CSCI 2710 – Discrete Structures
Identifying Properties of Relations

Property	Definition	Identification with a matrix	Identification with a digraph
Reflexive	A relation R on a set A is reflexive if (a, a) ∈ R for all a ∈ A.	All 1's on the main diagonal	Every vertex has a cycle of length 1
Irreflexive	A relation R on a set A is irreflexive if (a, a) ∉ R for all a ∈ A.	All 0's on the main diagonal	No vertex has a cycle of length 1
Symmetric	A relation R on a set A is symmetric if whenever (a, b) ∈ R, then (b, a) ∈ R.	The matrix is symmetric across the main diagonal	Every edge is undirected, i.e., it goes both ways.
Asymmetric	A relation R on a set A is asymmetric if whenever (a, b) ∈ R, then (b, a) ∉ R.	All 0's on the main diagonal and every 1 in the matrix is paired with a 0 opposite it across the main diagonal.	No cycles of length 1 and every edge is directed, i.e., no edge can be paired with an equal edge in the opposite direction.
Antisymmetric	A relation R on a set A is antisymmetric if whenever (a, b) ∈ R and (b, a) ∈ R, then a = b.	1's may exist on the main diagonal, but every 1 in the matrix is paired with a 0 opposite it across the main diagonal.	Cycles of length 1 are allowed, but every edge is directed, i.e., no edge can be paired with an equal edge in the opposite direction.
Transitive	A relation R on a set A is transitive if when (a, b) ∈ R and (b, c) ∈ R, then (a, c) ∈ R.	Not obvious: If $a_{ij} = 1$ and $a_{jk} = 1$, then a_{ik} must equal 1.	Every path of length two must be "matched" with a path of length one.