Master 1 international, Université de Nice Sophia-Antipolis

23/10/2012

# Formal Models of Computation for Concurrency

# Discussion sections

Marked Graph and Synchronous Data Flow

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## Marked graph (Petri Net)

Marked graphs (MG) are a sub-class of Petri Net (PN) where places have exactly one incoming and one outgoing arc. Thanks to this restriction, MGs are conflict free.

Q1/ Draw a PN which is not a MG.

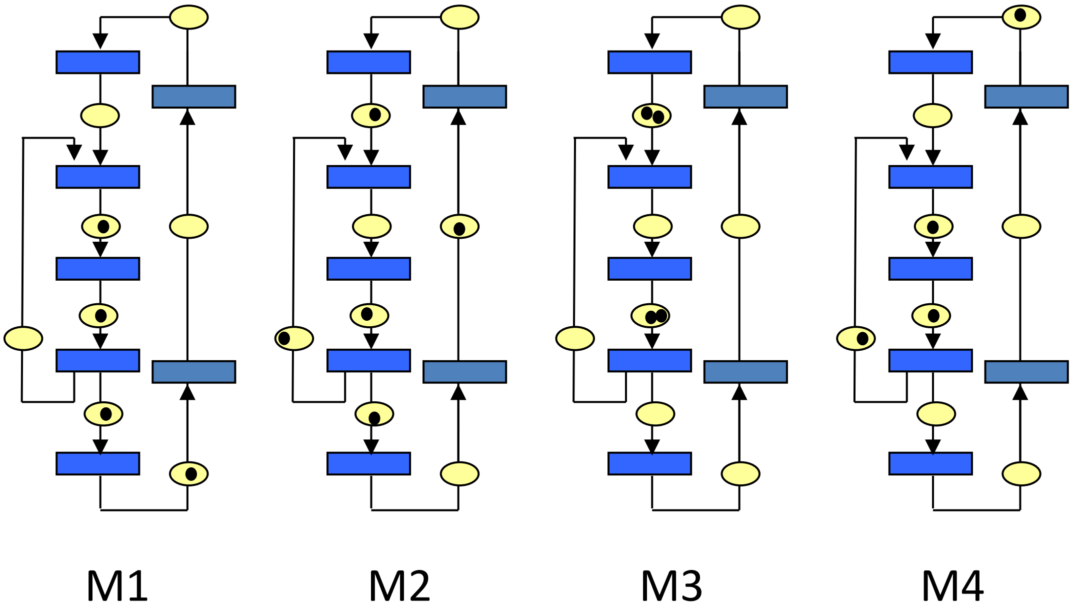
Q2/ Draw an MG which is i) not live, ii) live.

Q3/ Draw an MG which is not safe.

Q4/ Run the MG of Q3 with an ASAP scheduling. What do you see? How can you change the behavior so that the capacity of every place will be bounded?

Q5/ Draw an MG with a throughput 3/5.

Q6/ Consider the following MG and each of the four possible markings.



-Run the MG from M1 to M2.

-Run the MG from M1 to M3.

-Could you run the MG from M3 to M1 and M3 to M2?

-Could you run the MG from M3 to M4?

-Is there any invariant through the execution of these MGs?

Q7/ Run M1, M2, M3, and M4 with an ASAP scheduling until you reach the initial marking. While doing it, write the activation sequence (schedule) of each transition as a binary words (1=activity, 0=inactivity).

-What can you say about the obtained binary words?

-What can you say about the schedule of two successive transitions?

-What can you say about the schedules of M3? And M4?

# Synchronous Data Flow (SDF)

SDF is used to analyze data flow applications where the size of the computed data varies. For example: cryptography, error correcting code, audio and video processing…

SDF is a generalization of the MG model where the transitions consume and produce a fix amount of tokens. For example, each time a transition fires, it consumes three tokens on its left input, two on its right input and then produces four tokens on its output.

If the ratios are not correctly set up, the execution will lead to starvation or buffer overflow. Consequently, an SDF is considered as valid if and only if the ratios are balanced.

One can verify that an SDF graph is correct by building and solving the balance equations.

Q11/ Draw an SDF graph composed of four transitions with at least a cycle.

Q12/ Abstract this SDF graph in its topology matrix. Is it balanced? If not, modify it such that it is.

Q13/ How many times each transition should be fired such that each of them computes the same amount of data? How to compute these values?

Q14/ What is the necessary and sufficient condition to make your SDF live? Where one should put the tokens? How many?

-To think about this question, it is useful to transform the SDF graph in a homogeneous SDF graph (where each transition consumes and produces the same amount of token). Why is it useful?