Introduction to Symbolic Math: A Pythonian Approach

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Overview

- **Installation**
- **Example 1 – Linear Equation**
- **Example 2 - Polynomials**
- **Classwork – Box Surface Area**
- **Classwork – Plot a circle**

Installation

- Pip -install
- https://docs.sympy.org/latest/tutorial/index.html
-
- Why learn symbolic computation?
  - You'll be able to check your work
    - In MS, HS, College, etc
  - Calculators can't compete

SymPy Tutorial

Installation

Open up the command prompt and
>>> pip install sympy

From there, the library we'll be importing

from sympy import *

This imports all classes and functions into your python session
Do this in a new file and run to verify that you have sympy working. Switch to IDLE if issues occur

Example: Linear equation

```
1   from sympy import symbols
2
3   x, y, m, b = symbols('x y m b')
4   expr = x + 2*y
5   y = m*x+b
6   print(expr)
7   print(expr+expr)
8   print(expr+expr+expr)
9   print(expr+expr+expr+expr)
10  print(y + expr)
11
12  print(y)
13  print(y+y)
14  print(y+y+y)
15
16  print(y**2 + 3*expr*y)
17
```

Example: Polynomial Manipulation

EXAMPLE 3 ■ **Multiplying Polynomials**

Find the product: $(2x + 3)(x^2 - 5x + 4)$

SOLUTION 1: Using the Distributive Property

$$\begin{aligned}(2x + 3)(x^2 - 5x + 4) &= 2x(x^2 - 5x + 4) + 3(x^2 - 5x + 4)\\ &= (2x \cdot x^2 - 2x \cdot 5x + 2x \cdot 4) + (3 \cdot x^2 - 3 \cdot 5x + 3 \cdot 4)\\ &= (2x^3 - 10x^2 + 8x) + (3x^2 - 15x + 12)\\ &= 2x^3 - 7x^2 - 7x + 12\end{aligned}$$

SOLUTION 2: Using Table Form

$$\begin{array}{r} x^2 - 5x + 4 \\ \hline 2x + 3 \\ \hline 3x^2 - 15x + 12 \\ 2x^3 - 10x^2 + 8x \\ \hline 2x^3 - 7x^2 - 7x + 12 \end{array}$$

```python
from sympy import *
x = symbols('x')

factor1 = 2*x+3
factor2 = x**2 - 5*x+4
soln = factor1*factor2
print(soln)

# Now let's expand the solution
# to return to a canical form of the solution use this expand function
solnE = expand(soln)
print(solnE)

# to return to a simplified version of this use the simpliy function
solnF = factor(solnE)
print(solnF)

# is this the same as the original soln? check
solnCheck = factor(soln)
print(solnCheck)
# if both "solnF" and "solnCheck" are equivalent then you can
# say they're the same solution
# use this to help you in your homework, but do not become addicted to it
# with great power comes what?
```

Classwork: write a script to solve

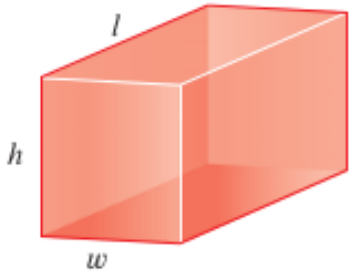

FIGURE 1 A closed rectangular box

EXAMPLE 3 ■ **Solving for One Variable in Terms of Others**

The surface area A of the closed rectangular box shown in Figure 1 can be calculated from the length l, the width w, and the height h according to the formula

$$A = 2lw + 2wh + 2lh$$

Solve for w in terms of the other variables in this equation.

SOLUTION Although this equation involves more than one variable, we solve it as usual by isolating w on one side, treating the other variables as we would numbers.

$$A = (2lw + 2wh) + 2lh \qquad \text{Collect terms involving } w$$

$$A - 2lh = 2lw + 2wh \qquad \text{Subtract } 2lh$$

$$A - 2lh = (2l + 2h)w \qquad \text{Factor } w \text{ from RHS}$$

$$\frac{A - 2lh}{2l + 2h} = w \qquad \text{Divide by } 2l + 2h$$

The solution is $w = \dfrac{A - 2lh}{2l + 2h}$.

Write a script to solve for w, screen shot and e-mail

Classwork: Plotting a Circle

ClassWork: Done in-class

Hint: Use trig functions x=cos(t) and y=sin(t) to get your point(x,y) values. Once you get your t-chart filled with points, simply plot them.

Emailing ScreenShots

E-mail your file and/or screenshots of your plot to jfigueroa@nasriacademy.org for credit