CSI 201
for loops!

1. Goals for today: practicing for loops, minor graphics!

2. Remember how we repeat tasks many times:

```
for(int i = 0; i < 10; i++) {
    //this task happens 10 times!
}
```

3. There are many ways to test for understanding with loops. Types of practice include "how many times does this loop run" and "what is the output of this loop." and "how do I code this"

4. For example: how many times do the following loops run:

```
for(int i = 0; i < 100; ++i)
for(int i = 10; i < 20; ++i)
for(int i = 3; i <= 5; ++i)
for(int k = 5; k < 15; k = k + 3)
```

5. We could also ask about output of those loops. What is the output of this loop:

```
for(int i = 0; i < 5; ++i) {
   cout << i+1 << endl;
}
```

6. What is the output of this loop:

```
for(int j = 10; j < 20; j = j + 2) {
   cout << j*2 << endl;
}
```

7. We can use for loops in nested environments as well. Last time we used it to output 100 stars. We could base this on user input:

```
int how_many_stars;
cin >> how_many_stars;
for(int i = 0; i < how_many_stars; i++) {
        cout << "*";
}
cout << endl;
```

8. Starting at the `for` loop we have a block of code that prints a line of stars that has `how_many_stars` in it.

9. Can we write code that "repeats" this loop 10 times? Try this on the board.

10. What do you think happens when we run this code?

11. Is there any way to get a "square" of stars instead of a rectangle based on user input?

12. How about this:

```
for(int j = 0; j < how_many_stars; ++j) {
    for(int i = 0; i < how_many_stars; ++i) {
        cout << "*";
    }
    cout << endl;
}
```

13. Let's walk through this together for `how_many_stars = 3`

14. How can we draw this picture?

```
*
**
***
```

15. How about this one?

```
***
**
*
```

16. How about this one:

```
  *
 ***
*****
```

17. Can we change these loops such that the number of rows is based on user input? (The examples above would be for user input of 3 in 3 different cases.)

18. Above we've shown a filled in rectangle and square. Can we make a hollow square? For example, if user input is 4, I want a 4x4 square with nothing in the middle like:

```
****
*  *
*  *
****
```

19. How about an open rectangle where the user gives width and length? For example an input of 3 4 would give:

```
***
* *
* *
***
```

20. Drawing fun pictures is not the only thing we can do with for loops. We've seen computing sequences from last worksheet. And the while loop worksheet from the while practice worksheet. Let's try making loops that output different things.

21. Make a loop that outputs multiples of 3. For example, it could output `0,3,9,12,15,...`

22. Make a loop that outputs all the numbers from 1 to 100 that are both even and a multiple of 3. We could use % here again. Remember that when $a\%b == 0$ then a is divisible by b. So 12%3 is 0 and 12%2 is also 0.