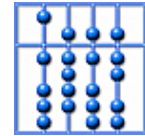


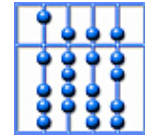
Vorlesung Specification of Distributed Systems

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Sommersemester 2005



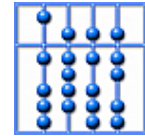
Overview

1. Introduction
2. Basics: Behavior, Interaction, Concurrency
3. Coroutines
4. Communicating Processes
5. Data Flow Models
6. Coordination
7. Executions
8. State-Based Models
9. Property Descriptions



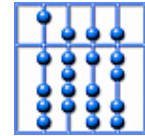
Overview

1. Introduction
2. Basics: Behavior, Interaction, Concurrency
3. Coroutines
4. Communicating Processes
5. Data Flow Models
6. Coordination
 1. Simple Coordination
 2. Data Flow Extensions
7. Executions
8. State-Based Models
9. Property Descriptions



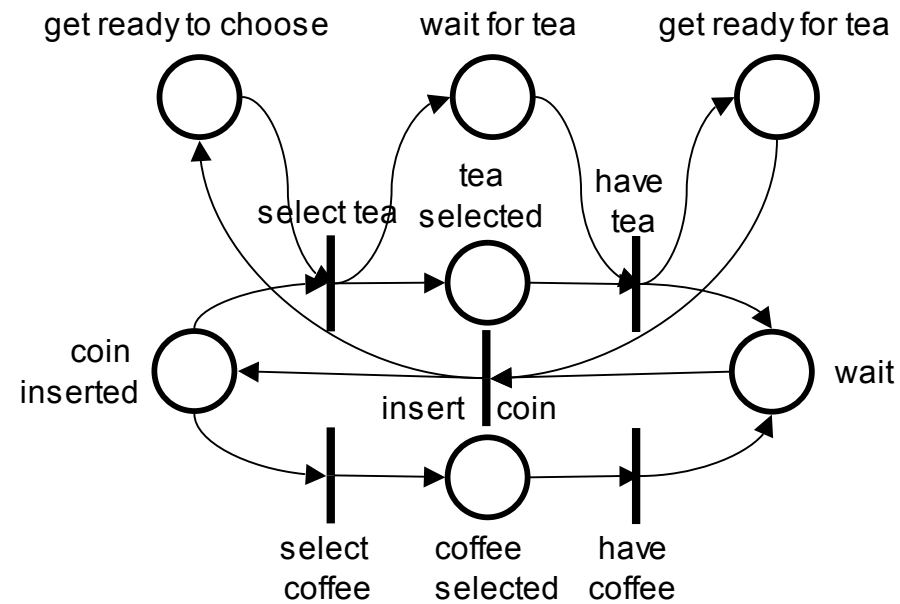
5 Questions

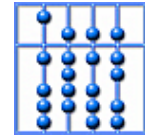
1. Exercise: Describe the regular vending machine using a C/E net. Add a customer operating the vending machine.
2. Exercise: Describe two processes using a shared resource via an acquire/release operation. Describe variants with and without termination in the critical section.
3. How can the mutual exclusion property be formulated as a property over the places of the C/E net?
4. How can the property of Question 3 be extended to describe an invariant property over the places of the net?
5. How can invariant sets be used to demonstrate the liveness of the net?
6. What are the commonalities and differences between a labeled transition system and a P/T net?
7. What are the commonalities and differences of a data flow system and a P/T net?



Exercise 1

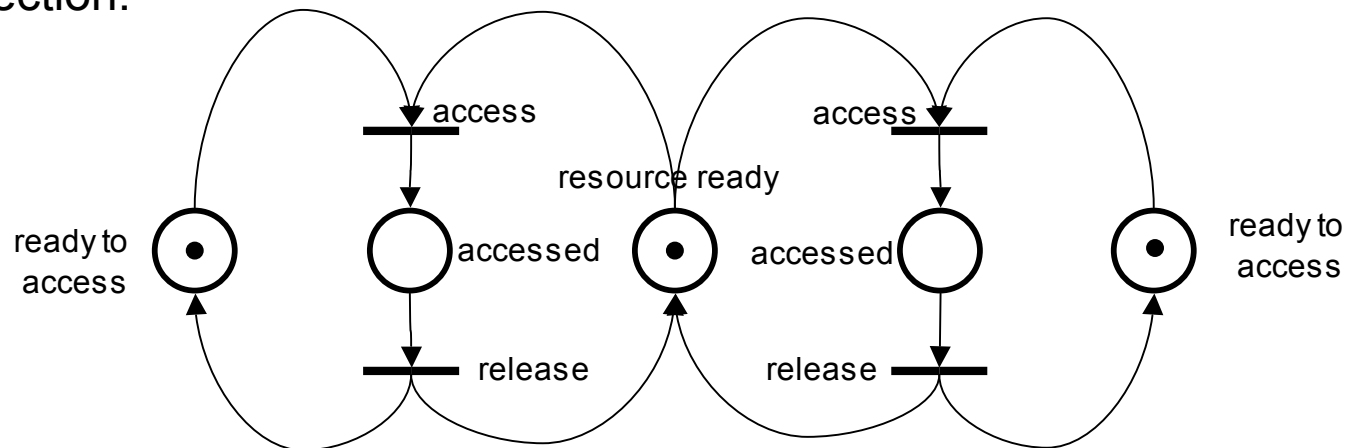
Describe the regular vending machine using a C/E net. Add a customer operating the vending machine.





Exercise 2

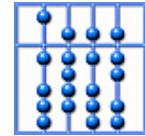
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Variant: Processes without termination

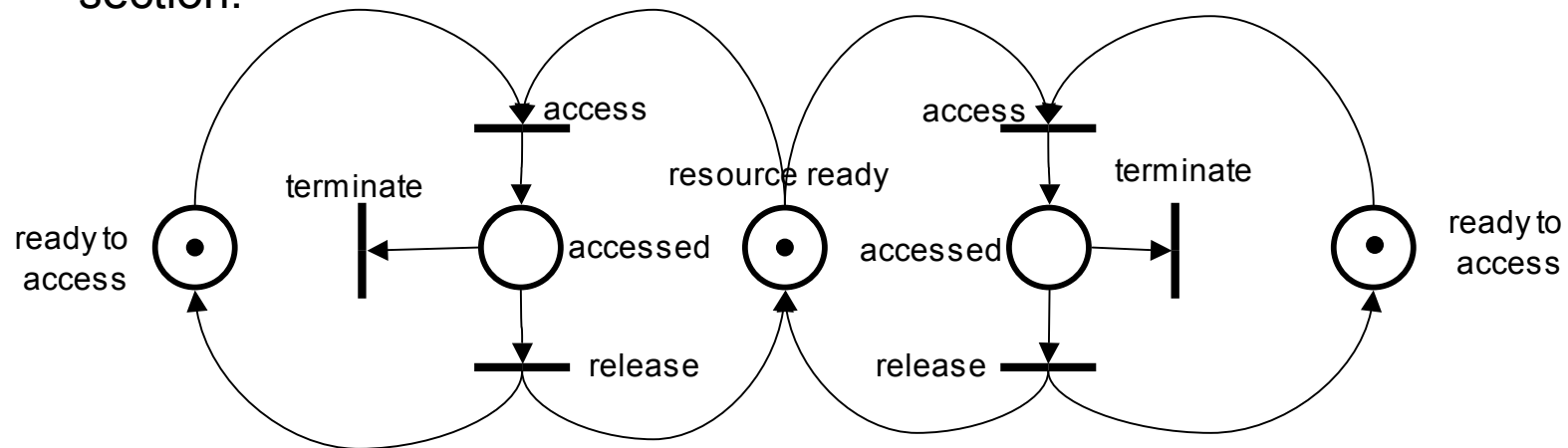
C/E-Net: Conditions concerning access to resource

- Using Pattern “Shared resource”
- Variation: No condition for “Resource accessed”



Exercise 2

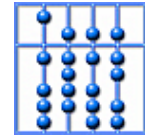
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Variant: Processes with termination

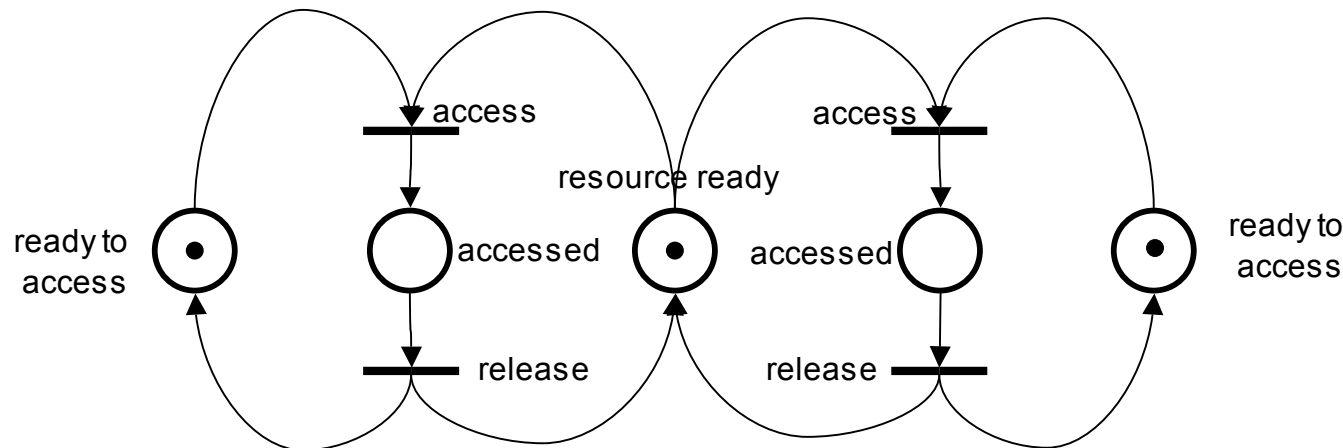
C/E-Net: Conditions concerning access to resource

- Using Pattern “Shared resource”
- Variation: No condition for “Resource accessed”



Question 3

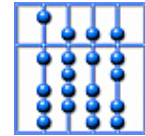
How can the mutual exclusion property be formulated as a property over the places of the C/E net?



Intuitively: “The resource is either accessed by process 1 or process 2”

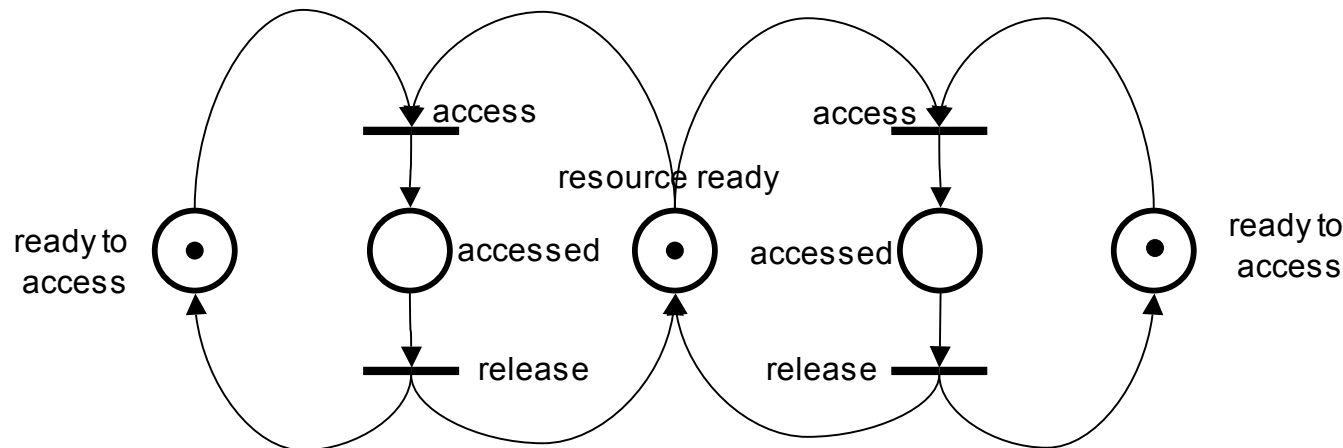
Using conditions: Either “accessed” is true for process 1 or “accessed” is true for process 2

Using places: Either “accessed” is marked in for process 1 or “accessed” is marked in process 2



Question 4

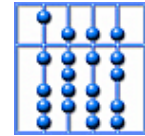
How can the property of Question3 be extended to describe a invariant property over the places of the net?



Place invariant (concerning a set of transition): The number of markings within a place set does not change when firing a transition (from the respective set)

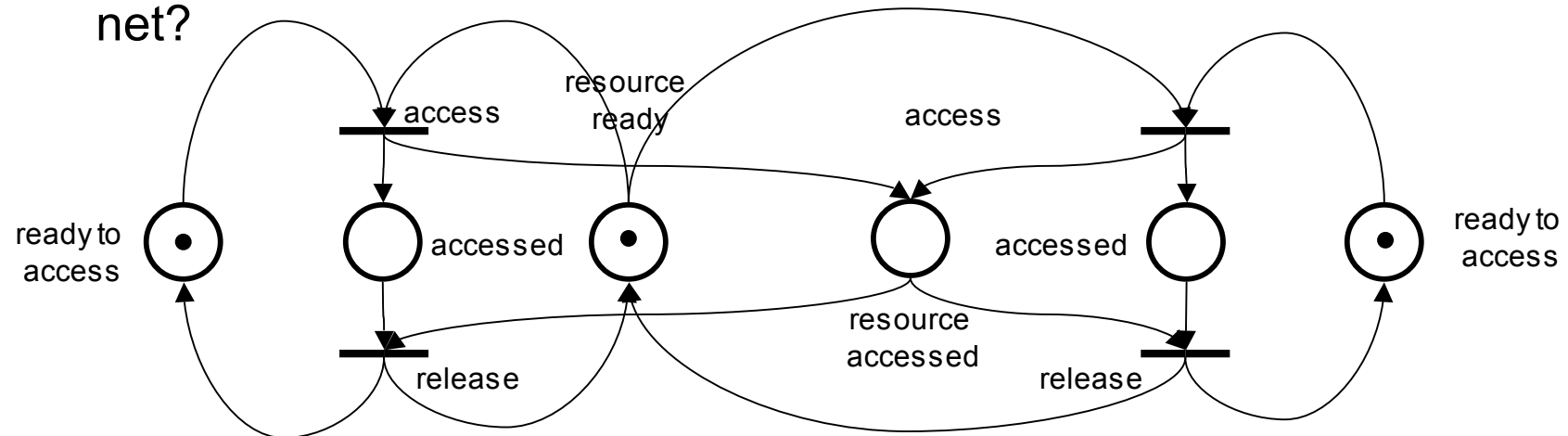
Here: Invariant set containing access1 and accessed2:

- {accessed1,accessed2,resource_ready}
- Marks: Exactly one mark in this set



Question 5

How can invariants be used to demonstrate the liveness of the C/E net?

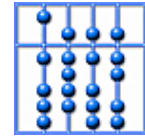


Liveness of a (C/E) net: Each marking reachable from the initial marking has at least one transition enabled.

Here: Invariant sets (Using the standard pattern for synchronization)

- { readytoaccess1, accessed1, resource_ready, resource_accessed }, 2 marks
- { readytoaccess2, accessed2, resource_ready, resource_accessed }, 2 marks
- { resource_ready, accessed1, accessed2 }, 1 mark
- { readytoaccess1, readytoaccess2, resource_accessed } 2 mark

Interpretation: Either access1, access2, release1, or release2 are enabled



Question 6

What are the commonalities and differences between a labeled transition system and a P/T net?

Commonalities:

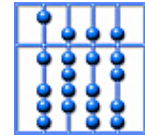
- Places/state represent observations about properties of the system
- Transitions represent changes concerning the observations about the system

Differences:

- P/T nets may have several active places, a LTS has only a single active state

Notes:

- Syntactically: LTS can be understood as a restricted form of P/T net
- Methodically: LTS describe concurrent systems and therefore support the composition via shared labels using product automata not found in core net theory



Question 7

What are the commonalities and differences between a data flow system and a P/T net?

Commonalities: Data flow = Communication by asynchronous messages

- Transitions as well as components represent computing nodes
- Places as well as channels represent buffers of messages

Differences:

- Channels (generally) maintain order of messages, places do not maintain any order
- Data flow systems may exhibit causality pathologies in perfect synchronous communication, P/T nets use a stepwise computation