Refining Network Intents for Self-Driving Networks

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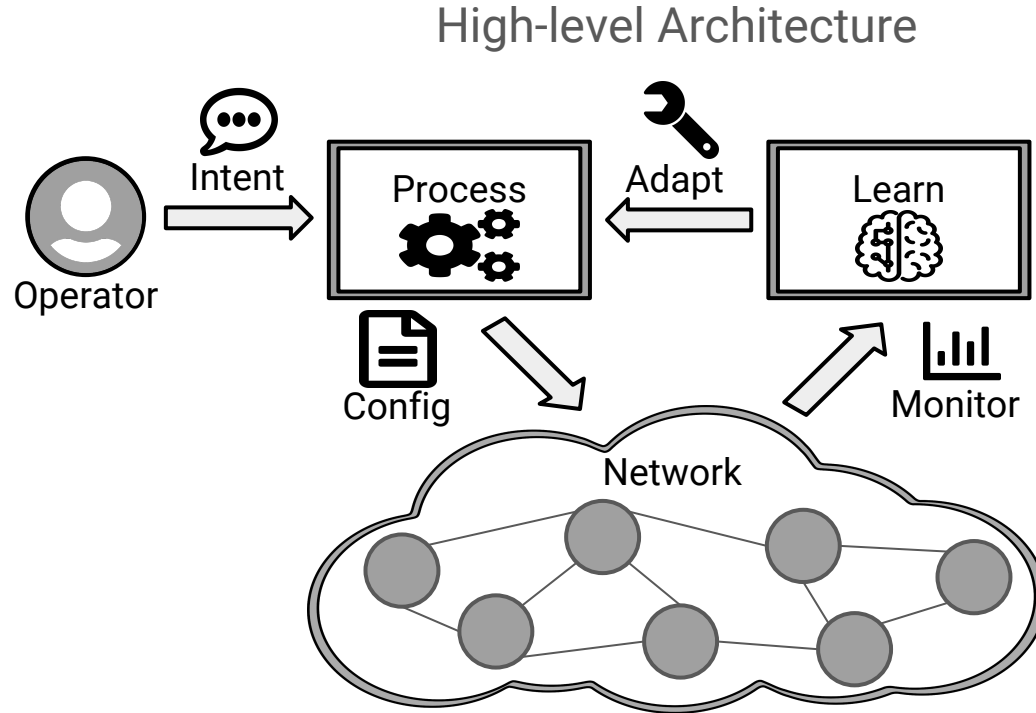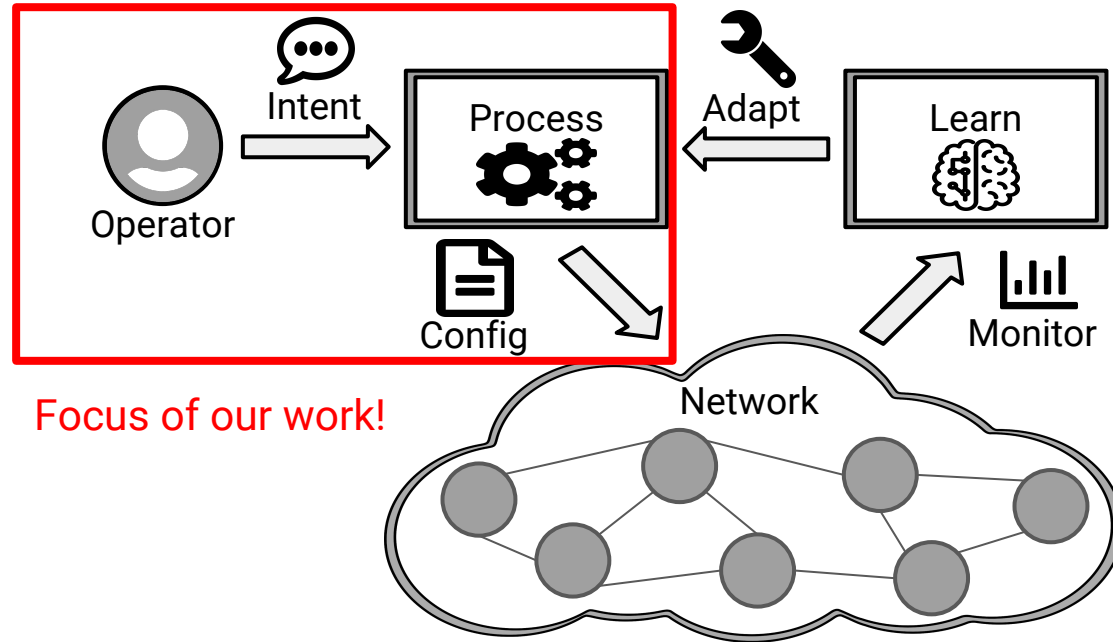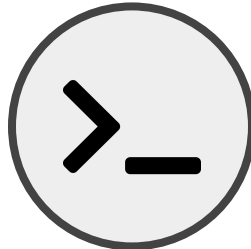
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Budapest, Hungary
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Self-Driving Networks

High-level Architecture

Self-Driving Networks

High-level Architecture

Operator — Intent — Process — Config — Network — Monitor — Learn — Adapt

Focus of our work!

Nowadays...

Nowadays...

Higher-level

Nowadays...

Higher-level

PGA / JANUS

COCOON

NetKat

○○○

OpenFlow

P4.org

>_
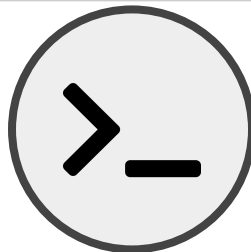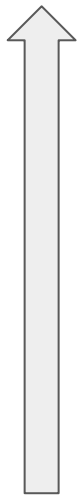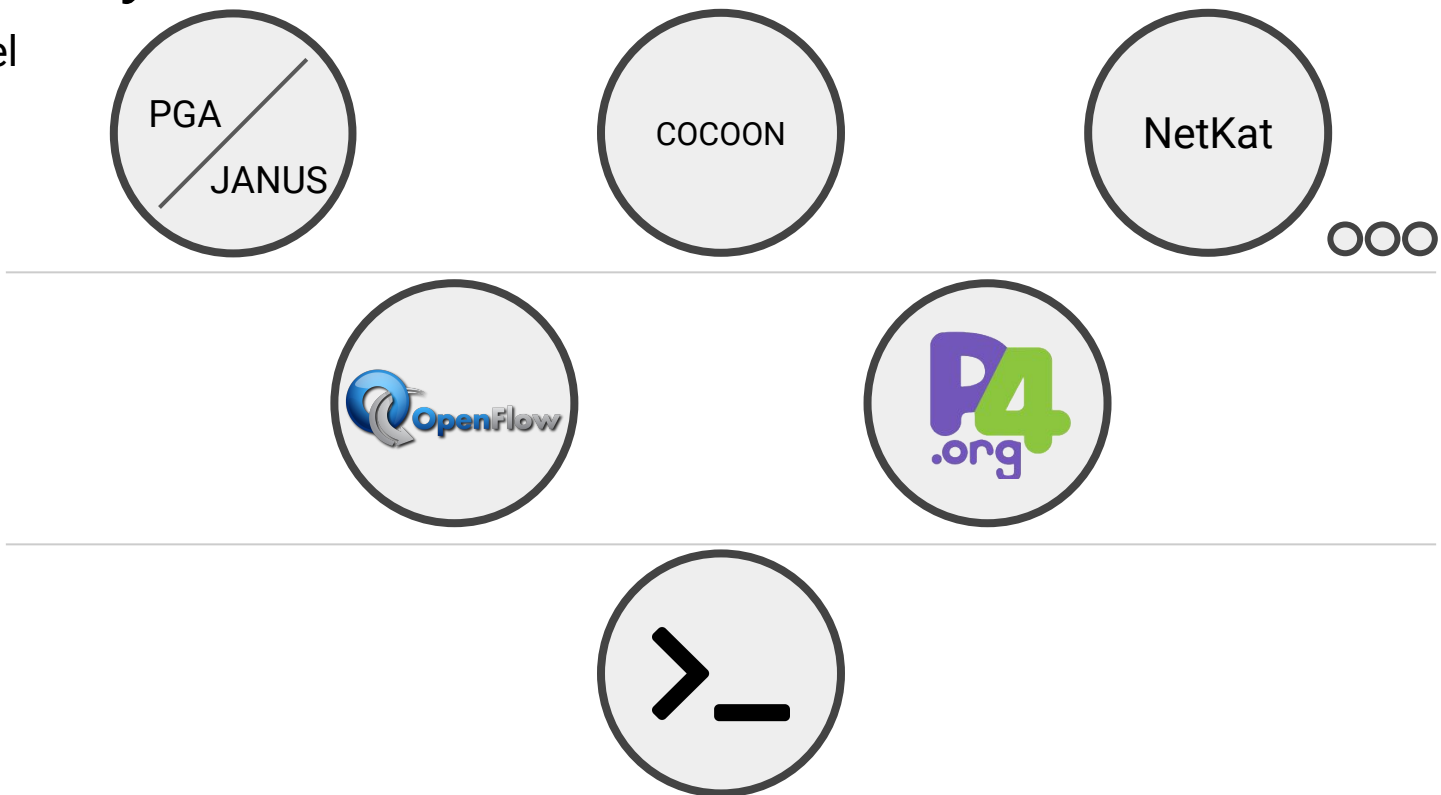
How to deploy intents expressed in natural language?

A Network Intent Refinement using *Nile*
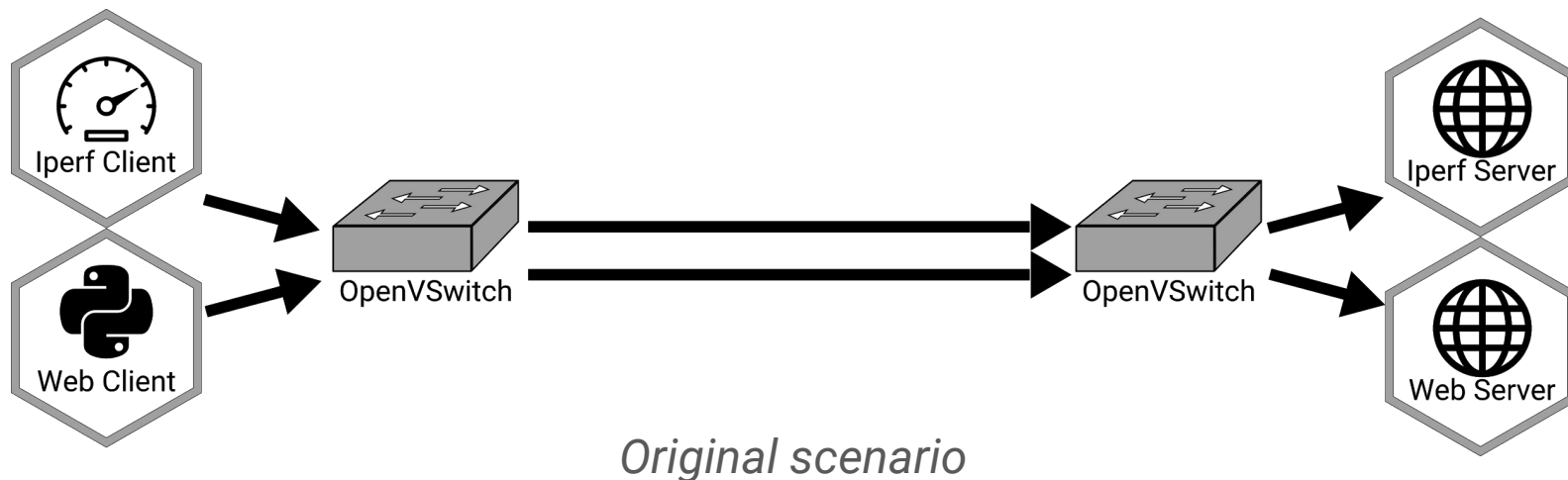
A Network Intent Refinement using *Nile*

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
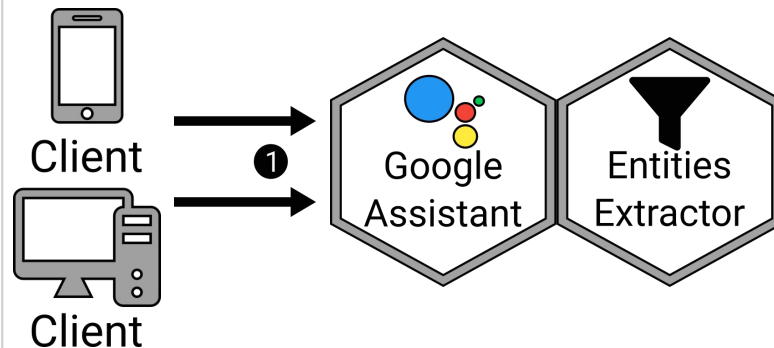
Intent Refinement By Example

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

Original Intent

Intent Refinement By Example

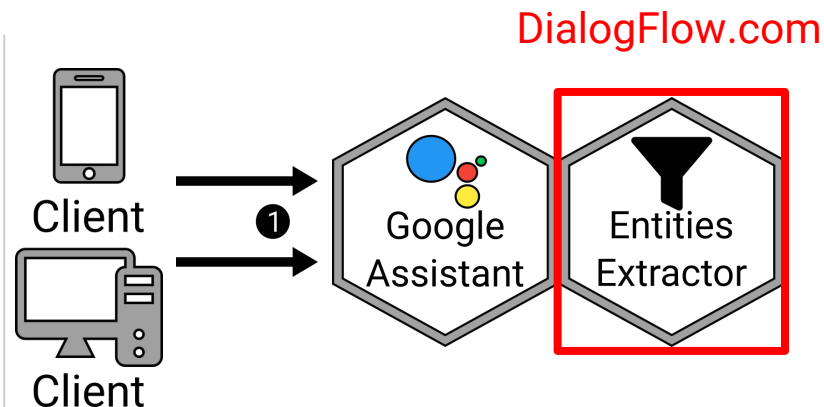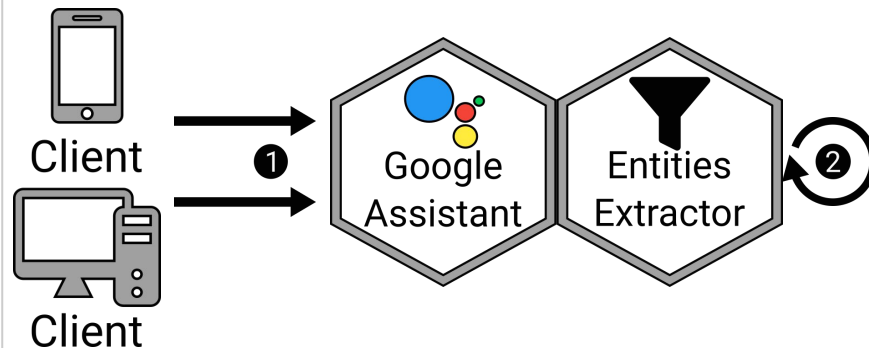"Please add a firewall and an IDS from Iperf client to server"

Original Intent

Intent Refinement By Example

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

Original Intent

DialogFlow.com

Intent Refinement By Example

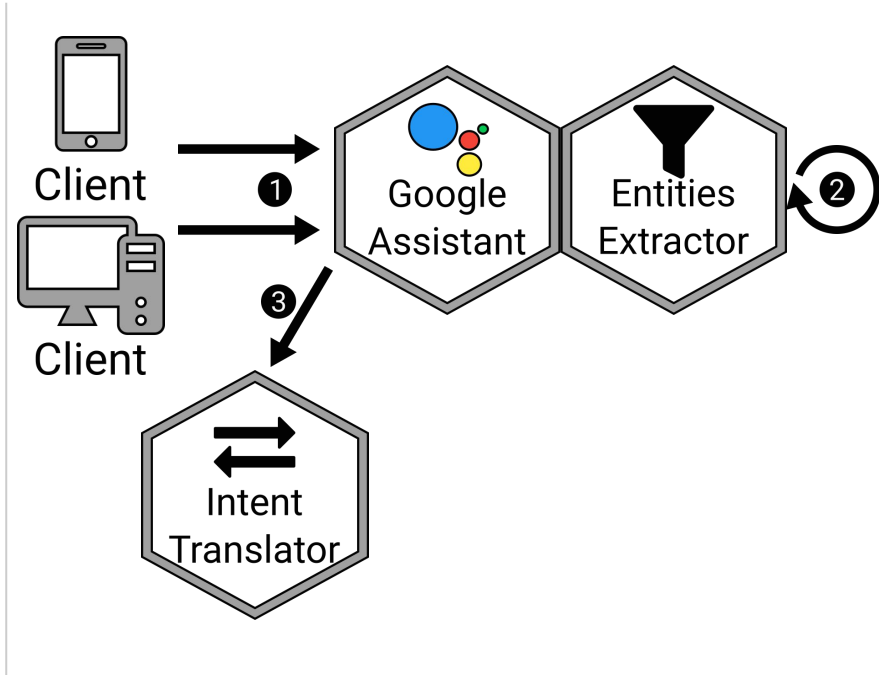"Please add a firewall and an IDS from Iperf client to server"

Extracted entities

Intent Refinement By Example

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

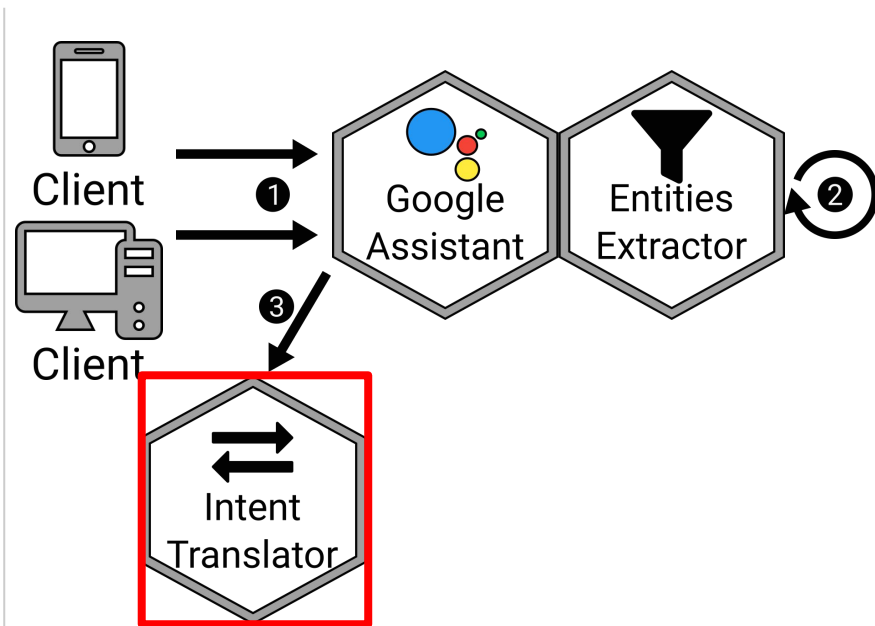*Extracted entities*

Intent Refinement By Example

"Please add a firewall and an IDS from Iperf client to server"
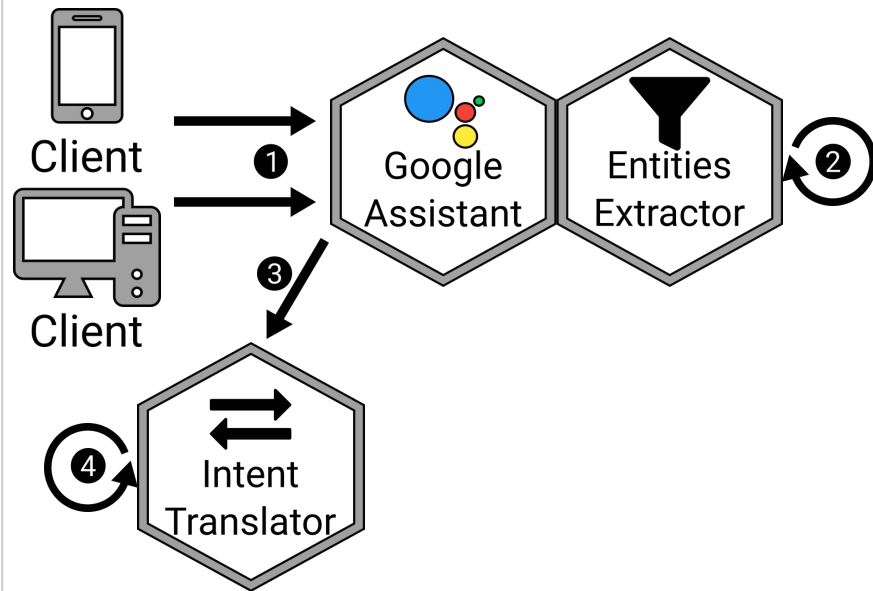
Extracted entities

Neural Sequence to Sequence learning model, using Recursive Neural Networks.

Intent Refinement By Example

```
define intent testIntent:
    from endpoint('iperf client')
    to endpoint('iperf server')
    add middlebox('firewall'),
        middlebox('ids')
```

Nile intent

Intent Refinement By Example

Is this what you want?

```
define intent testIntent:
    from endpoint('iperf client')
    to endpoint('iperf server')
    add middlebox('firewall'),
        middlebox('ids')
```

Nile intent

YES   NO
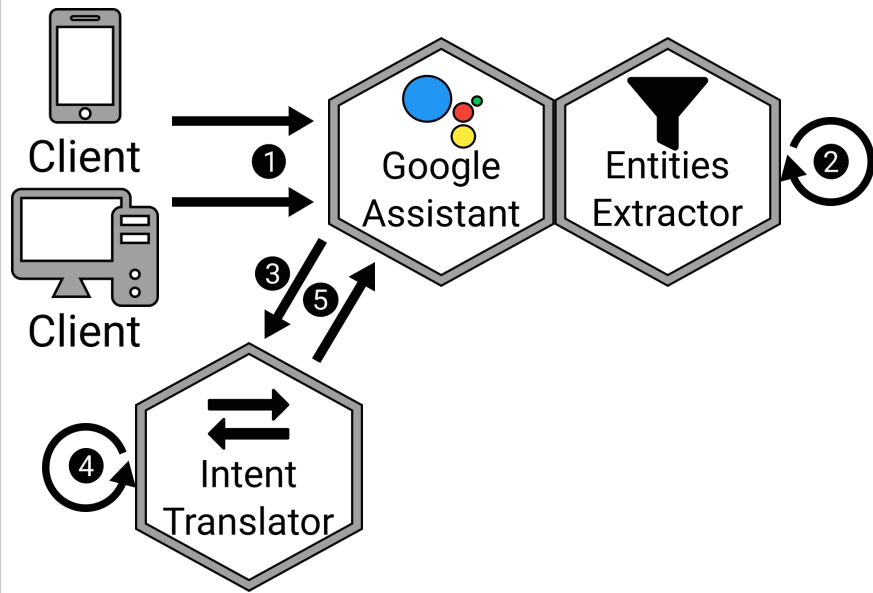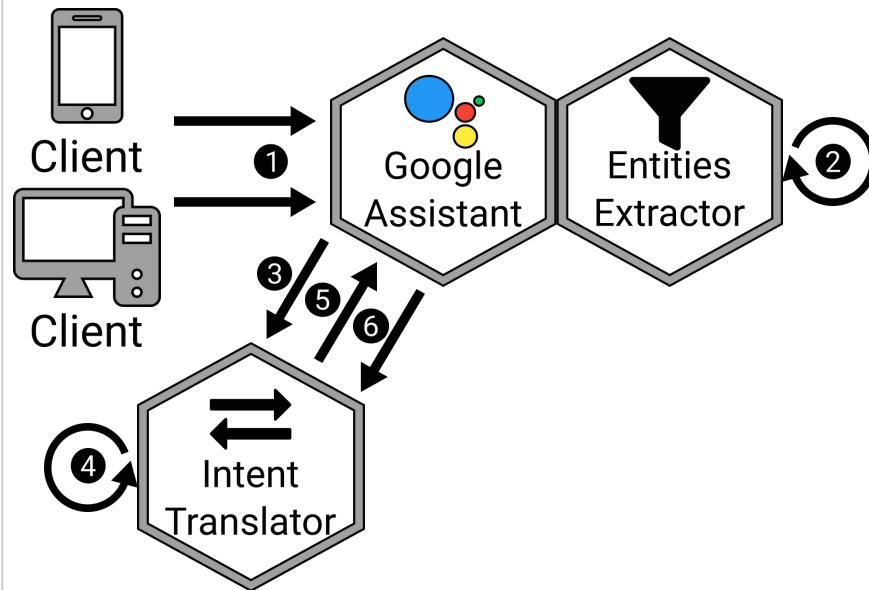
Intent Refinement By Example


```
Is this what you want?

define intent testIntent:
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                Nile intent

                    YES        NO
```

Intent Refinement By Example

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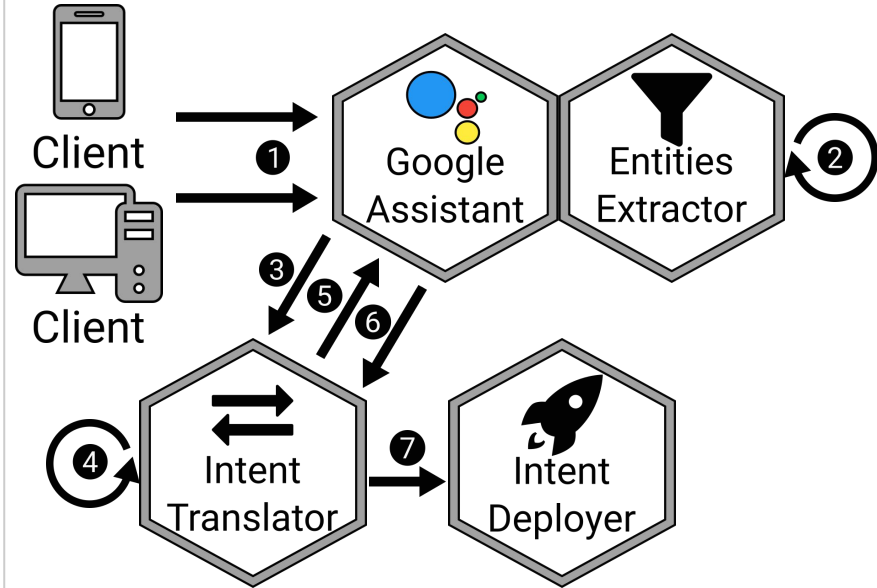
Nile intent

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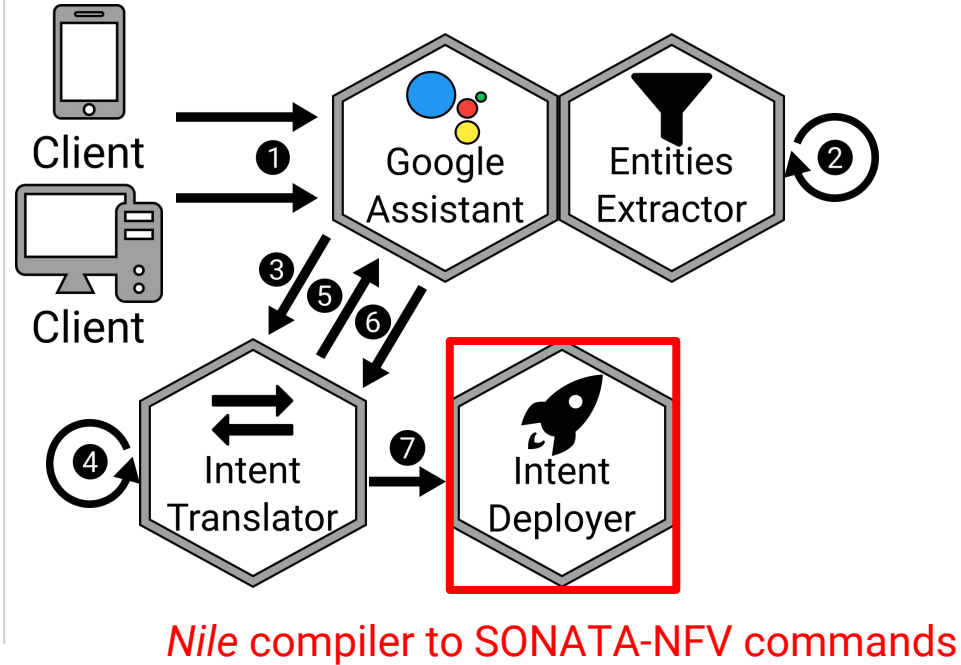
Nile intent

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

```
# deploy vnfs
vim-emu compute start -n fw <params>
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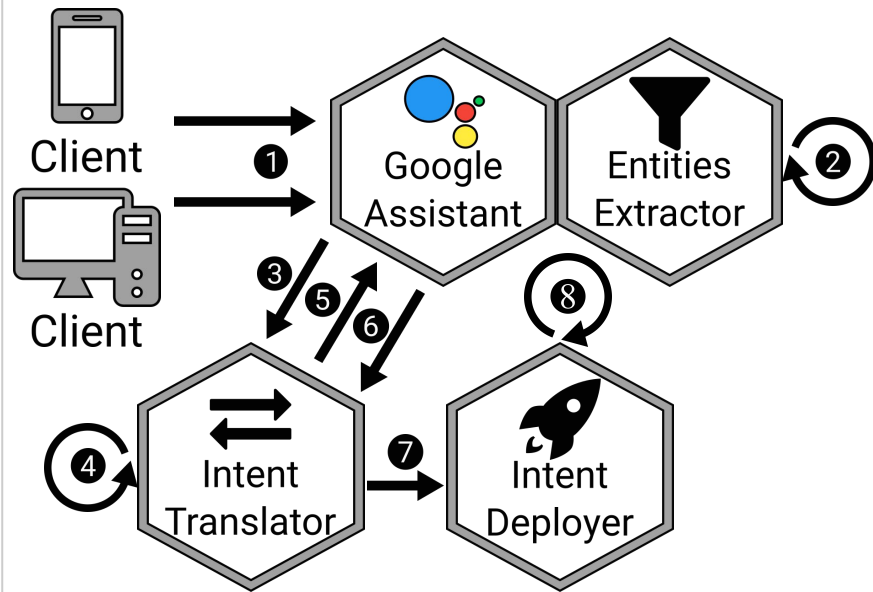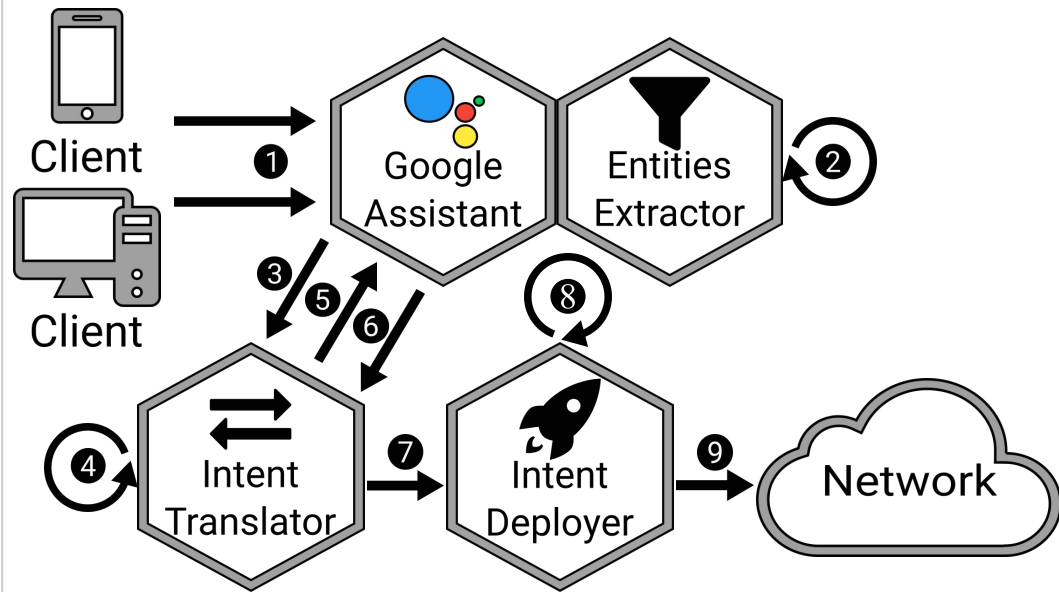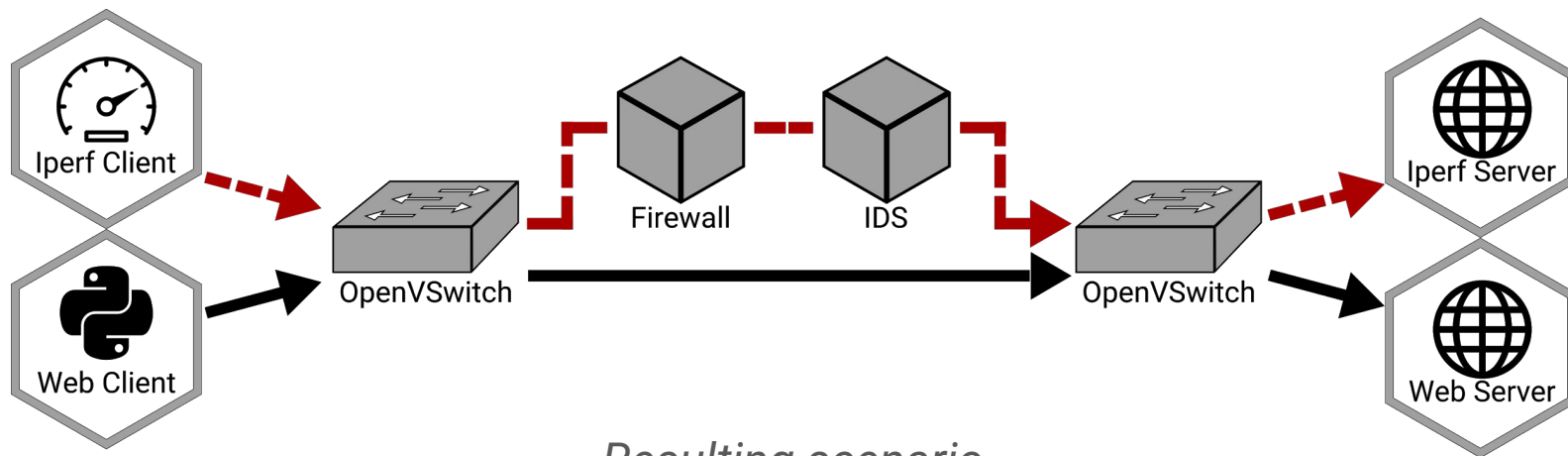
Compiled SONATA-NFV commands

Intent Refinement By Example

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


Resulting scenario

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.
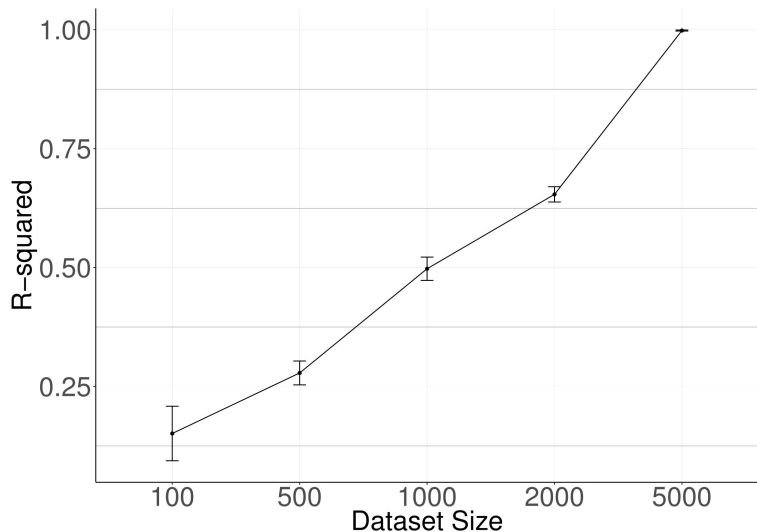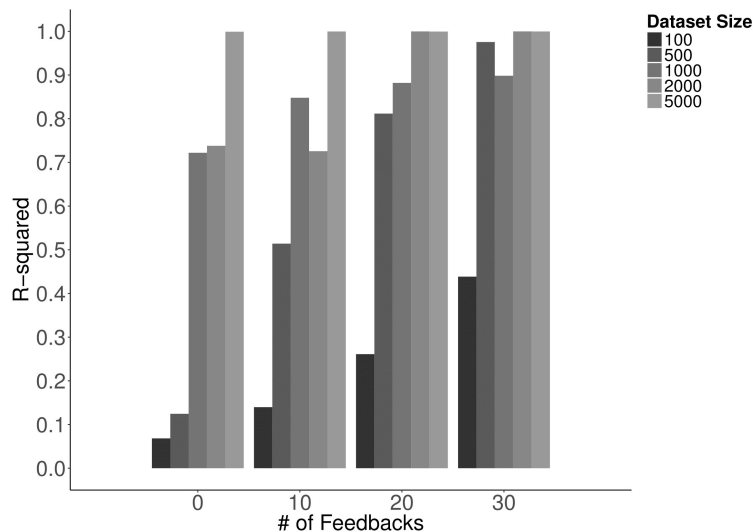
Results

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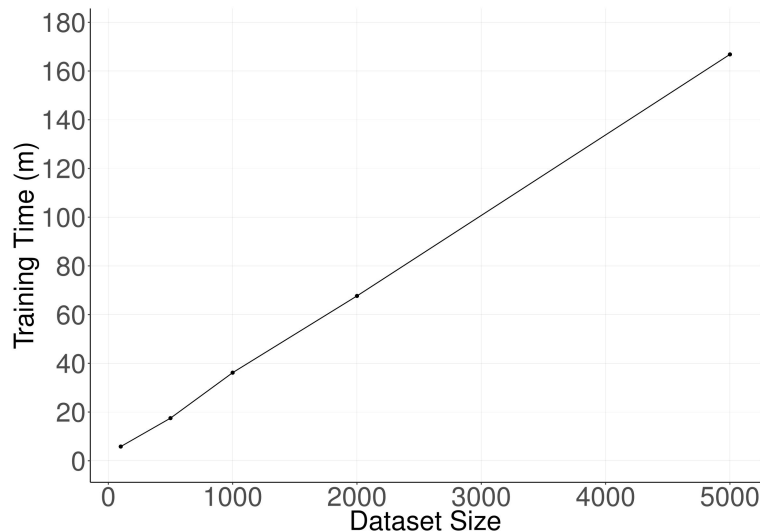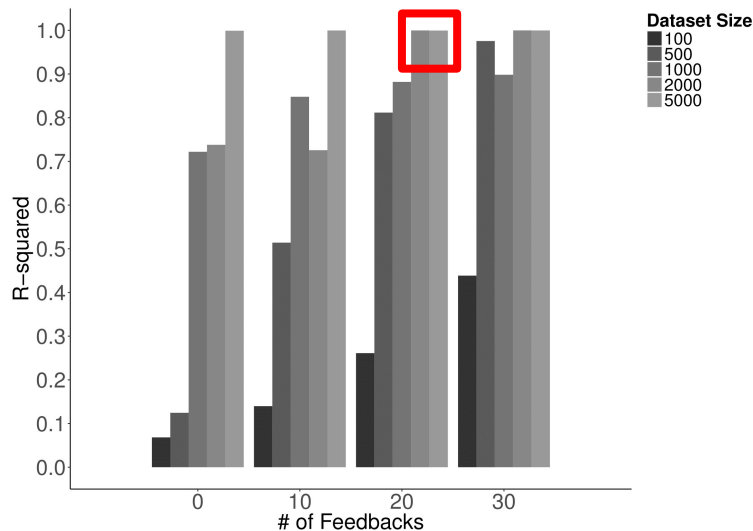
Results

(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