# Geodesic and related betweenness in graphs using transit functions

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**Abstract**

Problems on betweenness and associated convexities in graphs are discussed using the tool of 'Transit Functions'. A *transit function* on a nonempty finite set $V$ is a function $R : V \times V \to 2^V$ satisfying the three transit axioms, $\forall x, y \in V$ :

($t1$): $x \in R(x, y)$
($t2$): $R(x, y) = R(y, x)$ and
($t3$): $R(x, x) = \{x\}$.

Transit functions form a powerful tool to study betweeness in mathematics. The theory of betweeness has a rich history starting from geometry, and to order theoretic structures, metric spaces, graphs and recently to hypergraphs, directed graphs and so on.

In this talk, after a brief historical note on betweeness, we discuss the geodesic betweeness and their variations in connected simple undirected graphs. The well studied 'geodesic betweenness' is defined using the "interval function" of a graph, which is the function $I$ from $V \times V \to 2^V$, mapping every pair of vertices $u, v \in V$ to the set $I(u, v) = \{v \in V | v$ lies on a shortest $u, v$-path in $G\}$, where $V$ is the vertex set of a connected simple undirected graph $G$.

Special case of the geodesic betweeness like the cut-vertex betweenness ( cut-vertex transit function), the stress (or strong geodesic) betweeness ( stress transit function), and pre-fiber transit function are introduced and various problems on these transit functions are discussed.