Lecture 7:
Finish Memory Stuff, Prepare for 2D
Important Memory Concepts in C: Dereferencing

• There are two operators for getting the value at a memory location: *, and []
  – This is called dereferencing
    • * = “dereference operator”

• int *p = malloc(sizeof(int)*1);
• *p = 2; /* sets memory p points to to have value 2 */
• p[0] = 2; /* sets memory p points to to have value 2 */
Important Memory Concepts in C: Arrays

- Arrays lie in contiguous memory
  - So if you know address to one element, you know address of the rest
- int *a = malloc(sizeof(int)*1);
  - a single integer
  - ... or an array of a single integer
- int *a = malloc(sizeof(int)*2);
  - an array of two integers
  - first integer is at ‘a’
  - second integer is at the address ‘a+4’
  - Tricky point here, since C/C++ will refer to it as ‘a+1’
Important Memory Concepts in C: pointer arithmetic

• `int *p = malloc(sizeof(int)*5);`
• C/C++ allows you to modify pointer with math operations
  – called pointer arithmetic
  – “does the right thing” with respect to type
    • `int *p = malloc(sizeof(int)*5);`
    • `p+1` is 4 bytes bigger than `p`!!

• Then:
  – “p+3” is the same as “&(p[3])” (ADDRESSES)
  – “*(p+3)” is the same as “p[3]” (VALUES)
Important Memory Concepts in C: Pointers to pointers

- `int **p = malloc(sizeof(int *)*5);`
- `p[0] = malloc(sizeof(int)*50);`
- `...`

![Diagram showing pointers and memory allocation](image)
Important Memory Concepts in C: NULL pointer

• int *p = NULL;
• often stored as address 0x00000000
• used to initialize something to a known value
  – And also indicate that it is uninitialized...
Project 2D

• You now know what you need to do Project 2D
  – But: practice writing C programs and testing yourself!!
  – Reminder: you can printf with a pointer

```c
#include <stdlib.h>
#include <stdio.h>
int main()
{
    /* allocates memory */
    int *ptr = malloc(2*sizeof(int));
    printf("%p\n", ptr);
}
```

```
fawcett:VIS2016 childs$ cat t.c
fawcett:VIS2016 childs$ gcc t.c
fawcett:VIS2016 childs$ ./a.out
0x100100080
```
Project 2D

• Assigned now
• Worksheet. You print it out, complete it on your own, and bring it to class.
• Due Thursday 10am in class
  – Graded in class
• No Piazza posts on this please
• Practice with C, vi, gcc, printf