CAF

Given a CRS $\mathcal{Q} = (X, \mathcal{R}, C, F)$, a subset $\mathcal{R}'$ of $\mathcal{R}$ is a *CAF* (constructively autocatalytic F-generated set) for $\mathcal{Q}$ if $\mathcal{R}'$ is nonempty and the reactions in $\mathcal{R}'$ can be ordered in such a way that for reach reaction r in $\mathcal{R}'$, each reactant and at least one catalyst of r has the property that it is either produced by an earlier reaction from $\mathcal{R}'$ or is present in the food set.

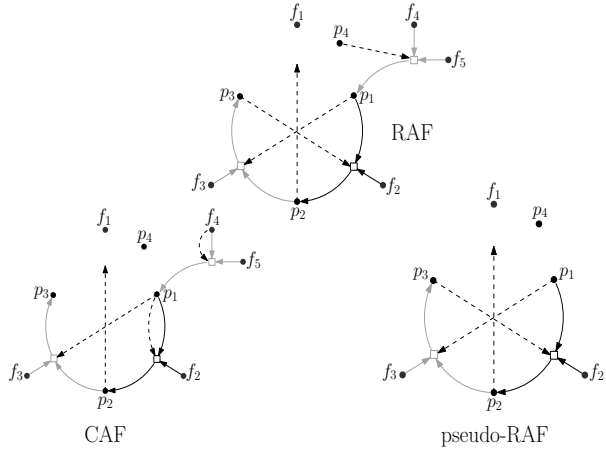
In words, a CAF is like a RAF with the extra requirement that no spontaneous (uncatalysed) reactions are allowed to occur in its formation (i.e. the catalyst needs to be already present when it is first needed).

pseudo-RAF

Given a CRS $\mathcal{Q} = (X, \mathcal{R}, C, F)$, a subset $\mathcal{R}'$ of $\mathcal{R}$ is a *p-RAF* (pseudo-RAF) if $\mathcal{R}'$ is nonempty and it satisfies the reflexively autocatalytic property for a RAF, and the following weakened form of the F-generated condition.

- For each reaction $r \in \mathcal{R}'$, each reactant of r is either present in the food set or generated by another reaction in $\mathcal{R}'$.

In words, a pseudo-RAF is a subset of reactions that is collectively autocatalytic and where each reaction proceeds from products of the other reactions or food elements. Once a pseudo-RAF exists it will continue as a collectively autocatalytic self-sustaining system, however unlike a RAF or a CAF it cannot 'get going' from scratch starting with just the molecules in a food set. Note that if one of these objects (RAF, CAF or p-RAF) exists within a CRS then there is always a unique maximal one, and it can be found by a fast algorithm. The Figure below illustrates the difference between these three notions. RAF, CAF, p-RAF involving food molecule types (green dots labeled f_i), non-food molecule types (black dots labelled p_i) and catalysis arcs in red. The RAF (top) is not a CAF and the p-RAF is not a RAF.



Note that every CAF is a RAF and every RAF is a pseudo-RAF. In origin-of-life theory, RAF seems the most relevant concept since the catalysis rates required for their formation are much lower than those required for a CAF.