**Problem 1.** Consider the directed weighted graph with weighting matrix

$$
\begin{bmatrix}
\infty & 2 & 1 & 9 & \infty & \infty & \infty \\
9 & \infty & 8 & \infty & 4 & 2 & \infty \\
1 & 1 & \infty & 1 & \infty & 1 & \infty \\
3 & \infty & 1 & \infty & \infty & 1 & 1 \\
\infty & 1 & \infty & \infty & \infty & 1 & \infty \\
\infty & 3 & 1 & 5 & 1 & \infty & 1 \\
\infty & \infty & \infty & 4 & \infty & 3 & \infty
\end{bmatrix}
$$

(i) Compute the adjacency matrix.

(ii) Create this graph in Magrada, introducing the weighting matrix (Menu **Graph**, option **New,** Select **Weighted,** Insert **Weighted adjacency matrix**). Check the adjacency matrix computed in (i) using Magrada (Menu **Basic Calculations**, option **Adjacency matrix**).

Problem 2. Consider the directed weighted graph
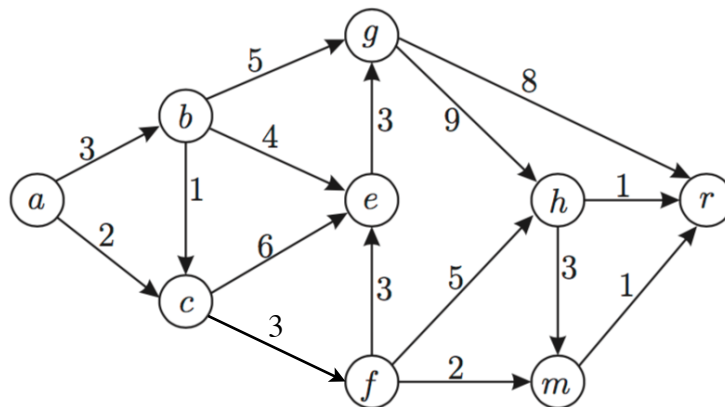
(i) Apply the numbering algorithm of vertices and argue if the graph has circuits or not.

(ii) Using Bellman's equations, compute the shortest paths and their weights from the initial vertex a to the rest.

(iii) Introduce the graph in Magrada using **Graphic Mode**. Check the result of **(ii)** with Magrada (Menu **Algorithms**, Option **Shortest paths in acyclic graphs,** first select **Renumber** and then **Apply**).

Problem 3. Bake a cake project.

Task	Task time in minutes	Immediate predecessors
1. Buy frosting ingredients	30	-
2. Clean up kitchen	45	-
3. Buy cake ingredients	30	-
4. Prepare frosting	15	1, 2
5. Prepare batter	30	2, 3
6. Bake	60	5
7. Frost cake	30	4, 6

(i) Draw the graph that represents the project (including the fictitious vertices representing the start and the end of the project).

(ii) Obtain the weighting matrix of the graph.

(iii) Argue if the graph has circuits or not.

(iv) Compute the critical path and the minimum time needed to complete the project.

(v) Introduce the graph in Magrada using **Graphic mode**. Check the result of **(iv)** with Magrada (Menu **Algorithms**, Option **PERT,** first select **Renumber** and then **Apply**).