

# List of Figures

Figure	Title	page
1.1	Signed cycles.	2
1.2	Signed graphs. The dotted circles encompass the clusters of vertices. Each edge inside a cluster is positive, while each edge between the clusters is negative. For strongly balanced graph there are exactly two clusters, while for weakly balanced graph there can be more than two clusters.	2
1.3	Signed graphs $G_1$ and $G_2$ both are strongly unbalanced. The only strongly unbalanced cycle in $G_1$ is the cycle on vertices $v_4, v_9, v_{10}$ , while $G_2$ has many strongly unbalanced cycles.	2
2.1	Coates digraph and linear subdigraphs of (a) $A_{2 \times 2}$ , where $L_1$ and $L_2$ are linear subdigraphs (b) Balanced $C_4$ where $L_1, L_2, L_3$ , and $L_4$ are linear subdigraphs.	10
3.1	(Left) Evolution of the balance among the six major players of the World War I at different time periods. Solid lines account for alliances and broken lines represent enmities. GB: Great Britain; Ru:Russia; Ge: Germany; Fr: France; AH: Austro-Hungarian Empire; It: Italy. (Right) Balance among the subtribes in the highlands of New Guinea [Hage, 1979]. Solid dark blue lines are for alliance (Rova) relations and red dashed lines are for antagonistic (Hina) relations.	17
3.2	Variation of degree of unbalance $U(\beta, \infty)$ w.r.t $\beta$ (a) WK (b) SD (c) EPN	18
3.3	Variation of degree of unbalance $U(\beta, \infty)$ of random networks w.r.t $\beta$ (a) RN-I (b) RN-II (c) RN-III	18
3.4	Variation of degree of Unbalance w.r.t length of closed walks for a given $\beta$ (a) WK (b) SD (c) EPN (d) RN-I	19
3.5	Variation of degree of Unbalance as a function of $\beta, k$ (a) WK (b) SD (c) EPN (d) RN-I	20
3.6	Accuracy of sign prediction as a function of $\beta, k$ (a) WK (b) SD (c) EPN	23
4.1	Examples: (a) A complete signed graph with negative cliques, $K_8^{2,3}$ (b) Weakly balanced signed graph corresponding to $K_8^{2,3}$ , (c) 3-regular star block graph.	26
4.2	Example of weakly balanced graphs. (a) A complete weakly balanced graph. (b) A complete-cycle weakly balanced graph. (c) A complete-path weakly balanced graph.	26
4.3	(a) Eigenvalues of balanced (Blue) and unbalanced (Green) cycle graph $C_{20}$ . (b) Difference in eigenvalues of balanced and unbalanced cycle graph $C_{100}$ .	29
5.1	(a) Digraph of matrix $M_1$ (b) Digraph of matrix $M_2$	46
5.2	Example of a $\mathcal{B}$ -partition of (a) Digraph of matrix $M_1$ (b) Digraph of matrix $M_2$	49
5.3	$\mathcal{B}$ -partitions of the digraph of matrix $M_1$	50
5.4	$\mathcal{B}$ -partitions of the digraph of matrix $M_2$	51
6.1	Examples. (a) Block graph with negative cliques. (b) $U(C_5, \{T_3, T_3\})$ . (c) $U(C_5, T_3, T_3, 2)$ . (d) Mix complete graph. (e) Mix star block graph.	60
6.2	Digraph of matrix $A(mK_n \setminus v_1)$ after elementary operations.	71
8.1	A non separable graph on 6 vertices.	82

