Practice Quiz 4 (Weeks 9–10)

Name: _____

This work complies with the JMU Honor Code. I have neither given nor received unauthorized assistance. I will not discuss the quiz contents with anyone who has not taken the quiz. Initials: _____

Question 1 (0 pts)

Create these two files in the same folder. Start each file with a docstring: a one-line description, a blank line, and `Name:` followed by your name. After the docstring, type this code.

prac4.py

```
def digit_chain(n: int) -> list[int]:
    pass
```

test_prac4.py

```
import pytest

def test_digit_chain():
    pass

if __name__ == "__main__":
    pytest.main()
```

Question 2 (0 pts)

The `digit_chain()` function builds and returns a **digit chain** for a positive integer n. The chain starts with n. To get the next number, square each digit and add the squares. For example, the chain for 13 starts with 13. After 13 comes $1^2 + 3^2 = 10$, and after 10 comes $1^2 + 0^2 = 1$.

The chain ends when the next number is **already in the chain**. After 1 comes 1 again, so the chain for 13 is `[13, 10, 1]`. Other chains fall into a cycle, like the chain for 4, which comes back to 4.

In `test_prac4.py`, replace `pass` with four assert statements: one for each row of this table. Run the test program to make sure there are no syntax errors; the tests should fail at this point.

Call	Returns
`digit_chain(13)`	`[13, 10, 1]`
`digit_chain(1)`	`[1]`
`digit_chain(7)`	`[7, 49, 97, 130, 10, 1]`
`digit_chain(4)`	`[4, 16, 37, 58, 89, 145, 42, 20]`

Question 3 (6 pts) — 3 pts each

Before you write `digit_chain()`, plan the `while` loop that builds the chain. Fill in each blank with Python code or an English description.

a) The function builds the chain in a **list** named `chain`.

(1) Before the loop, `chain =` _____.

(2) Each time through the loop, add _____ to `chain`.

(3) Return `chain` _____ (inside or after the loop?).

b) Use a **set** named `seen` for the numbers already in the chain.

(1) Before the loop, `seen =` _____.

(2) The loop keeps going while _____.

(3) Each time through the loop, run _____.

Question 4 (2 pts) — 1 pt each

You will write a second `while` loop to calculate the sum of the squares of the digits of a number `x`. To get the digits without converting `x` to a string, use floor division and modulo. `x % 10` is the last digit of `x`, and `x // 10` is `x` without its last digit.

Suppose `x` starts at 149. Compute `total` to be the sum of the squares of the digits of 149. Each time through the loop, add the square of `x % 10` to `total`, then replace `x` with `x // 10`. Fill in the rest of the table to work through the loop by hand.

Time through the loop	`x` **at start**	`x % 10`	`total` **at end**	`x` **at end**
1st	149	9	81	14
2nd				
3rd				

Question 5 (2 pts)

(1) The loop in Question 4 keeps going while _____.

(2) After that loop, the next number in the chain is _____.

Now write `digit_chain` in `prac4.py`, with the digit loop inside the chain loop (no `for` loops, no strings). Run `test_prac4.py` until your tests pass, then submit both files to Gradescope.