mem to alloc

array var points to 1st element

can assign array vars to pointers

Example:

```
int a[10];
int *p;
p = a;   // but cannot reassign a
```

p[1] & a[1] both access 2nd element

Can use [] w/ pointers if pointer points to array

pointer simply becomes base addr

Ordinary arrays cannot be assigned like ptrs

```
a = p;   // illegal
```

protection method

Creating & Using Dynamic Arrays

in Ch 7, dealt w/ issue of unknown size using partially filled arrays

- wasteful of memory
- cannot grow beyond maximum

dynamic arrays are "just right" size

give arg to new to say "want an array"

```
int *p;
p = new int[10];
```

Can use var for size too

```
int size = 5;
int *p;
p = new int[size];
```

must also give new arg to delete

lets delete know its an array

```
delete [] p;
```

w/o [], delete only frees space used by first element

do not call new again w/o first delete
can create mem leak
after delete, can call new again

Pointer Arithmetic
operates on addresses, not numbers
Example:

```
double *p;
p= new double[10];
cout << *(d+1) << " " << d[1];
```

this would output same element
d+1 evals to "add one offset"
d+1 = d + 1* size_of_double
d+i = d + i * size_of_double
can only add or subtract

Multidimensional Dynamic Arrays
multidimensional are arrays of arrays
eg pointers to pointers

```
typedef int* IntPtr;
IntPtr *m = new IntPtr[3];
for(int i=0; i<3 ; i++)
  m[i] = new int[4];
for(int i=0; i<3; i++)
   delete [] m[i]; // inner array
delete [] m; // outer array
```