A short story of Diagnosis

from passivity to on-line diagnosis of distributed systems

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2008/06/17

Definition

diagnosis [ˌdaɪ.əgˈnəʊ.sɪs] *(diagnosis diagnoses)*

> Diagnosis is the discovery and naming of what is wrong with someone who is ill or with something that is not working properly.
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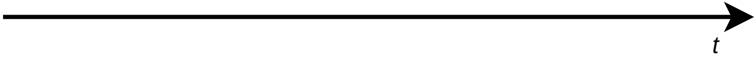
Diagnosis is motivated by three-step logic:

1. every system is subject to faults
2. faults are costly
3. someone must pay

Diagnosis' theory of evolution

Autonomous systems



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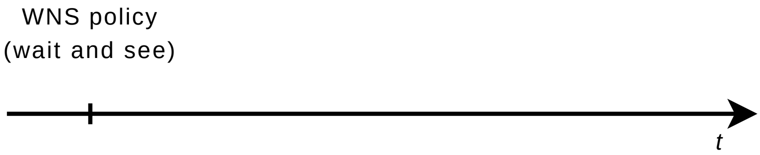

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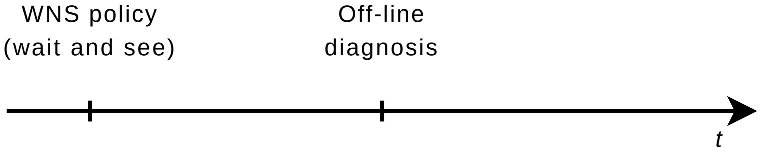

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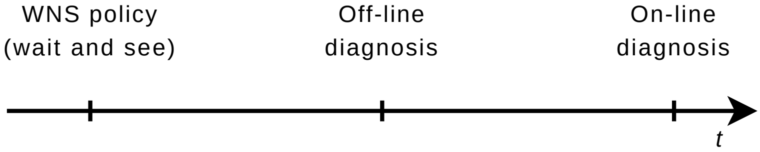

Off-line diagnosis

Role of forensics: no matter how long after a fault, determine what fault happened.

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$\Rightarrow$ need for on-line diagnosis

On-line diagnosis

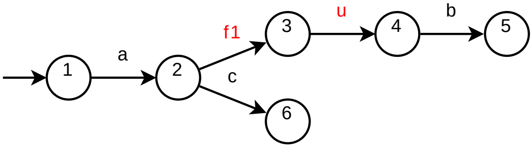
Role of monitor: permanently provide an explanation to an incomplete flow of ordered observations.

- need for a model of the system
- need for efficient algorithms

We consider the “diagnoser” approach.

The model

In this approach, an automaton represents the trajectories of the system



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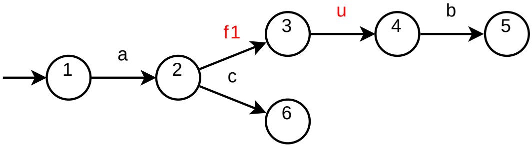
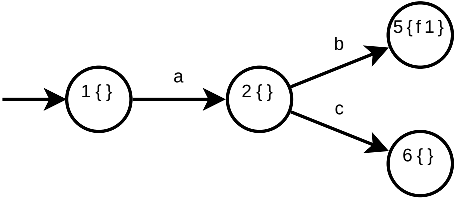


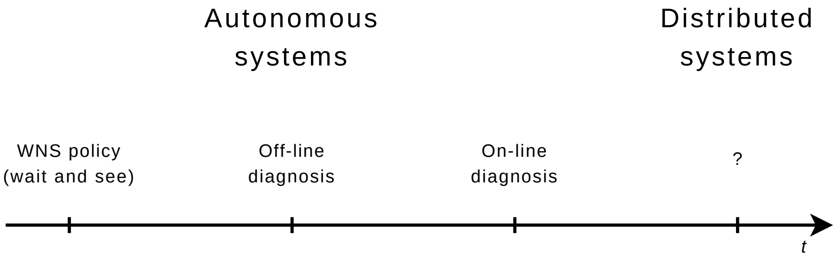
From this automaton we extract a deterministic "diagnoser"



At run-time

- A flow of observable events is generated by the system
- The diagnoser is fed by this flow
- A (partial) diagnosis is always available

Diagnosis' theory of evolution (r2)



A first step: decentralized systems

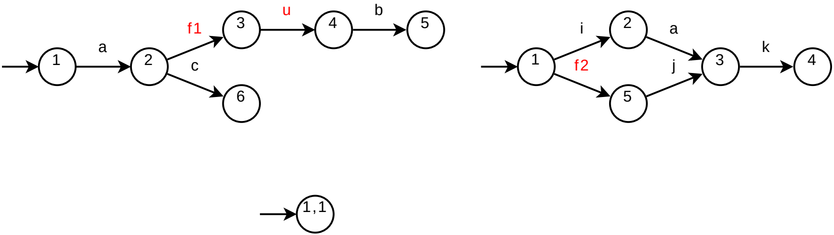
The system:

- a set of components
- a single flow of observations

The diagnosis method:

- merging automata thanks to a shared alphabet
- building the diagnoser
- recognizing on-line

How to merge automata. . .



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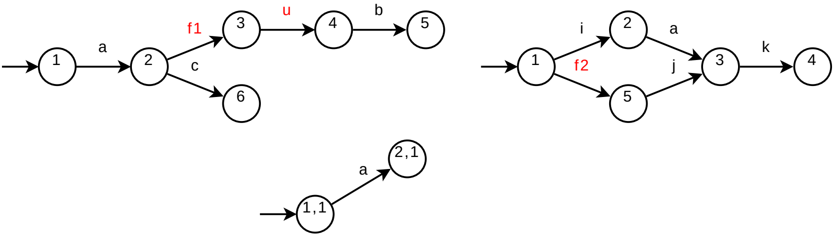

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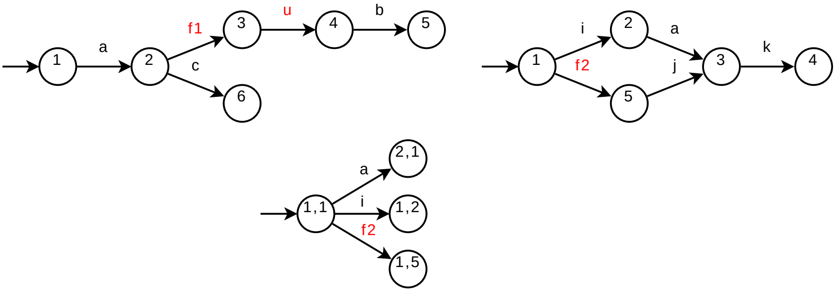

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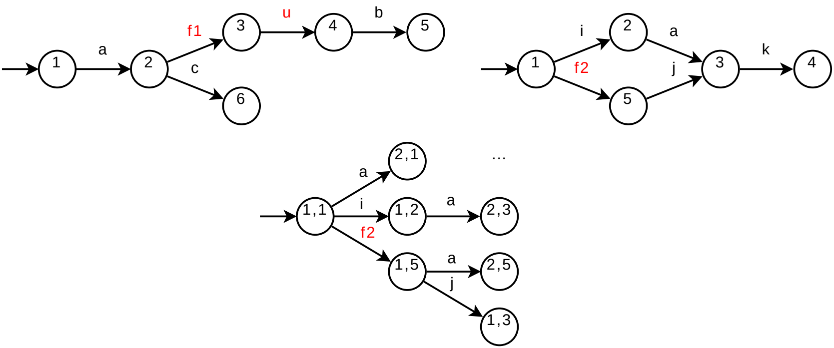


Limits of this methods

- Global knowledge of the system
- Single flow of events
- Complexity of the global automaton ($e^{|c|}$)

On-line diagnosis of distributed systems

The very idea:

- apply a monitoring algorithm locally
- merge local diagnoses on a global diagnoser

The very crucial thing:

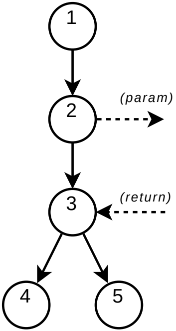
- find a valid merging operation

Our method

At design time:

1. list all the possible behaviours of a component
2. “label” the status of variables exchanged between components for each path
3. decide whether this path can trigger a global diagnosis process

About status of variables

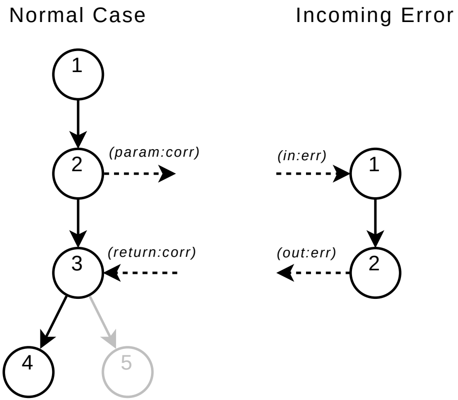


Considering different behaviours (diagnoses):

- normal case
  - both *param* and *return* are correct
- local error
  - both *param* and *return* are erroneous
- external error
  - *param* is correct but *return* is erroneous

Merging strategy

Local diagnoses can only merge if their variables have the same status:



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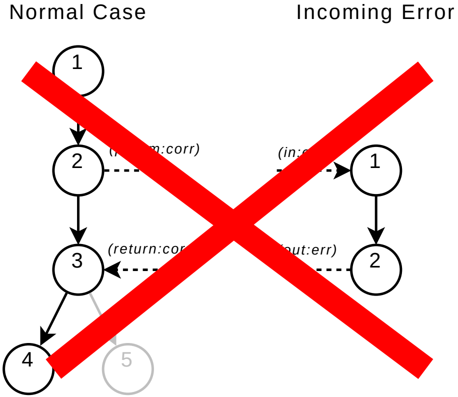

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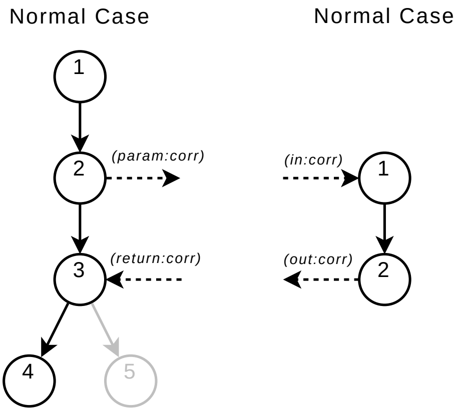
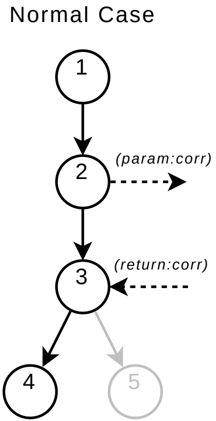
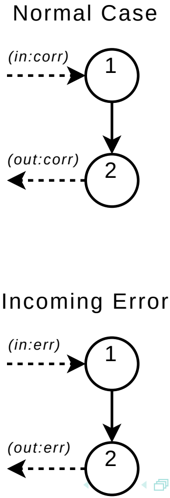


Where is the interest?

Concurrence between local behaviours: refinement





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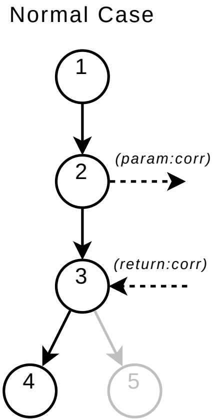

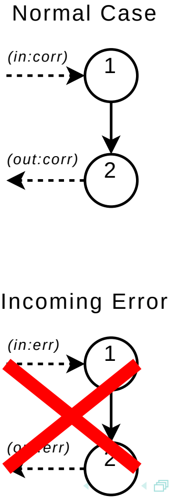

Conclusion

A decentralized approach to monitor distributed systems:

- respect of privacy (no intrusion)
- no need for global model

Prospects:

- include a model of interactions
- learn model from logs