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%{
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ECE 202
Exercise M8
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the purpose of this script is to find the three coefficients, c1, c2, and c3.
when doing partial fraction decomposition

%}
%initialize
clear

%givens (create system of equations in terms of all 3 variables)
A=[1  1  1;
  -5 -4 -3;
   6  3  2]; % 3 x 3 matrix representing (6x^2+5x+4)/((x-1)(x-2)(x-3))

b=[6; 5; 4]; % create column matrix of the constants in the equation 6x^2+5x+4

%Calculation

r = A^(-1)*b %calculate the 3 numerators

%Checks

%given
while 1 %loop infinitely
    n = input('input number of test numbers (input 0 to break): ');
    %ask user how many test inputs to use
    if n == 0 %check if input == 0
        fprintf('Exiting Simulation.\n') %tell user what happening
        break %exit loop
    end
    xmin = -4; %min value of x
    xmax = 4; %max value of x
    x = linspace(xmin,xmax,n); %make array of values between xmin and xmax with
    %number of steps

    %initialize values of denominators
    d1 = x-1;
    d2 = x-2;
    d3 = x-3;

    %calculation
    n = 6.*x.^2+5*x+4; %calculate numerator values
    y1 = n./(d1.*d2.*d3); %calculate the numerical value of equation with fraction
    % decomposition
    y2 = r(1)./d1 + r(2)./d2 + r(3)./d3; %calculate numerical value of equation
    % with original formula
    check = sum(abs(y1) - abs(y2)) %compare values, should be close to
    % zero because values are equiv
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52 end
53
54 %the reason the check sometimes returns NaN is because the linspace set
55 %will contain the roots of the equation, you are unable to divide by zero
56 %so the check will return an error value. with linspace 5, the set will
57 %contain -4, -2, 0, 2, 4
58 %2 is in this set, and 2 is a root.
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>> M8

r =

    7.5000
  -38.0000
   36.5000

input number of test numbers (input 0 to break): 5

check =

   NaN

input number of test numbers (input 0 to break): 6

check =

   6.9750e-14

input number of test numbers (input 0 to break): 101

check =

   NaN

input number of test numbers (input 0 to break): 234

check =

   1.0856e-11

input number of test numbers (input 0 to break): 8

check =

   1.9593e-13

input number of test numbers (input 0 to break): 9

check =

   NaN

input number of test numbers (input 0 to break): 13

check =

   NaN

input number of test numbers (input 0 to break): 17
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```
check =

   NaN

input number of test numbers (input 0 to break): 44

check =

   1.0593e-12

input number of test numbers (input 0 to break): 2

check =

   7.5495e-15

input number of test numbers (input 0 to break): 0
Exiting Simulation.
>>
```

$$\frac{6x^2+5x+4}{(x-1)(x-2)(x-3)} = \frac{C_1}{x-1} + \frac{C_2}{x-2} + \frac{C_3}{x-3}$$

$$6x+5x+4 = C_1(x-2)(x-3) + C_2(x-1)(x-3) + C_3(x-1)(x-2)$$

distribute

$$6x+5x+4 = C_1x^2 - 5C_1x + 6C_1 + C_2x^2 - 4C_2x + 3C_2 + C_3x^2 - 3C_3x + 2C_3$$

pull out like terms

$$x^2(C_1+C_2+C_3) \qquad 6x^2$$

$$x(-5C_1-4C_2-3C_3) = 5x$$

$$1(6C_1+3C_2+2C_3) \qquad 4$$

convert to matrix

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