CSc 110, Autumn 2017

Lecture 3: Functions

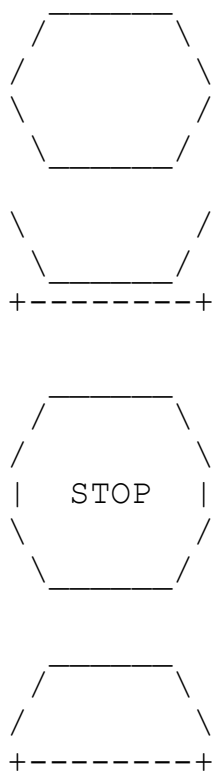
Structure of a program

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

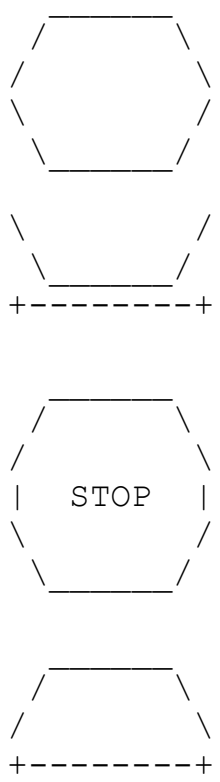
```
def main():
    message1()
    message2()
    print("Done with everything.")
def message1():
    print("This is message1.")


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

main()
```

Functions question

- Write a program to print these figures using functions.



Development strategy



First version (unstructured):

- 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

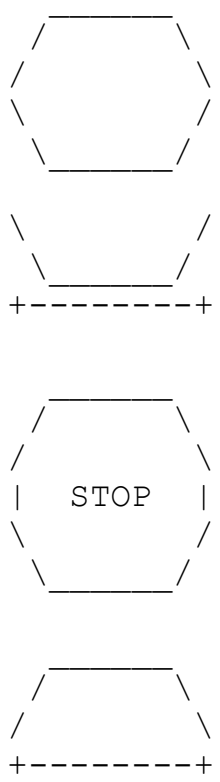
```
def main():
    print("  ______")
    print(" /      \\")
    print("/        \\")
    print("\\        /")
    print(" \\______/")
    print()
    print("\\        /")
    print(" \\______/")
    print("+--------+")
    print()
    print("  ______")
    print(" /      \\")
    print("/        \\")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

main()
```

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.)

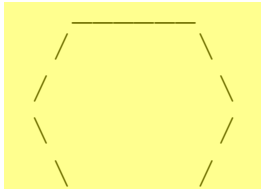
Development strategy 2

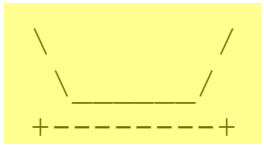


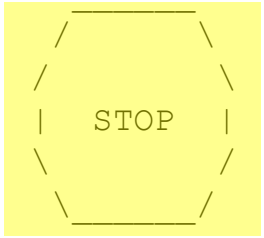
Second version (structured, with redundancy):

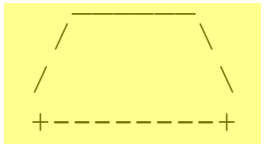
- Identify the structure of the output.
- Divide the code into functions based on this structure.

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:

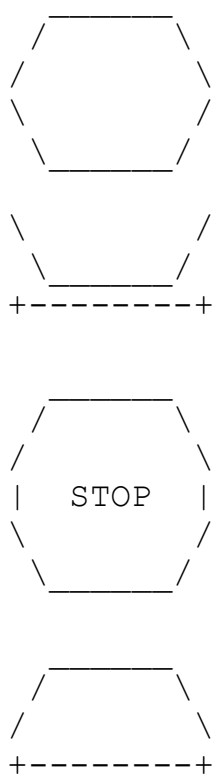
- `egg`
- `tea_cup`
- `stop_sign`
- `hat`

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("+--------+")
```

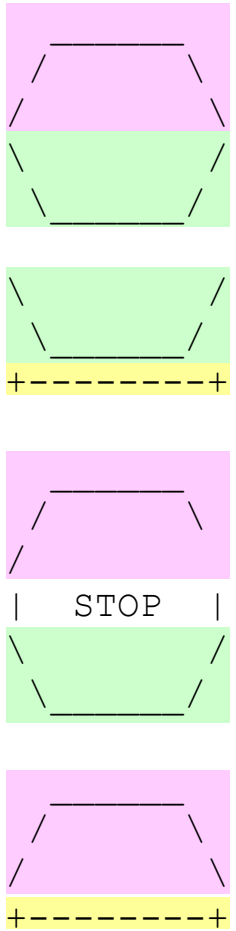
Development strategy 3



Third version (structured, without redundancy):

- Identify redundancy in the output, and create functions to eliminate as much as possible.
- Add comments to the program.

Output redundancy



The redundancy in the output:

- egg top: reused on stop sign, hat
- egg bottom: reused on teacup, stop sign
- divider line: used on teacup, hat

This redundancy can be fixed by functions:

- `egg_top`
- `egg_bottom`
- `line`

Program version 3

```
# Suzy Student, CSc 110, Spring 2094
# Prints several figures, with methods for structure and redundancy.
def main():
    egg()
    tea_cup()
    stop_sign()
    hat()

# Draws the top half of an an egg figure.
def egg_top():
    print("  ______")
    print(" /      \\")
    print("/        \\")

# Draws the bottom half of an egg figure.
def egg_bottom():
    print("\\        /")
    print(" \\______/")

# Draws a complete egg figure.
def egg():
    egg_top()
    egg_bottom()
    print()
```

```
# Draws a teacup figure.
def tea_cup():
    egg_bottom()
    line()
    print()

# Draws a stop sign figure.
def stop_sign():
    eggTop()
    print("|  STOP  |")
    egg_bottom()
    print()

# Draws a figure that looks sort of like a hat.
def hat():
    egg_top()
    line()

# Draws a line of dashes.
def line():
    print("+--------+")
```