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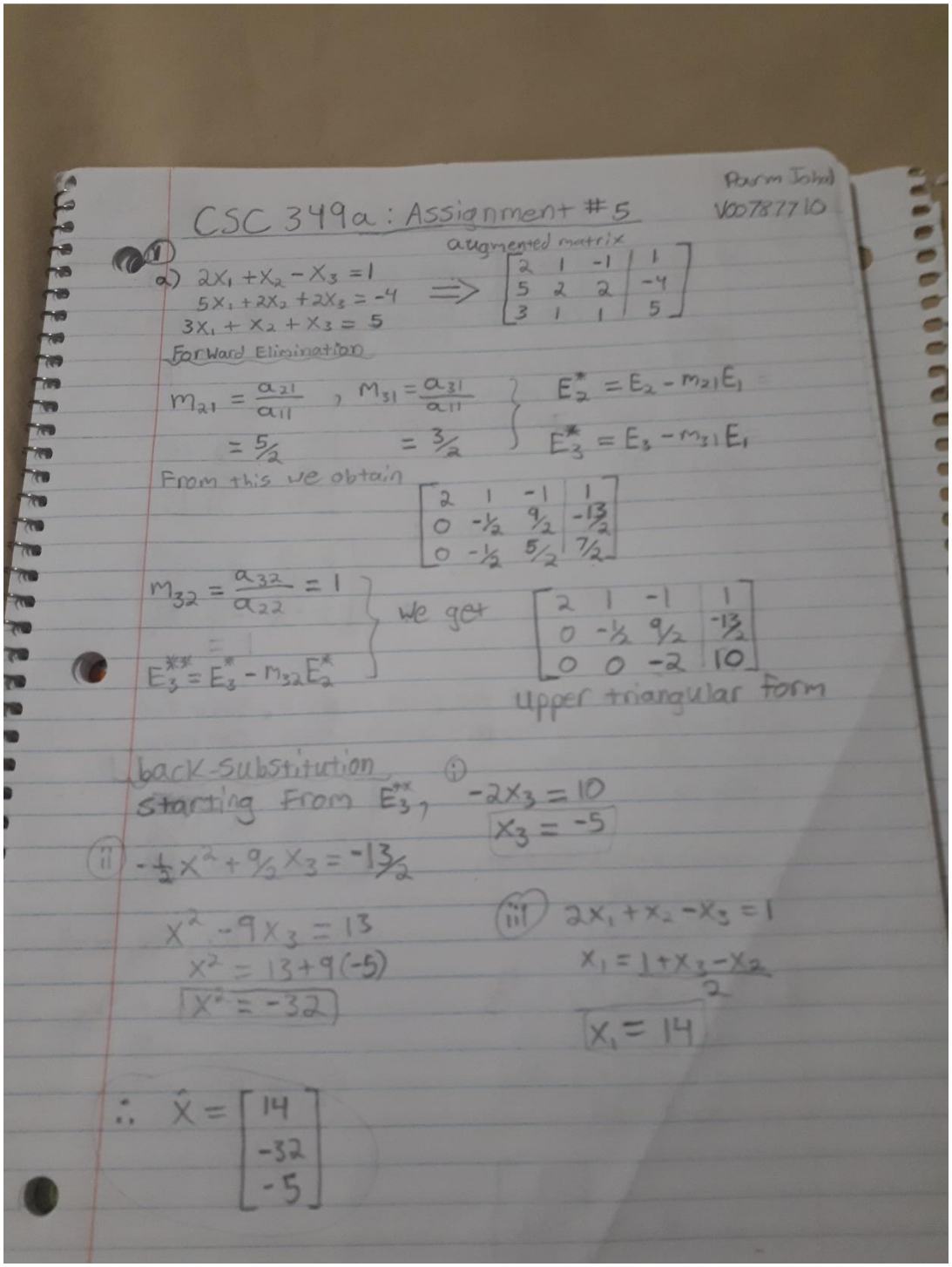
CSC 349a: Assignment #5



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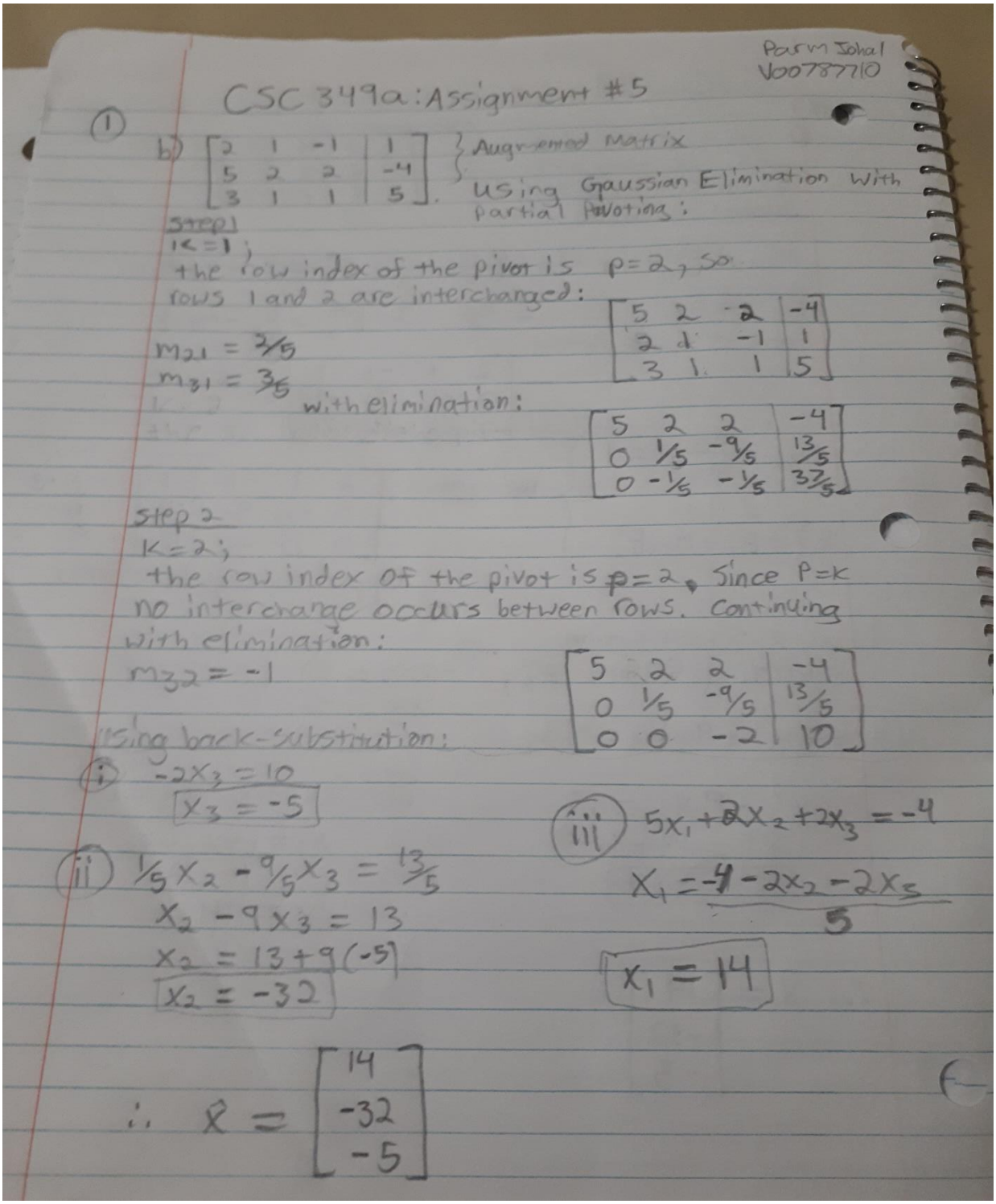

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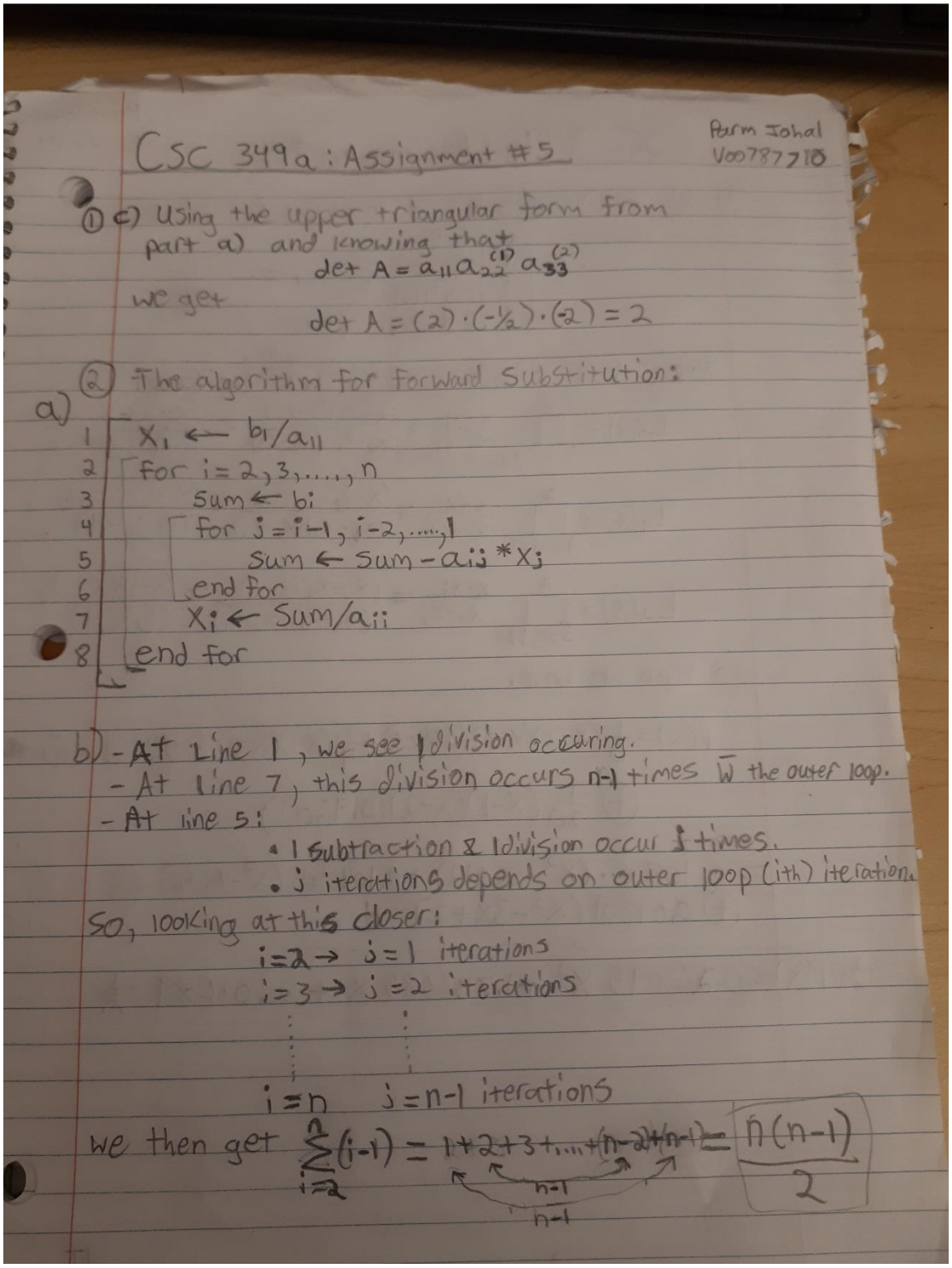

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① c) Using the upper triangular form from part a) and knowing that

$$\det A = a_{11} a_{22}^{(1)} a_{33}^{(2)}$$

we get

$$\det A = (2)\cdot(-\tfrac{1}{2})\cdot(-2) = 2$$

② The algorithm for forward substitution:

a)

```
1  X1 ← b1/a11
2  for i = 2, 3, ..., n
3      sum ← bi
4      for j = i-1, i-2, ..., 1
5          sum ← sum - aij * Xj
6      end for
7      Xi ← sum/aii
8  end for
```

b) - At Line 1, we see 1 division occuring.
- At Line 7, this division occurs n-1 times w/ the outer loop.
- At line 5:
  - 1 subtraction & 1 division occur j times.
  - j iterations depends on outer loop (ith) iteration.

So, looking at this closer:

i=2 → j=1 iterations
i=3 → j=2 iterations
⋮ ⋮
i=n j=n-1 iterations

we then get $\sum_{i=2}^{n}(i-1) = 1+2+3+\ldots+(n-2)+(n-1) = \frac{n(n-1)}{2}$

(n-1 terms; n-1)

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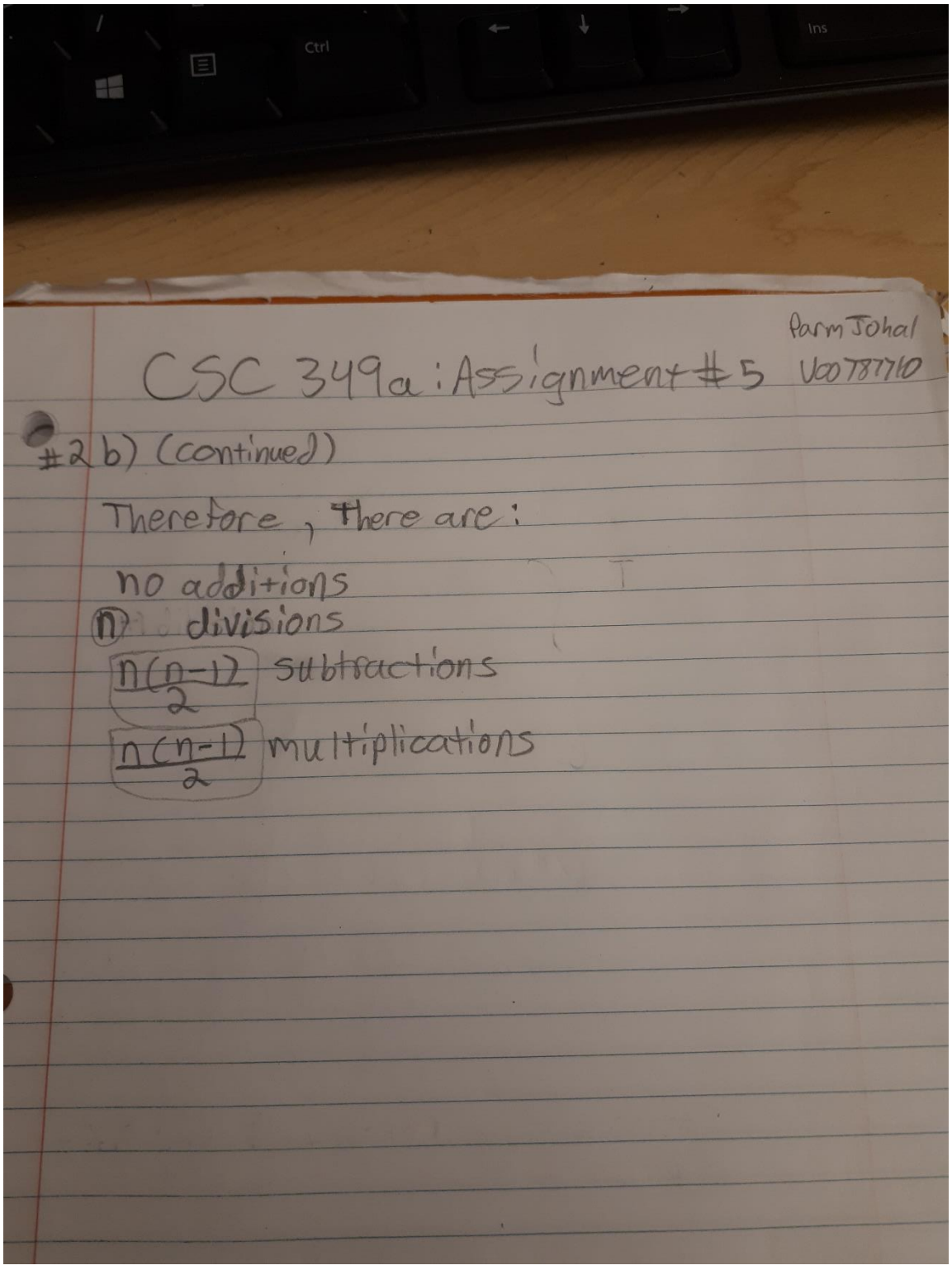

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#2 c)

```
function [x] = ForwardSub(A, b)
%Algorithm for forward substitution, A is a lower
%triangular matrix and b is a column vector.
    %First calculate the number of columns n in b
    n = length(b);
    %Empty vector x
    x = [];
    %Start by solving trivial first step and
    %storing it into x(1)
    x(1) = b(1)/A(1,1);
    fprintf ( 'i-val: %2.0f \t x(i): %2.8f \n\n', 1, x(1) );
    %Outer loop iterates through each row
    for i = 2 : n
        fprintf ( 'i-val: %2.0f \n', i );
        %Make sum equal to the row's corresponding
        %b value
        sum = b(i);
        %Inner loop iterates through each nonzero
        %value of the ith row and multiplies it
        %with the solved x value from previous
        %row
        for j = i-1 :-1: 1
        sum = sum - A(i,j) * x(j);
        fprintf ( 'j = %2.0f \t sum = %2.8f \n', j, sum );
        end
        x(i) = sum/A(i,i);
        fprintf ( 'sum: %2.8f \t A(i,i): %2.8f \t x(i): %2.8f \n', sum,
A(i,i), x(i) );
        fprintf('\n');
    end
    fprintf('Vector x =\n')
    fprintf('%i\n', x)
end
```

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output:

```
>> ForwardSub(A,b);
i-val:  1           x(i): 1.00000000

i-val:  2
j =  1    sum = 3.00000000
sum: 3.00000000        A(i,i): 3.00000000     x(i): 1.00000000

i-val:  3
j =  2    sum = 10.00000000
j =  1    sum = 6.00000000
sum: 6.00000000        A(i,i): 6.00000000     x(i): 1.00000000

i-val:  4
j =  3    sum = 25.00000000
j =  2    sum = 17.00000000
j =  1    sum = 10.00000000
sum: 10.00000000       A(i,i): 10.00000000    x(i): 1.00000000

Vector x =
1
1
1
1
```

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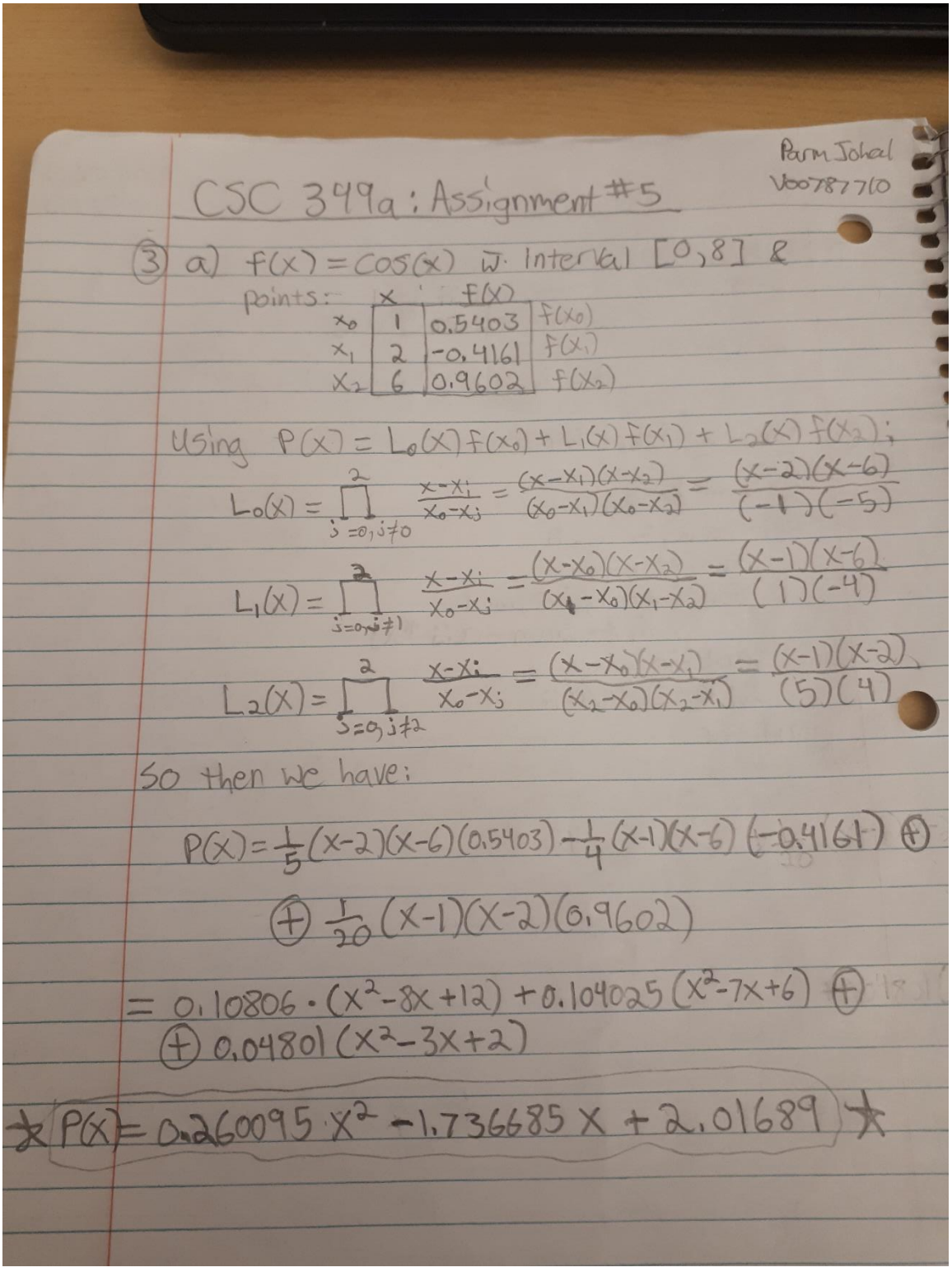

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CSC 349a: Assignment #5

(3) a) $f(x) = \cos(x)$ w. interval $[0, 8]$ &

points:

	x	f(x)	
x_0	1	0.5403	$f(x_0)$
x_1	2	-0.4161	$f(x_1)$
x_2	6	0.9602	$f(x_2)$

Using $P(x) = L_0(x)f(x_0) + L_1(x)f(x_1) + L_2(x)f(x_2)$;

$$L_0(x) = \prod_{j=0, j\neq 0}^{2} \frac{x - x_j}{x_0 - x_j} = \frac{(x-x_1)(x-x_2)}{(x_0-x_1)(x_0-x_2)} = \frac{(x-2)(x-6)}{(-1)(-5)}$$

$$L_1(x) = \prod_{j=0, j\neq 1}^{2} \frac{x - x_j}{x_0 - x_j} = \frac{(x-x_0)(x-x_2)}{(x_1-x_0)(x_1-x_2)} = \frac{(x-1)(x-6)}{(1)(-4)}$$

$$L_2(x) = \prod_{j=0, j\neq 2}^{2} \frac{x - x_j}{x_0 - x_j} = \frac{(x-x_0)(x-x_1)}{(x_2-x_0)(x_2-x_1)} = \frac{(x-1)(x-2)}{(5)(4)}$$

So then we have:

$$P(x) = \frac{1}{5}(x-2)(x-6)(0.5403) - \frac{1}{4}(x-1)(x-6)(-0.4161) \oplus$$

$$\oplus \frac{1}{20}(x-1)(x-2)(0.9602)$$

$$= 0.10806 \cdot (x^2 - 8x + 12) + 0.104025(x^2 - 7x + 6) \oplus$$

$$\oplus 0.04801(x^2 - 3x + 2)$$

$$\star P(x) = 0.260095 \cdot x^2 - 1.736685x + 2.01689 \star$$

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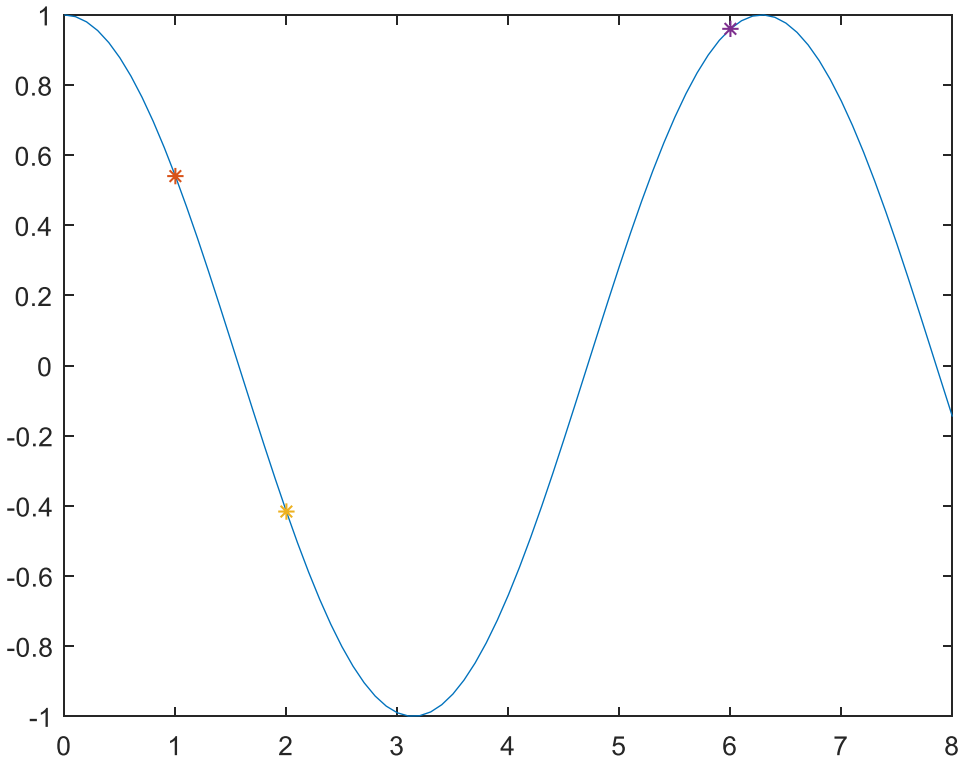
#3 b)

```
>> x = 0:0.1:8;
>> y = cos(x);
>> plot(x, y);
>> hold on
>> plot(1, 0.5403, '*')
>> plot(2, -0.4161, '*')
>> plot(6, 0.9602, '*')
>> hold off
```



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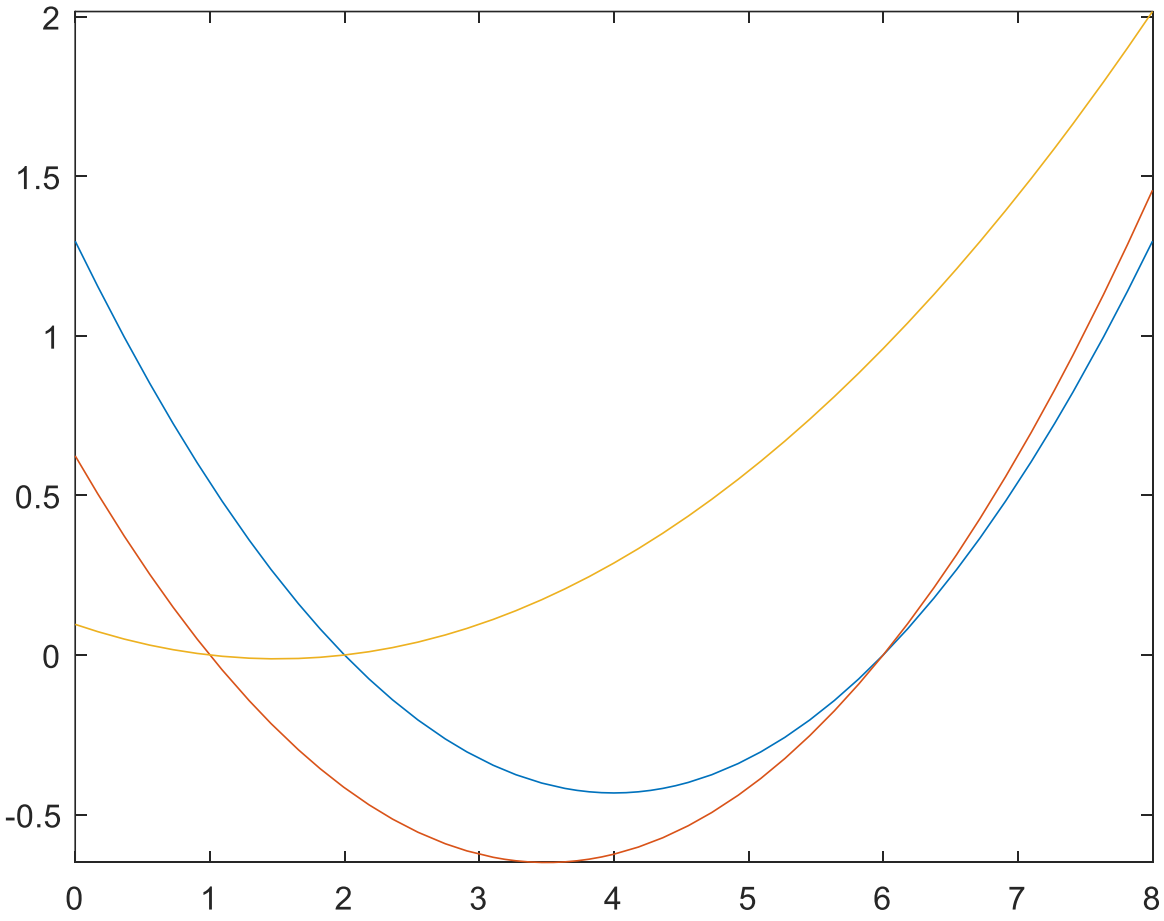
c)

```
>> fplot(@(x) 0.10806*(x*x-8*x+12), [0,8])
>> hold on
>> fplot(@(x) 0.104025*(x*x-7*x+6), [0,8])
>> fplot(@(x) 0.04801*(x*x-3*x+2), [0,8])
```



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d)

```
>> fplot(@(x) 0.260095*x*x - 1.736685*x + 2.01689, [0,8])
>> hold on
>> fplot(@(x) cos(x), [0,8])
>> plot(1, 0.5403, '*')
>> plot(2, -0.4161, '*')
>> plot(6, 0.9602, '*')
```