Capturing fugitives

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Capturing fugitives

- An absconding/a fugitive lives in hiding to escape arrest (e.g. a mafia boss)

- In organized crime, he/she is helped by a certain number of *supporters*

- Only few supporters have direct contacts with the fugitive; we call them *trusted people*

- Usually, a fugitive does not use electronic devices to communicate, but paper notes (called ***pizzini*** by italian mafia) that are exchanged by hand until they reach the receivers and vice-versa

- To capture a fugitive, it is important to discover the information flow, that is the **pizzini's paths**, among the fugitive, the trusted people and the supporters.

Investigations: observations

- During the investigation, the police collect many information: persons and their social network, credit cards, bank accounts, phone numbers and phone calls, companies, places, ip addresses, information from undercover agents, etc.

- We call them **observations**

- Each observation has a certainty degree e.g. based on statistical algorithms

- ***Crime is not aware of police observation***

Investigations: invasive methods

- the police can receive **reliable information using invasive methods** e.g. search warrants, arrests or interrogations

- in this case, **crime** becomes **aware** of the investigation and it can adopt **countermeasures**

Approaches

- We can model this kind of investigation using
  - graphs
  - formal methods (transition systems, process algebra, model checking, Petri Nets)
  - game theory

Graph theory approach

- Using graphs, we define a bunch of problems to help arrest a fugitive

- Each node of the graph represents a person

- Each arc represents the connection among persons, identified by a label (e.g. a phone call, a meeting)

- A certainty degree is associated to each label

Investigative hypothesis

- During the investigation, the police specify an investigative hypothesis about a pizzino path, identifying initial, intermediate, final nodes of the **observation graph**

- Problem 1: What are the paths of the observation graph that satisfy the investigative hypothesis?

Enlarging the investigation scope

- The police want an algorithm that, on the basis of a criterion, creates nodes and arcs (sub-graphs) to "complete" the observation graph in a coherent manner. We call this graph a **enriched graph**

- A **criterion** can specify the initial nodes of the sub-graphs and establish constraints on the values of labels, the number of arcs of the nodes, etc..

- Problem 2: What are the sub-graphs that satisfy the investigative hypothesis and the police criterion, and fit to the observation graph? Which are the paths of the enriched graph that satisfy the investigative hypothesis?

- It is useful consider the case of **sporadic but regular contacts** among supporters, in which important information could be exchange

Transition systems/Process Algebra approach

- We use transition systems/process algebras to model the observation graph

- Each node (each person) is a state

- Each arc is a transition function with its labels

Transition systems/Process Algebra benefits

- This approach is complementary respect to graph theory one

- It increases the usability when the police specify investigative hypotheses, criteria and constraints

- It allows to apply Model Checking algorithms
    - we can verifying some properties of the graph expressed in temporal logics (e.g. LTL).
    - we can check properties not only on the present model, but we can also compare the behavior of a person during the time, keeping track of the modifications of the observation graph.

- Petri Nets can be useful for modeling the information flow (the pizzini are tokens)

Specifying investigative hypoteses and criteria

- The police can use
    - prolog-like sentencies
    - temporal logics formula (e.g. LTL)
    - constraint programming
    - or ad hoc language

Suggesting a perquisition

- We want to measure the information gain trend of an investigation

- If the information gain trend is stable, we suggest a perquisition or other invasive methods (e.g. interrogations)

- Problem 3: When is it better carrying out a perquisition?

Game theory approach

- We point out that a game theory approach is effective, above all to model the reaction of organized crime to perquisitions or other invasive investigation methods

- Problem 4: When is it better carrying out a perquisition, considering the countermeasures of the organized crime?

Thanks for your attention