

MATLAB and Octave for beginners

[illegible]

EPFL

# Multiplication of vectors and matrices

## Terminal Octave ou MATLAB

```
>> clear all
>> u = [3; -1; 2]; v = [0.4; 4; -0.1];
>> u*v
error: operator *: nonconformant arguments (op1
is 3x1, op2 is 3x1)
>> u'*v
ans = -3
>> u*v'
ans =

    1.0e+01 *
    0.12000    1.20000   -0.03000
   -0.04000   -0.40000    0.01000
    0.08000    0.80000   -0.02000

>> A = [2 0 1; 3 2 1]; B = [2 3;1 0];
>> A*v
ans =

    0.70000
    9.10000

>> B*v
```

## Products:

- Scalar product  $u \cdot v$
- Matrix-vector  $Av$
- Matrix-matrix  $AB$

Matrices and vectors needs to be of compatible sizes, otherwise these products can not be computed

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Let us now see what are the mathematical operations, that you can do with these matrices and these vectors. First, I clean up my environment as usual. so 'clear all' and then all variables are gone. Then I set my new vectors. I take two column vector of size 3 and I use second columns so that they are not displayed. I define 'u' and 'v'. I define them one after the other no need to press enter between them. So once I would press enter Octave will execute both commands. done. How to define a scalar product? so I can define a scalar product by doing u times v but if I just write like that may be there is a problem because of the sizes of these two vectors. Indeed the star is a matrix multiplication. So I have to write it in with a Transpose command u' Transpose times v gives me the scalar product between u and v. while if I do 'u' times 'v' Transpose then I get a 3 by 3 matrix. Now I can define two matrices A, which is a two times 3 matrix. and then B, which is a 2 by 2 matrix. So I can do the multiplication between a and v A is a 2 times 3 matrix, v is a size 3 vector and I do the multiplication I should get a vector of size 2 as in mathematics, here it is.

Notes

Summary



# Multiplication of vectors and matrices

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```
0.12000  1.20000  -0.03000
-0.04000  -0.40000  0.01000
0.08000  0.80000  -0.02000

>> A = [2 0 1; 3 2 1]; B = [2 3; 1 0];
>> A*v
ans =
    0.70000
    9.10000

>> B*v
error: operator *: nonconformant arguments (op1
is 2x2, op2 is 3x1)
>> B*A
ans =
    13     6     5
     2     0     1

>> A*B
error: operator *: nonconformant arguments (op1
is 2x3, op2 is 2x2)
>>
```

Products:

- Scalar product  $u \cdot v$
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I can also try to multiply B times v but now the sizes are not compatible and they get an error. A vector B is a 2 by 2 and they can only multiply by a vector of 2. I can also do a multiplication between matrices for example B times A gives me a 2 by 3 matrix. It is possible. While if I do a times b then there is a mistake because the size are incompatible.

Notes

Summary



# Solving linear systems of equations

## Terminal Octave ou MATLAB

```
>> b = [3; 1; 0.9];
>> A = [2 3 0; 1 0 -2; 0 0 3];
>> inv(A)
ans =

    0.00000    1.00000    0.66667
    0.33333   -0.66667   -0.44444
    0.00000    0.00000    0.33333

>> x = inv(A)*b
x =

    1.60000
   -0.06667
    0.30000

>> z = A\b; % resolution de A z = b
>> [x z]
ans =

    1.60000    1.60000
   -0.06667   -0.06667
    0.30000    0.30000

>>
```

How to solve  $Ax = b$ ?

- With the inverse of A
- With the backslash operator

Pay attention to the syntax:

$A \backslash b$  is different from  $b/A$

MATLAB and Octave for beginners

If you are able to do mathematical operations like matrix times vector. why not to try to solve  $Ax = B$ ? So I take a vector of size 3 b equal to this line vector but oops, when I do this matrix vector operations so I need a column vectors, so actually I need to define B with semi colons, so that it is a column vector and not a row vector. And then I take a matrix A which is 3 times 3 and it has to be invertible then otherwise there is no sense in trying to a solve  $Ax = b$ . I want a A to be invertible. So I can click and calculate this solution of  $Ax = b$  by saying that x is equal to inv of a times b and I get my solution. but using the inv function is not very efficient especially if the matrix is very large. So there are other ways to solve this problem. So here we can set z equal to A, which divides b. So what is this? This is equivalent to solving the system. A z equal to b. okay, so here I put some commands so with ampersand with this percentage symbol, I have a command. This makes the rest of the line just a command that MATLAB will not see and now I can see if z and x are the same. So I have two different ways of solving the problem and I will put on screen x and z one aside the other.

Notes

Summary



# Solving linear systems of equations

Terminal Octave ou MATLAB

```
-0.06667
0.30000

>> z = A\b; % resolution de A z = b
>> [x z]
ans =

    1.6000    1.6000
   -0.0667   -0.0667
    0.3000    0.3000

>> x-z
ans =

    1.0e-17 *

    0.00000
    5.55112
    0.00000

>> b/A
error: operator /: nonconformant arguments (op1
is 3x1, op2 is 3x3)
>> x = inv(A)*b;
>> z = A\b; % resolution de A z = b
```

How to solve  $Ax = b$ ?

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okay, I see two columns which are the same, one is x and the other is z. I can also take the difference between the two and I see that the difference is really tiny. okay. It depends on the order of accuracy of the machine so 10 to the minus 17. Note that if you divide B by A well, there is a mismatch of sizes. so, here is like if I'm multiplying B times the inverse of A, which is not correct So in summary we can write x equal to inverse A times B which is not very per-formant or writing Z equal to A divided by B which is a more appropriate.

Notes

Summary

