Motivation

Synchronous data flow graphs (SDFGs)
- Nodes (actors) model the computations
- Edges ( FIFO channels) model data dependency between actors
- E.g., an iteration of $G_i$ includes one firing of actor $A$, two firings of $B$ and four of $C$

Iteration period (IP)
- The average computation time per iteration
- The reciprocal of the throughput.

Problem & Solution(1)

Memory abstraction $xy$
- $x = 1$, release space at the start of a firing; $x = 0$, at the end of a firing.
- $y = 1$, claim space at the start of a firing; $y = 0$, at the end of a firing.

A memory constraint of SDFG $G = (V,E)$ is a vector $MC(E)$, in which $MC(e)=d(e)$. $IP_x(G,MC)$ is the minimal achievable IP of SDFG $G = (V,E)$ under memory constraint $MC(E)$ based on the memory abstraction $xy$. Then $1/IP_x(G,MC)$ is the maximal achievable throughput.

Given an SDFG $G$ and a memory constraint $MC$, $IP_x(G,MC) = ?$

Memory-constrained SDFG (MC SDFG)
- The bound on buffer of an edge $e\in E$ of an SDFG can be modeled by adding edge $<$end, $<$available storage space
- $<$edge is called an MC edge

An self-timed execution (STE) analysis method is used in our solutions

Instead of using a clock in the operational semantics of SDFGs as traditional STE analysis methods, we use time stamps to tokens to model the time progress. Each token is tagged with a time stamp to indicate the time when it is produced.

Solution(2)

- The time stamps of tokens produced on $E$ are not affected by the abstractions. They are always $\beta t$, although the values of $\beta$ may differ with respect to claim abstraction $y$.
- The time stamps of tokens on MC edges are decided by the abstraction used.

Abstract:

Streaming applications are often modeled with Synchronous data flow graphs (SDFGs). A proper analysis of the models is helpful to predict the performance of a system. In this paper, we focus on the throughput analysis of memory-constrained SDFGs (MC SDFGs), which need to choose a memory abstraction that decides when the space of consumed data is released and when the required space is claimed. Different memory abstractions may lead to different achievable throughputs. The existing techniques, however, consider only a certain abstraction. If a model is implemented according to other abstractions, the analysis result may not truly evaluate the performance of the system. In this paper, we present a unified framework for throughput analysis of MC SDFGs for different abstractions, aiming to provide evaluations matching up to the corresponding implementations.

References

[2] E.A. Lee is a claim of memory space at the start of the firing