+
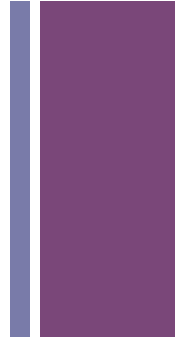
Writing Programs

+ 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.
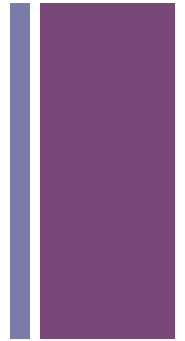
5 Coins: How should we display the following

- 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.
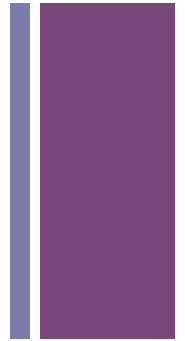
- We could just display the whole thing as text:

```
size(displayWidth,displayHeight);
textSize(width/30);
text("I have a collection of 5 coins, a
      10,10,0.8*width,0.8*height);
```

+ Just display it all!

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.
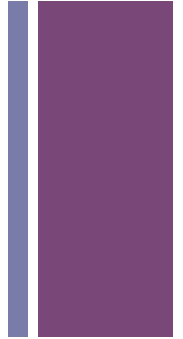
5 Coins: How should we display the following

- We could display each line separately.

```
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, :
text("A Quarter from 1916 that looks very worn.", 50, 10 +
text("A penny from 1946 in mint condition.",50, 10 + 3*wid·
text("A silver dollar from 2015 in brilliant uncirculated ·
text("A Kennedy Half-dollar from 1970 in good 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:

```
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*
text("Quarter \t 1916 \t very worn.", 50, 10 + 3*w
text("penny \t 1946 \t mint condition.",50, 10 + 4
text("silver dollar \t 2015 \t brilliant uncircula
text("Half-dollar \t 1970 \t good ", 50, 10 + 6*wi
```

+ Labeled Columns?

My Coins from the United States:

type date condition
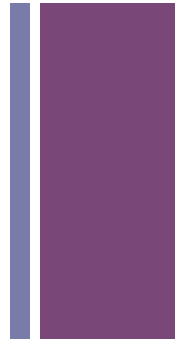
nickel 1875 uncirculated

Quarter 1916 very worn.

penny 1946 mint condition.

silver dollar 2015 brilliant uncirculated

Half-dollar 1970 good

5 Coins: How should we display the following

- We need to do columns ourselves:

```
size(displayWidth, displayHeight);
textSize(width/30);
text("My Coins from the United States:", 10, 10, 0.8*width, w
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, 0
text("Quarter \t 1916 \t very worn.", 50, 10 + 3*width/20, 0.
text("penny \t 1946 \t mint condition.",50, 10 + 4*width/20,
text("silver dollar \t 2015 \t brilliant uncirculated ", 50,
text("Half-dollar \t 1970 \t good ", 50, 10 + 6*width/20, 0.8
```

Labeled Columns?

My Coins from the United States:
 type   date   condition
 nickel 1875 uncirculated
 Quarter 1916 very worn.
 penny 1946 mint condition.
 silver dollar 2015 brilliant uncirculated
 Half-dollar 1970 good

5 Coins: How should we display the following

- Let's repeat for all cells:

```
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

text("Quarter",50, 10 + 3*width/20, 0.8*wi
```

All rows with labeled columns:

My Coins from the United States:

type	date	condition
Nickel	1875	uncirculated
Quarter	1916	very worn
penny	1946	mint
silver dollar	2015	brilliant uncirculated
Half-dollar	1970	good

+ Fix the column width

```
size(displayWidth, displayHeight);
textSize(width/30);
text("My Coins from the United States:", 10, 10, 0
text("type",50, 10 + width/20, 0.8*width, width/20
text("date",50 + 300, 10 + width/20, 0.8*width, wi
text("condition",50 + 500, 10 + width/20, 0.8*widt

text("Nickel",50, 10 + 2*width/20, 0.8*width, widt
text("1875",50 + 300, 10 + 2*width/20, 0.8*width,
text("uncirculated",50 + 500, 10 + 2*width/20, 0.8

text("Quarter",50, 10 + 3*width/20, 0.8*width, wic
```
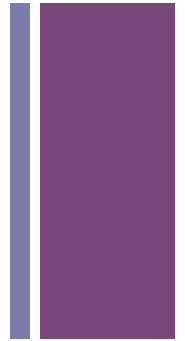
My Coins from the United States:		
type	date	condition
Nickel	1875	uncirculated
Quarter	1916	very worn
penny	1946	mint
silver dollar	2015	brilliant uncirculated
Half-dollar	1970	good

+ So far
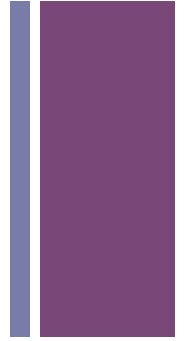
- We displayed 5 coins without
  - variables
  - conditions
  - loops
  - arrays
  - classes

- How can we improve this?

+ Refactoring:
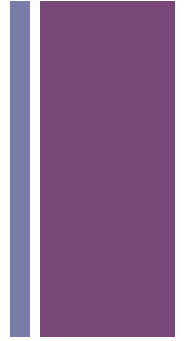
- Which values should be stored as variables?

- 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?
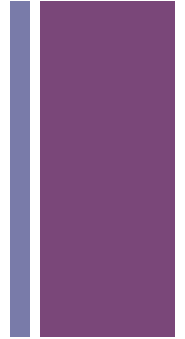
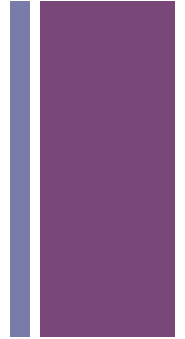- Short answer:
  - All of them.

- 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

Repeated Code (variables)

- 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:

  - ```
    text("type",50, 10 + width/20, 0.8*width, width/20);
    text("date",50 + 300, 10 + width/20, 0.8*width,
    width/20);
    text("condition",50 + 500, 10 + width/20, 0.8*width,
    width/20);
    ```

  - ```
    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, 2*width/20);
text("A Kennedy Half-dollar from
1970 in good condition.", 20, 10
+ 6*width/20, 0.8*width,
2*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

Arrays of Strings	Array of Objects

- `String[] types;`
  `String[] years;`
  `String[] conditions;`

- Alternatively:
  - `String[][] cells;`

- `Coin[] coins;`

```
class Coin {
    String type;
    String year;
    String condition;
}
```

Loop through your array(s) to display your coins row by row.

+

Exercise: Refactor FiveCoins

Step 1: make more general	Step 2: read a file

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.