Problem 1)

Verify the solution $u(t) = A \cdot \exp^{-kt} + \frac{I(t)}{k}$ (1) of the leaky-integrator equation $\frac{du}{dt} = -k \cdot u(t) + I(t)$ (2) by differentiation of (1) with respect to **t** and insertion into (2).

Problem 2)

Let **A, B, C** be the matrices

$$A = \begin{pmatrix} 2 & 5 & 0 \\ -2 & 1 & -1 \end{pmatrix} \qquad B = \begin{pmatrix} 4 \\ 7 \\ -1 \end{pmatrix} \qquad C = \begin{pmatrix} 3 & -3 \end{pmatrix}$$

Compute the following products (where possible):

a) **A*B** b) **B*A** c) **A*C** d) **C*A** e) **B*C** f) **C*B**

Problem 3)

Compute the product of the variable matrices D, E. You may use the *Falk-Schema* for simplicity.

$$D = \begin{pmatrix} s & 0 & -t \\ 1 & v & w \end{pmatrix} \qquad E = \begin{pmatrix} 1 & 1 & x \\ -y & 0 & 0 \\ 0 & -z & -1 \end{pmatrix}$$

Problem 4)

a) Use the explicit formula from the tutorial to compute the inverse matrices of **F, G**:

$$F = \begin{pmatrix} 3 & 7 \\ 1 & 2 \end{pmatrix} \qquad G = \begin{pmatrix} 3 & 6 \\ 1 & 2 \end{pmatrix}$$

b) Validate the results by computing $\mathbf{F*F^{-1}}$ and $\mathbf{G*G^{-1}}$

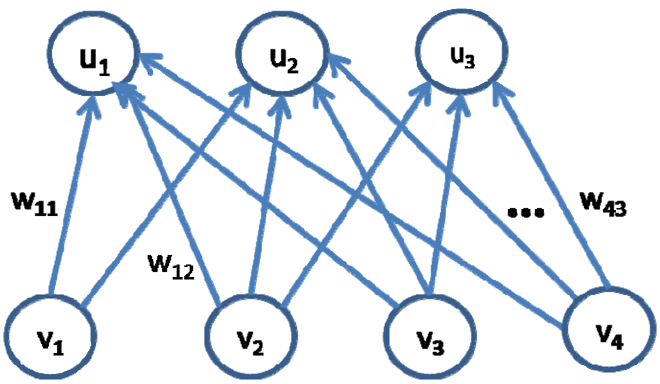
Problem 5)

Think of a simple (but non-trivial) example of matrices with dimension **(2,2)**, where

$$H \cdot J \neq J \cdot H.$$

Problem 6)

Given the linear associator in this scheme with weight matrix **W**



$$W = \begin{pmatrix} 0.1 & 0.4 & -0.3 & 0 \\ 0.2 & -0.7 & 0.7 & -0.8 \\ 0.8 & 0 & -0.1 & 0.9 \end{pmatrix}$$

a) Explicate the dimensions of **u** and **v.**

b) What output **u** is generated by an input $v = \begin{pmatrix} 1 & 0 & 1 & 0.5 \end{pmatrix}^T$?

c) Which synapses between $\mathbf{v_i}$ and $\mathbf{u_j}$ are missing and how can you tell that from W?

d) What output **u'** would you expect for **v' = 2*v** ?