CS 225
Data Structures

January 18 – Memory
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Pointers and References

A variable containing an instance of an object:

```cpp
1 Cube s1;
```

A reference variable of a Cube object:

```cpp
1 Cube & s1;
```

A variable containing a pointer to a Cube object:

```cpp
1 Cube * s1;
```
Pointers

Three key ideas:

1.

2.

3.
```cpp
#include <iostream>
#include "Cube.h"

int main() {
    cs225::Cube c;
    std::cout << "Address storing `c`:" << &c << std::endl;
    cs225::Cube *ptr = &c;
    std::cout << "Addr. storing ptr: " << &ptr << std::endl;
    std::cout << "Contents of ptr: " << ptr << std::endl;
    return 0;
}
```
Indirection Operators

Given any variable v:

&v

*v

v->
Stack Memory
```cpp
int main() {
    int a;
    int b = -3;
    int c = 12345;
    int *p = &b;
    return 0;
}
```
```cpp
#include <iostream>

int main() {
    std::cout << sizeof(int) << std::endl;
    return 0;
}
```
```cpp
#include <iostream>

int main() {
    std::cout << sizeof(int*) << std::endl;
    return 0;
}
```
```cpp
int main() {
    int a;
    int b = -3;
    int c = 12345;
    int *p = &b;
    return 0;
}
```

Real results when running on `linus.ews.illinois.edu`

```
&a: 0x7ffe2ee87218
&b: 0x7ffe2ee87214
&c: 0x7ffe2ee87210
&p: 0x7ffe2ee87208
```
```cpp
#include "Cube.h"

int main() {
    cs225::Cube c;
    cs225::Cube *p = &c;
    return 0;
}
```
```cpp
#include <iostream>
#include "Cube.h"

int main() {
    std::cout << sizeof(cs225::Cube) << std::endl;
    std::cout << sizeof(cs225::Cube *) << std::endl;
    return 0;
}
```
```c
int hello() {
    int a = 100;
    return a;
}

int main() {
    int a;
    int b = -3;
    int c = hello();
    int d = 42;
    return 0;
}
```
Problems of the Day (POTD)

**POTDs** are small, daily problems for you to practice programming in an environment similar to the CBTF exam environment.

Each POTD is worth +1 extra credit point, capped at +40. *(Course-wide, all extra credit is capped at +100.)*

*POTD#1 is available on Tuesday, until 8:00am Wednesday morning when POTD#2 becomes available!*
Code Reading Questions

**Code reading questions** are also small problems to practice your programming knowledge (+1 extra credit, capped at 5)

```c
int f(int x, int y) {
    if (x > y) {
        return x;
    }
    return y;
}
```

Give a high-level description of the highlighted code
#include "Cube.h"

using cs225::Cube;

Cube *CreateCube() {
    Cube c(20);
    return &c;
}

int main() {
    Cube *c = CreateCube();
    double r = c->getVolume();
    double v = c->getSurfaceArea();
    return 0;
}