Breaking the Caesar Cipher

Developing an Algorithm

Duke
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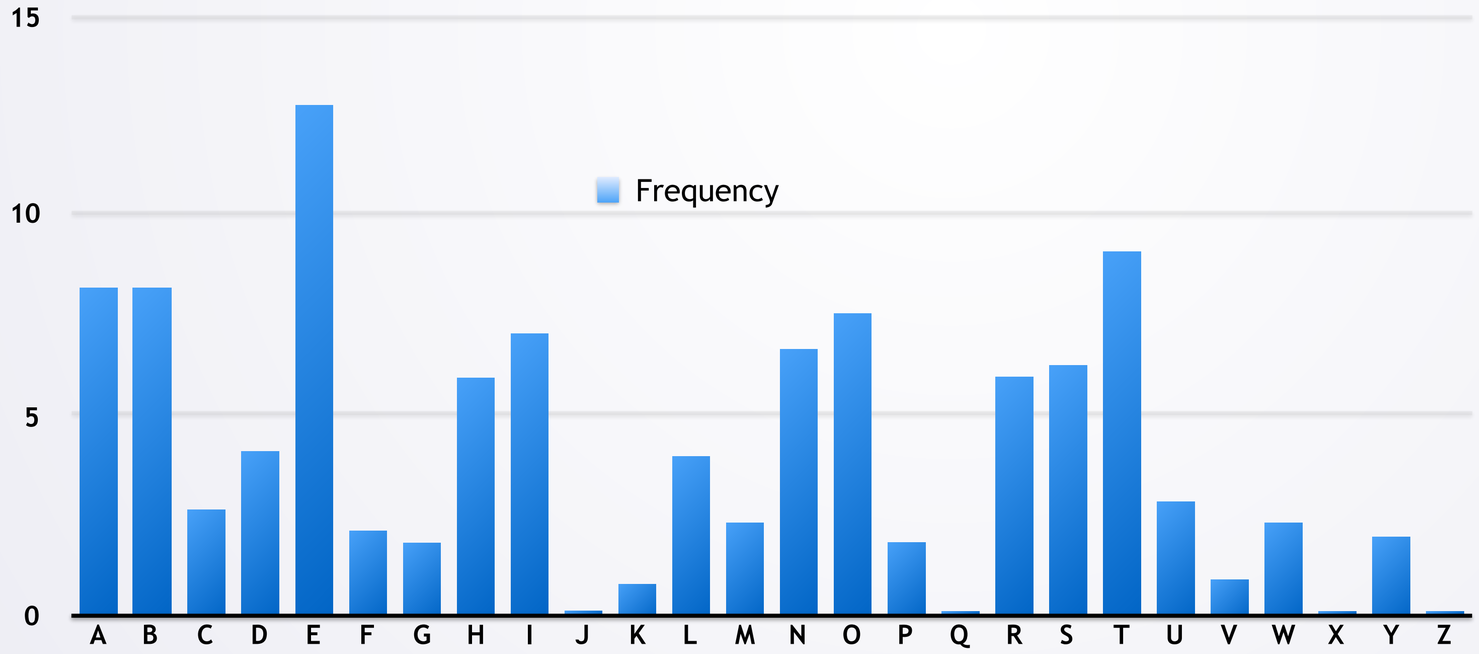
Decrypt Without Eyeball/Human

- Rely on letter frequencies in English
  - Use frequencies in other languages as needed
  - We will find the maximally occurring character
  - Assume this is 'e', find shift!



Counting Occurrences

```
Hi, do you want a lollipop today?
I own many good flavors,
but banana is outstanding.
```

- Code to scan text and increment counter

```
{0,0,0,0,0,0,0,0,0,0,0,0,0,0…,0,0,0}
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"A B C D E F G H I…… O       X Y Z"
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```
{9,2,0,4,0,1,2,1,5,0,0,4,1,7,10,2,0,1,3,5,3,1,2,0,3,0}
```

```
 0 1 2 3 4 5 6 7 8……14      23 24 25
"A B C D E F G H I…… O       X  Y  Z"
```

Counting Occurrences with Code

```
String alph = "abcdefghijklmnopqrstuvwxyz";
int[] counts = new int[26];
for(int k=0; k < message.length(); k++){
    char ch = Character.toLowerCase(message.charAt(k));
    int dex = alph.indexOf(ch);
    if (dex != -1){
        counts[dex] += 1;
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}
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- Scan message, if character is alphabetic:
  - Find location in "abcdefghijklmnopqrstuvwxyz"
  - Use index to increment one of 26 counters

From Algorithm to Code

```
public String decrypt(String encrypted){
   CaesarCipher cc = new CaesarCipher();
   int[] freqs = countLetters(encrypted);
   int maxDex = maxIndex(freqs);
   int dkey = maxDex - 4;
   if (maxDex < 4) {
     dkey = 26 - (4-maxDex);
   }
   return cc.encrypt(encrypted,26-dkey);
}
```

- Count 26 frequencies of 'a'-'z', 'A'-'Z'

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  - Find distance from 'e' which has index 4

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- Count 26 frequencies of 'a'-'z', 'A'-'Z'
  - Find largest value, assume it's 'e'
  - Find distance from 'e' which has index 4
  - Use 26-distance to decrypt using encrypt!

Values, Indexes, Details

- Array **`freqs`** has relationship between index and value, **`freqs[8]`** is how many times 'i' occurs
  - When looking for maximal value, return ***index***, use to find distance from 'e' or 4 as shift

```
public int maxIndex(int[] vals){
    int maxDex = 0;
    for(int k=0; k < vals.length; k++){
      if (vals[k] > vals[maxDex]){
        maxDex = k;
      }
    }
    return maxDex;
}
```

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- Using the CaesarCipher class makes writing CaesarBreaker easier

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- Array **`freqs`** has relationship between index and value, **`freqs[8]`** is how many times 'i' occurs
  - When looking for maximal value, return ***index***, use to find distance from 'e' or 4 as shift
- Using the CaesarCipher class makes writing CaesarBreaker easier
  - Call methods that work rather than rewriting