Refining Network Intents for Self-Driving Networks

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Budapest, Hungary
August 24, 2018
Self-Driving Networks
Self-Driving Networks

High-level Architecture

Focus of our work!
Nowadays...
Nowadays...
Nowadays...

Higher-level

PGA / JANUS

COCOON

NetKat

OpenFlow

P4.org

>
How to deploy intents expressed in natural language?
A Network Intent Refinement using *Nile*
A Network Intent Refinement using *Nile*

1. Receive intents expressed in natural language
A Network Intent Refinement using *Nile*

1. Receive intents expressed in natural language

2. Use *Nile* to ask for operator feedback
Intent Refinement By Example

Experimental Service Chaining scenario, using SONATA-NFV and Mininet

Original scenario
Intent Refinement By Example

“Please add a firewall and an IDS from Iperf client to server”

Original Intent
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Original Intent
Intent Refinement By Example

“Please add a **firewall** and an **IDS** from **Iperf client** to **server**”

*Extracted entities*
“Please add a **firewall** and an **IDS** from **Iperf client** to **server**”

*Extracted entities*
Intent Refinement By Example

“Please add a firewall and an IDS from Iperf client to server”

Extracted entities

Neural Sequence to Sequence learning model, using Recursive Neural Networks.
define intent testIntent:
  from endpoint('iperf client')
  to endpoint('iperf server')
  add middlebox('firewall'),
  middlebox('ids')

Nile intent
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  from endpoint('iperf client')
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Nile intent

Is this what you want?

<table>
<thead>
<tr>
<th>YES</th>
<th>NO</th>
</tr>
</thead>
</table>

1. Client
2. Entities Extractor
3. Google Assistant
4. Intent Translator
5. Client
**Intent Refinement By Example**

<table>
<thead>
<tr>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image-url" alt="Diagram" /></td>
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Nile intent

Nile compiler to SONATA-NFV commands
Intent Refinement By Example

# deploy vnfs
vim-emu compute start -n fw <params>
vim-emu compute start -n ids <params>

# chain vnfs
vim-emu network add -b -src iperf-c:c-eth0 -dst fw:in
vim-emu network add -b -src fw:out -dst ids:in
vim-emu network add -b -src ids:out -dst iperf-s:s-eth0

Compiled SONATA-NFV commands
Intent Refinement By Example

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Compiled SONATA-NFV commands
"Please add a firewall and an IDS from Iperf client to server"
Evaluation

(i) The accuracy we can achieve with different sizes of training datasets, aiming to find the optimal ratio between dataset size and prediction accuracy.

(ii) The impact of the operator feedback on the accuracy of predictions over time to determine if it improves accuracy.

- 5 dataset sizes:
  - 100, 500, 1000, 2000, 5000 entries.
  - 20% validation split.

- We generated the datasets automatically with random sets of entities and Nile intent pairs, combining a different number of middleboxes, endpoints, traffic matching rules, time, and QoS requirements in each intent.
Results

(i) The accuracy we can achieve with different sizes of training datasets, aiming to find the optimal ratio between dataset size and prediction accuracy.
Results

(ii) The impact of the operator feedback on the accuracy of predictions over time to determine if it improves accuracy.
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(ii) The impact of the operator feedback on the accuracy of predictions over time to determine if it improves accuracy.
Summary

“How to deploy network intents expressed as natural language?”

Using our refinement process + Nile

Low-level of technical knowledge required
Feedback from user allows to learn over time

“What’s next?”

Fully implement Nile compilation into OpenFlow and P4 backends.

Further evaluate the end-to-end proposed solution.
Thank you!

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github.com/NetworkIntentAssistent