Homework 17

Symbolic math

Problem 1

Part a

Import the library needed for using symbolic math in python. Also setup the notebook for printing.

Part b

Set variables x, y, z, and function f, and g.

Part c

Set an expression for the following:

$$x^2 + 2x - 5.$$

Part d

Evaluate the expression for $x = 1.5$. Also, make a variable substitution: z for x. Do a variable substitution y^2 for x.

Problem 2

Part a

Simplify the following expression:

$$\frac{x^2 - x - 6}{x^2 - 3x}.$$

Part b

Expand the following expression symbolically:

$$(x+1)^3(x-2)^2.$$

Part c

Factor the following expression:

$$3x^4 - 36x^3 + 99x^2 - 6x - 144.$$

Problem 3

Part a

Compute the symbolic derivative:

$$\frac{d}{dx}\sin^2(x)e^{2x}.$$

Then evaluate the resulting expression for $x = 3.3$.

Part b

Create a sympy expression representing the following integral:

$$\int_0^5 x^2 \sin(x^2)dx.$$

Then evaluate the integral symbolically.

Problem 4

Part a

Solve for the roots of the following equation:

$$x^3 + 15x^2 = 3x - 10.$$

Use the `Eq` and `solve` functions and save as an expression. Show the expression (it will be a list). Then find the numerical value of each root using the evalf function. You can use evalf on some expression using `my_expression.evalf()`.

Part b

Solve the system of three equations in three unknowns symbolically:

$$x + y + z = 0$$
$$2x - y - z = 10$$
$$y + 2z = 5$$

Compare the result to the answer computed with fsolve from scipy.optimize.

Part c

Solve the following differential equation symbolically using the `dsolve` function:

$$\frac{df(x)}{dx} = x\cos(x).$$

Problem 5

Part a

For the system $Ax = b$ with

$$A = \begin{bmatrix} 1 & 2 & 5 \\ 3 & 4 & 6 \\ -1 & 0 & 3 \end{bmatrix},$$
$$b = \begin{bmatrix} 1 \\ 0 \\ -2 \end{bmatrix}.$$

Setup the matrices A and b

Part b

For the system in Part a, solve for matrix x by matrix algebra.

Part c

For matrix A above, return the middle row, and the middle column.

Part d

Create a matrix M using the `zeros` function that has 2 rows and 2 columns. Fill in some values using array notation (like M[i,j]=value).