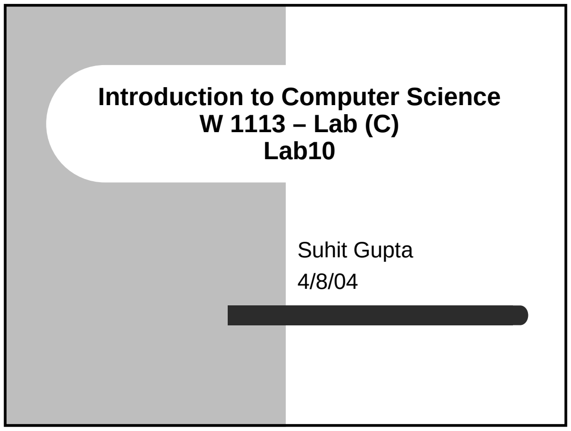
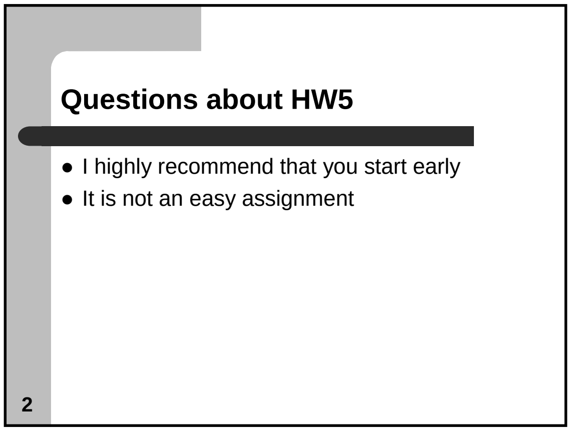


Introduction to Computer Science
W 1113 – Lab (C)
Lab10

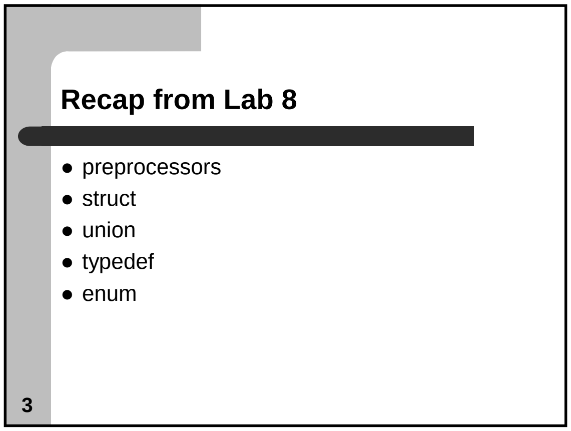
Suhit Gupta

4/8/04



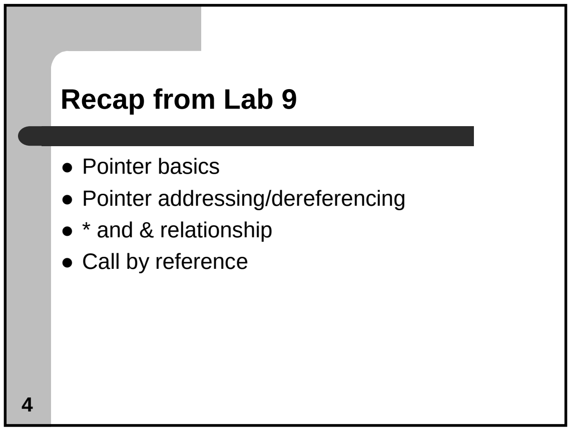
Questions about HW5

- I highly recommend that you start early
- It is not an easy assignment



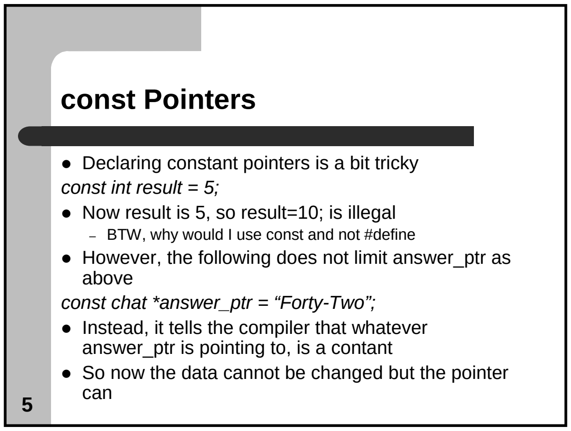
Recap from Lab 8

- preprocessors
- struct
- union
- typedef
- enum



Recap from Lab 9

- Pointer basics
- Pointer addressing/dereferencing
- * and & relationship
- Call by reference



const Pointers

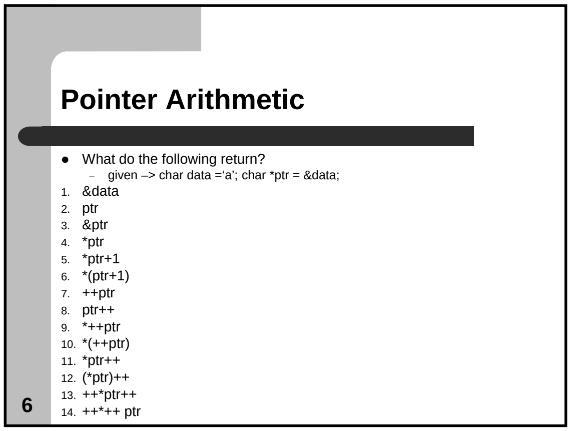
- Declaring constant pointers is a bit tricky

const int result = 5;

- Now result is 5, so result=10; is illegal
  - BTW, why would I use const and not #define
- However, the following does not limit answer_ptr as above

_const chat *answer_ptr = “Forty-Two”;_

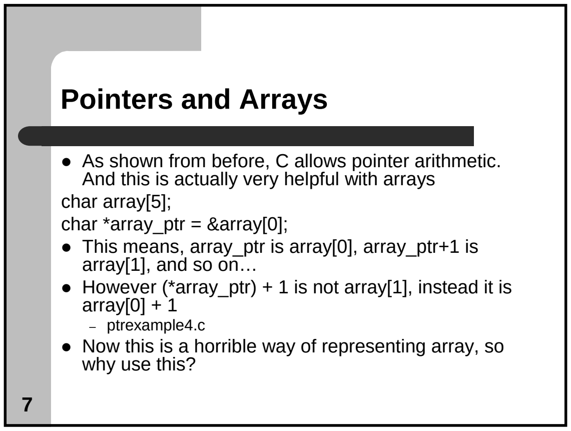
- Instead, it tells the compiler that whatever answer_ptr is pointing to, is a contant
- So now the data cannot be changed but the pointer can



Pointer Arithmetic

- What do the following return?
  - given –> char data =‘a’; char *ptr = &data;

1. &data
2. ptr
3. &ptr
4. *ptr
5. *ptr+1
6. *(ptr+1)
7. ++ptr
8. ptr++
9. *++ptr
10. *(++ptr)
11. *ptr++
12. (*ptr)++
13. ++*ptr++
14. ++*++ ptr



Pointers and Arrays

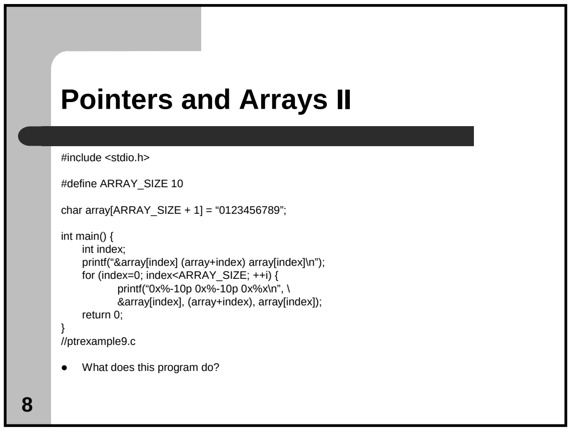
- As shown from before, C allows pointer arithmetic. And this is actually very helpful with arrays

char array[5];

char *array_ptr = &array[0];

- This means, array_ptr is array[0], array_ptr+1 is array[1], and so on…
- However (*array_ptr) + 1 is not array[1], instead it is array[0] + 1
  - ptrexample4.c
- Now this is a horrible way of representing array, so why use this?

7

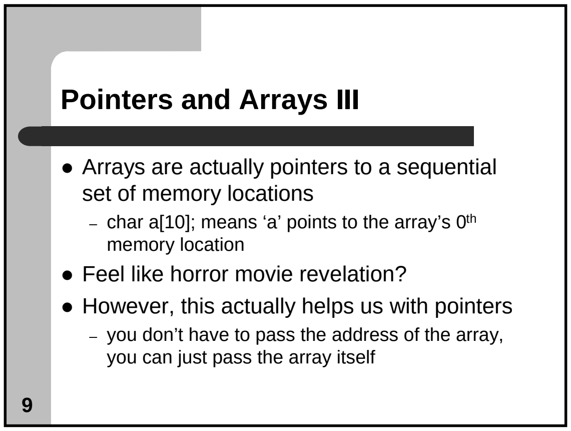


Pointers and Arrays II

```
#include <stdio.h>

#define ARRAY_SIZE 10

char array[ARRAY_SIZE + 1] = “0123456789”;

int main() {
      int index;
      printf(“&array[index] (array+index) array[index]\n”);
      for (index=0; index<ARRAY_SIZE; ++i) {
                printf(“0x%-10p 0x%-10p 0x%x\n”, \
                &array[index], (array+index), array[index]);
      return 0;
}
//ptrexample9.c
```

- What does this program do?

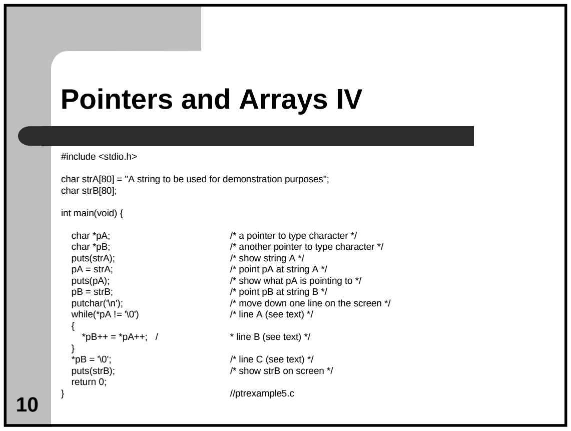
8



Pointers and Arrays III

- Arrays are actually pointers to a sequential set of memory locations
  - char a[10]; means ‘a’ points to the array’s 0th memory location
- Feel like horror movie revelation?
- However, this actually helps us with pointers
  - you don’t have to pass the address of the array, you can just pass the array itself

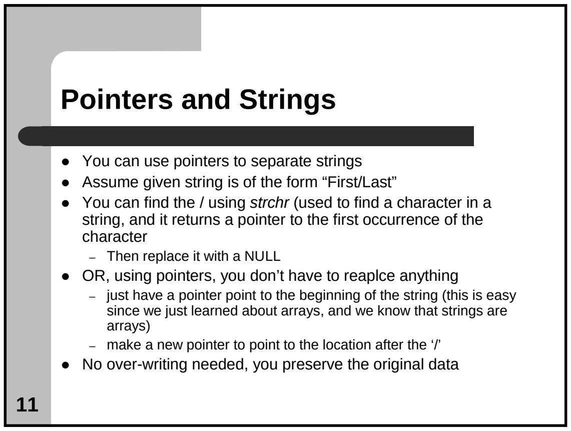
9



Pointers and Arrays IV

```
#include <stdio.h>

char strA[80] = "A string to be used for demonstration purposes";
char strB[80];

int main(void) {

    char *pA;                          /* a pointer to type character */
    char *pB;                          /* another pointer to type character */
    puts(strA);                        /* show string A */
    pA = strA;                         /* point pA at string A */
    puts(pA);                          /* show what pA is pointing to */
    pB = strB;                         /* point pB at string B */
    putchar('\n');                     /* move down one line on the screen */
    while(*pA != '\0')                 /* line A (see text) */
    {
        *pB++ = *pA++;   /             * line B (see text) */
    }
    *pB = '\0';                        /* line C (see text) */
    puts(strB);                        /* show strB on screen */
    return 0;
}                                      //ptrexample5.c
```

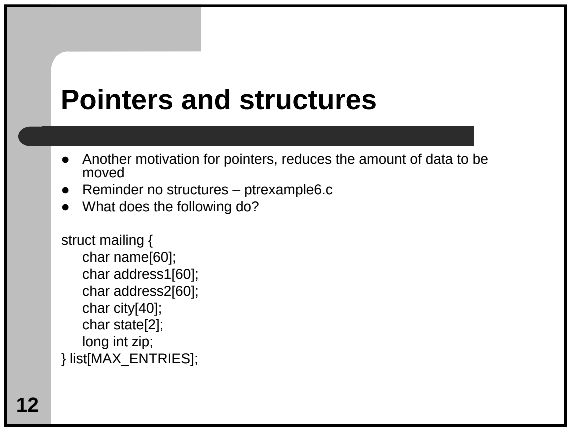
10



Pointers and Strings

- You can use pointers to separate strings
- Assume given string is of the form “First/Last”
- You can find the / using *strchr* (used to find a character in a string, and it returns a pointer to the first occurrence of the character
  - Then replace it with a NULL
- OR, using pointers, you don’t have to reaplce anything
  - just have a pointer point to the beginning of the string (this is easy since we just learned about arrays, and we know that strings are arrays)
  - make a new pointer to point to the location after the ‘/’
- No over-writing needed, you preserve the original data

11

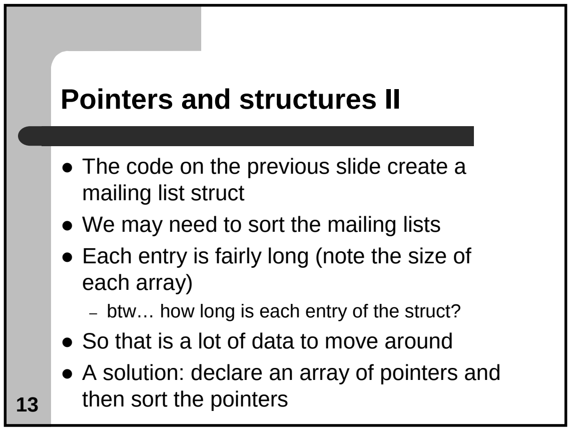


Pointers and structures

- Another motivation for pointers, reduces the amount of data to be moved
- Reminder no structures – ptrexample6.c
- What does the following do?

```
struct mailing {
    char name[60];
    char address1[60];
    char address2[60];
    char city[40];
    char state[2];
    long int zip;
} list[MAX_ENTRIES];
```

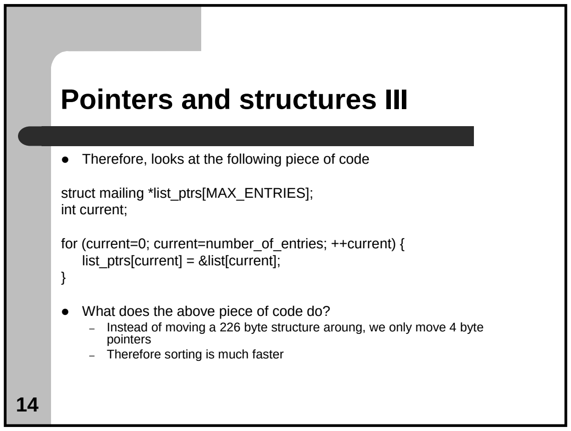
12



Pointers and structures II

- The code on the previous slide create a mailing list struct
- We may need to sort the mailing lists
- Each entry is fairly long (note the size of each array)
  - btw… how long is each entry of the struct?
- So that is a lot of data to move around
- A solution: declare an array of pointers and then sort the pointers

13



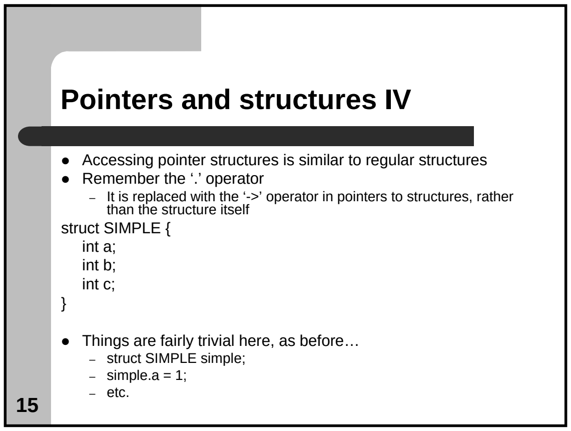
Pointers and structures III

- Therefore, looks at the following piece of code

```
struct mailing *list_ptrs[MAX_ENTRIES];
int current;

for (current=0; current=number_of_entries; ++current) {
    list_ptrs[current] = &list[current];
}
```

- What does the above piece of code do?
  - Instead of moving a 226 byte structure aroung, we only move 4 byte pointers
  - Therefore sorting is much faster

14



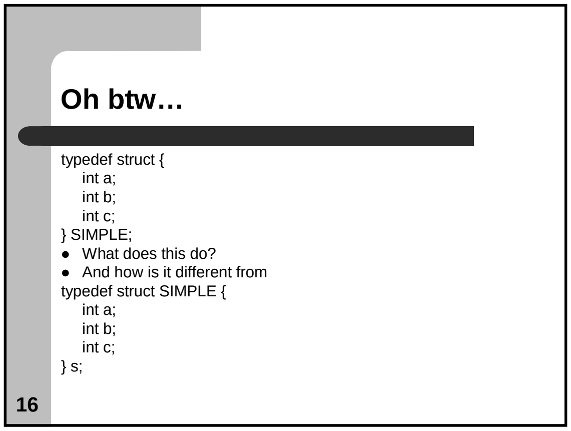
Pointers and structures IV

- Accessing pointer structures is similar to regular structures
- Remember the '.' operator
  - It is replaced with the '->' operator in pointers to structures, rather than the structure itself

```
struct SIMPLE {
    int a;
    int b;
    int c;
}
```

- Things are fairly trivial here, as before…
  - struct SIMPLE simple;
  - simple.a = 1;
  - etc.

15



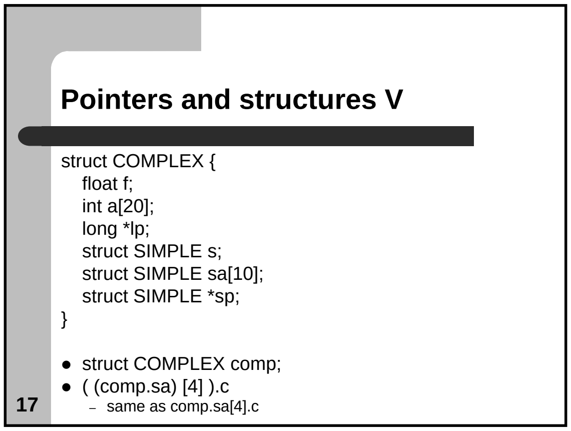
Oh btw…

```
typedef struct {
    int a;
    int b;
    int c;
} SIMPLE;
```

- What does this do?
- And how is it different from

```
typedef struct SIMPLE {
    int a;
    int b;
    int c;
} s;
```

16

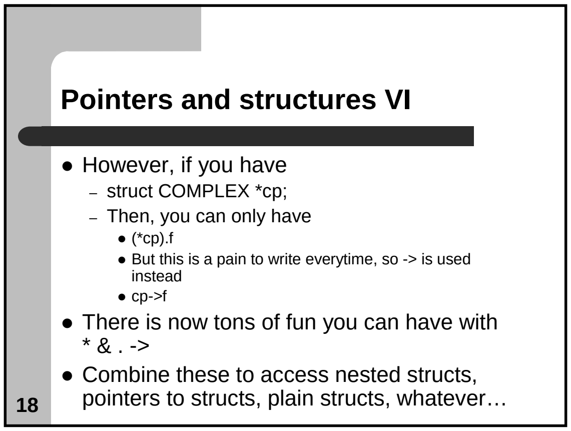


Pointers and structures V

```
struct COMPLEX {
    float f;
    int a[20];
    long *lp;
    struct SIMPLE s;
    struct SIMPLE sa[10];
    struct SIMPLE *sp;
}
```

- struct COMPLEX comp;
- ((comp.sa) [4]).c
  - same as comp.sa[4].c

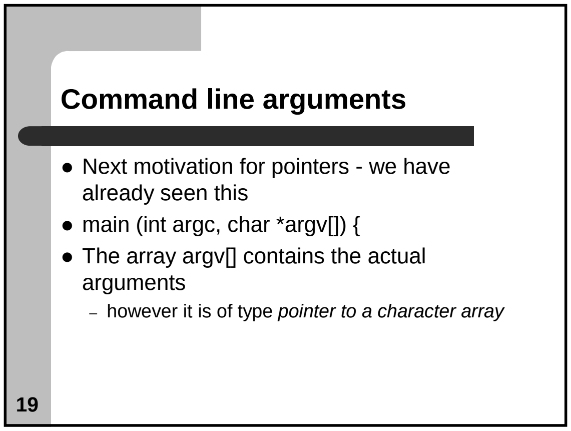
17



Pointers and structures VI

- However, if you have
  - struct COMPLEX *cp;
  - Then, you can only have
    - (*cp).f
    - But this is a pain to write everytime, so -> is used instead
    - cp->f
- There is now tons of fun you can have with * & . ->
- Combine these to access nested structs, pointers to structs, plain structs, whatever…

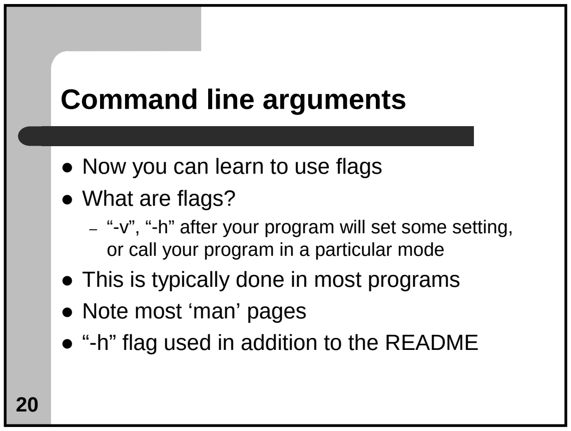
18



Command line arguments

- Next motivation for pointers - we have already seen this
- main (int argc, char *argv[]) {
- The array argv[] contains the actual arguments
  - however it is of type *pointer to a character array*

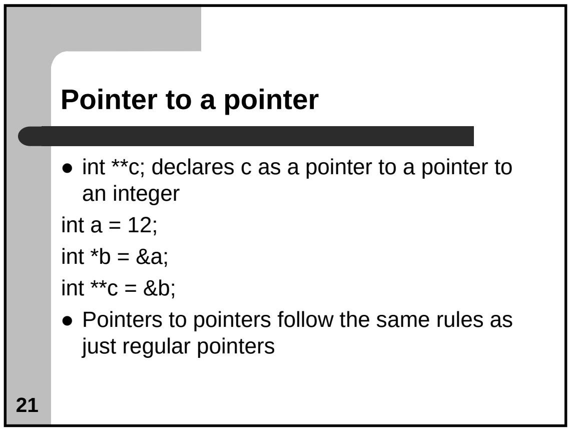
19



Command line arguments

- Now you can learn to use flags
- What are flags?
  - “-v”, “-h” after your program will set some setting, or call your program in a particular mode
- This is typically done in most programs
- Note most ‘man’ pages
- “-h” flag used in addition to the README

20



Pointer to a pointer

- int **c; declares c as a pointer to a pointer to an integer

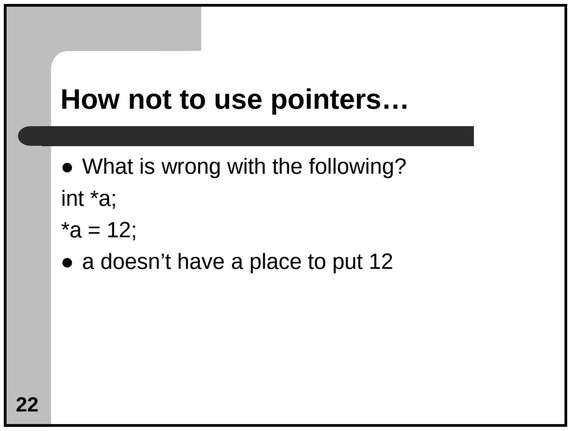
int a = 12;

int *b = &a;

int **c = &b;

- Pointers to pointers follow the same rules as just regular pointers

21



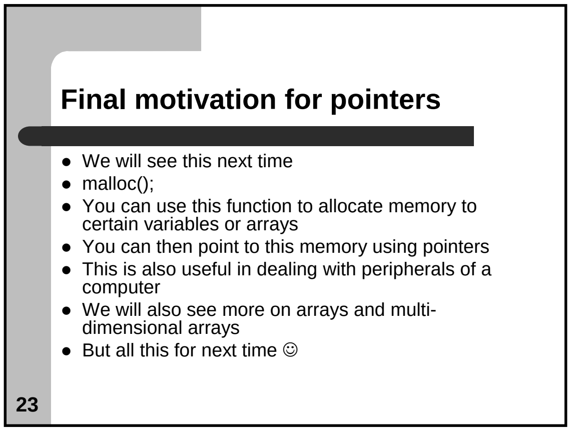
How not to use pointers…

- What is wrong with the following?

```
int *a;
*a = 12;
```

- a doesn’t have a place to put 12

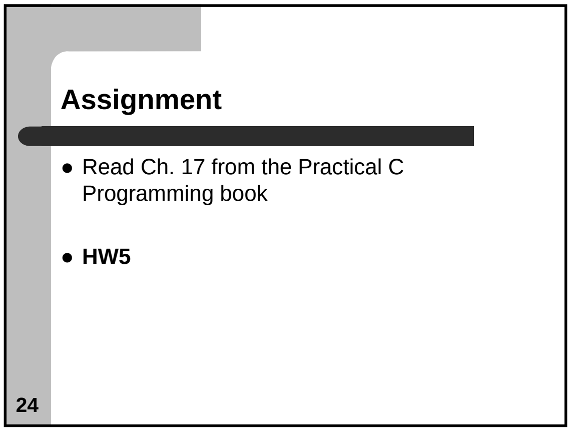
22



Final motivation for pointers

- We will see this next time
- malloc();
- You can use this function to allocate memory to certain variables or arrays
- You can then point to this memory using pointers
- This is also useful in dealing with peripherals of a computer
- We will also see more on arrays and multi-dimensional arrays
- But all this for next time ☺

23



Assignment

- Read Ch. 17 from the Practical C Programming book
- **HW5**

24