**Please, upload your answers in Canvas: assignment PC LAB – May 12**

Name: Vu The Doan

Student nr: 12918687

**PC6a - Matrices**

**1.** Using the vector r=1:4, construct the matrix



You may *not* use for-loops.

**2.** Determine which of the following operations are viable (i.e. which are syntactically correct):

A <- matrix(1,3,3)

B <- 2\*matrix(1,3,2)

C <- 3\*matrix(1,2,3)

cbind(A,B) - possible

cbind(A,t(B)) - impossible

cbind(A,C) - impossible

cbind(A,t(C)) - possible

rbind(A,C) - possible

rbind(A,t(B)) - possible

Verify your answers by executing the R statements.

**3.** Determine by hand what will be the outcome of:







Verify your answers by executing the R statements.

**4.** Solve using R the following system of linear equations:



**5.** Determine whether the following systems have solutions and if these are unique:

(i)  unique solution: x=7/3, y=0

(ii)  no solution

(iii)  unique solution: x=1, y=z=a=b=c=0

**6.** Consider the matrix:



**a.** Calculate by hand the determinant of the matrix (expand along the first row).



= s^3+1

Verify your answer using R:

library(Ryacas)

yac("A:={{0,1,s},{s,0,1},{1,s,0}}")

yac("Determinant(A)")

**b.** The determinant is a cubic polynomial. We can get its four coefficients by evaluating the determinant at four different values of *s* using the next two steps:

1. Evaluate the determinant of this matrix for for Denote these values as .

2. Determine the coefficients of the cubic polynomial based on using polyfit.

**c.** For which value of *s* is the matrix singular (only real values, not imaginary)? **s = -1**

**7.** Consider the matrix below:



**a.** Determine the eigenvalues and eigenvectors of this matrix.

**b.** Write an R-script that checks:  for 

Example output:

A\*v\_1 lambda\_1\*v\_1:

-1.41421 -1.41421

0.00000 0.00000

0.00000 0.00000

1.41421 1.41421

A\*v\_2 lambda\_2\*v\_2:

0.00000 0.00000

1.00000 1.00000

0.00000 0.00000

0.00000 0.00000

A\*v\_3 lambda\_3\*v\_3:

0.00000 0.00000

0.00000 0.00000

1.00000 1.00000

0.00000 0.00000

A\*v\_4 lambda\_4\*v\_4:

0.00000 0.00000

0.00000 0.00000

0.00000 0.00000

-0.00000 0.00000

**8.** Consider the following transition matrix (horizontal is ‘from’ and vertical is ‘to’):



From this matrix, we see that a sunny day is followed by another sunny day with a 90% chance, while a rainy day is be followed by another rainy day with a 50% chance. Let  be the ratio of sunny days and  the ratio of rainy days and 

Suppose that day 0 is a sunny day: 

The prediction of the weather on day 1 is:



so there is 90% chance that day 1 is sunny, while a 10% chance that day 1 is rainy.

The probabilities of the two weather states (sunny versus rainy) on day 2 are given by:



In general, we get: 

1. Determine the decomposition 

What can be said about 

1. Verify in R that 
2. In case of an equilibrium (also called steady-state), it must hold that  i.e. Hence, we get  such that  and 

Solve these two equations and verify the answer.

setwd("D:/UvA/Year 1/Block 5/Programming and Numerical Analysis/Week 7")

rm(list = ls())

#1

A <- matrix(0, nrow = 4, ncol = 4); A

r <- 1:4

A[1, ] <- r; A[ , 4] <- rev(r)

#2

A <- matrix(1,3,3); A

B <- 2\*matrix(1,3,2); B

C <- 3\*matrix(1,2,3); C

cbind(A,B)

cbind(A,t(B))

cbind(A,C)

cbind(A,t(C))

rbind(A,C)

rbind(A,t(B))

#3

A <- matrix(c(1,2,3,4), 2, 2, byrow = TRUE); A

B <- matrix(c(3,4,-1,2), 2, 2, byrow = TRUE); B

A%\*%B

A <- matrix(c(3,5,6,-2),2,2, byrow = TRUE); A

B <- matrix(c(-1,0,2,1),2,2,byrow = TRUE); B

2\*A - 4\*B

A <- c(1,3,5)

B <- matrix(c(2,-1,-1,0,7,-2), 3, 2, byrow = TRUE); B

A%\*%B

#4

A <- matrix(c(1,1,2,1,-1,-3,-2,-5,1), 3, 3, byrow = TRUE); A

b <- c(1,0,4)

solve(A, b)

#5

#6

library(Ryacas)

yac("A:={{0,1,s},{s,0,1},{1,s,0}}")

yac("Determinant(A)")

a <- NULL

for(i in 1:4) {

s <- (i-1)\*(pi/4)

a[i] <- s^3 + 1

}

a

i <- 1:4

s <- (i-1)\*(pi/4)

y <- s^3 + 1

library(pracma)

a <- polyfit(s,y,3); a

y <- polyval(p=a, x=1:100)

plot(y, type = "l")

#7

A <- matrix(c(1,0,0,-1,0,1,0,0,0,0,1,0,-1,0,0,1), 4,4); A

ev <- eigen(A)

V <- ev$vectors; V

lambda <- ev$values; lambda

av <- vector(mode = "list", length = 4)

lv <- vector(mode = "list", length = 4)

for (i in 1:4) {

av[[i]] <- A%\*%V[,i]

lv[[i]] <- lambda[i]%\*%V[,i]

}

for (i in 1:4) {

cat(sprintf("A\*v\_%d lambda\_%d\*v\_%d", i,i,i), "\n")

cat(sprintf("%2.5f %2.5f", av[[i]][1], lv[[i]][1]), "\n")

cat(sprintf("%2.5f %2.5f", av[[i]][2], lv[[i]][2]), "\n")

cat(sprintf("%2.5f %2.5f", av[[i]][3], lv[[i]][3]), "\n")

cat(sprintf("%2.5f %2.5f", av[[i]][4], lv[[i]][4]), "\n")

}

for (i in 1:4) {

cat(sprintf("A\*v\_%d lambda\_%d\*v\_%d", i,i,i), "\n")

for (j in 1:4) {

cat(sprintf("%2.5f %2.5f", av[[i]][j], lv[[i]][j]), "\n")

}

}

#8