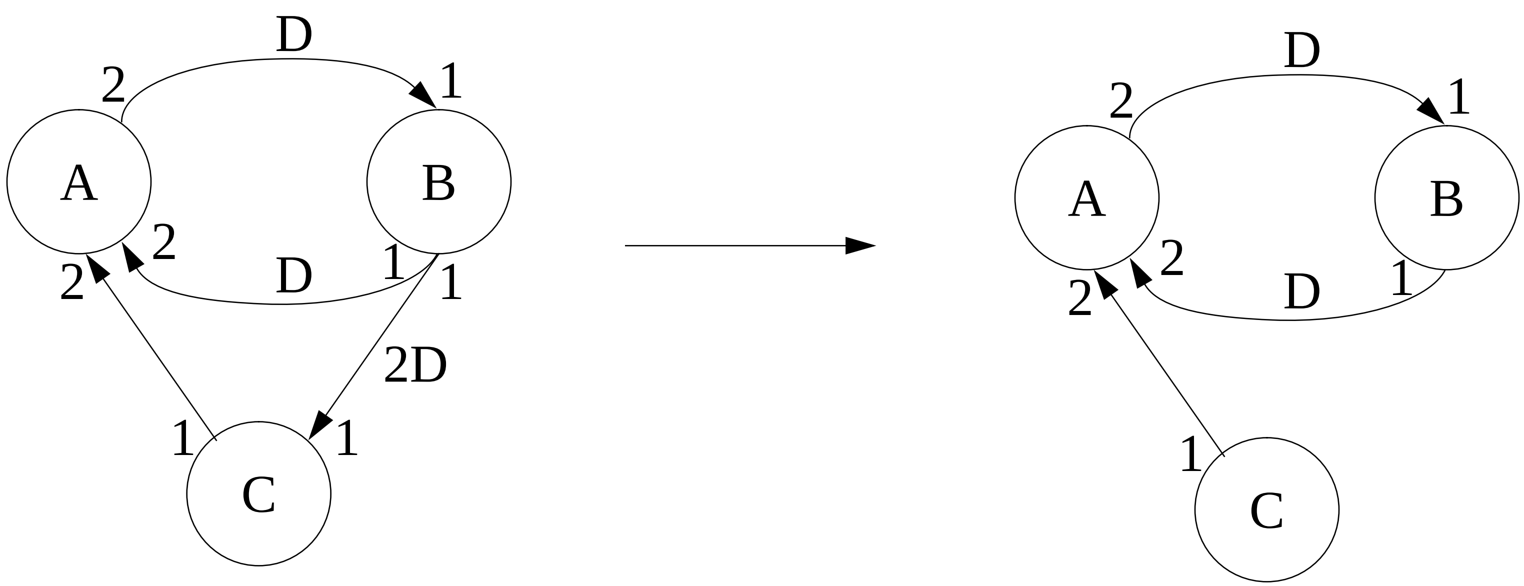
Existence of Single Appearance Schedules

- Every acyclic SDF graph has a single appearance schedule.
- An arbitrary SDF graph has a single appearance schedule iff each strongly connected component has a single appearance schedule.
- A strongly connected SDF graph has a single appearance schedule only if the nodes can be partitioned into Z_1 and Z_2 such that for any arc α directed from Z_1 to Z_2, $\mathit{delay}(\alpha) \quad \mathbf{q}_{\mathrm{sink}(\alpha)} \times \mathit{consumed}(\alpha)$.
- "*Subindependent Partition*"

Finding a Subindependent Partition

Remove each arc α for which $\mathit{delay}(\alpha) \geq \mathbf{q}_{\mathrm{sink}(\alpha)}$

Any "source" strongly connected component is subindependent of the rest of the graph.



{C} is subindependent of {A, B}

Components of the Scheduling Framework

- Subindependent Partitioning Algorithm.
- Acyclic Scheduling Algorithm.
- Tight Scheduling Algorithm.

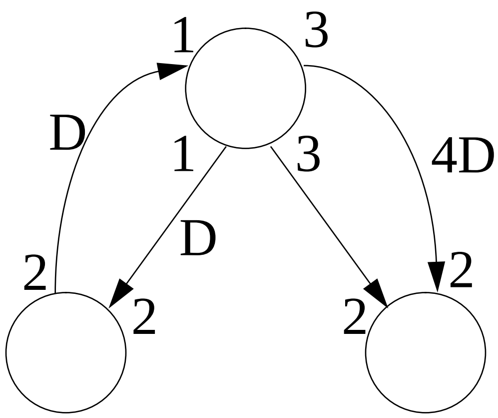
algorithm *schedule-loops*

- Consolidate each strongly connected component $\{C_i\} \rightarrow$ *acyclic graph* G'.
- Apply acyclic scheduling algorithm to G' $\rightarrow$ single appearance schedule of strongly connected components S'.
- For each strongly connected component C_i
  - — Apply the subindependence partitioning algorithm
  - — If a subindependent partition (P_1, P_2) is found
    - — Determine looping factors: $r_i = gcd(\{\mathbf{q}_N \mid N \in P_i\})$, for $i = 1, 2$
    - — Apply schedule-loops() to P_1 and $P_2 \rightarrow$ subschedules S_1 and S_2
    - — Replace appearance of C_i in S' with $(r_1 S_1)(r_2 S_2)$
  - — If no subindependent partition is found
    - — Apply the tight scheduling algorithm $\rightarrow$ subschedule S_T
    - — Replace appearance of C_i in S' with S_T

- We say that a strongly connected SDF graph is *tightly interdependent* if it does not have a subindependent partition.

- If Z_1 and Z_2 are subsets of nodes in an SDF graph such that $Z_1 \cap Z_2 \neq \emptyset$ and *subgraph*(Z_1) & *subgraph*(Z_2) are both tightly interdependent, then *subgraph*($Z_1 \cup Z_2$) is tightly interdependent.

- *Tightly interdependent components.*



Properties of the Scheduling Framework

- Constructs a single appearance schedules whenever one exists.
- Actors outside the tightly interdependent components are scheduled with only one appearance.
- For actors inside tightly interdependent components, the number of appearances is determined entirely by the tight scheduling algorithm.