1 CDS and CDR

1.1. Consider the permutation $\alpha = [5, 7, 6, 9, 8, 3, 4, 10, 1]$:
   
   1. Construct the cycle graph of $\alpha$
   2. Construct all the alternating paths of this cycle graph.
   3. Assume that $A$ has as elements the permutations $[k+1, \cdots, 10, 1, 2, \cdots, k]$ for $k = 2, 5, 7$. Which player has a winning strategy in the game CDS($\alpha, A$)?
   4. Construct the overlap graph of $\alpha$.

1.2. For the signed permutation $\beta = [5, 7, -6, 9, 1, 8, -3, 10, 2, -4]$
   
   1. Construct the oriented overlap graph of $\beta$
   2. Is $\beta$ cdr sortable?
   3. If $\beta$ is cdr sortable, find a sequence of cdr moves that sorts $\beta$.
   4. What is the length of the shortest sequence of cdr applications, starting with signed permutation $\beta$, resulting in a permutation to which no further cdr operations are applicable?

2 Cryptography

1.1. Is the set $\{RSA_k : k \in \mathbb{K}\}$ a group under functional composition?\(^1\)

1.2. Let $\theta : \mathbb{Z}_3^3 \times \mathbb{Z}_3^3 \to \mathbb{Z}_3^3 \times \mathbb{Z}_3^3$ be the function $\theta(x, y) = (y, x)$. What is the parity of $\theta$? How about $\theta$ defined over $\mathbb{Z}_5^2 \times \mathbb{Z}_5^2$? How about $\theta$ defined over $G^t \times G^t$?

\(^1\)The symbol RSA denotes the RSA encryption function.