

**On some graph transformations that preserve  
 $\text{sgn}(\lambda_2 - 2)$**

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For a simple graph  $G$  (a non-oriented graph without loops or multiple edges), with the  $(0, 1)$ -adjacency matrix  $A$ , we define  $P_G(\lambda) = \det(\lambda I - A)$  to be its *characteristic polynomial*. The roots of the characteristic polynomial are the *eigenvalues* of  $G$ , and, since they are all real numbers, we can assume the non-increasing order:  $\lambda_1 \geq \lambda_2 \geq \dots \geq \lambda_n$ . Graphs having  $\lambda_2 \leq 2$  are called *reflexive graphs*. A *cactus* is a graph whose any two cycles have at most one common vertex.

So far we have determined all classes of reflexive cacti with 4 and 5 cycles and several classes of reflexive cacti with 2 and 3 cycles. Now we describe some graph transformations that preserve  $\text{sgn}(\lambda_2 - 2)$ , which establish connections between correspondent families of reflexive graphs within the same class, as well as between families that belong to different classes. Using these transformations, we improved our previous results and discovered some new classes of reflexive cacti.