# CV202, HW1

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## Problem 1 – which definition is better?

## Problem 2

*It must satisfy: , in our case:*

We can see that

## Problem 3

is invertible if we can find an affine transformation such that:

## Problem 4

## Problem 5

We have

There exist a such that

There exist b such that

We need to find c such that

If we take the matrix

*Therefore is invertible affine map.*

## Problem 6

We will show that G1, G2 and G3 are satisfied:

*G1:*

*G2:*

*G3:*

## Problem 7

*We found 2 matrices that belongs to GL(2) and not Abelian.*

## Problem 8

We will show that G1, G2 and G3 are satisfied:

*G1:*

*G2:*

*G3:*

## Problem 9

Lets look at G2:

## Problem 10

## Problem 11

We will show that G1, G2 and G3 are satisfied:

*G1:*

*G2:*

*G3:*

## Problem 12

## Problem 13

We can see that the vector satisfy: for all

Therefore the matrix is the zero element.

## Problem14

A linear subspace of a linear space must contain the 0 element.

We know that if A belongs to a matrix group there exists

We also know that .

If the zero element will be chosen as A then

Therefore the zero element cannot be in the linear subset of the linear space, it cannot contain the zero element.

## Problem 15

We will show that G1, G2 and G3 are satisfied:

*G1:*

*G2:*

*G3:*

## Problem 16

We will show that G1, G2 and G3 are satisfied:

*G1:*

*G2:*

*G3:*

## Problem 17

Lets look at G2:

## Problem 18

## Problem 19

## Problem 20

## Problem 21

## Problem 22

## Problem 23

We showed in definition 9 that

Now we will show

Intuition: if at (0,0) the value of is 1 and otherwise its 0, it means that it preserve only the pixel that the convolution is affecting, without any influence by other pixels (they are multiplied by 0).

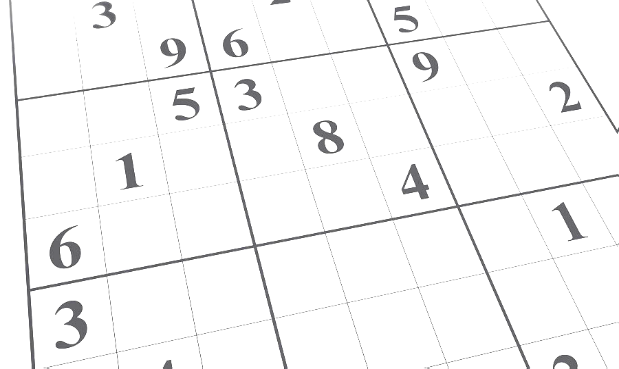
## Problem 24

We have , this is our image.

If we want to do filter (3x3) on x(I,j) the relevant pixels are:

*Now in order to define H so that the matrix multiplication will activate the filter, each row in H should represent a cell in y after multiply x with the filter h, first lets define the image index by the index of H.*

## Problem 25



## Problem 26

*We cant determine det(Y) but we can tell that it is either -1 or 1.*

1. *We need to show that is orthogonal square matrix:*
2. *One of the square orthogonal matrix properties is that the column vectors are form of orthonormal basis, which mean that they are orthogonal to each other, therefore:*

1. *TODO*

## Problem 27

A matrix is invertible if all of its eigenvalues are non-zero.

Also we know from Fact 2 that a filter is separable iff he has exactly 1 non-zero singular value.

In our case K is a separable filter, which means it has exactly one singular value that is nonzero. Singular value is the absolute value of the eigenvalues of by definition. So , which means that is not invertible.

Let's assume that K is invertible, K is also a square matrix so should also be invertible**, but we know that is not invertible, therefore K is not invertible.**

## Problem 28

Bilateral filtering uses the absolute function, therefor it is not linear

## Problem 29

First derivative:

Second derivative:

## Problem 30