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Lab 13: Debugging

Roots.py:

line 39:

```
for i in range(n + l):
for i in range(n + 1):
```

Syntax error

The alphanumeric character *l* is written instead of the number *1*, causing python to call an undefined variable into the equation and crash.

Line 160:

```
xr = newton_step(x0, fun, fun_prime)
xr = newton_step(x0, fun, fun_prime, args)
```

Runtime error

The function *newton_step* did not call the arguments that function *polynomial* and *poly_der* required. The coefficients to the polynomial equations.

Line 113:

```
xr = x0 + f / fp
xr = x0 - f / fp
```

Logic Error

The formula for Newton's method equation is wrong here. It should be subtraction rather than addition.

Line 159:

```
while error > TOL and i < imax:
while abs(error) > TOL and i < imax:
```

Logic Error

Does not take negative numbers into account and causes the program to end prematurely in the computation.

Root_script.py:

Line 67:

```
for i in range(len(n)):
for i in range(n + 1):
```

Runtime error

n is an integer not a list, so the *len()* function will not be able to count the number of items in it and will fail because of an incompatible type.

Logic error

A polynomial of *nth order* requires *n+1* coefficients rather than *n*.

Line 71:

```
done = True
done = False
```

Logic error

Initially the root finding code should not be marked as *done*. This will cause the program to exit without crashing, but also without printing the desired output.

Line 80:

```
else
else:
```

Syntax error

else statement requires a colon after it.

Line 83:

```
ans = print('\nDo you want to try again? (y/n): ')
ans = input('\nDo you want to try again? (y/n): ')
```

Runtime error

Uses *print* statement rather than *input* statement and does not store a value for next line's boolean operation.

Lab 13: Test Cases

Test Case 1

Inputs:

Coefficient input: *-7, 4, 32*

Resultant Polynomial: $f(x) = -7x^2 + 4x + 32$

Derivative of polynomial: $f'(x) = -14x + 4$

Outputs:

$f(13) = 1267$ $f(0) = 32$ $f(-13) = 1215$

$f'(13) = -178$ $f'(0) = 4$ $f'(-13) = 186$

Roots: $x \approx -1.871381267, 2.44280939$

Test Case 2

Input:

Coefficient input: *9, -13, 0.5, -150*

Resultant Polynomial: $g(x) = 9x^3 - 13x^2 + 0.5x - 150$

Derivative of polynomial: $g'(x) = 27x^2 - 26x + 0.5$

Output:

$g(13) = 17432.5$ $g(0) = -150$ $g(-13) = -22126.5$

$g'(13) = 4224.5$ $g'(0) = 0.5$ $g'(-13) = 4901.5$

Roots: $x \approx 3.12997775$

Test Case 3

Input:

Coefficient input: *1, -1, -6*

Resultant Polynomial: $h(x) = x^2 - x - 6$

Derivative of polynomial: $h'(x) = 2x - 1$

Output:

$h(2) = -4$

$h'(2) = 3$

Roots: $x = 3, -2$