

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

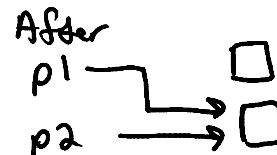
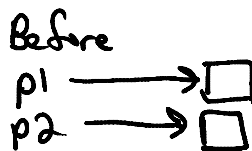
`&` is "address-of" (referencing) operator

`p1 = p2` works when both are pointers

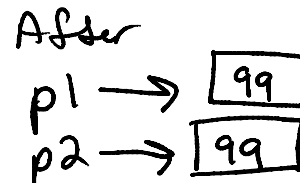
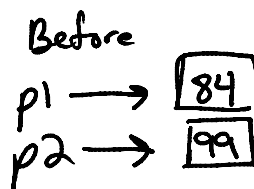
`*p1 = *p2` assign values, not addr

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 new's

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 accidentally 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"

$d+1 = d + 1 * \text{size-of-double}$

$d+i = d + i * \text{size-of-double}$

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
```