

Graph Pattern	Hop Type	Expressions in $\mu - RA$
(a) - [FriendOf] -> (b), (b) - [Knows] -> (c)	One Hop And Branch	$\tilde{\pi}_m \left( \rho_{fid}^m(F) \bowtie \rho_{pid}^m(K) \right)$
(a) - [FriendOf] -> (b) - [FriendOf] -> (c), (b) - [Knows] -> (d)	Two Hops And Branch	$\tilde{\pi}_m \left( \rho_{fid}^m(F) \bowtie \rho_{pid}^m(F) \bowtie \rho_{pid}^m(K) \right)$
(a) - [FriendOf] -> (b) - [FriendOf] -> (c), (c) - [FriendOf] -> (d), (c) - [Knows] -> (d)	Three Hops And Branch	$\tilde{\pi}_m \left( \rho_{fid}^m \left( \tilde{\pi}_m \left( \rho_{fid}^m(F) \bowtie \rho_{pid}^m(F) \right) \bowtie \rho_{pid}^m(F) \bowtie \rho_{pid}^m(K) \right) \right)$
(a) - [FriendOf] -> (b) - [FriendOf] -> (c), (c) - [FriendOf] -> (d), (b) - [Knows] -> (d)	Three Hops And Branch	$\tilde{\pi}_{m,n} \left( \rho_{fid}^n \left( \rho_{fid}^m(F) \bowtie \rho_{pid}^m(F) \right) \bowtie \rho_{fid}^n(F) \bowtie \rho_{pid}^m(K) \right)$
(a) - [FriendOf] -> (b) - [FriendOf] -> (c), (c) - [FriendOf] -> (d), (b) - [Knows] -> (d)	Three Hops And Branch	$\tilde{\pi}_{m,n} \left( \rho_{fid}^m(F) \bowtie \rho_{pid, fid}^{m,n}(F) \bowtie \rho_{pid}^n(F) \bowtie \rho_{pid}^m(K) \right)$
(a) - [FriendOf] -> (b) - [FriendOf] -> (c), (c) - [FriendOf] -> (d), (b) - [Knows] -> (e) (c) - [Knows] -> (f)	Three Hops And Two Branches	$\tilde{\pi}_{m,n} \left( \rho_{fid}^m(F) \bowtie \rho_{pid}^m \left( \rho_{fid}^n(F) \right) \bowtie \rho_{pid}^m \left( \rho_{kid}^k(K) \right) \bowtie \rho_{pid}^n(F) \bowtie \rho_{pid}^n(K) \right)$