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**STUDENT NUMBER:** 17330208

Please indicate your answers by entering the option ( (i), (ii), (iii) or (iv) ) where asked.  
You should append the completed document as a pdf with your type written worked solutions and upload to Blackboard by Friday 22<sup>nd</sup> of February 2019.

**Q 2.31**          matlab code included.

Part (a):

- (i) 4
- (ii) 13
- (iii) 26
- (iv) 18

**Your Answer (i)-(iv):** (ii) 13

Part (b):

- (i) 0
- (ii) 12
- (iii) 7
- (iv) 4

**Your Answer (i)-(iv):** (i) 0

**Q 3.2**                      mathematically worked solution included.

Part (a):

- (i)      0.1241
- (ii)     0.8125
- (iii)    0.074995
- (iv)    0.003462

**Your Answer (i)-(iv):**    (ii) 0.8125

Part (b):

- (i)      0.72481
- (ii)     0.85261
- (iii)    0.62849
- (iv)    0.17238

**Your Answer (i)-(iv):**    (ii) 0.85261

Part (c):

- (i)      0.65782
- (ii)     0.59371
- (iii)    0.45802
- (iv)    0.85261

**Your Answer (i)-(iv):**    (iv) 0.85261

**Q 4.24** mathematically worked solution included.

(i) Inverse(a)=

-0.7143	0.0	1.4286
0.2571	0.1000	0.2857
-0.2286	-0.2000	0.8571

Inverse(b)=

1.6667	2.8889	-2.2222	1.0000
0.0	0.3333	-0.3333	0.0
-0.3333	-0.4444	0.1111	0.0
1.5000	2.0000	-1.5000	0.5000

(ii)

Inverse(a)=

0.7243	0.0	1.3286
1.2571	0.1000	0.2757
-0.2386	-0.2010	0.9571

Inverse(b)=

1.6677	2.9889	3.2222	1.01700
0.3433	-0.3433	0.3333	0.00371
-0.3433	-0.2879	0.2111	0.0
1.2400	2.0120	-1.5783	0.5600

(iii)

Inverse(a)=

0.7143	0.003	2.3276
1.2671	0.1100	0.3759
-0.2486	-0.2110	0.9771

Inverse(b)=

1.6877	3.9789	3.2002	2.01800
0.3533	-0.4433	0.3333	0.02371
-0.3443	-0.2999	0.3121	0.0382
1.2420	3.0130	-1.5733	0.5610

(iv)

Inverse(a)=

0.8343	1.01	1.3336
2.2572	0.1003	0.3857
-0.2486	-0.2110	0.9671

Inverse(b)=

1.6777	4.9889	3.2232	1.11700
0.3443	-0.3443	0.3233	0.07371
-0.3443	-0.2979	0.3211	0.07800
1.2480	2.1220	-1.5883	0.5621

**Your Answer (i)-(iv):** (i)

# Computational Mathematics Assignment 1

**Student name: Davy Nolan**

**Student number: 17330208**

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## Q 2.31

Matlab code:

```
function det = Determinant(a)
    [m,n] = size(a);
    if m == 2 || n == 2
        ad = a(1,1) * a(2,2);
        bc = a(1,2) * a(2,1);
        det = ad - bc;
    elseif m == 3 || n == 3
        ei = a(2,2) * a(3,3);
        fh = a(2,3) * a(3,2);
        eifh = a(1,1) * (ei-fh);

        di = a(2,1) * a(3,3);
        fg = a(2,3) * a(3,1);
        difg = a(1,2) * (di - fg);

        dh = a(2,1) * a(3,2);
        eg = a(2,2) * a(3,1);
        dheg = a(1,3) * (dh - eg);

        det = eifh - difg + dheg;
    elseif m == 4 || n == 4
        m1 = [a(2,2) a(2,3) a(2,4); a(3,2) a(3,3) a(3,4); a(4,2) a(4,3)
a(4,4)];
        detm1 = Determinant(m1);

        m2 = [a(2,1) a(2,3) a(2,4); a(3,1) a(3,3) a(3,4); a(4,1) a(4,3)
a(4,4)];
        detm2 = Determinant(m2);

        m3 = [a(2,1) a(2,2) a(2,4); a(3,1) a(3,2) a(3,4); a(4,1) a(4,2)
a(4,4)];
        detm3 = Determinant(m3);

        m4 = [a(2,1) a(2,2) a(2,3); a(3,1) a(3,2) a(3,3); a(4,1) a(4,2)
a(4,3)];
        detm4 = Determinant(m4);
```

```

        det = (a(1,1)*detm1) - (a(1,2)*detm2) + (a(1,3)*detm3) -
(a(1,4)*detm4);

    else
        disp('The matrix must be square.');
```

$$\det = 0;$$

```

    end
end
```

```

>> a = [1 5 4; 2 3 6; 1 1 1];
>> d = Determinant(a)
```

d =

13

```

>> a = [1 2 3 4; 5 6 7 8; 9 10 11 12; 13 14 15 16];
>> d = Determinant(a)
```

d =

0

26/02/2020

# Comp Maths Assignment 1

~~2/2/20~~ ~~2/2/20~~

Q 3.2

Get the root of  $f(x) = x - 2e^{-x}$

(a) Bisection method: (first 3 iterations)

Start:

$$a = 0$$

$$b = 1$$

$$f(a) = -2$$

$$f(b) = 0.264241117$$

Iteration 1:

$$m = \frac{a+b}{2} = \frac{0+1}{2} = \frac{1}{2}$$

$$f(m) = \frac{1}{2} - 2e^{-\frac{1}{2}} = -0.713061319$$

Since  $f(m) < 0$ , replace  $a$  with  $m$

$$a = \frac{1}{2} \quad b = 1$$

$$f(a) = -0.713061319$$

$$f(b) = 0.264...$$

Iteration 2:

$$m = \frac{a+b}{2} = \frac{\frac{1}{2} + 1}{2} = \frac{3}{4}$$

$$f(m) = \frac{3}{4} - 2e^{-\frac{3}{4}} = -0.194733105$$

Since  $f(m) < 0$ , replace  $a$  with  $m$

$$a = \frac{3}{4} \quad b = 1$$

$$f(a) = -0.1947 \dots$$

$$f(b) = 0.264 \dots$$

Iteration 3:

$$m = \frac{a+b}{2} = \frac{\frac{3}{4} + 1}{2} = \frac{7}{8}$$

$$f(m) = \frac{7}{8} - 2e^{-\frac{7}{8}} = 0.04127596$$

Since  $f(m) > 0$ , replace  $b$  with  $m$

$$a = \frac{3}{4} \quad b = \frac{7}{8}$$

$$f(a) = -0.1947 \dots$$

$$f(b) = 0.0412 \dots$$

$$m = \frac{a+b}{2} = \frac{\frac{3}{4} + \frac{7}{8}}{2} = \frac{13}{16} = \boxed{0.8125} = x$$



~~Iteration~~

(b) Secant method: (First 3 iterations)

Start:

$$x_1 = 0$$

$$x_2 = 1$$

$$f(x) = x - 2e^{-x}$$

Iteration 1:

~~Secant method~~  
 ~~$x_{n+1} = x_n - \frac{f(x_n)}{f(x_n) - f(x_{n-1})}$~~

Secant Formula:

$$x_{n+1} = x_n - \frac{f(x_n)}{f(x_n) - f(x_{n-1})} = \frac{x_n - 2e^{-x_n}}{(x_n - 2e^{-x_n}) - (x_{n-1} - 2e^{-x_{n-1}})}$$

$$x_1 = 0$$

$$x_2 = 1$$

$$x_3 = 1 - \frac{1 - 2e^{-1}}{(1 - 2e^{-1}) - (0 - 2e^0)} = 0.883298154$$

Iteration 2

$$x_4 = 0.8832... - \frac{\frac{0.883... - 2e^{-0.883...}}{(0.883... - 2e^{-0.883...}) - (1 - 2e^{-1})}}{0.8832... - 1} = 0.851584208$$

Iteration 3

$$x_5 = 0.851... - \frac{\frac{0.851... - 2e^{-0.851...}}{(0.851... - 2e^{-0.851...}) - (0.883... - 2e^{-0.883...})}}{0.851... - 0.883...} = \boxed{0.852612692}$$

c) Newton's method: (First 3 iterations)

Start:

$$x_1 = 1$$

$$x_{n+1} = x_n - \frac{F(x_n)}{F'(x_n)}$$

Iteration 1

~~$x_2 = x_1 - \frac{F(x_1)}{F'(x_1)}$~~

$$F(x) = x - 2e^{-x}$$

$$F'(x) = 2e^{-x} + 1$$

$$x_2 = x_1 - \frac{F(x_1)}{F'(x_1)} = 1 - \frac{1 - 2e^{-1}}{2e^{-1} + 1} = 0.84776623$$

Iteration 2

$$x_3 = x_2 - \frac{F(x_2)}{F'(x_2)} = 0.847 - \frac{0.847 - 2e^{-0.847}}{2e^{-0.847} + 1} = 0.852600107$$

Iteration 3

$$x_4 = x_3 - \frac{F(x_3)}{F'(x_3)} = 0.852 - \frac{0.852 - 2e^{-0.852}}{2e^{-0.852} + 1}$$

$$= \boxed{0.852605502}$$

Q 4.24

$$(a) \begin{bmatrix} -1 & 2 & 1 \\ 2 & 2 & -4 \\ 0.2 & 1 & 0.5 \end{bmatrix}$$

Put identity matrix on right side and try make left side the identity matrix

$$\begin{array}{l} R1 \\ R2 \\ R3 \end{array} \left[ \begin{array}{ccc|ccc} -1 & 2 & 1 & 1 & 0 & 0 \\ 2 & 2 & -4 & 0 & 1 & 0 \\ 0.2 & 1 & 0.5 & 0 & 0 & 1 \end{array} \right] \left\{ \begin{array}{l} \textcircled{4} -2R1 + R3 \rightarrow R3 \\ \textcircled{1} -2R1 + R2 \rightarrow R2 \end{array} \right. \left[ \begin{array}{ccc|ccc} 1 & -2 & -1 & -1 & 0 & 0 \\ 0 & 6 & -2 & 2 & 1 & 0 \\ 0 & 14 & 7 & 2 & 0 & 10 \end{array} \right]$$

①  $R1 \times -1 \rightarrow R1$

$$\left[ \begin{array}{ccc|ccc} 1 & -2 & -1 & -1 & 0 & 0 \\ 2 & 2 & -4 & 0 & 1 & 0 \\ 0.2 & 1 & 0.5 & 0 & 0 & 1 \end{array} \right]$$

⑤  $R2 \div 6 \rightarrow R2$

$$\left[ \begin{array}{ccc|ccc} 1 & -2 & -1 & -1 & 0 & 0 \\ 0 & 1 & -\frac{1}{3} & \frac{1}{3} & \frac{1}{6} & 0 \\ 0 & 14 & 7 & 2 & 0 & 10 \end{array} \right]$$

②  $-2R1 + R2 \rightarrow R2$

$$\left[ \begin{array}{ccc|ccc} 1 & -2 & -1 & -1 & 0 & 0 \\ 0 & 6 & -2 & 2 & 1 & 0 \\ 0.2 & 1 & 0.5 & 0 & 0 & 1 \end{array} \right]$$

⑥  ~~$2R2 + R1 \rightarrow R1$~~   
 $-14R2 + R3 \rightarrow R3$

$$\left[ \begin{array}{ccc|ccc} 1 & 0 & -\frac{5}{3} & -\frac{1}{3} & \frac{1}{3} & 0 \\ 0 & 1 & -\frac{1}{3} & \frac{1}{3} & \frac{1}{6} & 0 \\ 0 & 0 & \frac{35}{3} & -\frac{8}{3} & -\frac{7}{3} & 10 \end{array} \right]$$

③  $R3 \times \frac{3}{35} \rightarrow R3$

$$\left[ \begin{array}{ccc|ccc} 1 & -2 & -1 & -1 & 0 & 0 \\ 0 & 6 & -2 & 2 & 1 & 0 \\ 2 & 10 & 5 & 0 & 0 & 10 \end{array} \right]$$

$$\textcircled{7} R3 \div \frac{35}{3} \rightarrow R3$$

$$\left[ \begin{array}{ccc|ccc} 1 & 0 & -\frac{5}{3} & -\frac{1}{3} & \frac{1}{3} & 0 \\ 0 & 1 & -\frac{1}{3} & \frac{1}{3} & \frac{1}{6} & 0 \\ 0 & 0 & 1 & -\frac{8}{35} & \cancel{\frac{2}{5}} & \frac{6}{7} \end{array} \right]$$

$$\textcircled{8} \frac{1}{3} R3 + R2 \rightarrow R2$$

$$\frac{5}{3} R3 + R1 \rightarrow R1$$

$$\left[ \begin{array}{ccc|ccc} 1 & 0 & 0 & -\frac{5}{7} & 0 & \frac{10}{7} \\ 0 & 1 & 0 & \frac{9}{35} & \frac{1}{10} & \frac{2}{7} \\ 0 & 0 & 1 & -\frac{8}{35} & -\frac{1}{5} & \frac{6}{7} \end{array} \right]$$

inverse(a)

$$= \left[ \begin{array}{ccc} -\frac{5}{7} & 0 & \frac{10}{7} \\ \frac{9}{35} & \frac{1}{10} & \frac{2}{7} \\ -\frac{8}{35} & -\frac{1}{5} & \frac{6}{7} \end{array} \right]$$

(b)

$$\left[ \begin{array}{cccc|cccc} -1 & -2 & 1 & 2 & 1 & 0 & 0 & 0 \\ 1 & 1 & -4 & -2 & 0 & 1 & 0 & 0 \\ 1 & -2 & -4 & -2 & 0 & 0 & 1 & 0 \\ 2 & -4 & 1 & -2 & 0 & 0 & 0 & 1 \end{array} \right]$$

①  $-1R1 \rightarrow R1$

Eliminate 1st col.

$$\left[ \begin{array}{cccc|cccc} 1 & 2 & -1 & -2 & -1 & 0 & 0 & 0 \\ 0 & -1 & -3 & 0 & 1 & 1 & 0 & 0 \\ 0 & -4 & -3 & 0 & 1 & 0 & 1 & 0 \\ 0 & -8 & 3 & 2 & 2 & 0 & 0 & 1 \end{array} \right]$$

②  $-1R2 \rightarrow R2$

Eliminate 2nd col

$$\left[ \begin{array}{cccc|cccc} 1 & 0 & -7 & -2 & 1 & 2 & 0 & 0 \\ 0 & 1 & 3 & 0 & -1 & -1 & 0 & 0 \\ 0 & 0 & 9 & 0 & -3 & -4 & 1 & 0 \\ 0 & 0 & 27 & 2 & -6 & -8 & 0 & 1 \end{array} \right]$$

③  $R3 \div 9 \rightarrow R3$

Eliminate 3rd col

$$\left[ \begin{array}{cccc|cccc} 1 & 0 & 0 & -2 & -1.\bar{3} & -1.\bar{1} & 0.\bar{7} & 0 \\ 0 & 1 & 0 & 0 & 0 & 0.\bar{3} & -0.\bar{3} & 0 \\ 0 & 0 & 1 & 0 & -0.\bar{3} & -0.\bar{4} & 0.\bar{1} & 0 \\ 0 & 0 & 0 & 2 & 3 & 4 & -3 & 1 \end{array} \right]$$

④  $R_4 \div 2 \rightarrow R_4$

Eliminate 4<sup>th</sup> col

$$\left[ \begin{array}{cccc|cccc} 1 & 0 & 0 & 0 & 1.6 & 2.8 & -2.2 & 1 \\ 0 & 1 & 0 & 0 & 0 & 0.3 & -0.3 & 0 \\ 0 & 0 & 1 & 0 & -0.3 & -0.4 & 0.1 & 0 \\ 0 & 0 & 0 & 1 & 1.5 & 2 & -1.5 & 0.5 \end{array} \right]$$

inverse<sup>n</sup> matrix