Objectives

- Data Representations, continued
- String Formatting

FORMATTING STRINGS

Solution: `format` Method

- How to use:
  - `"templatestring".format(<tobeformatted>)`
- `templatestring` allow us to control how output is displayed to user
  - Examples:
    - Right, left justification
    - Number of decimals to display

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Solution: `format` Method

- How to use:
  - `"templatestring".format(<tobeformatted>)`
- Semantics: creates a **formatted string**
  - Means "format the `templatestring`, using the format(s) specified by ***format specifiers*** on the corresponding replacement values"
  - Evaluates to/returns a `str` data type
- Typically used with print statements

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Formatting Strings: format Method

- `templatestring` is a template for the resulting string with format specifiers instead of the values
  - For each format specifier in templatestring, should have a ***replacement value***

```
"{:.2f}".format(3.14159)
```

Evaluates to `"3.14"`

One format specifier in template string

Corresponding replacement value

  - Throws **`IndexError`** if not enough replacements for specifiers in `templatestring`

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Format Specifiers

[ ] mean optional

- General format: `{[field_name]:conversion}`

index number of the argument, i.e., which field in the template string

- `conversion`
  - conversion code of the data type

Code	Type
s	string
d	integer
f	float
e	floating point with exponent

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Format Specifiers

[ ] mean optional

Conversion options

```
:[flags][width][.precision][code]
```

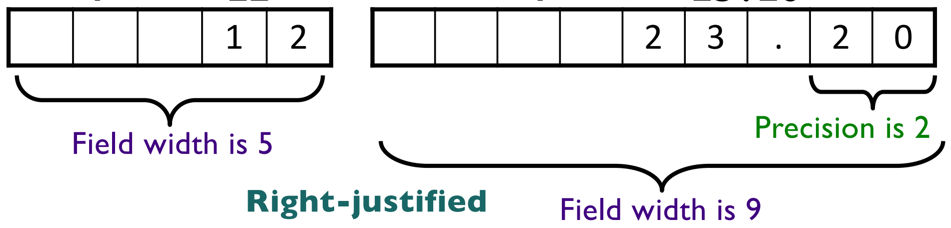
- flags:

Flag	Meaning
0	Zero fill to width
+	Adds a + sign before positive values
<	Left justify (default for strings)
>	Right justify (default for numbers)
^	center

- **width**:
  - *Minimum* number of character spaces reserved to display the entire value
  - Includes decimal point, digits before and after the decimal point and the sign
- **precision**:
  - Number of digits after the decimal point for **floating point** values

Example Format Specifiers

```
"{:5d}".format(12)   "{:9.2f}".format(23.1999)
      → "   12"            → "     23.20"
```

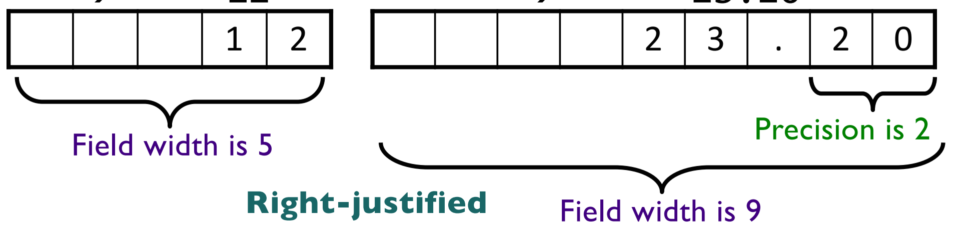


- What if precision is bigger than the decimal places?
- What if field width is smaller than the length of the value?

Any guesses? Try out in interpreter.

Example Format Specifiers

```
"{:5d}".format(12)        "{:9.2f}".format(23.1999)
     → "   12"                   → "    23.20"
```



- What if precision is bigger than the decimal places?
  - Fills decimal with 0s
- What if field width is smaller than the length of the value?
  - String contains entire value

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Formatting Practice

- `x = 10`
- `y = 3.5`
- `z = "apple"`
- `"{:6d}".format(x)`
- `"{:6.2f}".format(x)`
- `"{:6.2f}".format(y)`
- `"{:06.2f}".format(y)`
- `"{:^11s}".format(z)`
- `"{:5d} {:<7.3f}".format(x,y)`

What is the resulting string?

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String Formatting

- There is a lot more you can do with string formatting
  - This is a subset of the most commonly used functionality
- When formatting strings, consider
  - What is the data type of your data?
    - If a float, how many decimal places do you want?
  - How wide do you want the data to be?
  - What justification? Zero fill? Other flags?
- The answer to these questions help guide your creation of format specifiers

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Using `format` Method in `print`

- You often want to format data within a broader context.
- Example: printing out money values
  - How do you want that data formatted?

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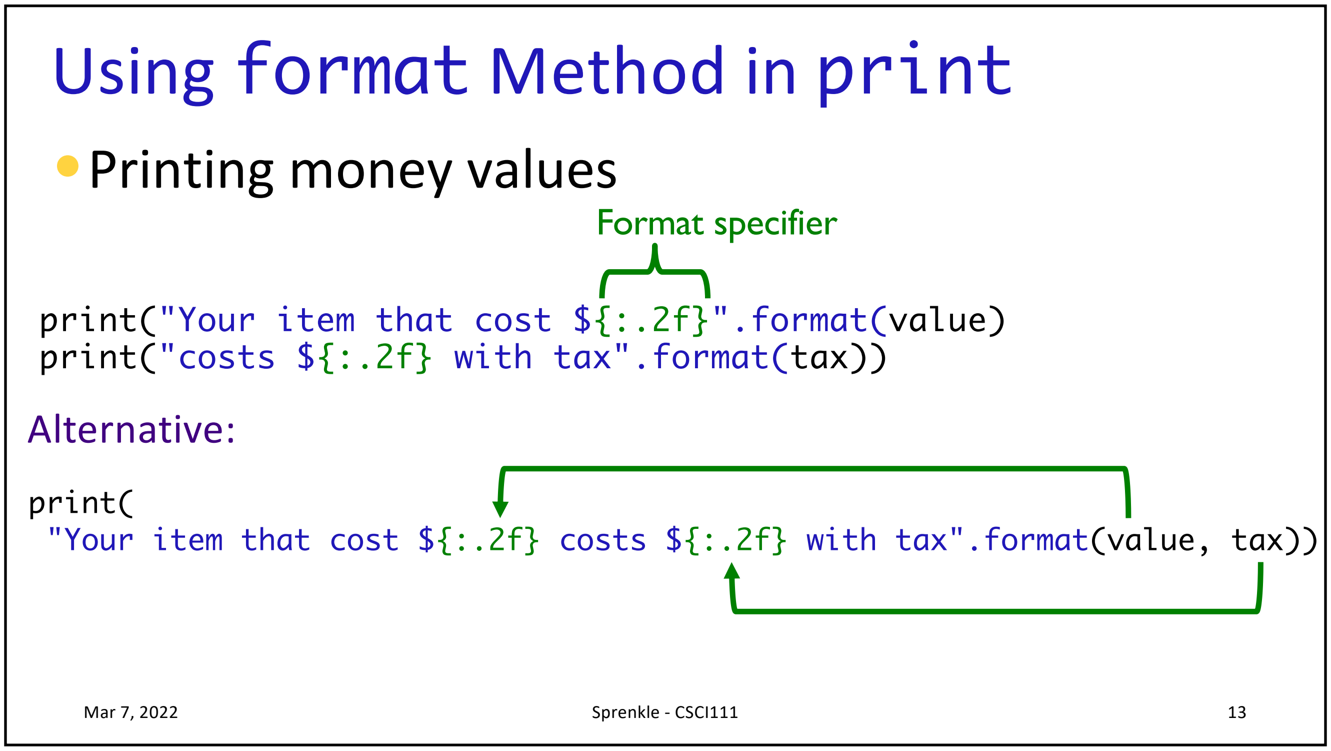

Using format Method in print

- Printing money values

Format specifier

```
print("Your item that cost ${:.2f}".format(value)
print("costs ${:.2f} with tax".format(tax))
```

Alternative:

```
print(
 "Your item that cost ${:.2f} costs ${:.2f} with tax".format(value, tax))
```

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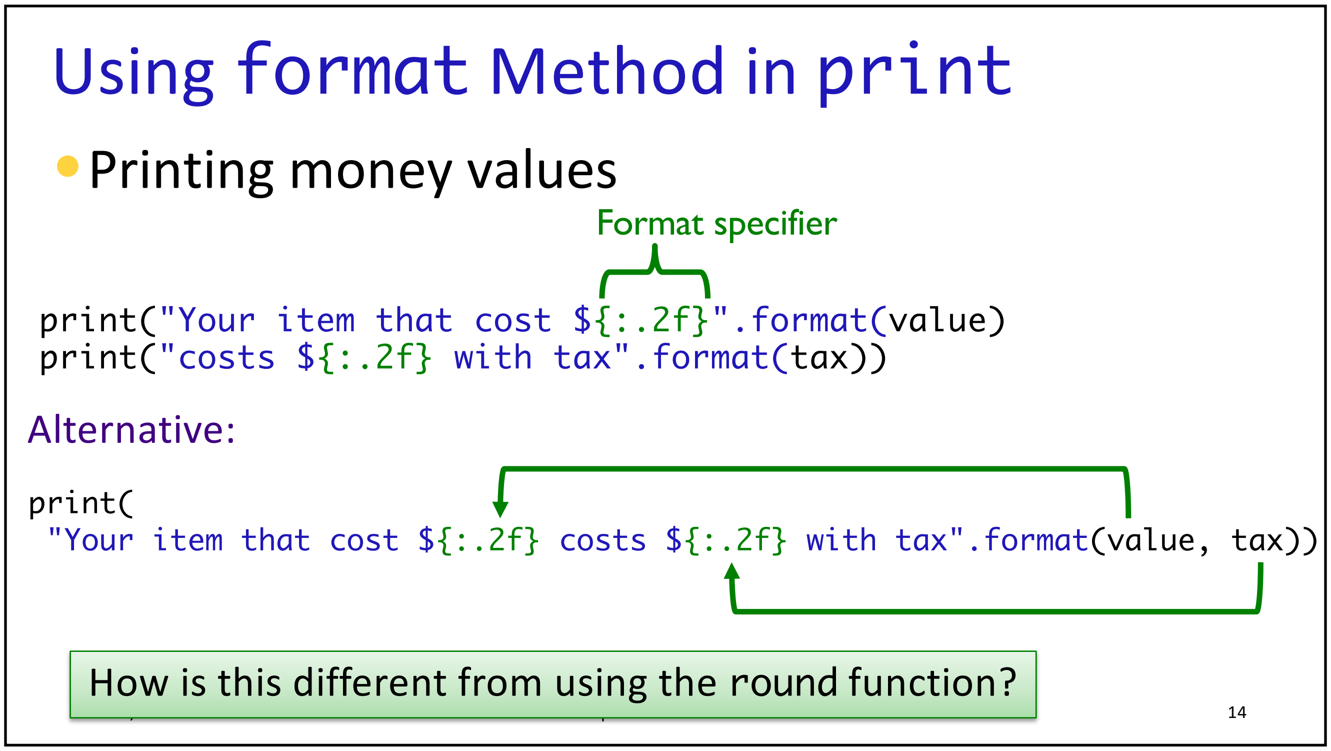

Using format Method in print

- Printing money values

Format specifier

```
print("Your item that cost ${:.2f}".format(value)
print("costs ${:.2f} with tax".format(tax))
```

Alternative:

```
print(
 "Your item that cost ${:.2f} costs ${:.2f} with tax".format(value, tax))
```

How is this different from using the round function?

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Example: Printing Out Tables

- A table of temperature conversions

```
Temp F      Temp C      Temp K
------      ------      ------
-459.7      -273.1         0.0
   0.0       -17.8       255.2
  32.0         0.0       273.1
```

- If we want to print data in rows, what is the template for what a row looks like?
  - How do we make the column labels line up?
  - For above, not as simple as using tabs. Why not?

`temp_table.py`

String Formatting Conclusion

- There is a lot more you can do with string formatting
  - This is a subset of the most commonly used functionality
- When formatting strings, consider the data's type and how you want it to look and then apply the appropriate format specifier to get that look

Review

- What is the special name for one way that computers encode strings?
  - How can we convert between characters and their numerical representation?
  - How can we convert from the numerical representation to the character?
- How does the Caesar Cipher work?

Review: Translating to/from ASCII

- Translate a character into its ASCII numeric code using **built-in function** `ord`
  - `ord('a') ==> 97`
- Translate an ASCII numeric code into its character using **built-in function** `chr`
  - `chr(97) ==> 'a'`

`ascii_table.py`
`ascii.py`

Review: Caesar Cipher

- Replace character with a character X places away
    - X is called the ***key***
- Julius Caesar used technique to communicate with his generals
- "Wrap around" within the lowercase letters
- Write program(s) to do this in next lab

Original Letter	Key	Encrypted Letter
'a'	1	'b'
'b'	1	'c'
'z'	1	'a'

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Caesar Cipher

- Using the ASCII handout, what would be the encoded messages?

Message	Key	Encoded Message
apple	5	
zebra	5	
the eagle flies at midnight	-5	

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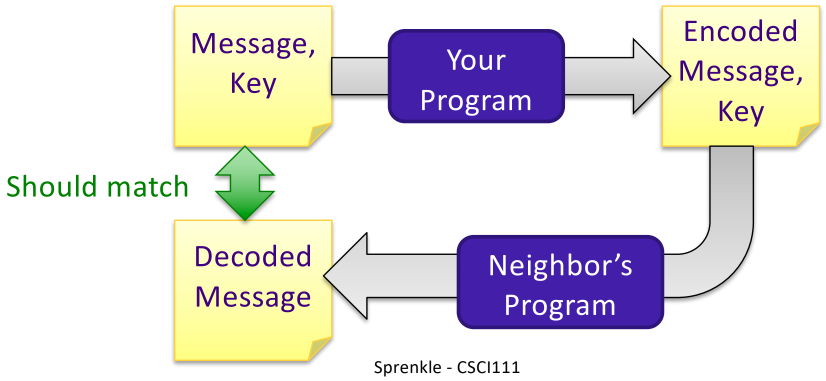
Caesar Cipher

Message	Key	Encoded Message
apple	5	fuuqj
zebra	5	ejgwf
the eagle flies at midnight	-5	ocz zvbgz agdzn vo hdyidbco

What is your algorithm for the encoding process?
→ Break into pieces
How would you *decode* an encrypted message?

Next Lab

- Write an encoding/decoding program
  - Encode a message
  - Give to a friend to decode



Caesar Cipher: `encryptLetter`

- Given a letter and key
- Convert the character to its ASCII value
- Add the key to that value
- Make sure that the new value is a "valid" ASCII value, i.e., that that new value is in the range of lowercase letter ASCII values
  - If not, "wrap around" to adjust that value so that it's in the valid range
- Convert the ASCII value into a character
- Return the encrypted letter

Caesar Cipher (Partial) Algorithm

- Given a message and key
- For each character in the message
  - Check if the character is a space or punctuation
    - if it is, it stays that character
  - Otherwise
    - encrypt letter
- Return the message

Looking Ahead

- Lab 7 prep
  - Repeat sections on simple tables (with escape characters), string methods (which includes the subsection on format method), and character classifications
  - Think about how to implement the Caesar Cipher
- Lab 7