Practice Python with Numerical Methods

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Goals

Practice !

- Be able to write four numerical methods that can *do something*

Review

Sunspots moving average example

"Main" Topics in Computational Methods

1. Integration

2. Linear Algebra

3. Root Finding

4. Differential Equations

Explore these on your own too, since we won't be able to cover everything...

Integration

Trapezoid method

1. Divide your interval into some number of sub-intervals

2. Each sub interval is a trapezoid, connecting the two points on the graph

```
trap = dx * (f(x + dx) + f(x)) / 2
```

Simpson's 3/8 rule

```
h = (b - a) / 3
factor = (f(a) +
          3*f((2*a + b) / 3) +
          3*f((a + 2*b) / 3) +
          f(b))
integral = (3 * h / 8) * factor
```

Simpson's 3/8 rule (for n intervals)

```
h = (b − a) / n
xi = a + i*h
integral = 3*h/8 * (
             f(x0) + 3f(x1) +
           3f(x2) + 2f(x3) + 3f(x4) +
           ... + f(xn) )
```

This only works if `n` is a multiple of 3

Root Finding

We already looked at bisection

Alternatives to bisection

- Newton's method (if we know the functional form of the derivative)

```
x1 = x0 - f(x0)/df(x0)
```

- Secant method (if we don't)

```
x2 = x1 - f(x1) *
     (x1 - x0)/(f(x1) - f(x0))
```

Practice

- Handout

- One more week of classes

- Office hours Tuesday 3pm in NSH 186