**Distributed algorithms TC1: Causal dependencies** Batna Oct 03 2004

**Exercice 1**

 Consider 4 processes interconnected via channels and executing the following pseudo-code sequences:

|  |  |  |  |
| --- | --- | --- | --- |
| Processus : P1 | Processus : P2 | Processus : P3 | Processus : P4 |
| 1. x = 1
 | 1. y = receive(P1)
 | 1. x = 4
 | 1. z = 3
 |
| 1. send(x, P2)
 | 1. y = y / 2
 | 1. x = receive(P4)
 | 1. z = receive(P2)
 |
| 1. x = x \* 2
 | 1. send(y, P4)
 | 1. x = 2 + x
 | 1. send(z, P3)
 |
| 1. x = receive(P2)
 | 1. y = receive(P3)
 | 1. send(x, P2)
 |  |
|  | 1. send(y, P1)
 |  |  |

**send (nb, Px)** sends the value of integer nb to process Px, **nb = receive(Px)** expects a message containing an integer from process Px. The integer received is placed in nb.

* Draw the chronogram corresponding to the parallel execution of the 4 processes.

**Exercice 2**

Consider the following chronogram (figure below) modeling the execution of a distributed calculation:

1. What is the causal past of $r4$?
2. What is the causal future of $r3$ ?
3. Is the path $e1\rightarrow r2 \rightarrow e5 \rightarrow r4 \rightarrow e7 \rightarrow r6 $a causal path linking e1 to$ r6$?
4. Add an event $ex$ that depends causally on $e3$, and on $e6$ .
5. Suggest two ways to introduce causal dependency between events $e3$ and $r5$?
6. Determine the causal history of the message $m$.
7. Deduce whether the deliveries $r5; r3; r6; r7$ respect causality.
8. Give two other possible executions of the distributed calculation given above.

**Exercice**

In a distributed calculation, there are fourteen (14) events designated by $e1, e2, …, e14$. All the direct causal dependencies between these events are given as follows:

* $e1\rightarrow e2 , et e1 \rightarrow e9 ; $ $e2\rightarrow e4 , et e2 \rightarrow e10 ; $ $e3\rightarrow e8 , et e3 \rightarrow e10 ;$
* $e4\rightarrow e5 , et e4 \rightarrow e14 ;$ $e5\rightarrow e11 ;$ $e6\rightarrow e12 ;$ $e7\rightarrow e13 ;$
* $e8\rightarrow e12 ,$ $e9\rightarrow e6 ;$ $e10\rightarrow e11 ;$ $e11\rightarrow e7 ;$ $e12\rightarrow e13 ;$ $e13\rightarrow e14 .$

a) Draw a graph representing these dependencies.

b) Draw a chronogram representing a possible execution respecting these dependencies.