Writing Programs
Example: Inventory Display

- Use cases
  - 5 items
  - 4 items with maintenance schedules
  - Inventory from receipts as they come.
5 Coins: How should we display the following

- I have a collection of 5 coins, all from the United States: A nickel from 1875 in uncirculated condition. A Quarter from 1916 that looks very worn, and a penny from 1946 in mint condition. I also have a silver dollar from 2015 in brilliant uncirculated condition. Last I have a Kennedy Half-dollar from 1970 in good condition.
5 Coins: How should we display the following

- I have a collection of 5 coins, all from the United States: A nickel from 1875 in uncirculated condition. A Quarter from 1916 that looks very worn, and a penny from 1946 in mint condition. I also have a silver dollar from 2015 in brilliant uncirculated condition. Last I have a Kennedy Half-dollar from 1970 in good condition.

- We could just display the whole thing as text:

```javascript
size(displayWidth,displayHeight);
textSize(width/30);
text("I have a collection of 5 coins, a
10,10,0.8*width,0.8*height");
```
I have a collection of 5 coins, all from the United States: A nickel from 1875 in uncirculated condition. A Quarter from 1916 that looks very worn, and a penny from 1946 in mint condition. I also have a silver dollar from 2015 in brilliant uncirculated condition. Last I have a Kennedy Half-dollar from 1970 in good condition.
5 Coins: How should we display the following

- We could display each line separately.

```plaintext
size(displayWidth, displayHeight);
textSize(width/30);
text("My Coins from the United States:", 10, 10, 0.8*width)
text("A nickel from 1875 in uncirculated condition.", 50, 10 +
text("A Quarter from 1916 that looks very worn.", 50, 10 + 3*width)
text("A penny from 1946 in mint condition.", 50, 10 + 3*width)
text("A silver dollar from 2015 in brilliant uncirculated condition.",
```
Each Line Separately

My Coins from the United States:
A nickel from 1875 in uncirculated condition.
A Quarter from 1916 that looks very worn
A penny from 1946 in mint condition.
A silver dollar from 2015 in brilliant uncirculated condition.
A Kennedy Half-dollar from 1970 in good condition.
5 Coins: How should we display the following

- We could display key parts and label the columns:

```plaintext
size(displayWidth, displayHeight);
textSize(width/30);
text("My Coins from the United States:", 10, 10, 0);
text("type \t date \t condition", 50, 10 + width/20);
text("nickel \t 1875 \t uncirculated", 50, 10 + 2*width/20);
text("Quarter \t 1916 \t very worn.", 50, 10 + 3*width/20);
text("penny \t 1946 \t mint condition.", 50, 10 + 4*width/20);
text("silver dollar \t 2015 \t brilliant uncirculated.");
text("Half-dollar \t 1970 \t good ", 50, 10 + 6*width/20);
```
## Labeled Columns?

<table>
<thead>
<tr>
<th>Type</th>
<th>Date</th>
<th>Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nickel</td>
<td>1875</td>
<td>Uncirculated</td>
</tr>
<tr>
<td>Quarter</td>
<td>1916</td>
<td>Very worn</td>
</tr>
<tr>
<td>Penny</td>
<td>1946</td>
<td>Mint condition</td>
</tr>
<tr>
<td>Silver dollar</td>
<td>2015</td>
<td>Brilliant Uncirculated</td>
</tr>
<tr>
<td>Half-dollar</td>
<td>1970</td>
<td>Good</td>
</tr>
</tbody>
</table>
5 Coins: How should we display the following

- We need to do columns ourselves:

```swift
size(displayWidth, displayHeight);
textSize(width/30);
text("My Coins from the United States:", 10, 10, 0.8*width, width/20);
text("type",50, 10 + width/20, 0.8*width, width/20);
text("date",50 + 200, 10 + width/20, 0.8*width, width/20);
text("condition",50 + 400, 10 + width/20, 0.8*width, width/20);
text("nickel \t 1875 \t uncirculated", 50, 10 + 2*width/20, width/20);
text("Quarter \t 1916 \t very worn.", 50, 10 + 3*width/20, 0.8*width, width/20);
text("penny \t 1946 \t mint condition.",50, 10 + 4*width/20, width/20);
text("silver dollar \t 2015 \t brilliant uncirculated ", 50, thickness/20, width/20);
text("Half-dollar \t 1970 \t good ", 50, 10 + 6*width/20, 0.8*width, width/20);
```
## Labeled Columns?

<table>
<thead>
<tr>
<th>type</th>
<th>date</th>
<th>condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>nickel</td>
<td>1875</td>
<td>uncirculated</td>
</tr>
<tr>
<td>Quarter</td>
<td>1916</td>
<td>very worn.</td>
</tr>
<tr>
<td>penny</td>
<td>1946</td>
<td>mint condition.</td>
</tr>
<tr>
<td>silver</td>
<td>2015</td>
<td>brilliant uncirculated</td>
</tr>
<tr>
<td>Half-dollar</td>
<td>1970</td>
<td>good</td>
</tr>
</tbody>
</table>
5 Coins: How should we display the following

- Let's repeat for all cells:

```r
text("My Coins from the United States:", 1
text("type",50, 10 + width/20, 0.8*width,
text("date",50 + 200, 10 + width/20, 0.8*w
text("condition",50 + 400, 10 + width/20,

text("Nickel",50, 10 + 2*width/20, 0.8*wid
text("1875",50 + 200, 10 + 2*width/20, 0.8
text("uncirculated",50 + 400, 10 + 2*width

```

```r
text("Quarter",50, 10 + 3*width/20, 0.8*wi
text("1916",50 + 200, 10 + 3*width/20, 0.8
```
All rows with labeled columns:

<table>
<thead>
<tr>
<th>My Coins from the United States:</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>type</td>
<td>date</td>
<td>condition</td>
</tr>
<tr>
<td>Nickel</td>
<td>1875</td>
<td>uncirculated</td>
</tr>
<tr>
<td>Quarter</td>
<td>1916</td>
<td>very worn</td>
</tr>
<tr>
<td>penny</td>
<td>1946</td>
<td>mint</td>
</tr>
<tr>
<td>silver dollar</td>
<td>1915</td>
<td>brilliant uncirculated</td>
</tr>
<tr>
<td>Half-dollar</td>
<td>1970</td>
<td>good</td>
</tr>
</tbody>
</table>
Fix the column width

size(displayWidth, displayHeight);
textSize(width/30);
text("My Coins from the United States:", 10, 10, 6)
text("type",50, 10 + width/20, 0.8*width, width/26)
text("date",50 + 300, 10 + width/20, 0.8*width, width/26)
text("condition",50 + 500, 10 + width/20, 0.8*width,

text("Nickel",50, 10 + 2*width/20, 0.8*width, width/26)
text("1875",50 + 300, 10 + 2*width/20, 0.8*width,

text("uncirculated",50 + 500, 10 + 2*width/20, 0.8*width,

text("Quarter",50, 10 + 3*width/20, 0.8*width, width/26)
My Coins from the United States:

<table>
<thead>
<tr>
<th>type</th>
<th>date</th>
<th>condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nickel</td>
<td>1875</td>
<td>uncirculated</td>
</tr>
<tr>
<td>Quarter</td>
<td>1916</td>
<td>very worn</td>
</tr>
<tr>
<td>penny</td>
<td>1946</td>
<td>mint</td>
</tr>
<tr>
<td>silver dollar</td>
<td>2015</td>
<td>brilliant uncirculated</td>
</tr>
<tr>
<td>Half-dollar</td>
<td>1970</td>
<td>good</td>
</tr>
</tbody>
</table>
So far

- We displayed 5 coins without
  - variables
  - conditions
  - loops
  - arrays
  - classes

- How can we improve this?
Refactoring:

- Which values should be stored as variables?

- Is there repeated code?
  - does it fit best in a
    - loop?
    - method?
  - Do you call the exact function/method multiple times?
  - What is the relationship between the repeated code?

- Is there repeated structure?
  - Would arrays make sense to handle this repeated structure?
  - What about making your own class?
Which values should be stored as variables?

- Short answer:
  - All of them.

- Long answer:
  - Values you use as arguments should have names with meaning.
    - such as int nickelYear;
  - You should always store the result of a (non-void) function/method call.
  - values that you use in expressions should have names with meaning
    - such as numCoins
An expression that is repeated in your code multiple times should be stored as a variable:

- for example
  - `ellipse(width/2, height/2, 200, 200);
    ellipse(width/2, height/2, 100, 100);
  - should become
  - `float centerX = width/2;
    float centerY = height/2;
    ellipse(centerX, centerY, 200, 200);
    ellipse(centerX, centerY, 100, 100);`
Repeated Code (functions)

- A block of code that is repeated multiple times should become a function/method:

```java
void plotRow(String left, String mid, String right, int index) {
    text(left, 50, 10 + index * width/20, 0.8*width, width/20);
    text(right, 50 + 300, 10 + index * width/20, 0.8*width, width/20);
    text(mid, 50 + 500, 10 + index * width/20, 0.8*width, width/20);
}
```
Repeated Code (loops)

A block of code that is repeated multiple times in sequence with regular or predictable changes each time should be put into a loop:

- `text("My Coins from the United States:", 10, 10, 0.8*width, width/20);
- `text("A nickel from 1875 in uncirculated condition.", 20, 10 + width/20, 0.8*width, width/20);
- `text("A Quarter from 1916 that looks very worn", 20, 10 + 2*width/20, 0.8*width, width/20);
- `text("A penny from 1946 in mint condition.", 20, 10 + 3*width/20, 0.8*width, width/20);
- `text("A silver dollar from 2015 in brilliant uncirculated condition.", 20, 10 + 4*width/20, 0.8*width, width/20);
- `text("A Kennedy Half-dollar from 1970 in good condition.", 20, 10 + 6*width/20, 0.8*width, width/20);

For loop version:

- `String[] lines =
  {"My Coins from the United States:",
   "A nickel from 1875 in uncirculated condition.",
   "A Quarter from 1916 that looks very worn",
   "A penny from 1946 in mint condition.",
   "A silver dollar from 2015 in brilliant uncirculated condition.",
   "A Kennedy Half-dollar from 1970 in good condition."};

  for (int i = 0; i < lines.length; i++) {
    `text(line[i],10,
    10 + i * width/20,
    0.8*width, width/20);
  }
**Arrays of Strings vs. Array of Objects**

<table>
<thead>
<tr>
<th>Arrays of Strings</th>
<th>Array of Objects</th>
</tr>
</thead>
<tbody>
<tr>
<td>String[] types;</td>
<td>Coin[] coins;</td>
</tr>
<tr>
<td>String[] years;</td>
<td>class Coin {</td>
</tr>
<tr>
<td>String[] conditions;</td>
<td>String type;</td>
</tr>
<tr>
<td>Alternatively:</td>
<td>String year;</td>
</tr>
<tr>
<td>String[][] cells;</td>
<td>String condition;</td>
</tr>
</tbody>
</table>

Loop through your array(s) to display your coins row by row.
Exercise: Refactor FiveCoins

Step 1: make more general
- variables
- repeated code changes
  - functions
  - variables
  - loops
- Make Arrays of Strings or Array of Coins

Step 2: read a file
- format:
  - comma separated
  - header line first
  - any number of rows after the header line.