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Tensor products of indecomposable integral matrix representations of the symmetric group of third degree

Diana Biletska, Ihor Shapochka

Let S_3 be the symmetric group of third degree with generators a, b and relations: $a^2 = b^3 = e$, $ba = ab^2$, where e is the identity of S_3. The result, which we have obtained, is based on the classification of all non-equivalent indecomposable integral matrix representations of the group S_3, obtained by L. A. Nazarova and A. V. Roiter [**1**]. The following representations of the group S_3 over the ring $\mathbb{Z}$ of rational integers presents all indecomposable integral pairwise non-equivalent representations of the group S_3 of the degree not greater then 3:

$$\Gamma_1 : a \to 1,\ b \to 1; \quad \Gamma_2 : a \to -1,\ b \to 1; \quad \Gamma_3 : a \to \begin{pmatrix} 0 & 1 \\ 1 & 0 \end{pmatrix},\ b \to \begin{pmatrix} 0 & -1 \\ 1 & -1 \end{pmatrix};$$

$$\Gamma_4 : a \to \begin{pmatrix} 0 & 1 \\ 1 & 0 \end{pmatrix}, \quad b \to \begin{pmatrix} -1 & -1 \\ 1 & 0 \end{pmatrix}; \quad \Gamma_5 : a \to \begin{pmatrix} 1 & 1 \\ 0 & -1 \end{pmatrix}, \quad b \to \begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix};$$

$$\Gamma_6 : a \to \begin{pmatrix} 1 & 0 & 0 \\ 0 & 0 & 1 \\ 0 & 1 & 0 \end{pmatrix},\ b \to \begin{pmatrix} 1 & 0 & 1 \\ 0 & 0 & -1 \\ 0 & 1 & -1 \end{pmatrix};$$

$$\Gamma_7 : a \to \begin{pmatrix} -1 & 0 & 0 \\ 0 & 0 & 1 \\ 0 & 1 & 0 \end{pmatrix},\ b \to \begin{pmatrix} 1 & 1 & 0 \\ 0 & -1 & -1 \\ 0 & -1 & 0 \end{pmatrix}.$$

Theorem 1. *Let Δ and Θ be an indecomposable integral representations of the group S_3. The tensor product $\Delta \otimes \Theta$ of the representations Δ and Θ is indecomposable if and only if one of the following conditions holds:*

1) *one of the representations Δ and Θ has degree* 1*;*
2) *both of the representations Δ and Θ are irreducible;*
3) *one of the representations Δ and Θ has degree* 2 *and another has degree* 3.

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Diagonability of idempotent matrices over duo rings

Andriy Bilous

It is proved that a idempotent matrix over PT duo ring R is diagonalizable under a similarity transformation.

Definition 1. A ring R is said to be a duo ring if every its left or right ideal is two sided.

Theorem 1. *Let R be a duo ring and A be an $n \times n$ idempotent matrix over R. If there exist invertible matrices P and Q such that PAQ is a diagonal matrix, then there is an invertible matrix U such that UAU^{-1} is a diagonal matrix.*

Definition 2. A ring R is a *PT* (projective trivial) ring if every idempotent matrix over R is similar to a diagonal matrix.