CSc 110, Spring 2018

Lecture 2: Functions

Escape sequences

- **escape sequence**: A special sequence of characters used to represent certain special characters in a string.

`\t`	tab character
`\n`	new line character
`\"`	quotation mark character
`\'`	quotation mark character
`\\`	backslash character

- Example:

```
print("\\hello\nhow\tare \"you\"?\\\\")
```

- Output:

```
\hello
how	are "you"?\\
```

Questions

- What is the output of the following `print` statements?

```
print("\ta\tb\tc")
print("\\\\")
print("'")
print("\"\"\"")
print("C:\nin\the downward spiral")
```

- Write a `print` statement to produce this output:

```
/ \ // \\ /// \\\
```

Answers

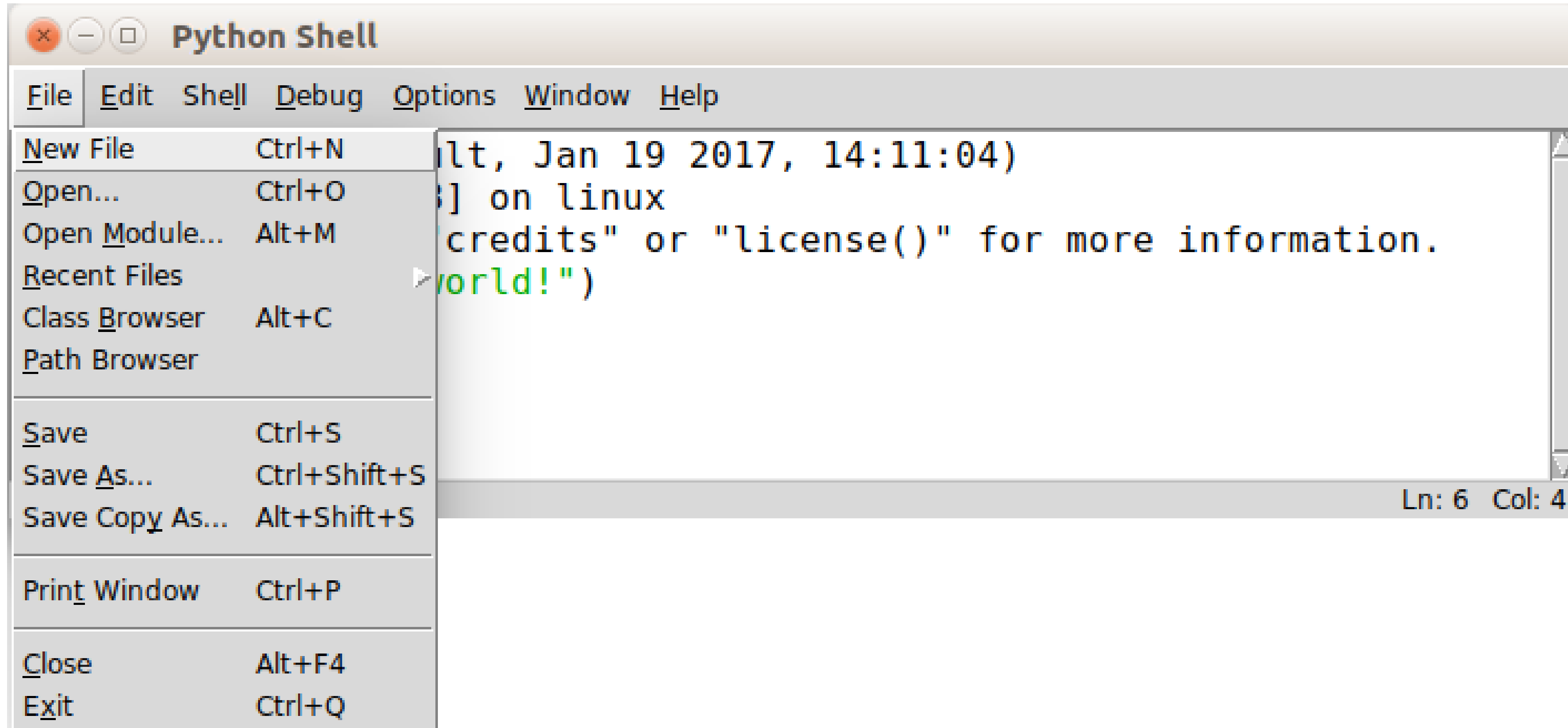
- Output of each `print` statement:

```
        a       b       c
\\
'
""""
C:
in      he downward spiral
```

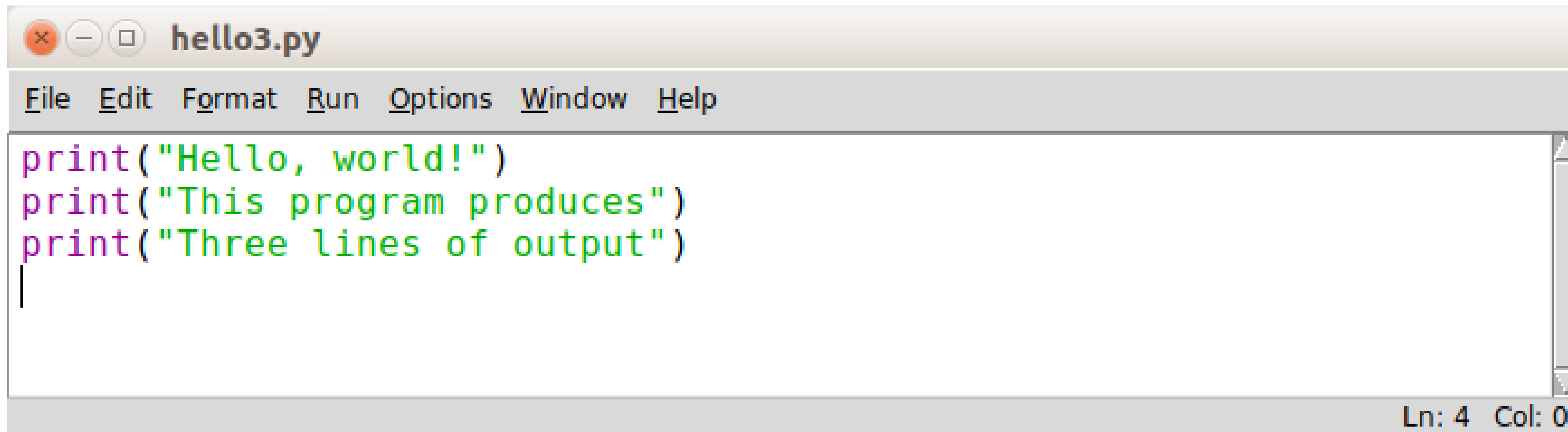
- `print` statement to produce the line of output:

```
print("/ \\ // \\\\ /// \\\\\\")
```

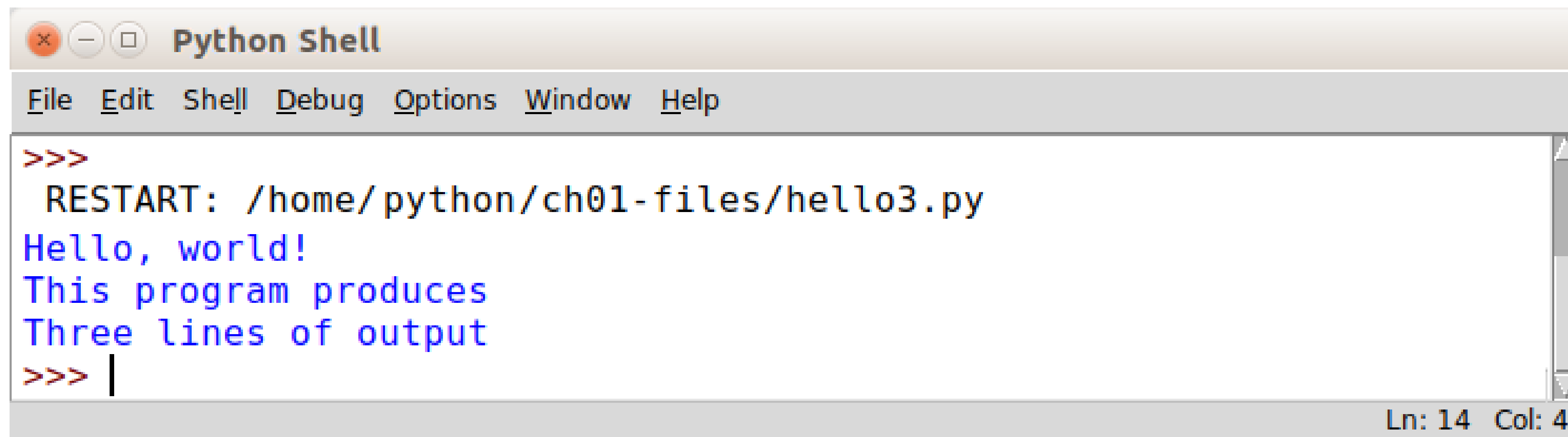
Creating a Python Program File



Creating a Python Program File



When Run -> Run Module is selected:



Comments

- **comment**: A note written in source code by the programmer to describe or clarify the code.
  - Comments are not executed when your program runs.
- Syntax:

  # **comment text**

- Examples:

```
# This is a one-line comment.

# This is a very long
# multi-line comment.
```

Comments example

```
# Suzy Student,
# CSc 110, Fall 2019
# Displays lyrics

# first line
print("When I first got into magic")
print("it was an underground phenomenon")
print()

# second line
print("Now everybody's like")
print("pick a card, any card")
```

functions

Algorithms

- **algorithm**: A list of steps for solving a problem.
- Example algorithm: "Bake sugar cookies"
  - Mix the dry ingredients.
  - Cream the butter and sugar.
  - Beat in the eggs.
  - Stir in the dry ingredients.
  - Set the oven temperature.
  - Set the timer for 10 minutes.
  - Place the cookies into the oven.
  - Allow the cookies to bake.
  - Spread frosting and sprinkles onto the cookies.
  - ...

Problems with algorithms

- *lack of structure*: Many steps; tough to follow.
- *redundancy*: Consider making a double batch...
  - Mix the dry ingredients.
  - Cream the butter and sugar.
  - Beat in the eggs.
  - Stir in the dry ingredients.
  - Set the oven temperature.
  - Set the timer for 10 minutes.
  - Place the first batch of cookies into the oven.
  - Allow the cookies to bake.
  - Set the timer for 10 minutes.
  - Place the second batch of cookies into the oven.
  - Allow the cookies to bake.
  - Mix ingredients for frosting.
  - ...

Structured algorithms

- **structured algorithm**: Split into coherent tasks.

  1 Make the batter.
  - Mix the dry ingredients.
  - Cream the butter and sugar.
  - Beat in the eggs.
  - Stir in the dry ingredients.

  2 Bake the cookies.
  - Set the oven temperature.
  - Set the timer for 10 minutes.
  - Place the cookies into the oven.
  - Allow the cookies to bake.

  3 Decorate the cookies.
  - Mix the ingredients for the frosting.
  - Spread frosting and sprinkles onto the cookies.

  ...

Removing redundancy

- A well-structured algorithm can describe repeated tasks with less redundancy.

1 Make the cookie batter.
- Mix the dry ingredients.
- ...

2a Bake the cookies (first batch).
- Set the oven temperature.
- Set the timer for 10 minutes.
- ...

2b Bake the cookies (second batch).
- Repeat Step 2a

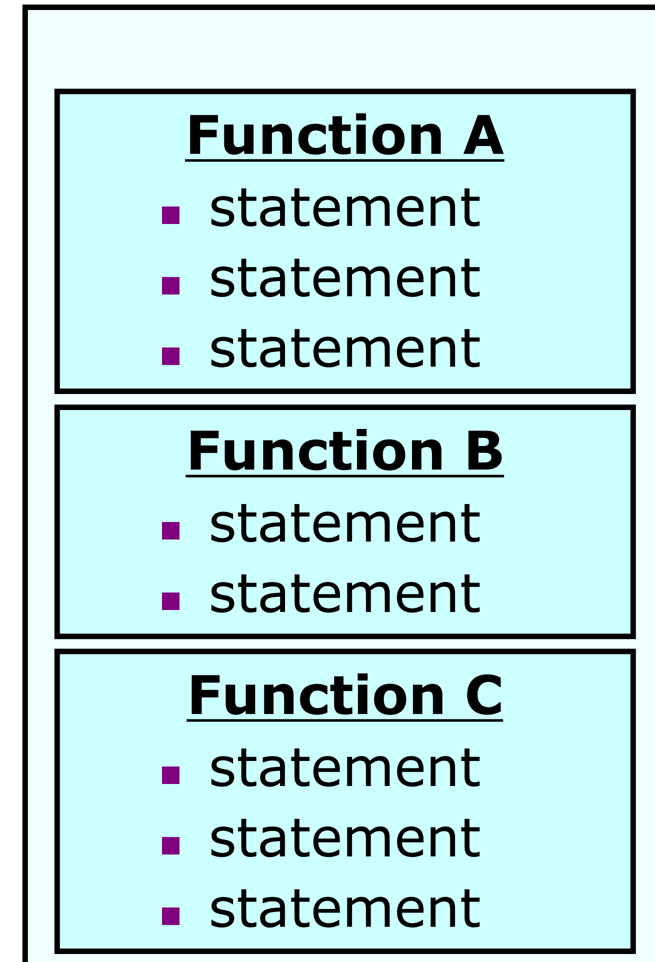
3 Decorate the cookies.
- ...

functions

- **function**: A named group of statements.
  - denotes the *structure* of a program
  - eliminates *redundancy* by code reuse

- **procedural decomposition**: dividing a problem into functions

- Writing a function is like adding a new command to Python.



Declaring a function

Gives your function a name so it can be executed

- Syntax:

```
def name():
    statement
    statement
    ...
    statement
```

- Example:

```
def print_warning():
    print("This product causes cancer")
    print("in lab rats and humans.")
```

Calling a function

Executes the function's code

- Syntax:

  name ()

  - You can call the same function many times if you like.

- Example:

```
print_warning()            #separate multiple words with underscores
```

  - Output:

```
This product causes cancer
in lab rats and humans.
```

Functions calling functions

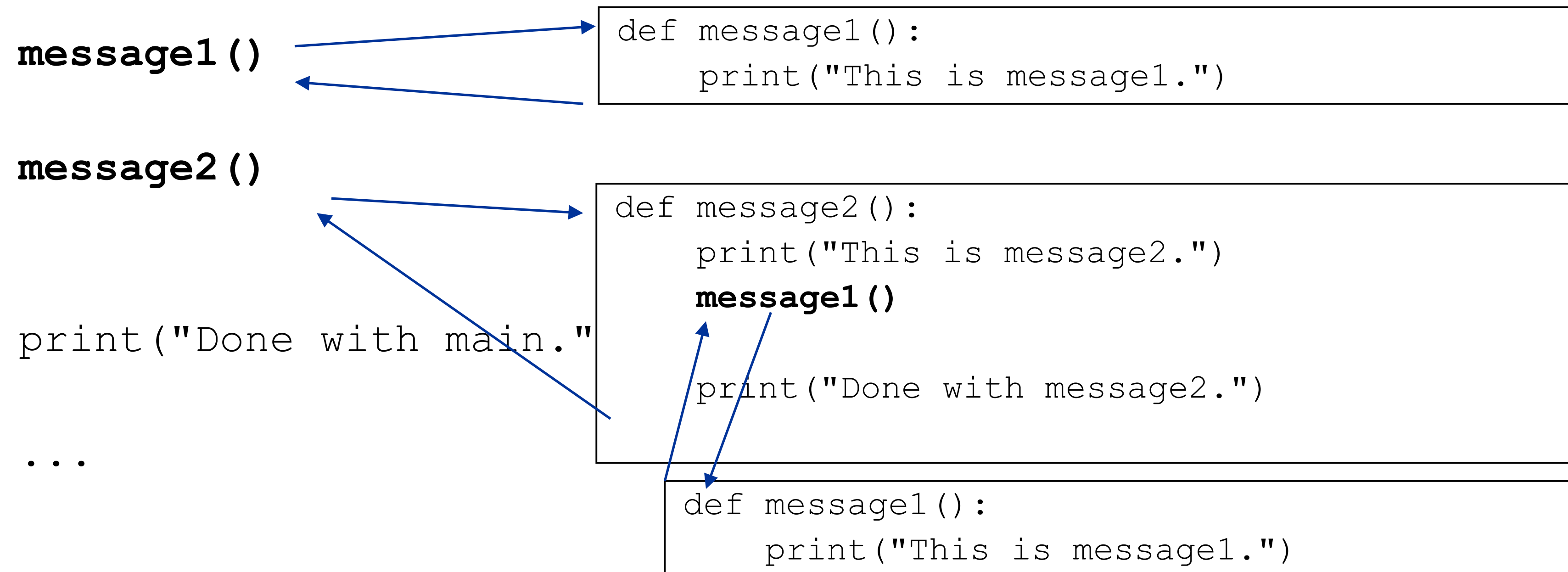
```
def message1():
    print("This is message1.")

def message2():
    print("This is message2.")
    message1()
    print("Done with message2.")

message1()
message2()
print("Done with everything.")
```

- **Output:**

```
This is message1.
This is message2.
This is message1.
Done with message2.
Done with main.
```

Control flow

- When a function is called, the program's execution...
  - "jumps" into that function, executing its statements, then
  - "jumps" back to the point where the function was called.



Structure of a program

- No code should be placed outside a function. Instead use a `main` function.
  - The one exception is a call to your main function

```
def main():
    message1()
    message2()
    print("Done with everything.")

def message1():
    print("This is message1.")


def message2():
    print("This is message2.")
    message1()
    print("Done with message2.")

main()
```

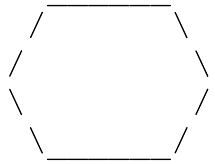
When to use functions (besides `main`)

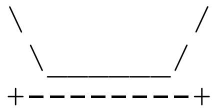
- Place statements into a function if:
  - The statements are related structurally, and/or
  - The statements are repeated.

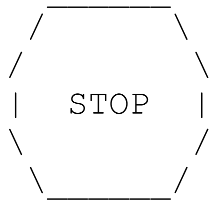
- You should not create functions for:
  - An individual `print` statement.
  - Only blank lines.
  - Unrelated or weakly related statements.
    (Consider splitting them into two smaller functions.)

Functions question

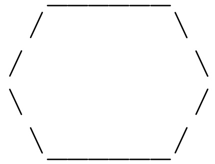
- Write a program to print these figures using functions.

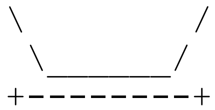


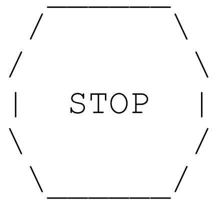


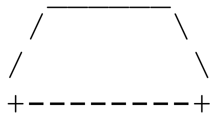


Development strategy









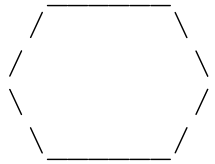
<u>First version (unstructured):</u>

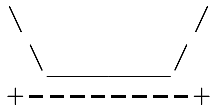
- Create an empty program.
- Copy the expected output into it, surrounding each line with `print` syntax.
- Run it to verify the output.

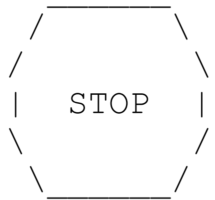
Program version 1

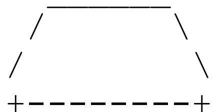
```
def main():
    print("  ______")
    print(" /      \\")
    print("/        \\")
    print("\\        /")
    print(" \\______/")
    print()
    print("\\        /")
    print(" \\______/")
    print("+--------+")
    print()
    print("  ______")
    print(" /      \\")
    print("/        \\")
    print("|  STOP  |")
    print("\\        /")
    print(" \\______/")
    print()
    print("  ______")
    print(" /      \\")
    print("/        \\")
    print("+--------+")

main()
```

Development strategy 2





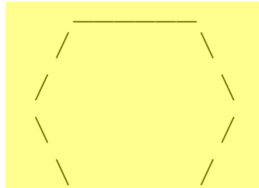


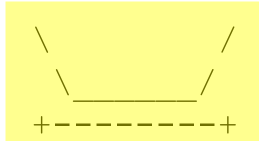


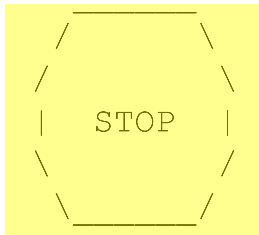
<u>Second version (structured, with redundancy):</u>

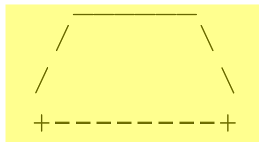
- Identify the structure of the output.
- Divide the code into functions based on this structure.

Output structure









The structure of the output:

- initial "egg" figure
- second "teacup" figure
- third "stop sign" figure
- fourth "hat" figure

This structure can be represented by functions:

- `egg`
- `tea_cup`
- `stop_sign`
- `hat`

Program version 2

```
def main():
    egg()
    tea_cup()
    stop_sign()
    hat()

def egg():
    print("   ______")
    print(" /       \\")
    print("/         \\")
    print("\\         /")
    print(" \\______/")
    print()

def tea_cup():
    print("\\         /")
    print(" \\______/")
    print("+--------+")
    print()

def stop_sign():
    print("   ______")
    print(" /       \\")
    print("/         \\")
    print("|  STOP   |")
    print("\\         /")
    print(" \\______/")
    print()

def hat():
    print("   ______")
    print(" /       \\")
    print("/         \\")
    print("+--------+")
```