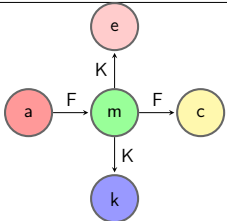
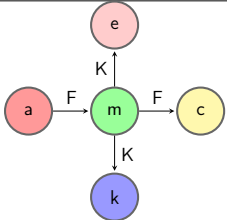


Graph Pattern	Hop Type	Expressions in $\mu - RA$
	One Hop And Branch	$\tilde{\pi}_m \left( \rho_{f_{id}}^m (F) \bowtie \rho_{p_{id}}^m (K) \right)$
	Two hops and a branch	$\tilde{\pi}_m \left( \rho_{f_{id}}^m (F) \bowtie \rho_{p_{id}}^m (F) \bowtie \rho_{p_{id}}^m (K) \right)$
	Three Hops And Branch	$\tilde{\pi}_m \left( \rho_{f_{id}}^m \left( \tilde{\pi}_m \left( \rho_{f_{id}}^m (F) \bowtie \rho_{p_{id}}^m (F) \right) \bowtie \rho_{p_{id}}^m (F) \bowtie \rho_{p_{id}}^m (K) \right) \right)$
	Three Hops And Branch	$\tilde{\pi}_{m,n} \left( \rho_{f_{id}}^n \left( \rho_{f_{id}}^m (F) \bowtie \rho_{p_{id}}^m (F) \right) \bowtie \rho_{f_{id}}^n (F) \bowtie \rho_{p_{id}}^m (K) \right)$
	Three Hops And Branch	$\tilde{\pi}_{m,n} \left( \rho_{f_{id}}^m (F) \bowtie \rho_{p_{id}, f_{id}}^{m,n} (F) \bowtie \rho_{p_{id}}^n (F) \bowtie \rho_{p_{id}}^m (K) \right)$
	Three Hops And Two Branches	$\tilde{\pi}_{m,n} \left( \rho_{f_{id}}^m (F) \bowtie \rho_{p_{id}}^m \left( \rho_{f_{id}}^n (F) \right) \bowtie \rho_{p_{id}}^m \left( \rho_{k_{id}}^k (K) \right) \bowtie \rho_{p_{id}}^n (F) \bowtie \rho_{p_{id}}^n (K) \right)$

Graph Pattern	Hop Type	Expressions in $\mu - RA$
	Star (Isomorphism based semantics)	$\tilde{\pi}_m \left( \sigma_{k < > k_{id}} \left( \rho_{f_{id}}^m (F) \bowtie \rho_{p_{id}}^m (F) \bowtie \rho_{p_{id}}^m (K) \bowtie \rho_{p_{id}}^m \left( \rho_{k_{id}}^k (K) \right) \right) \right)$
	Star (Homorphism based semantics)	$\tilde{\pi}_m \left( \rho_{f_{id}}^m (F) \bowtie \rho_{p_{id}}^m (F) \bowtie \rho_{p_{id}}^m (K) \bowtie \rho_{p_{id}}^m \left( \rho_{k_{id}}^k (K) \right) \right)$