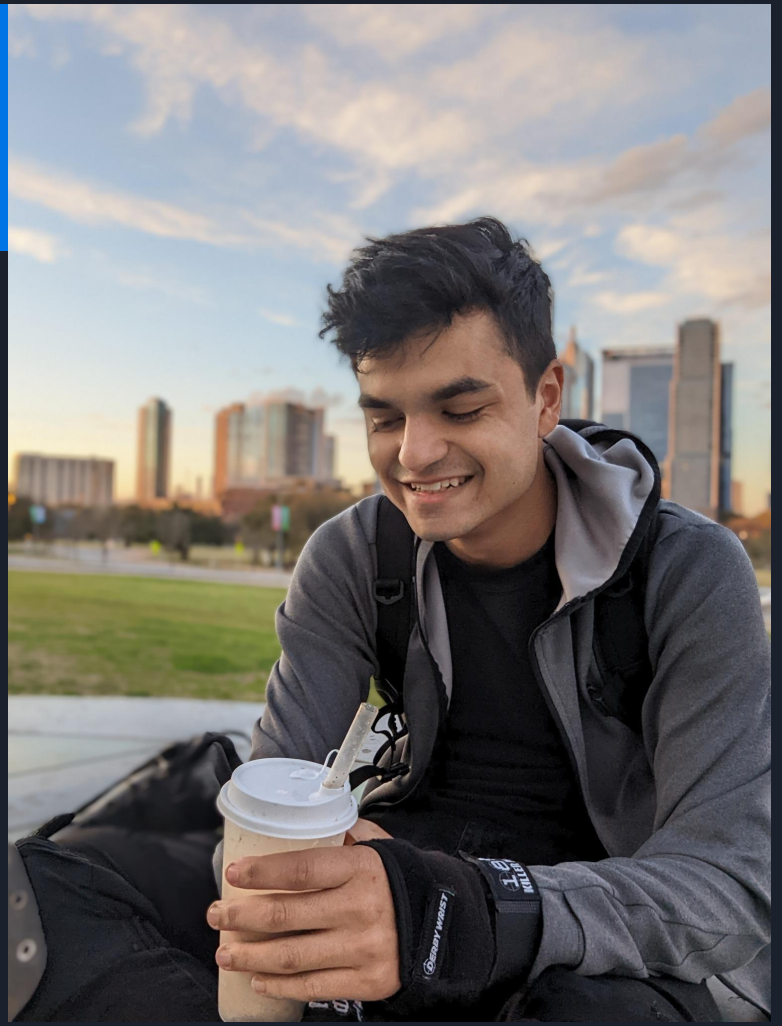
Welcome to CS 314!

Grab the section and extra problem from the chair in the back!

Your TA (me!)

- Skyler Vestal
- CS Senior (‘23)
- Completed a lot of stuff. Ask if you have questions about other CS/Math topics!
- Incoming SWE @ Zillow
- skylervestal@utexas.edu



Also me!

- Rollerblading … Everywhere
- Bouldering (v3)
- #1 Brewers Fan!
- #1 City Girl Fan!
- Learning Japanese (N3-ish)
- Windows & Linux
- VS Code Simp

Discussion Section Name

Algorithm Analysis!

1. A method is $O(2^N)$. It takes 1 second for the method to complete when N = 50.

What is the expected time in seconds for the method to complete when N = 54?

$$\frac{2^{54}}{2^{50}} = \frac{x}{1}$$

LaTeX

2. A method is $O(N^2 \log_2 N)$. It takes 20 seconds for the method to complete when N = 1,000,000.

What is the expected time in seconds for the method to complete when N = 2,000,000?

$$\frac{2\log_2(2 \times 10^6)}{\log_2(1 \times 10^6)} = \frac{x}{20}$$

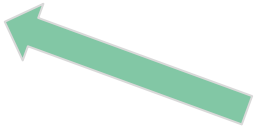
3. What is the T(N) for method `a`? Recall, T(N) is the function that represents the *actual* number of executable statements for a function or algorithm. N = `listA.length = listB.length`

```
// pre: listA.length == listB.length
public int a(int[] listA, int[] listB) {
     int total = 0;
     for (int i = 0; i < listA.length; i++)
          for (int j = 0; j < listB.length; j++) {
               total += listA[i] * listB[j];
               total += listA[i] / 10;
               total += listB[j] / 100;
     }
     return total;
}
```

$$1 + 1 + N + 1 + N + N(1 + N + 1 + N + N(1 + 1 + 1)) + 1$$

4. What is the worst case order (Big O) of method `d`? Assume `Arrays.fill` is O(N) and method `process` is O(N). N = `data.length`

```
public int[] d(int[] data, int key) {
      int[] result = new int[0];
      for (int i = 0; i < data.length; i++) {
            if (data[i] == key) {
                  result = new int[data.length];
                  Arrays.fill(data, i);
                  process(data, i, key);
            }
      }
      return result;
}
```



5. What is the best cases order of the following method? Assume method `numRows` is O(1) and that method `process` is O(1). Assume method `numRows` returns the number of rows in the 2d array sent as a parameter.

```
// mat is a square matrix. All rows have mat.length columns.
public static int num6(int[][] mat) {

     int result = 0;
     for (int r = 0; r < numRows(mat); r++) {
          int[] row = mat[r];
          for (int c = 0; c < mat[0].length; c++) {
               int val = mat[r][c];
               result += process(val, mat, row);
          }
     }
     return result;
}
```

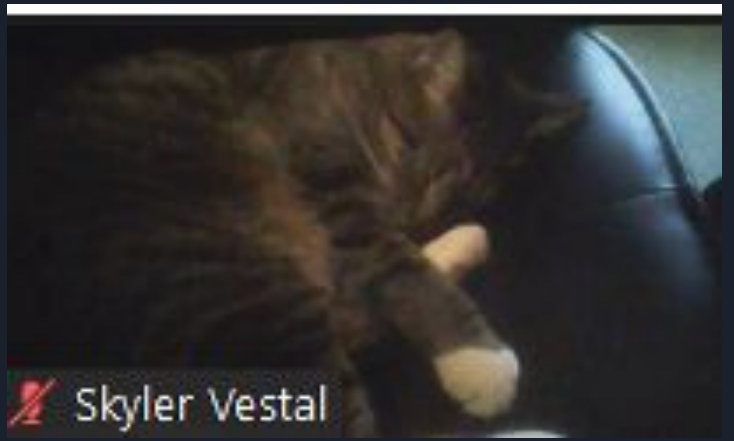
9. What is output by the following code? (it is very gacky)

```
int n = 64;
int r = 0;
for (int i = 1; i <= n; i *= 2) {
     for (int j = 1; j <= i; j++)  {
          r++;
     }
}
System.out.print(r);
```

$$1 + 2 + 4 + \cdots + N/2 + N = 2N - 1$$

Grading Schedule

- Grading on Saturday
- May spill to Sunday
- Some exceptions ...



Assignment Grading

- Don’t email me for:
  - Disagreeing on taking of a point for something you did
- *Please* email me for:
  - Mistake with your correctness
  - Mistake with adding up grade
  - Inconsistent deduction w/ past assignment
  - Inconsistency w/ assignment page
  - I took off for something you didn’t do

Assignment Grading

- I can only regrade for the five days after I release grades
- Don’t get stressed about small **style** deductions:
  - A single exam coding Q is a little less than an entire assignment
  - Assignments only make up 22% of your grade
  - Y’all get 42 slack points + 10 for extra credit

Common Style Issues

- Spacing on operators (***AUTO FORMATTER!!!!!!!***):
  - 3+3 -> 3 + 3
  - if(...) -> if (...)
  - public int method (){ -> method() {
  - //test -> // test
- Lines should be 100 long (set a vertical line)
- Private instance variables
- Checking preconditions on public methods

Common Style Issues

- ***USE AN AUTO FORMATTER!!!!!!!***
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- ***USE AN AUTO FORMATTER!!!!!!!***

Common Style Issues

- Magic numbers:
  - BAD:
    - `if (year < 10)`
  - GOOD:
    - `final int PERIOD_LENGTH = 10;`
    - `if (year < PERIOD_LENGTH)`
  - If you're using a magic number in multiple methods, declare it at the top of your class.

Common Style Issues

- Returning early:

```
// BAD:
int sum = 0;
for (int i = 0; i < a.length; i++) {
    if (a[i] == 0) {
        sum += 1;
    }
}
return sum == 0;
```

```
// GOOD:
for (int i = 0; i < a.length; i++) {
    if (a[i] == 0) {
        return false;
    }
}
return true;
```

Common Style Issues

- Boolean zen (part 1):

```
// BAD:
if (a == 0) {
    return true;
} else {
    return false;
}
```

```
// GOOD:
return a == 0;
```

Common Style Issues

- Boolean zen (part 2):

```
// BAD:
if (val == true) {
    ...
}
```

```
// GOOD:
if (val) {
    ...
}
```

Common Style Issues

- Preferred method header comments:

```
// Calculates the amount of birds in my yard at a given time
// pre: bar != null, t >= 0
// post: returns birds at time t
public int foo(int[] bar, int t) {

// Prints the amount of snails on my desk
// pre: none (For this example, bar handles null vals)
// post: none
public void bar(String desk) {
```

Style Preferences

- I can’t take off for this, but I’d prefer:

```
public void foo(String desk) {
    if (a) {

    }
}
```

```
// rather than
public void foo(String desk)
{
    if (a)
    {

    }
}
```

Common CodeCamp Issues

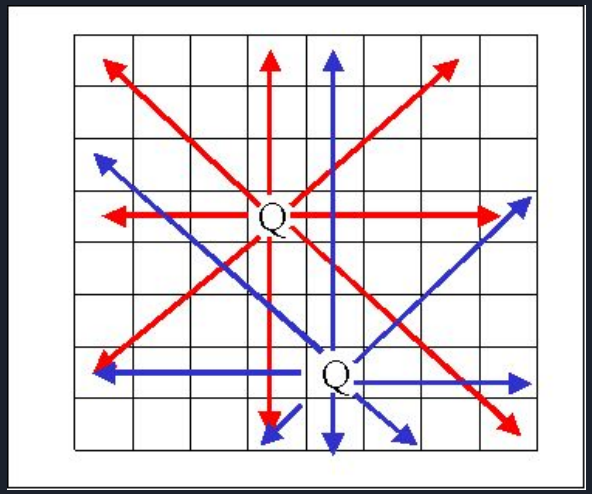
- Style:
  - Improper spacing on operators (3+3 should be 3 + 3)
  - Code or comments exceed 100 in the column space
  - Inadequate descriptions of inputs or outputs
  - Repetitive code AND redundant logic in queensAreSafe
  - Repetitive long if statement in mostVowels
  - Boolean zen
  - Return early if you can!

Common Matrix Issues

- Style:
  - Write the preconditions that Mike specifies in header comments!
  - Private instance variables!!!
  - Return early in equals if possible
  - Don’t let code exceed 100 in the column space
- Experiments
  - 1 int = 4 bytes
  - The Big O you report should be based off your algorithm analysis
    - We want to see if your timing supports this! Be honest!!! It doesn’t matter some are fuzzy/seem off.

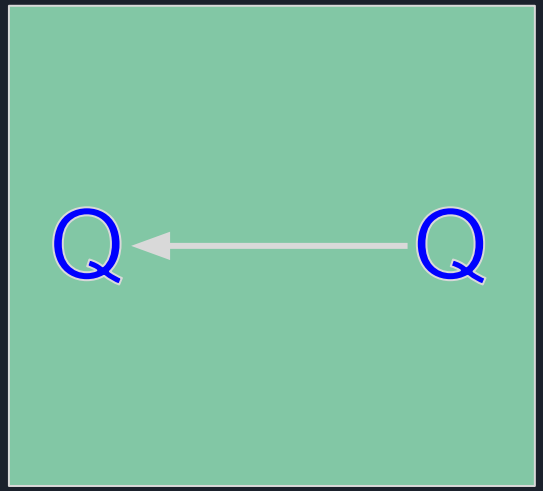
QueensAreSafe

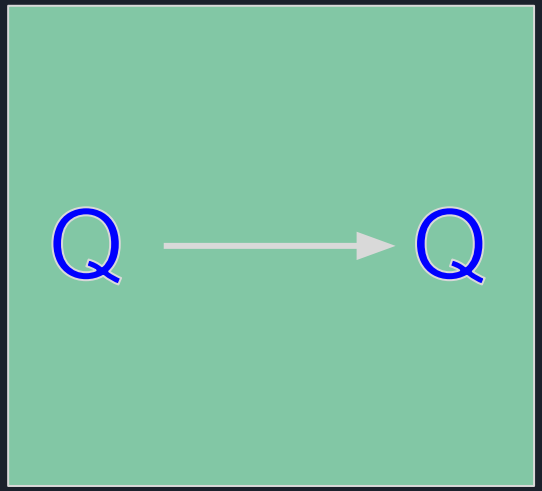
- Relevant Directions
- Parameterized Row/Col Solutions
- Slope Method

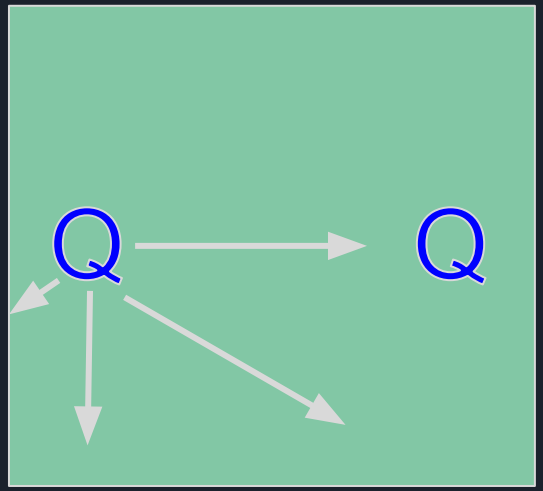


Directions

- Only need to check 4 directions

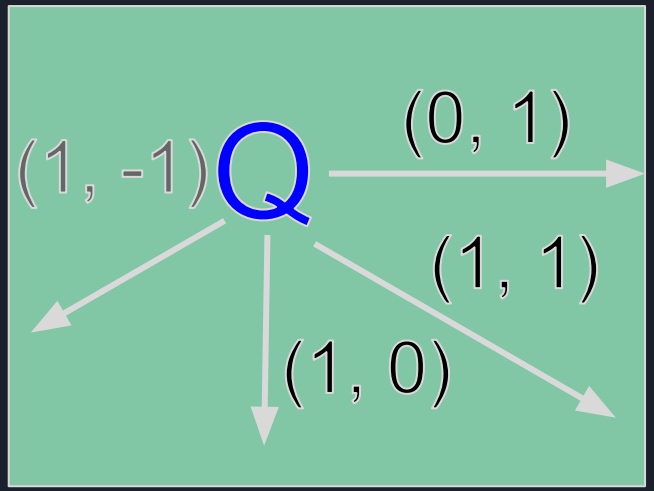






Directions

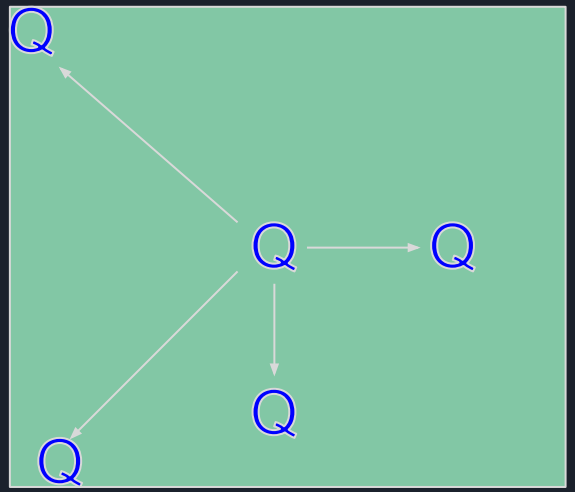
- You can use an array to store the different changes in rows and columns



rows = {0, 1, 1, 1}
cols = {1, 1, 0, -1}

Directions

- You can also use the slopes between queens to determine if they're in a line (if the abs slope is 0, 1, or infinity)



$$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{rise}{run}$$

```
public void removeRange(int start, int stop) {
    if (stop < start || start < 0 || stop > size) {
        throw new IllegalArgumentException("incorrect range");
    }
    if (stop > start) {
        int numRemoved = stop - start;
        for (int i = stop; i < size; i++) {
            con[i - numRemoved] = con[i];
        }
        size -= numRemoved;
    }
}
```