GeneNet: Temporal Graph Data Visualization for Gene Nomenclature and Relationships

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Abstract : This paper proposes a temporal graph approach to visualize and analyze the evolution of gene relationships and nomenclature over time. An interactive web-based tool implements this temporal graph, enabling researchers to traverse a timeline and observe coupled dynamics in network topology and naming conventions. Analysis of a real human genomic dataset reveals the emergence of densely interconnected functional modules over time, representing groups of genes involved in key biological processes. For example, the antimicrobial peptide DEFA1A3 shows increased connections to related alpha-defensins involved in infection response. Tracking degree and betweenness centrality shifts over timeline iterations also quantitatively highlight the reprioritization of certain genes' topological importance as knowledge advances. Examination of the CNR1 gene encoding the cannabinoid receptor CB1 demonstrates changing synonymous relationships and consolidating naming patterns over time, reflecting its unique functional role discovery. The integrated framework interconnecting these topological and nomenclature dynamics provides richer contextual insights compared to isolated analysis methods. Overall, this temporal graph approach enables a more holistic study of knowledge evolution to elucidate complex biology.

Keywords : temporal graph, gene relationships, nomenclature evolution, interactive visualization, biological insights

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