

# Matrix Algebra in R

## Introduction

### SickKids and DARTH

Change `eval` to `TRUE` if you want to knit this document.

This worksheet provides an introduction to matrix algebra in R:

Throughout the course, we will demonstrate code and leave some empty *code chunks* for you to fill in. We will also provide solutions after the session.

Feel free to modify this document with your own comments and clarifications.

**EXERCISE 1** Use the following *code chunk* to create a matrix `matrixB` with 2 rows and 4 columns and a matrix `matrixC` with 4 rows and 2 columns:

NOTE: you may decide what the elements are for both matrices - they can be anything as long as the dimensions are right.

```
matrixB <- matrix(1:8, nrow=2, ncol=4)
matrixC <- matrix(c(1,2,5,10,28,90,60,100), nrow = 4, ncol=2)
```

In R, there are three key operations that we can do with matrices, addition (+), multiplication (\*) and matrix multiplication (%\*%). Each of these operations can only be used if the matrices are compatible.

**EXERCISE 2** Perform the following operations on `m_A` and `m_B`:

- 1) Their sum
- 2) Their element-wise product (the Hadamard product)
- 3) Their product
- 4) The product of the first matrix with the transpose of the second matrix

```
m_A <- matrix(1:9, nrow=3, ncol=3)
m_B <- matrix(6:14, nrow=3, ncol=3)
```

```
# 1)
m_A + m_B
# 2)
m_A * m_B
# 3)
m_A %*% m_B
# 4)
m_A %*% t(m_B)
```

**EXERCISE 3** We created two matrices, `matrix1` and `matrix2` in the code chunk below. Perform the following operations and display the results:

- 1) Add `matrix1` to `matrix2` and take the transpose of the sum, and matrix-multiply the result with `matrix2`
- 2) Obtain the transpose of the product of `matrix1` and `matrix2` and element-wise multiply the result with `matrix1`

```
matrix1 <- matrix(1:9, nrow=3, ncol=3)
matrix2 <- matrix(c(1,0,0,0,3,4,5,9,2), nrow=3, ncol=3)

# 1)
# Your turn
t(matrix1 + matrix2) %*% matrix2
# 2)
# Your turn
t(matrix1 %*% matrix2) * matrix1
```