Pre-Lab

1.

```
% Optics 211
% Lab 3
% Prepared by Ezra A-K
% 2/29/24
%
% This script is designed to fill the workspace with the matrices necessary
% to complete the in-class portion of lab 3.  When the script is run via
% the command window, it will not yield any results or answers; however,
% the workspace will be filled with matrices.  These matrices can be called
% up from the command window for further manipulation.
%
% Appendix 1 of lab 3 serves as a companion to this script and shows all
% the matrices generated here in traditional mathematical formatting.
%
% This script can be found in Appendix 2 of lab 3.


% Part 1 of 2 of lab 3

% 5x5 matrix for data manipulation
A51= reshape((1:25), [5,5])';

% 4x4 matrix for computing the inner product and finding determinant and
% inverse
A41= [[1 2 3 4];[2 4 7 11];[3 7 14 25];[4 11 25 50]] ;

% 1x4 and 4x1 matrices for evaluating the inner product and using transpose
% operator
B41= [5;10;15;20];
B42= [5 10 15 20];

% 2x2 Matrix (invertible)
A21= [2 3;5 8];

% 2x2 Matrix (non-invertible)
A22= [6 3;8 4];


% Part 2 of 2 of lab 3

% 2 equation, 2 unknown, linear system of equations with 1 solution
A23= [2 6;-5 4];
B23= [10;-3];

% 3 equation, 3 unknown, linear system with 1 solution
A31= [1 2 3;1 3 2;3 2 1];
B31= [39;34;26];

% 3 equation, 3 unknown, linear system with an infinite number of solutions
A32= [2 4 6;4 5 6;7 8 9];
B32= [0;3;6];
```

```
% 3 equation, 3 unknown, linear System with no solution
A33= reshape((1:9), [3,3])';
B33= [0;3;0];

% End of script
```

2.

```
% Optics 211
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% 2x2 Matrix (invertible)
A21= [2 3;5 8];

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A22= [6 3;8 4];


% Part 2 of 2 of lab 3

% 2 equation, 2 unknown, linear system of equations with 1 solution
A23= [2 6;-5 4];
B23= [10;-3];

% 3 equation, 3 unknown, linear system with 1 solution
A31= [1 2 3;1 3 2;3 2 1];
```

```
B31= [39;34;26];

% 3 equation, 3 unknown, linear system with an infinite number of solutions
A32= [2 4 6;4 5 6;7 8 9];
B32= [0;3;6];

% 3 equation, 3 unknown, linear System with no solution
A33= reshape((1:9), [3,3])';
B33= [0;3;0];

% End of script
```

3.

```
A51
```

```
A51 =

     1     2     3     4     5
     6     7     8     9    10
    11    12    13    14    15
    16    17    18    19    20
    21    22    23    24    25
```

```
>> A41
```

```
A41 =

     1     2     3     4
     2     4     7    11
     3     7    14    25
     4    11    25    50
```

```
>> B41
```

```
B41 =

     5
    10
    15
    20

>> B42

B42 =

     5    10    15    20

>> A21

A21 =

     2     3
     5     8

>> A22

A22 =

     6     3
     8     4

>> A23

A23 =
```

```
     2     6
    -5     4

>> B23

B23 =

    10
    -3

>> A31

A31 =

     1     2     3
     1     3     2
     3     2     1

>> B31

B31 =

    39
    34
    26

>> A32

A32 =
```

```
     2     4     6
     4     5     6
     7     8     9

>> B32

B32 =

     0
     3
     6

>> A33

A33 =

     1     4     7
     2     5     8
     3     6     9

>> A33

A33 =

     1     4     7
     2     5     8
     3     6     9
A33
```

```
A33 =

     1     2     3
     4     5     6
     7     8     9

>> B33

B33 =

     0
     3
     0

>>
```

Bonus

`checkcode('matrices.m')` maybe? That checks there aren't any programing errors though to check if matrix are the same you could use the isequal() command but I don't have anything to compare them to.

Part 1 A

```
>> matrices
>> A51

A51 =

     1     2     3     4     5
     6     7     8     9    10
    11    12    13    14    15
    16    17    18    19    20
```

```
    21    22    23    24    25

>> A51(:,3)

ans =

     3
     8
    13
    18
    23

>> A51(3,:)

ans =

    11    12    13    14    15

>> A51(3,3)

ans =

    13

>> A51(:,:)

ans =

     1     2     3     4     5
     6     7     8     9    10
```

```
    11    12    13    14    15
    16    17    18    19    20
    21    22    23    24    25

>> Atest=A51(:,4)

Atest =

     4
     9
    14
    19
    24

>> Ctest=A51(5,2)

Ctest =

    22

>> A51(3,3)=42

A51 =

     1     2     3     4     5
     6     7     8     9    10
    11    12    42    14    15
    16    17    18    19    20
    21    22    23    24    25
```

```
>> A41

A41 =

     1     2     3     4
     2     4     7    11
     3     7    14    25
     4    11    25    50

>> B41

B41 =

     5
    10
    15
    20

>> B42

B42 =

     5    10    15    20

>> A41*B41

ans =

         150
         375
```

795

1505

```
>> A41*B42
Error using  *
Incorrect dimensions for matrix multiplication. Check that the number
of columns in the
first matrix matches the number of rows in the second matrix. To
operate on each element of
the matrix individually, use TIMES (.*) for elementwise
multiplication.

Related documentation

>> matrices
>> A41*B41
Error using  *
Incorrect dimensions for matrix multiplication. Check that the number
of columns in the
first matrix matches the number of rows in the second matrix. To
operate on each element of
the matrix individually, use TIMES (.*) for elementwise
multiplication.

Related documentation

>> A41*b42
Unrecognized function or variable 'b42'.

Did you mean:
>> A41*B42A41*B42
Unrecognized function or variable 'B42A41'.
```

```
>> A41*B42

ans =

         150
         375
         795
        1505

>> %I may or may not have accidently switched B41 and B42 initaily...
>> A51(3,3)=42

A51 =

     1     2     3     4     5
     6     7     8     9    10
    11    12    42    14    15
    16    17    18    19    20
    21    22    23    24    25

>> %everything should be back to how its supposed to be now...
>> A41*B41.'

ans =

         150
         375
         795
        1505
```

```
>> A21^-1

ans =

    8.0000   -3.0000
   -5.0000    2.0000

>> inv(A21)

ans =

    8.0000   -3.0000
   -5.0000    2.0000

>> invA(22)
Unrecognized function or variable 'invA'.

Did you mean:
>> inv(A22)
Warning: Matrix is singular to working precision.


ans =

   Inf   Inf
   Inf   Inf

>> det(A21)
```

```
ans =

    1.0000

>> det(A22)

ans =

     0

>> inv(A41)

ans =

   -6.0000    9.0000   -5.0000    1.0000
    9.0000   -1.0000   -5.0000    2.0000
   -5.0000   -5.0000    9.0000   -3.0000
    1.0000    2.0000   -3.0000    1.0000

>> det(A41)

ans =

   -1.0000

>>
```

Part 1 B

```
>> matrices
>> A21*eye(2)
```

```
ans =

     2     3
     5     8

>> A22*eye(2)

ans =

     6     3
     8     4

>> A41*eye(4)

ans =

     1     2     3     4
     2     4     7    11
     3     7    14    25
     4    11    25    50

>> A51*eye(5)

ans =

     1     2     3     4     5
     6     7     8     9    10
    11    12    13    14    15
    16    17    18    19    20
```

```
    21    22    23    24    25
```

Part 2

```
>> A23\B23

ans =

    1.5263
    1.1579

>> A23^-1*B23

ans =

    1.5263
    1.1579

>> inv(A23)*B23

ans =

    1.5263
    1.1579

>> AA23 = [A23 B23]

AA23 =

     2     6    10
```

```
    -5     4    -3

>> rref(AA23)

ans =

    1.0000         0    1.5263
         0    1.0000    1.1579

>> rref([A31 B31])

ans =

    1.0000         0         0    2.7500
         0    1.0000         0    4.2500
         0         0    1.0000    9.2500

>> rref([A32 B32)]
 rref([A32 B32)]
              ↑
Invalid expression. When calling a function or indexing a variable,
use parentheses.
Otherwise, check for mismatched delimiters.

Did you mean:
>> rref([A32 B32])

ans =

     1     0    -1     2
     0     1     2    -1
```

```
     0     0     0     0

>> rref([A33 B33])

ans =

     1     0    -1     0
     0     1     2     0
     0     0     0     1

>>
A41*inv(A41)

ans =

    1.0000   -0.0000         0         0
    0.0000    1.0000         0         0
         0   -0.0000    1.0000   -0.0000
         0   -0.0000         0    1.0000

>> A21*inv(A21)

ans =

     1     0
     0     1

>>
```

Post-Lab

```
>> eye(1)
```

```
ans =

     1

>> eye(2)

ans =

     1     0
     0     1

>> eye(3)

ans =

     1     0     0
     0     1     0
     0     0     1

>> eye(4)

ans =

     1     0     0     0
     0     1     0     0
     0     0     1     0
     0     0     0     1

>> eye(5)
```

```
ans =

     1     0     0     0     0
     0     1     0     0     0
     0     0     1     0     0
     0     0     0     1     0
     0     0     0     0     1

>>
```

1. Part a and b are in 1B

2.

```
det(B41)
Error using det
Matrix must be square.

>> det(B42)
Error using det
Matrix must be square.

>> inv(B41)
Error using inv
Matrix must be square.

>> inv(B42)
Error using inv
Matrix must be square.
```

There was a error because the matrices are not square and to take a determinate or an inverse the matrix needs to be square.

3.

4.

```
det(A32)


ans =


   1.3323e-15


>> det(A33)


ans =


   6.6613e-16


>> inv(A32)
Warning: Matrix is close to singular or badly scaled. Results may be
inaccurate. RCOND =
1.321694e-18.



ans =


   1.0e+16 *


   -0.2252    0.9007   -0.4504
    0.4504   -1.8014    0.9007
   -0.2252    0.9007   -0.4504
```

```
>> inv(A33)

Warning: Matrix is close to singular or badly scaled. Results may be
inaccurate. RCOND =

1.541976e-18.



ans =


   1.0e+16 *


   -0.4504    0.9007   -0.4504
    0.9007   -1.8014    0.9007
   -0.4504    0.9007   -0.4504


>>
```

The determinants are close to zero or are zero and that would give a divide by zero error when calculating the inverse. These answers are not reasonable. I cannot tell the difference between the two matrices with these calculations.

5.

```
>> A1 = [1 1 1;2 -1 1;1 2 -1]


A1 =


     1     1     1
     2    -1     1
     1     2    -1


>> A2 = [6;3;4]


A2 =
```

```
     6
     3
     4

>> rref([A1 A2])

ans =

    1.0000         0         0    1.5714
         0    1.0000         0    2.2857
         0         0    1.0000    2.1429

>> B1 = [1 2 -3;2 -4 6;3 6 -9]

B1 =

     1     2    -3
     2    -4     6
     3     6    -9

>> B2 = [7;-14;15]

B2 =

     7
   -14
    15

>> rref([B1 B2])
```

```
ans =

    1.0000         0         0         0
         0    1.0000   -1.5000         0
         0         0         0    1.0000

>> C1 = [1 1 1;2 2 2;3 3 3]

C1 =

     1     1     1
     2     2     2
     3     3     3

>> C2 = [6; 12; 18]

C2 =

     6
    12
    18

>> rref([C1 C2])

ans =

     1     1     1     6
     0     0     0     0
     0     0     0     0
```

```
>> D1 = [2 -3 4;5 6 -7;8 -9 10]

D1 =

     2    -3     4
     5     6    -7
     8    -9    10

>> D2 = [20;-14;30]

D2 =

    20
   -14
    30

>> rref([D1 D2])

ans =

    1.0000         0         0    1.1000
         0    1.0000         0   15.5333
         0         0    1.0000   16.1000


>> E1 = [4 -5 6;7 8 -9;10 -11 12]

E1 =

     4    -5     6
```

```
     7     8    -9
    10   -11    12

>> E2 = [14;-16;18]

E2 =

    14
   -16
    18

>> rref([E1 E2])

ans =

    1.0000         0         0         0
         0    1.0000         0   10.0000
         0         0    1.0000   10.6667

>>
```

c has infinite solutions and B has no solutions. I learned a much faster way to solve systems of equations and more about linear algebra.

6.I was just about able to finish during lab time with maybe 20 min outside of the lab.

7. About an hour.