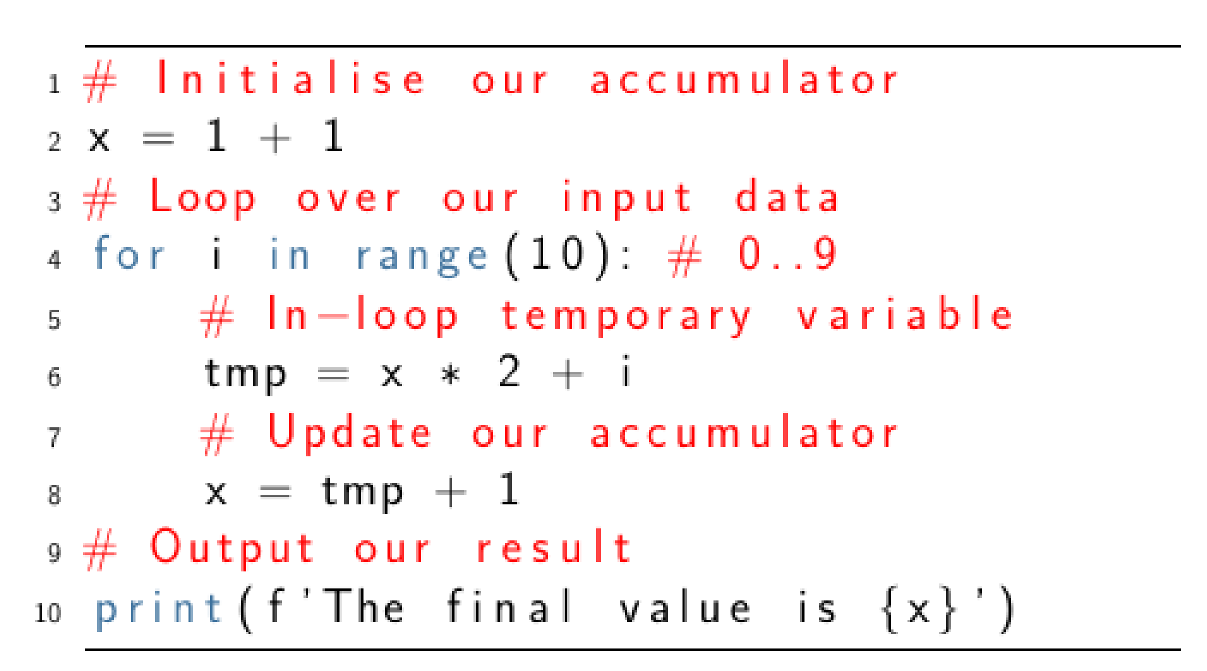
DEBUGGING, TRACING, AND FADING: IMPROVING STUDENT'S MENTAL MODEL OF CODE

Problem

Students have a poor working model of code which leads to numerous issues: they struggle to debug, to adjust copy-pasted code, and to predict runtime behaviour.



```
# Initialise our accumulator
x = 1 + 1
# Loop over our input data
for i in range(10): # 0..9
    # In-loop temporary variable
    tmp = x * 2 + i
    # Update our accumulator
    x = tmp + 1
# Output our result
print(f'The final value is {x}')
```

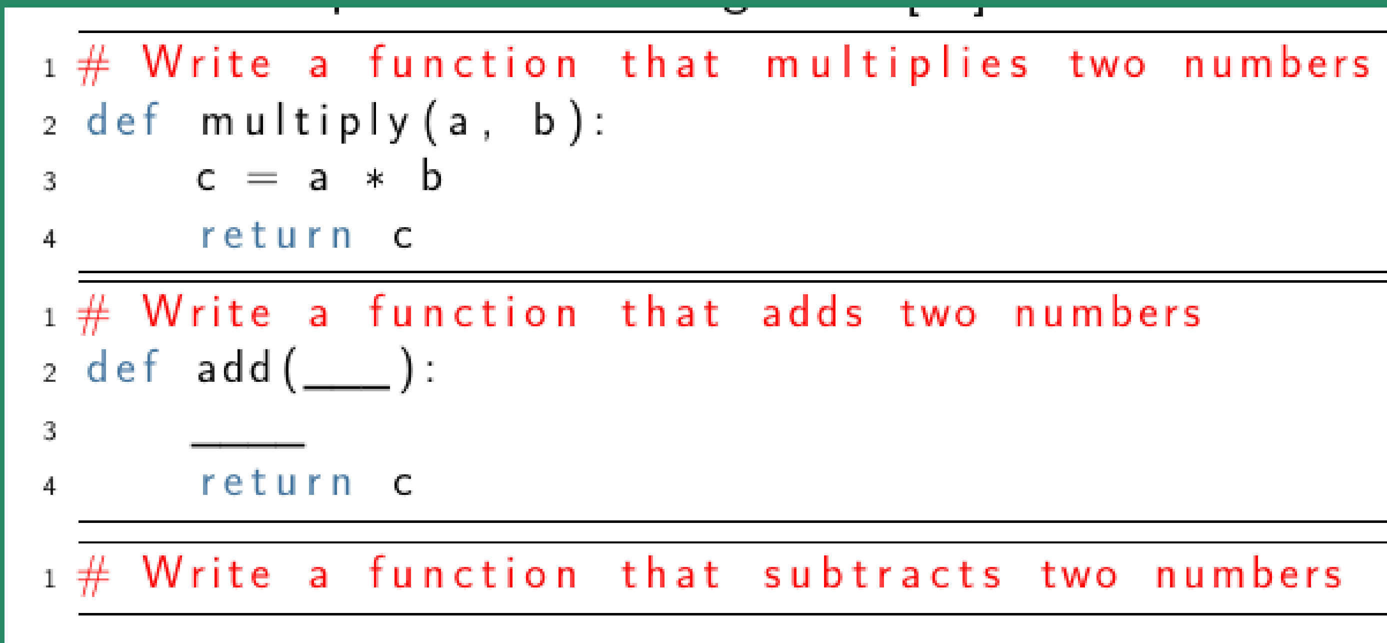
Tracing

"Tracing" is a valuable and easy to complete exercise, and the results can even be checked automatically. It improves student's **mental model**

Faded Examples

As students become more confident, we remove information.

A continuum of problem types!



```
# Write a function that multiplies two numbers
def multiply(a, b):
    c = a * b
    return c
```

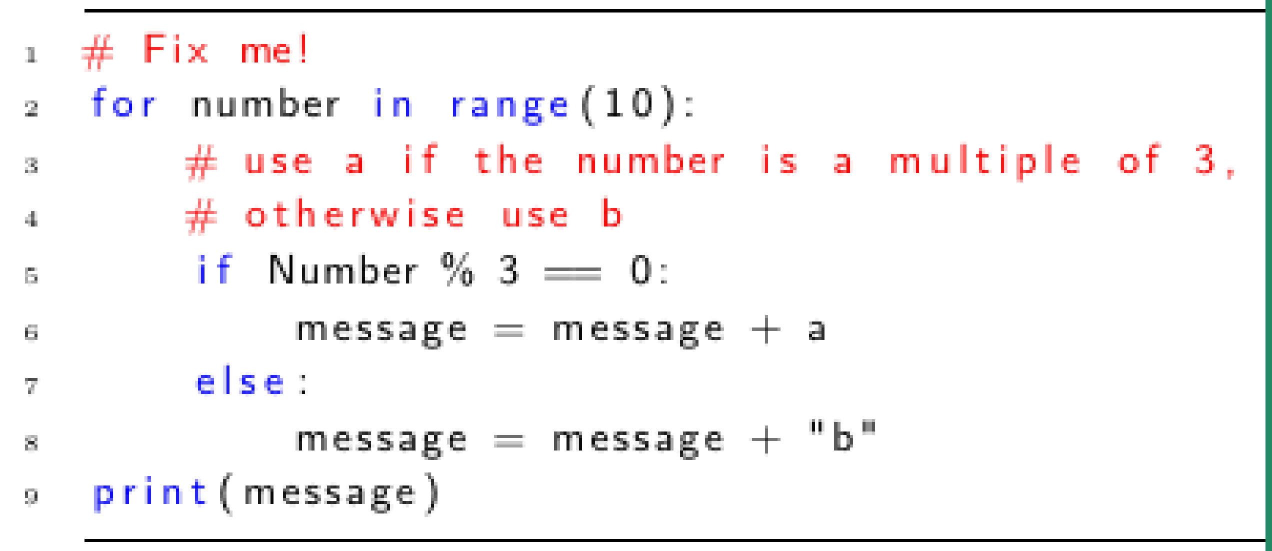
```
# Write a function that adds two numbers
def add(____):
    _____
    return c
```

```
# Write a function that subtracts two numbers
```

Hypothesis

We should augment lessons with:

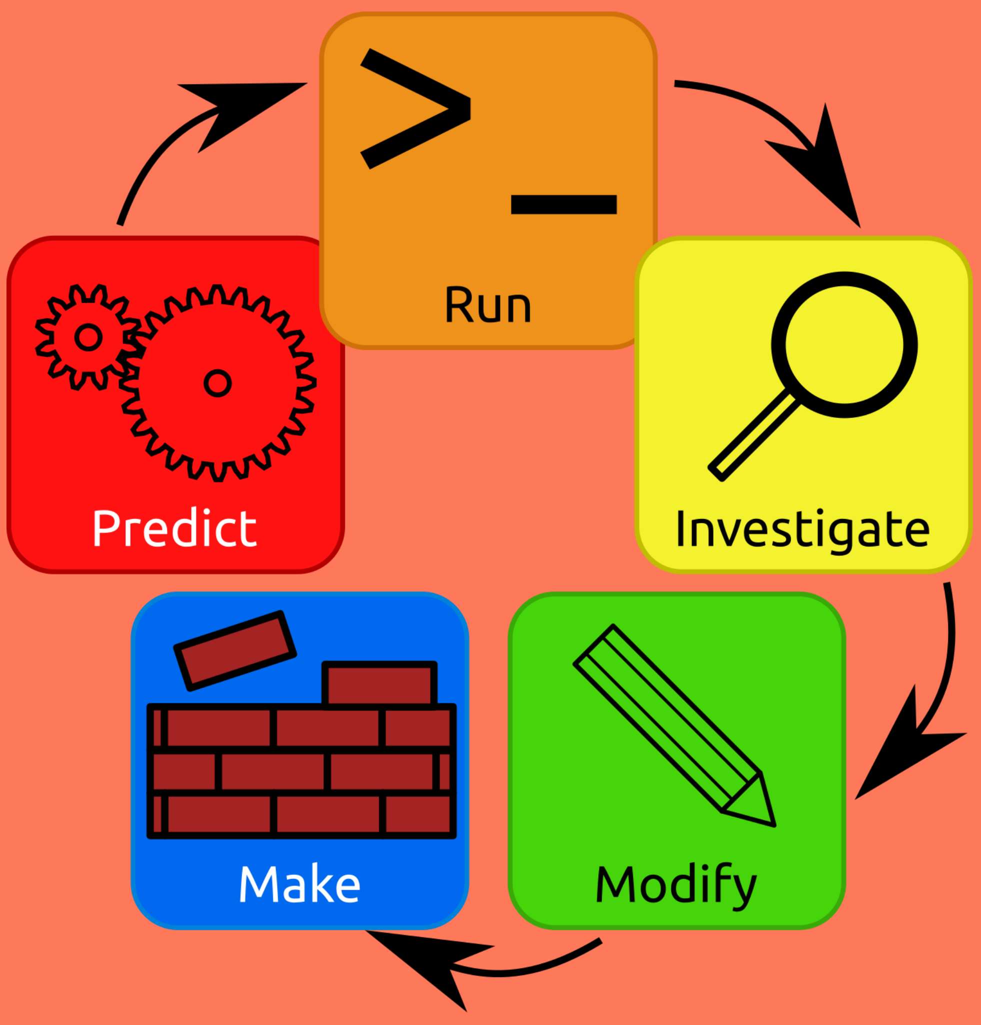
- Tracing - Stepping through the internal state
- Faded examples
- Debugging intentionally broken examples



```
# Fix me!
for number in range(10):
    # use a if the number is a multiple of 3,
    # otherwise use b
    if Number % 3 == 0:
        message = message + a
    else:
        message = message + "b"
print(message)
```

Debugging

Armed with techniques like the "Wolf Fence", students find bugs on their own



PRIMM: A similar model in K-12 education

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