Automated planning in practice

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Content

- Automated composition of Telecom Services
- Task automation in self driving networks

Automated context aware composition of Advanced Telecom Services for environmental early warnings

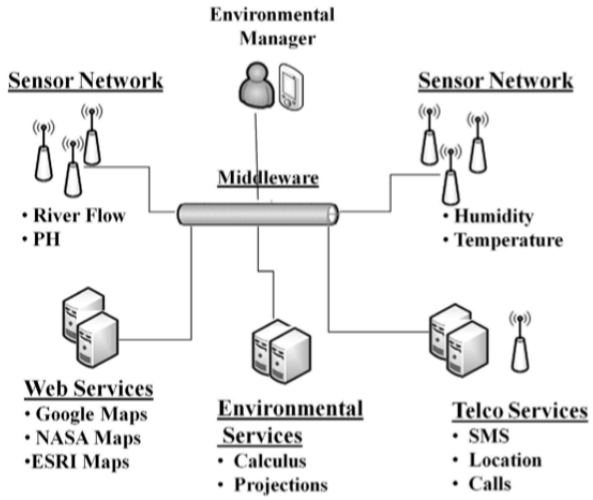
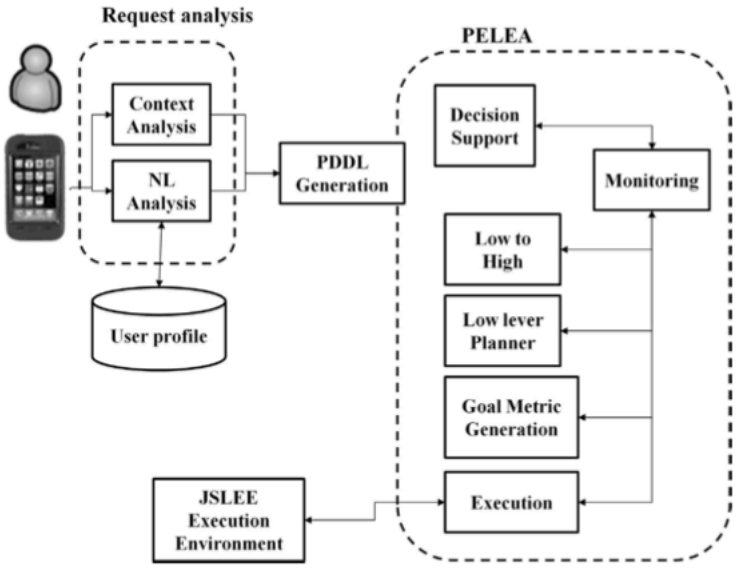
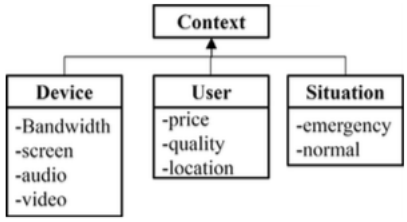


Fig. 1. Elements involved in the Early Warning Domain for Environmental Management.





(:types zone user source communication – object
map_step1 map_generation maptype – object)

```
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map_step1 map_generation maptype – object)

(:predicates (coordinates_taken ?z – zone)
   (sensed ?z – zone)
   (isolines ?z – zone) ...)
(:functions (time) (cost)
   (messages ?m – communication)
   (access ?m – maptype)
   (source-cost ?m – source) . . .)
```

```
(:action get_coordinates
   :parameters (?u - user ?z -zone ?m - source ?c - communication)
   :effect (and (coordinates_taken ?z) (sensed ?z)
   (increase (time) (source-time ?m))
   (increase (cost) (source-cost ?m)) . . .))

(:action generate_vector_map
   :parameters (?usr - user ?z - zone ?mt - maptype)
   :precondition (and (sensed ?z) (> (access ?mt) 0))
   :effect (and (generated_map ?z)
   (increase (time) (/ (time-map ?mt) 2))
   (increase (cost) (/ (cost-map ?mt) 2))
   (decrease (access ?mt) (access_quote))))
```

Context	Predicates
Phone Nokia 1100: Support for 2G Networks, monochrome display, only supports SMS Messaging	(output sms)
Request	Predicates
Necesito conocer	(Informed me)
Rutas de evacuacion	(Calculated evacuation_route my_location)
Rápidamente	(:metric minimize (time))

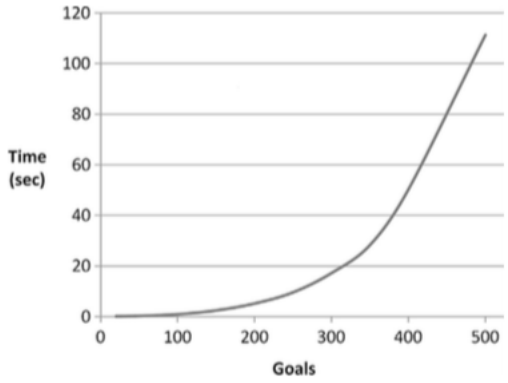

Fig. 4. Time spent by the planner in the service composition.

$$\text{Precision(P)} = \frac{\text{Correct}}{\text{Correct} + \text{Spurious}}$$

$$\text{Recall(R)} = \frac{\text{Correct}}{\text{Correct} + \text{Missing}}$$

$$\text{F} - \text{Measure} = \frac{\text{P} * \text{R}}{\text{P} + R}$$

Correct = PDDL predicates generated correctly.
Spurious = PDDL predicates not generated correctly.
Missing = PDDL predicates not generated from the user request that should have appeared.

Task automation in Self-driving networks

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Machine learning in SDN

- ML can be used for
  - Predict
  - Classify
  - Among others

Boutaba, R., Salahuddin, M. A., Limam, N., Ayoubi, S., Shahriar, N., Estrada-Solano, F., & **Caicedo, O. M**. (**2018**). A comprehensive survey on machine learning for networking: evolution, applications and research opportunities. JISA, 9(1), 16.

Task automation

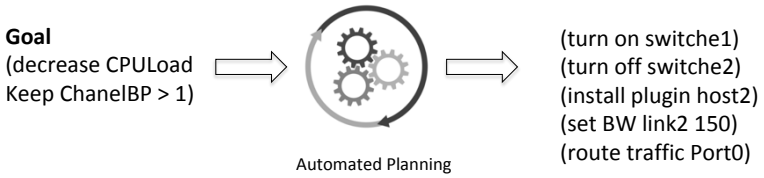
Sometimes It is necessary to know a set of actions that solve a problem, or achieve a goal

How to
(decrease CPULoad
Keep ChanelBP > 1)

Tasks
(turn on switche1)
(turn off switche2)
(install plugin host2)
(set BW link2 150)
(route traffic Port0)

Automated planning

Create a set of actions (PLAN) from a goal



Villota, Caicedo, Ordonez et al. (**2018**). On the Feasibility of Using Hierarchical Task Networks and Network Functions Virtualization for Managing SDN. **IEEE Access**, 6, 38026-38040.

However…

- Automated planning works using a <u>model</u> of the network

Reinforcement learning

- It works using rewards based on <u>experience</u>
- Can be used to optimize a metric

- However… execution time can be High.

Ipro: an Approach for Intelligent SDN Monitoring. Submitted to COMNET