Exercise 33: (Post correspondence problem light)

Exercise 34: (Decidable first-order logic)

a

b

Exercise 35: (Undecidable problem III: Mortal Matrices)

a

This set of matrices is not a set of mortal matrices.
A_1 is just $-1 \cdot \mathbb{E}$, as well as A_2^2, $A_3 \cdot A_2$ and A_3^2, so multiplakation with it will only result in the zero matrix if is multiplied with the zero matrix. Similarly $A_2 \cdot A_3$ is just $\mathbb{E}$. Furthermore, A_3 is just $A_1 \cdot A_2$

b

This set of matrices is a set of mortal matrices.

$$B_1 \cdot B_3 = \begin{pmatrix} 2 & 2 \\ 2 & 2 \end{pmatrix}$$

$$B_3 \cdot B_2 = \begin{pmatrix} 0 & 2 \\ -1 & 0 \end{pmatrix}$$

$$B_1 \cdot \begin{pmatrix} 0 & 2 \\ -1 & 0 \end{pmatrix} = \begin{pmatrix} -2 & 2 \\ -2 & 2 \end{pmatrix}$$

$$\begin{pmatrix} 2 & 2 \\ 2 & 2 \end{pmatrix} \cdot \begin{pmatrix} -2 & 2 \\ -2 & 2 \end{pmatrix} = \begin{pmatrix} 0 & 0 \\ 0 & 0 \end{pmatrix}$$

c

Exercise 36: (More Mortal Matrices)

We wrote a small python program (see attachments of the mail) to brute force our way to a solution, which was quite clever considering the solution is quite long:
$A \cdot B \cdot B \cdot A \cdot B \cdot A \cdot A \cdot B \cdot B \cdot B \cdot B \cdot A \cdot A \cdot A \cdot B \cdot B \cdot A = Zeromatrix$