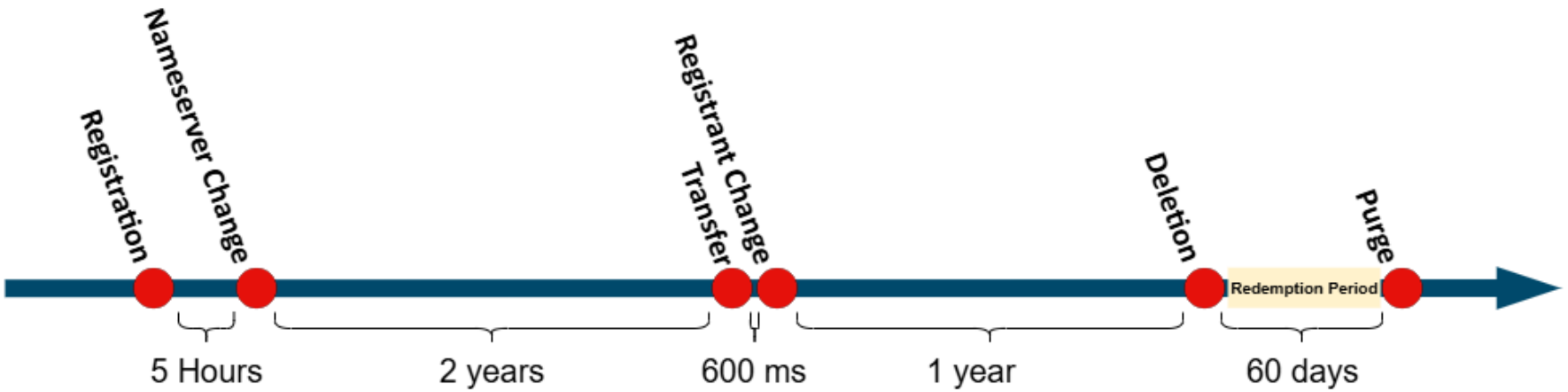
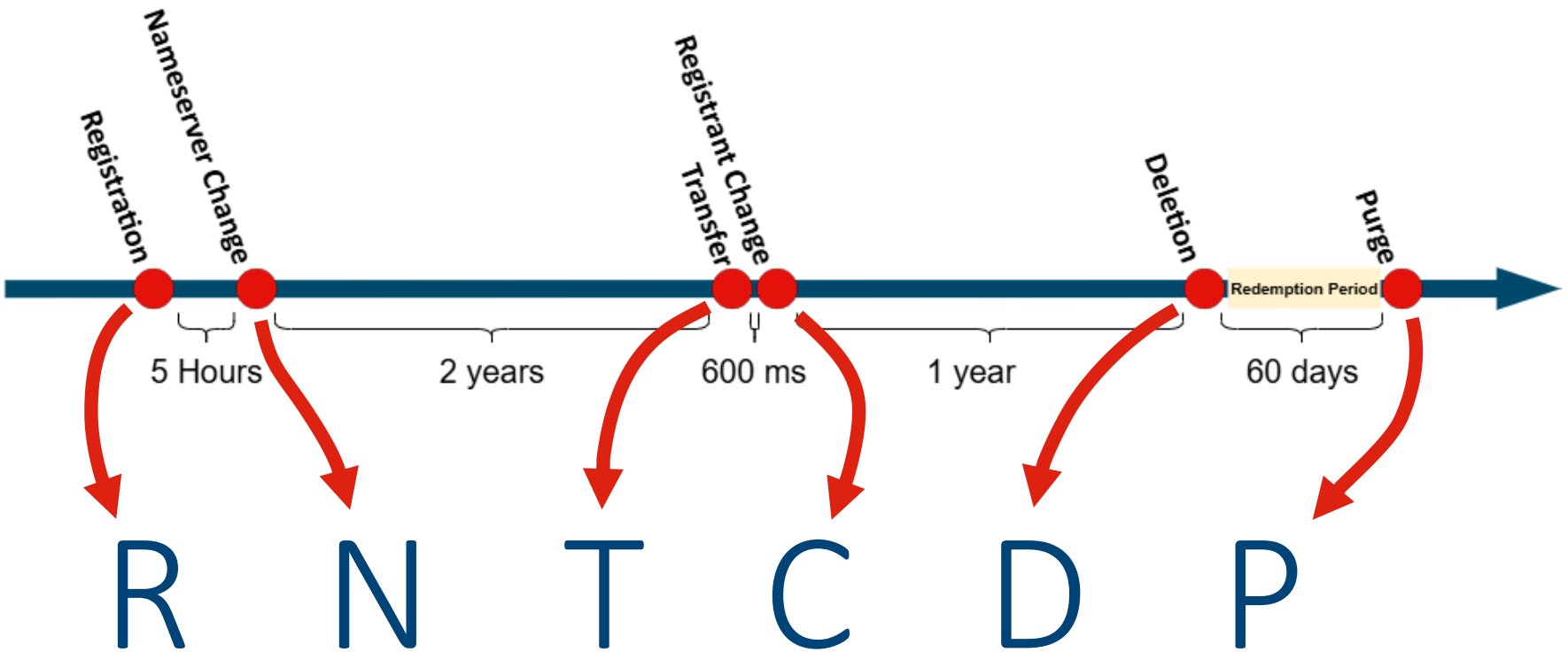
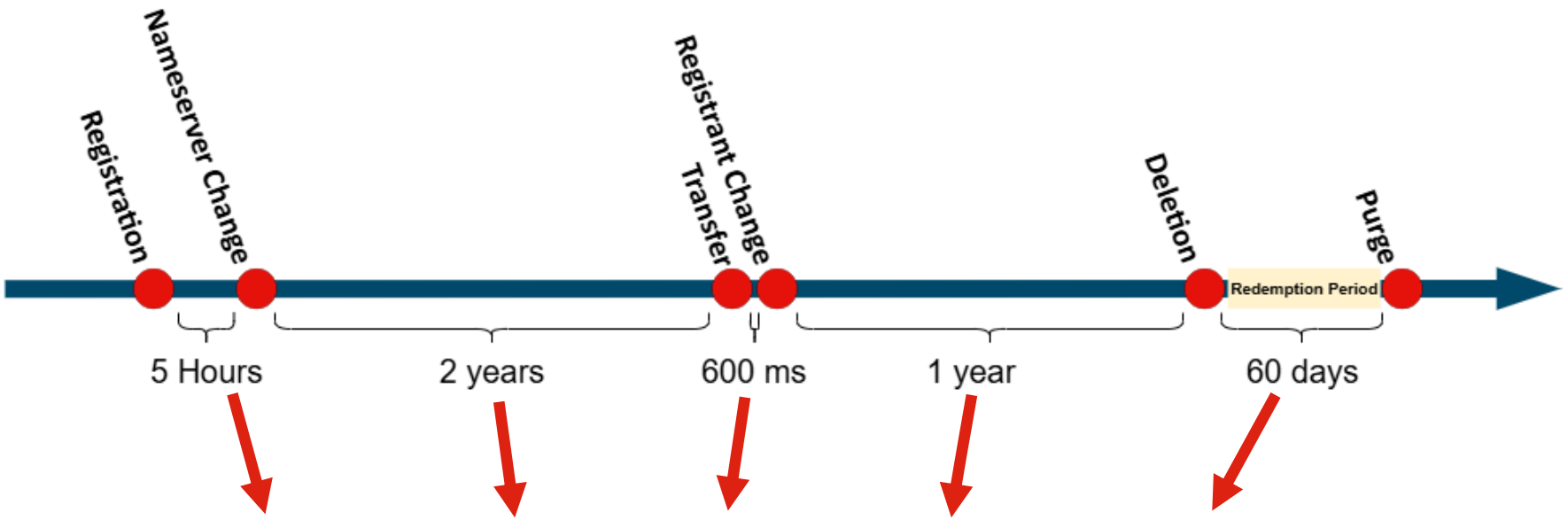
Domain DNA

01.10.2025 · Alexander Mayrhofer & Clemens Moritz · Research & Development

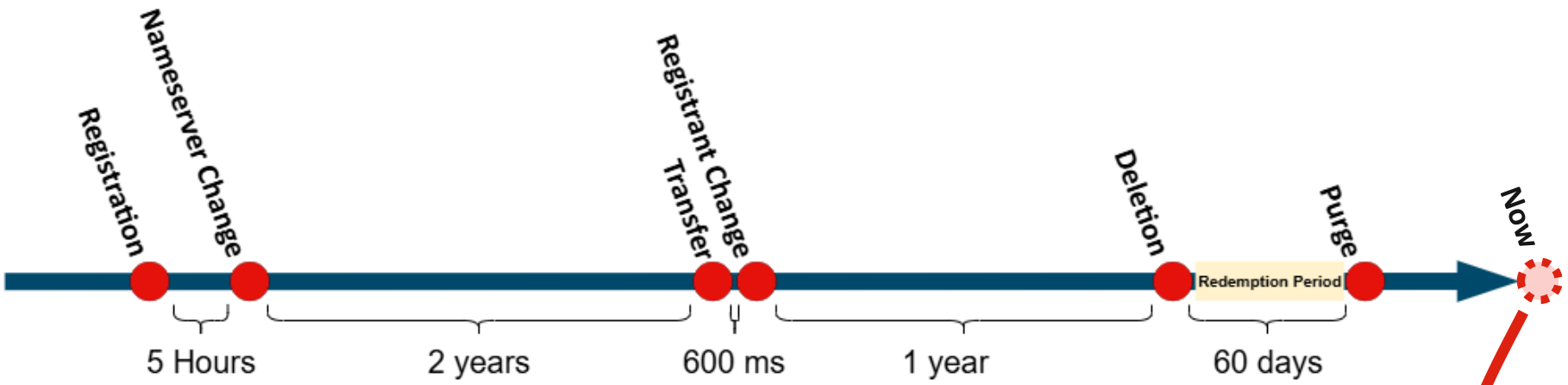
Lifecycle of a Domain



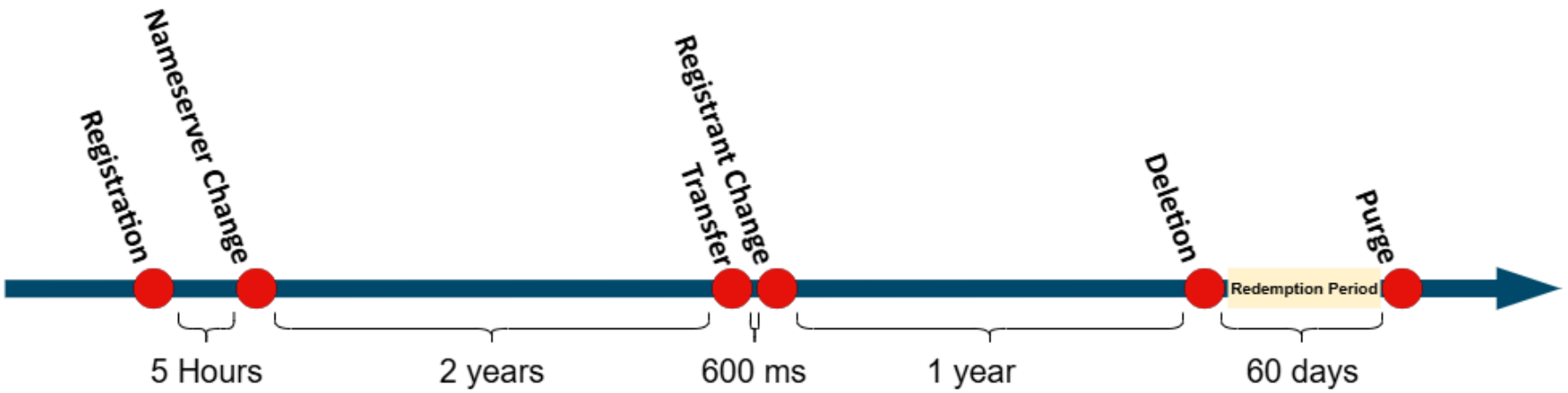

Registration
Nameserver Change
Registrant Change
Transfer
Deletion
Purge
Redemption Period
5 Hours
2 years
600 ms
1 year
60 days
R
N
T
C
D
P



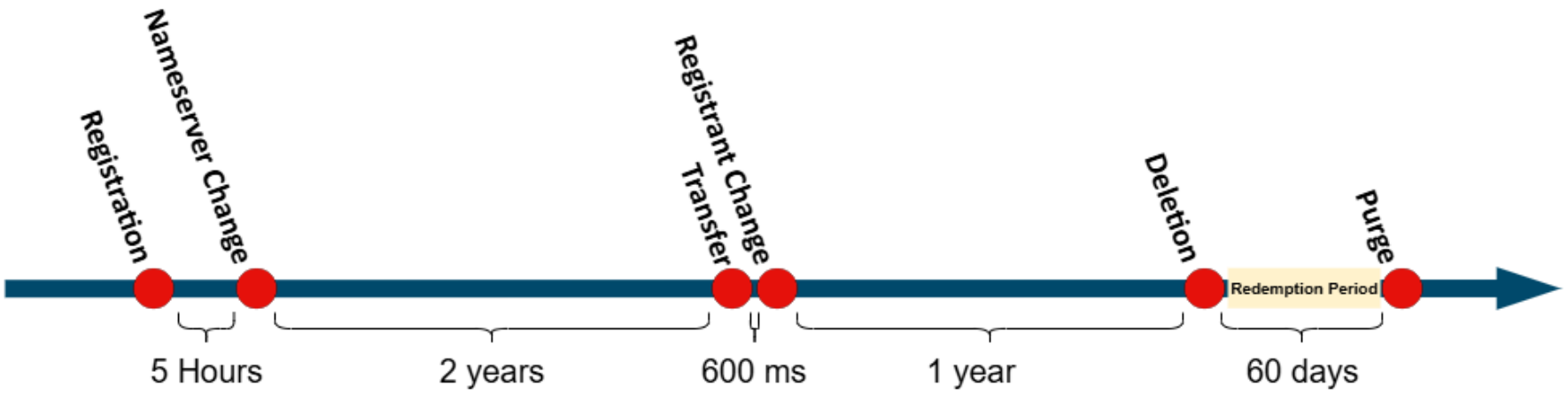
R 4N 8T 1C 7D 6P



/R 4N 8T 1C 7D 6P 7>

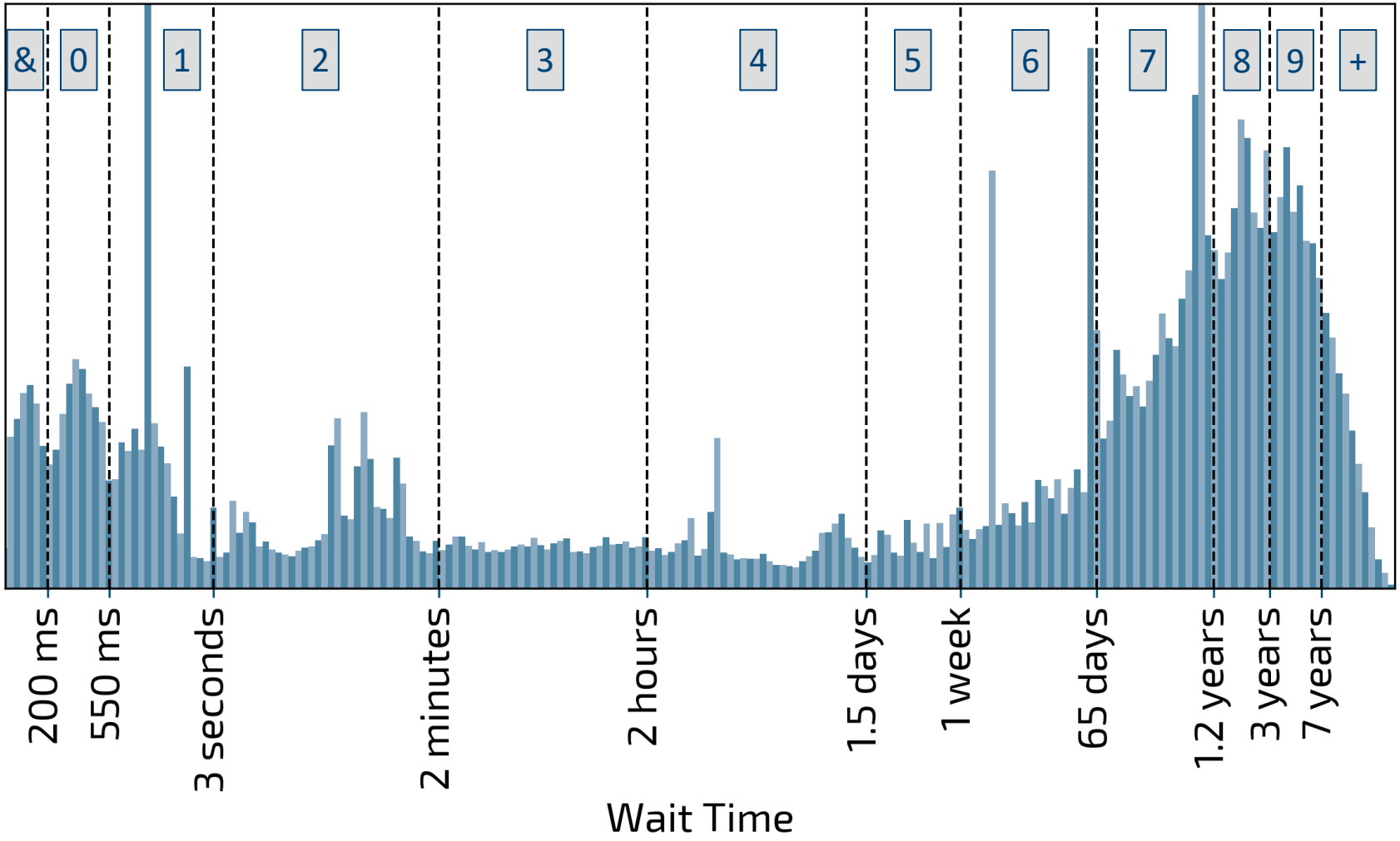


/R:4N:8T:1C:7D:6P:7>



/R:4N:8T:1C:7D:6P:7>

Domain DNAgs Notation (Abbreviated)


&
0
1
2
3
4
5
6
7
8
9
+
200 ms
550 ms
3 seconds
2 minutes
2 hours
1.5 days
1 week
65 days
1.2 years
3 years
7 years
Wait Time

Remarks: Views

Domain View

/R:2N:7T:8D:6P:1R:7D:6P:4>

&	Instantaneous
0	< 550 ms
1	< 3 s
2	< 2 minutes
3	< 2 hours
4	< 36 hours
5	< 7 days
6	< 65 days
7	< 438 days
8	< 3 years
9	< 7 years
+	>= 7 years

R	-> Registration
T	-> Transfer
N	-> Nameserver Change
D	-> Delete
L	-> Lock
U	-> Restore
P	-> Purge
S	-> DNSSEC Change
C	-> Registrant Change

Remarks: Views

Domain View

Delegation View

/R:2N:7T:8D:6P:1R:7D:6P:4>

&	Instantaneous
0	< 550 ms
1	< 3 s
2	< 2 minutes
3	< 2 hours
4	< 36 hours
5	< 7 days
6	< 65 days
7	< 438 days
8	< 3 years
9	< 7 years
+	>= 7 years

R	-> Registration
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Remarks: Fragments

Domain View

Delegation View

/R:2N:7T:8D:6P:1R:7D:6P:4>

Dropcatch

Normal Deletion

&	Instantaneous
0	< 550 ms
1	< 3 s
2	< 2 minutes
3	< 2 hours
4	< 36 hours
5	< 7 days
6	< 65 days
7	< 438 days
8	< 3 years
9	< 7 years
+	>= 7 years

R	-> Registration
T	-> Transfer
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P	-> Purge
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Remarks: Simultaneous Doings

/R:2C:&N:&S:9T:4N:...

/R:&S: ...

&	Instantaneous
0	< 550 ms
1	< 3 s
2	< 2 minutes
3	< 2 hours
4	< 36 hours
5	< 7 days
6	< 65 days
7	< 438 days
8	< 3 years
9	< 7 years
+	>= 7 years

R	-> Registration
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- **Contraction Rule:** if an event is implied by another simultaneous event, it is omitted.

.at example: Transfer implies a Registrant handle change -> Handle change is dropped

But: R does not imply S – so R:&S is kept

Remarks: Simultaneous Doings

/R:2C:&N:&S:9T:4N:...

/R:&S ...

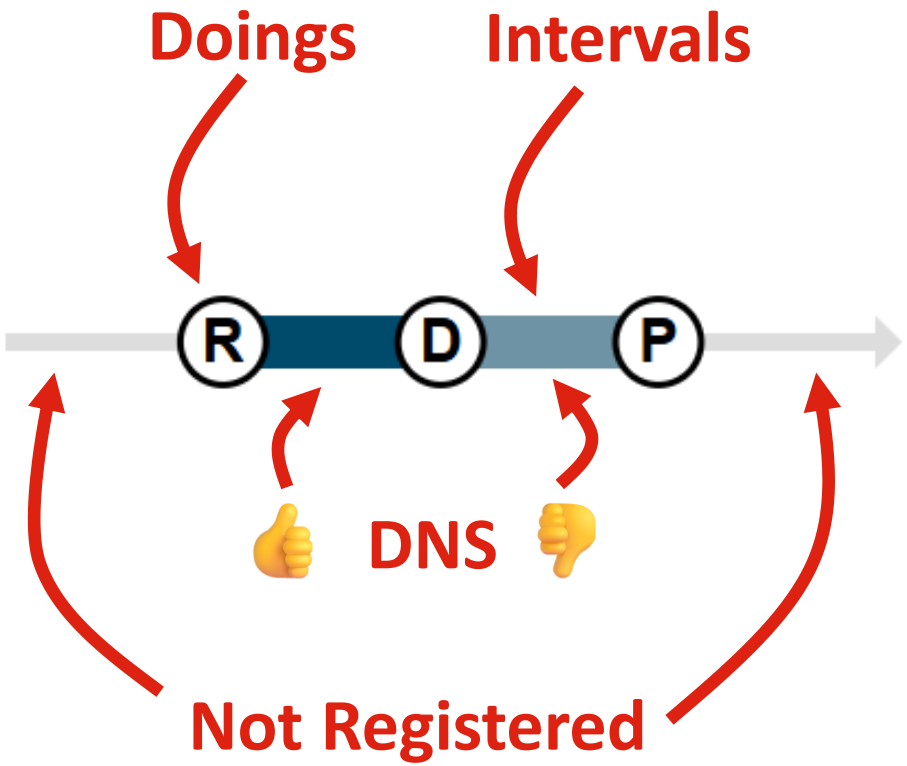
&	Instantaneous
0	< 550 ms
1	< 3 s
2	< 2 minutes
3	< 2 hours
4	< 36 hours
5	< 7 days
6	< 65 days
7	< 438 days
8	< 3 years
9	< 7 years
+	>= 7 years

R	-> Registration	(prio = 0)
T	-> Transfer	(prio = 0)
N	-> Nameserver Change	(prio = -1)
D	-> Delete	(prio = 0)
L	-> Lock	(prio = 0)
U	-> Restore	(prio = 0)
P	-> Purge	(prio = 0)
S	-> DNSSEC Change	(prio = -1)
C	-> Registrant Change	(prio = -1)

- **Sorting Rule:**
  Events are
  - first sorted by priority (descending),
  - then by alphabet.

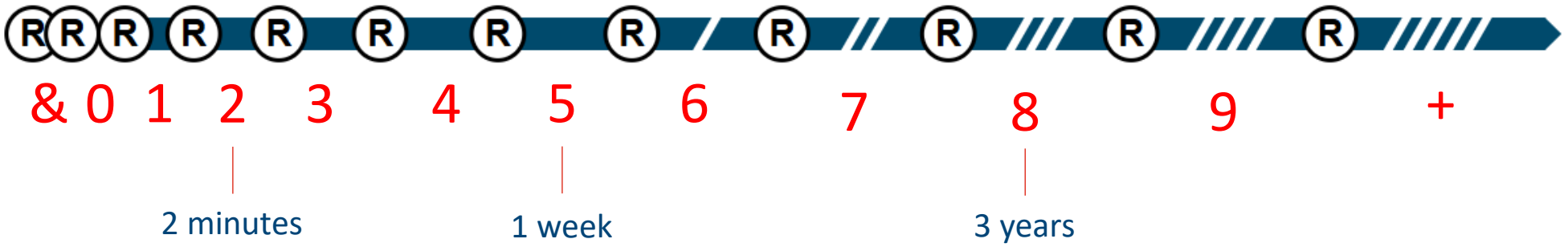
Example 1: Visualisations

- Based on „Metro Metaphor“



Visualizations – Interval Challenge

- Lots of different Intervals! (12)
- Huge scale of intervals (sub-seconds to multi-year)
- How to keep it simple?
  - Linear length -> „exponential“ periods!



Visualization – Real World Examples

~20 year old domains, 3 registrations.. Busy life:

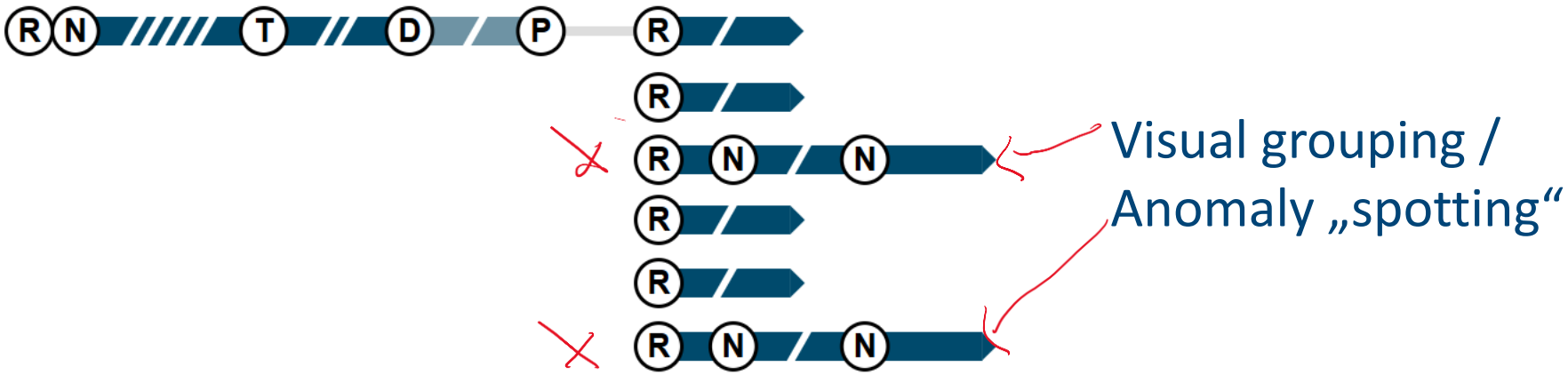
/R2N9D7P+R0N9D6P9R6>

Relatively young (fresh) domain, shady
(frequent) NS changes, got locked recently

/R4N6N5C&N3N2N6N7N3C3L6>

Example: Groups / Lists

- Registrations from 2025-09-02
- Centering around that „R“ event



Example 2: Clustering

R	-> Registration
T	-> Transfer
N	-> Nameserver Change
D	-> Delete
L	-> Lock
U	-> Restore
S	-> DNSSEC Change
C	-> Registrant Change

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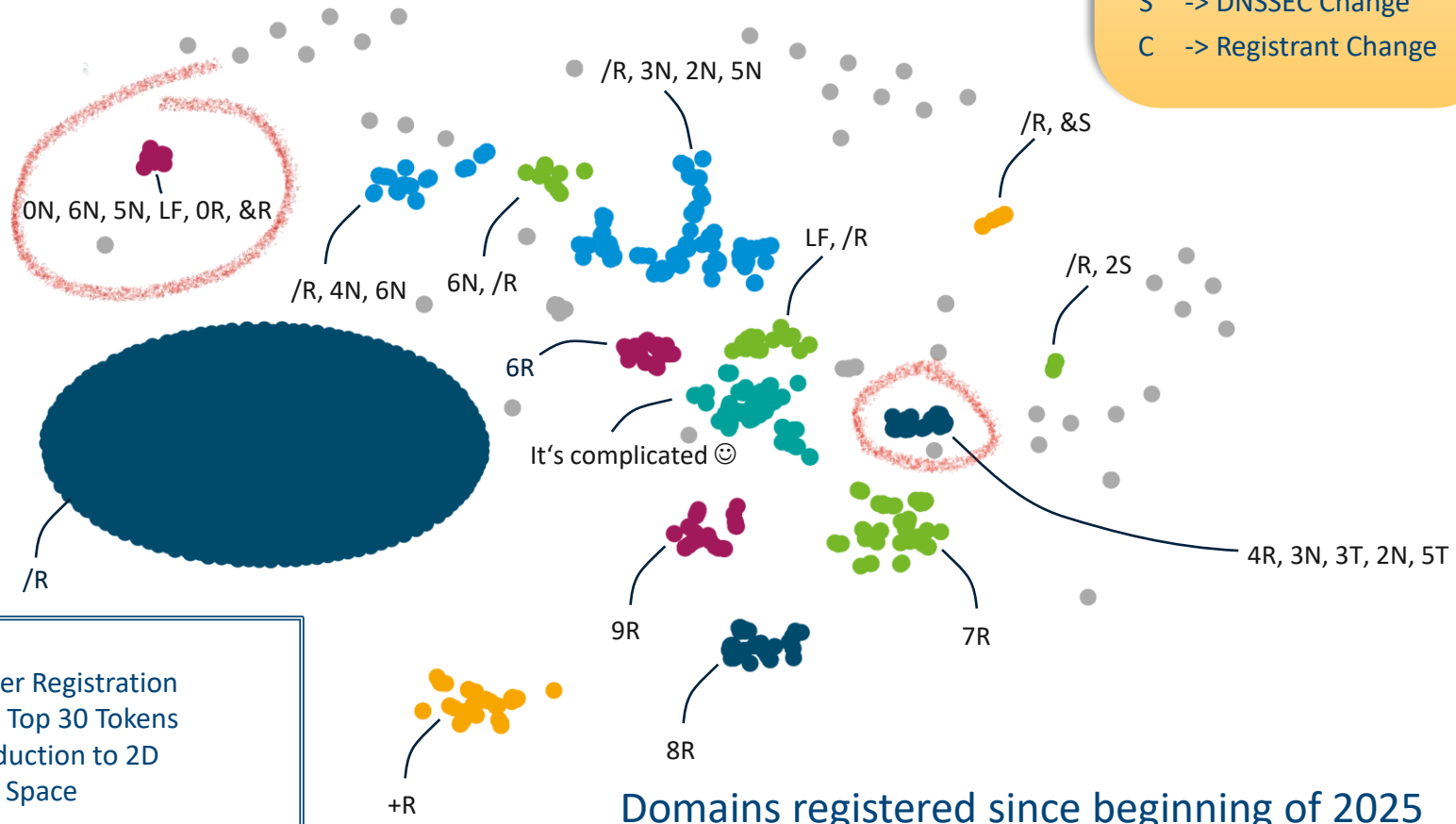

- Delegation View
- Events up to 1 month after Registration
- Count Vectorization with Top 30 Tokens
- t-SNE Dimensionality Reduction to 2D
- DBSCAN Clustering in 2D Space
- Scikit-Learn

Domains registered since beginning of 2025

Example 3: Domain-Doings-Oracle

- Textual description of Domain History
  -> Apply Text-based Machine Learning Techniques
- Similar models have been trained in other fields, e.g.:
  - *Using Sequences of Life-events to Predict Human Lives** Where an ML model is trained that predicts mortality based on a person's life medical and employment history.
  - *BEHRT: Transformer for Electronic Health Records‡* Where an ML model is trained to predict a patient's future conditions based on medical history
- Implementation idea: https://www.tensorflow.org/text/tutorials/text_generation

* https://www.nature.com/articles/s43588-023-00573-5
‡ https://www.nature.com/articles/s41598-020-62922-y

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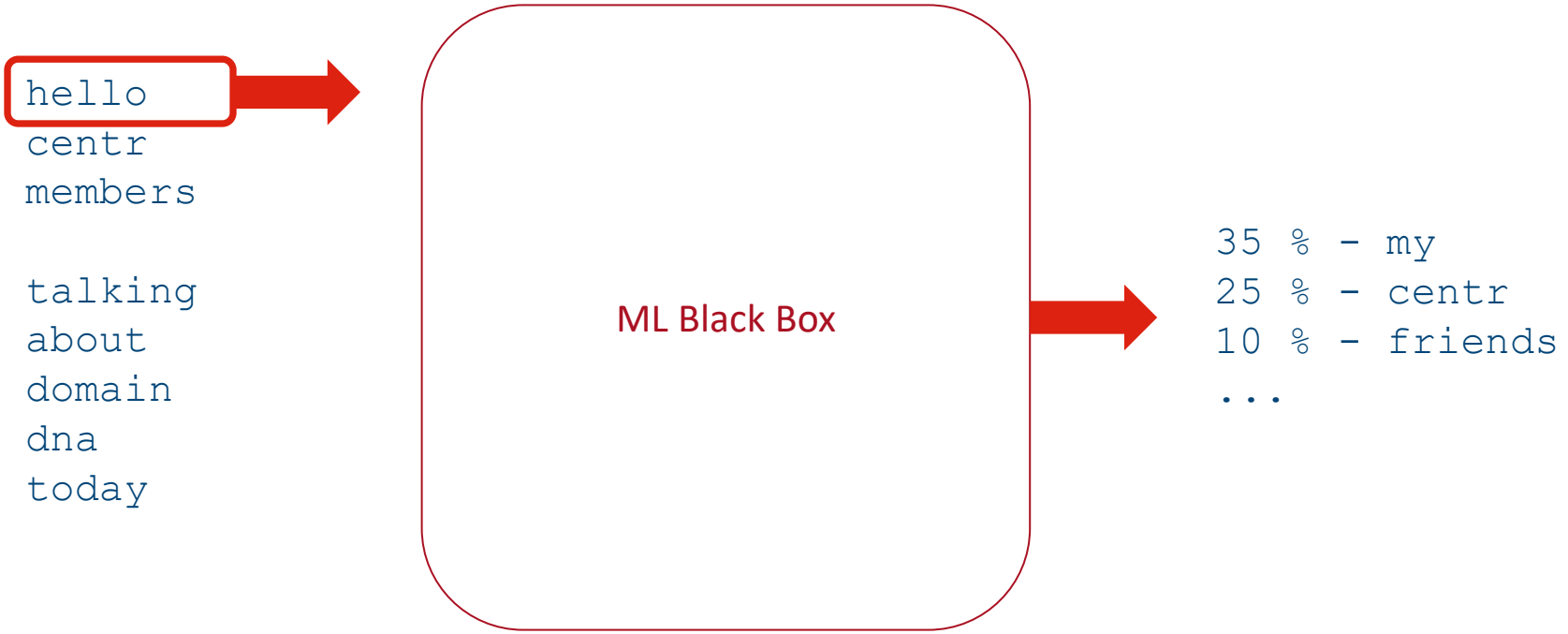

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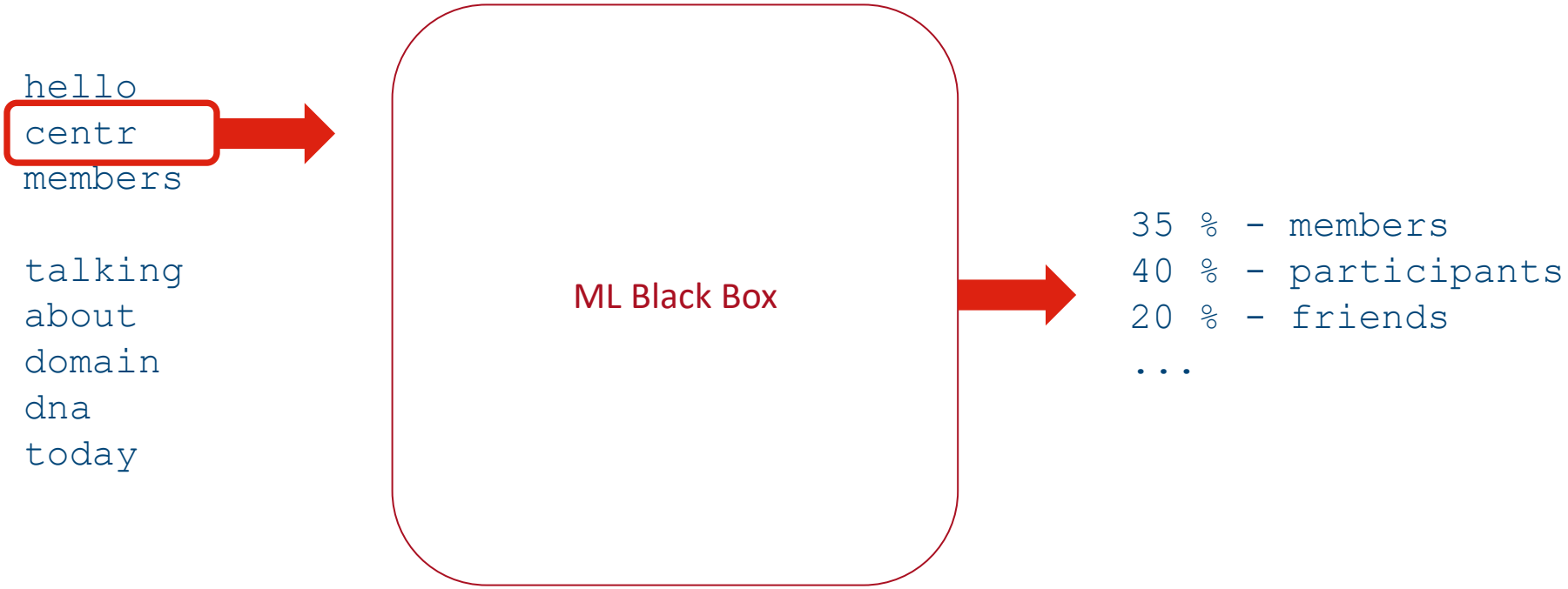

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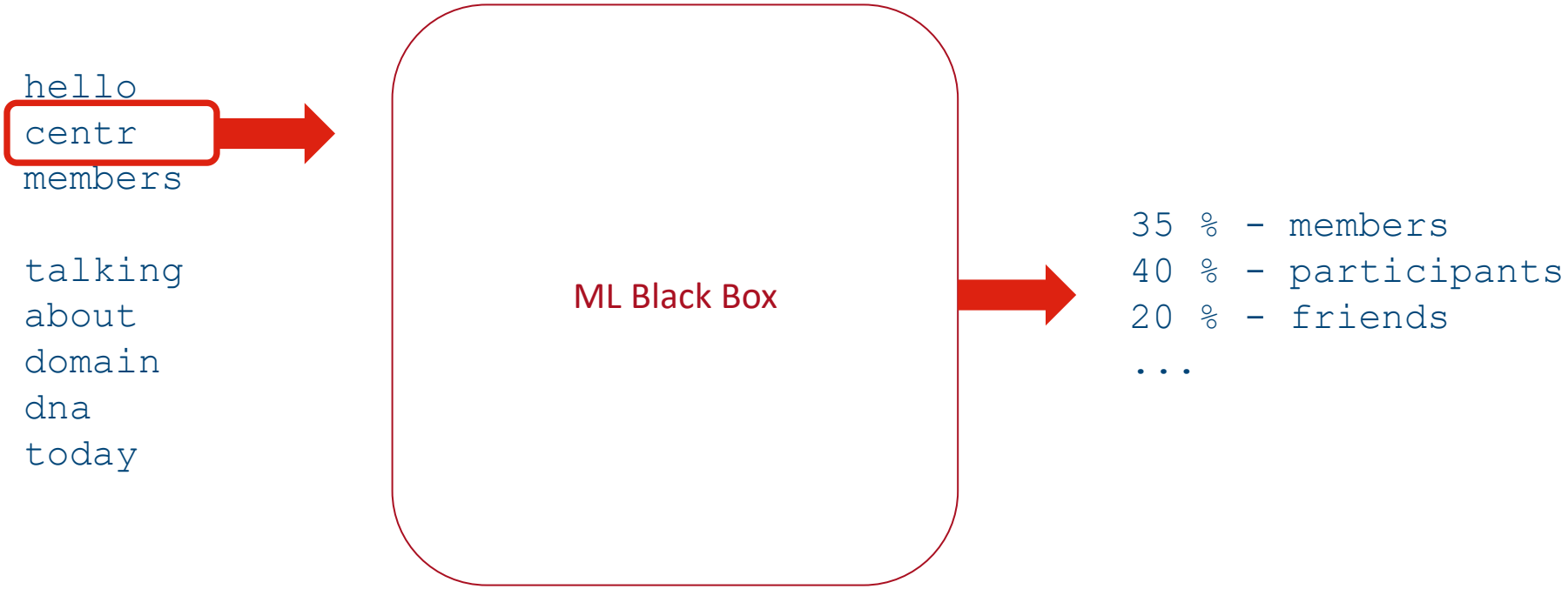

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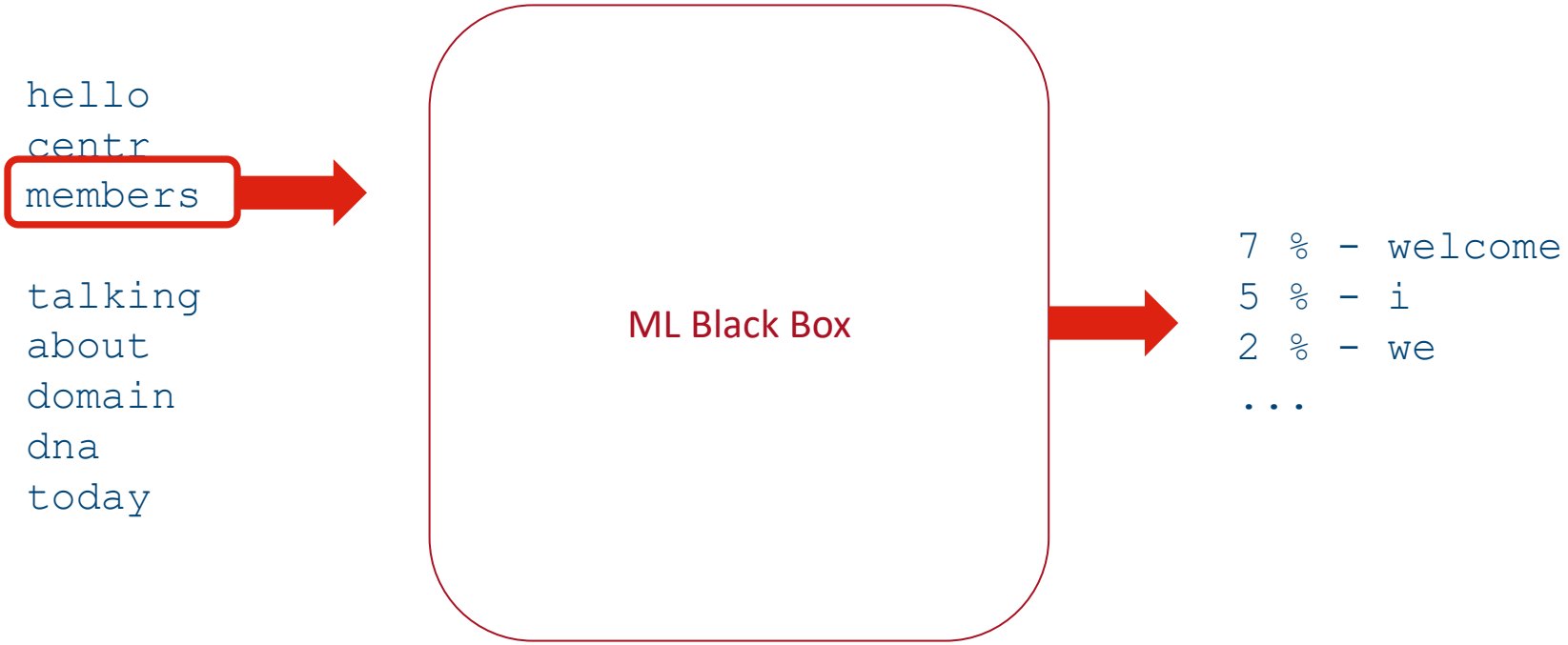

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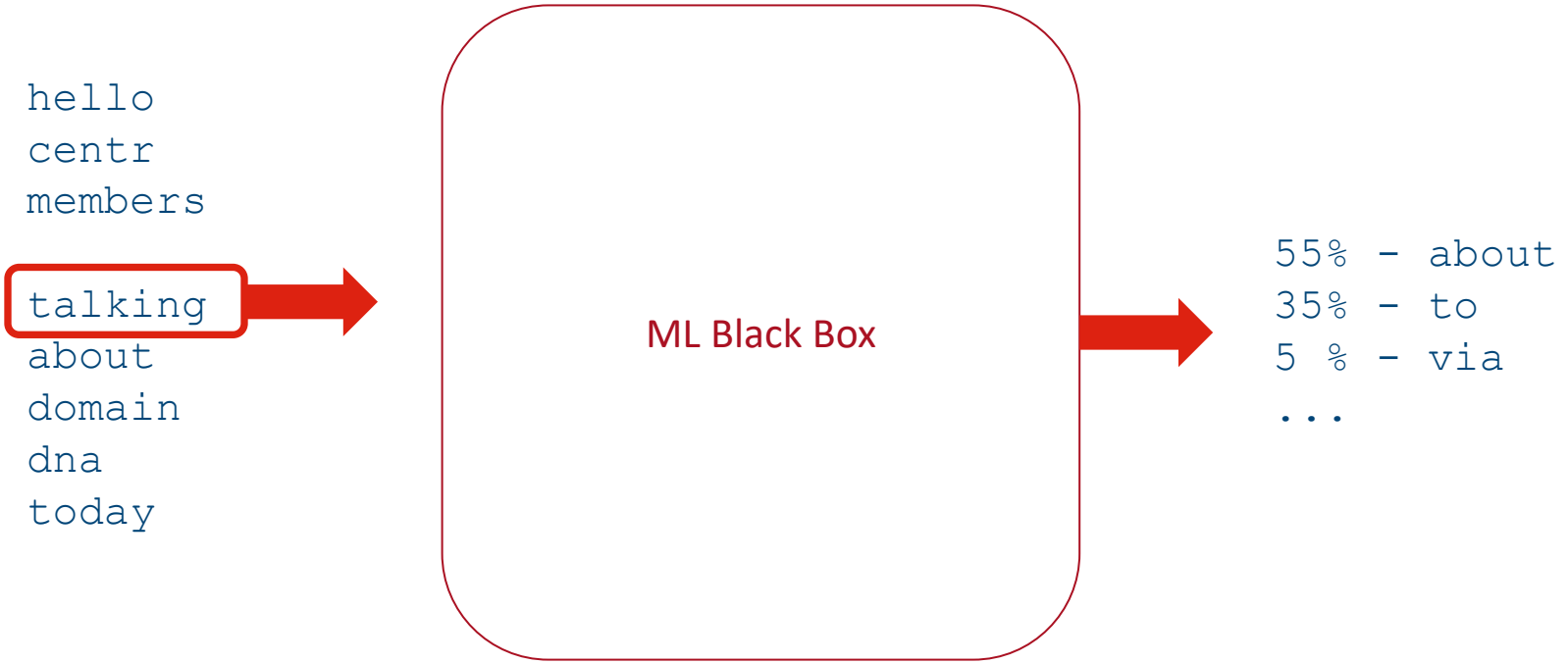

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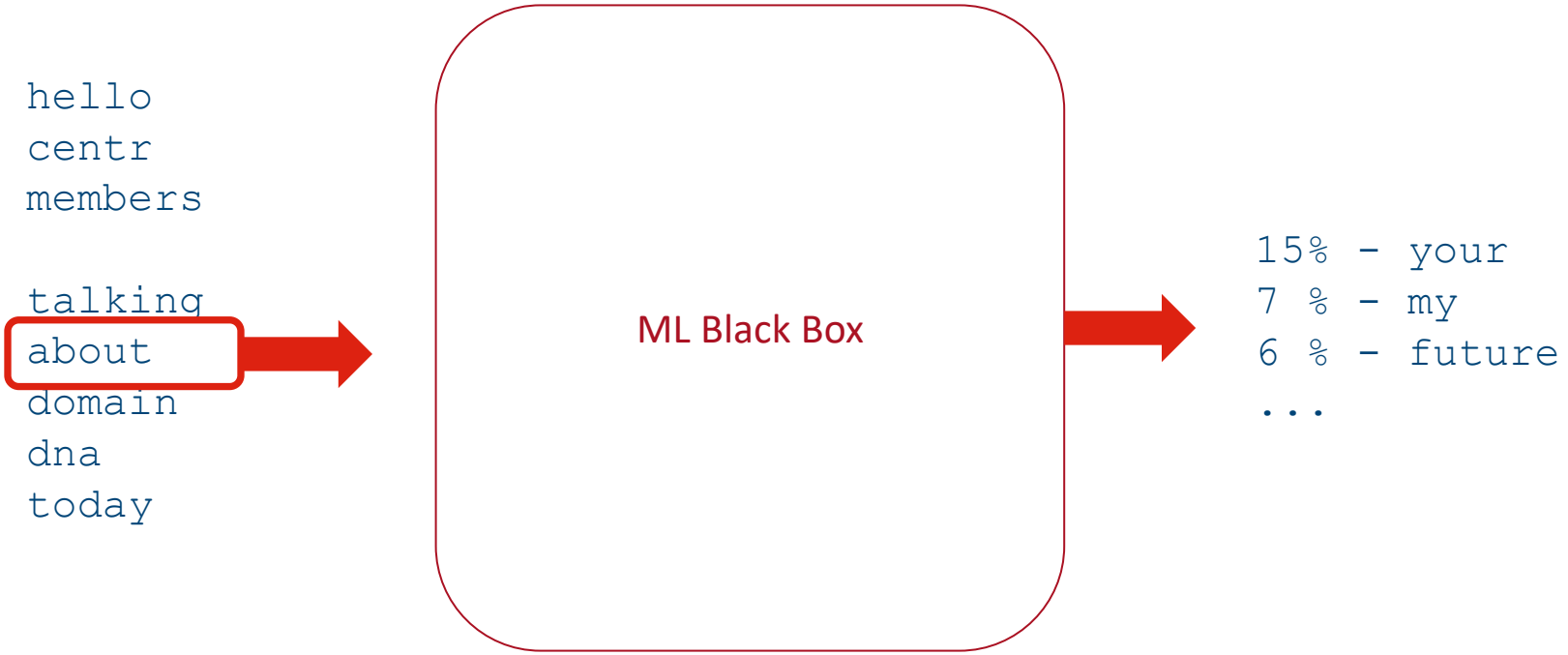

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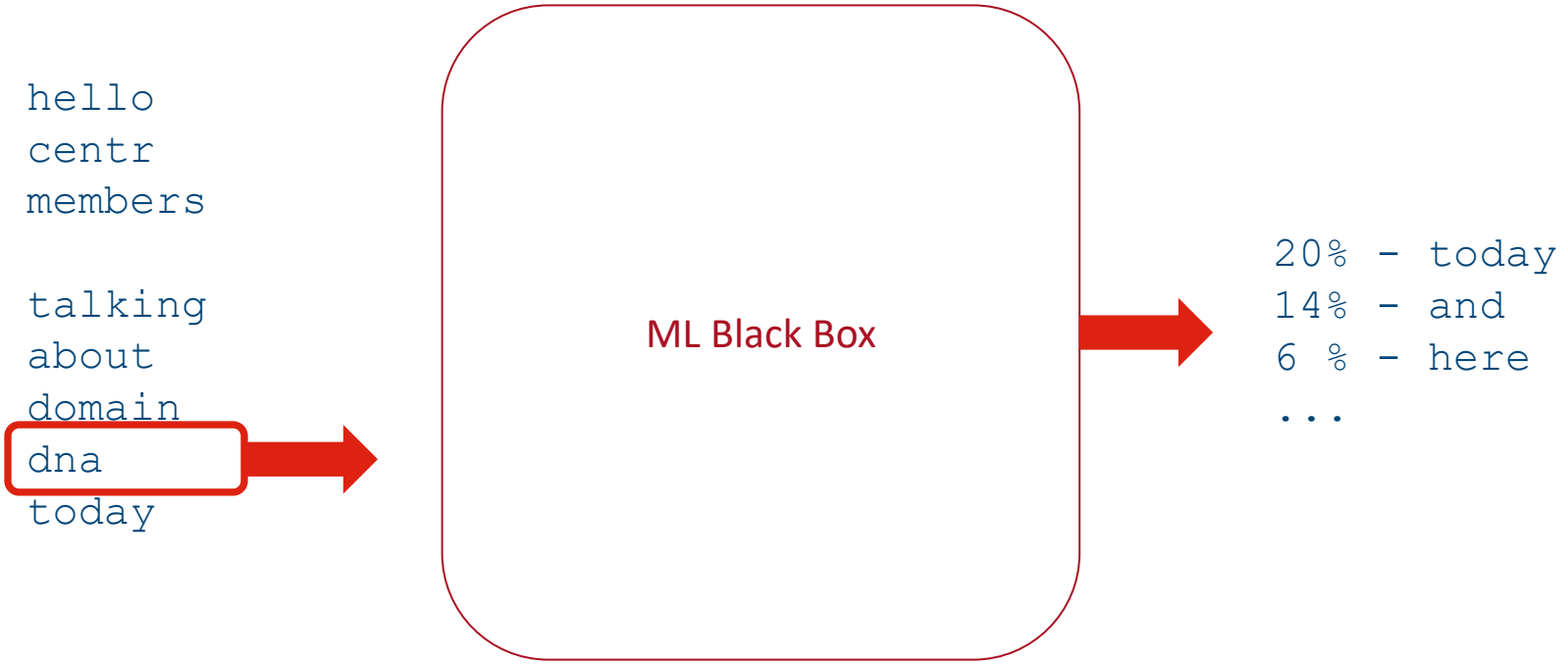

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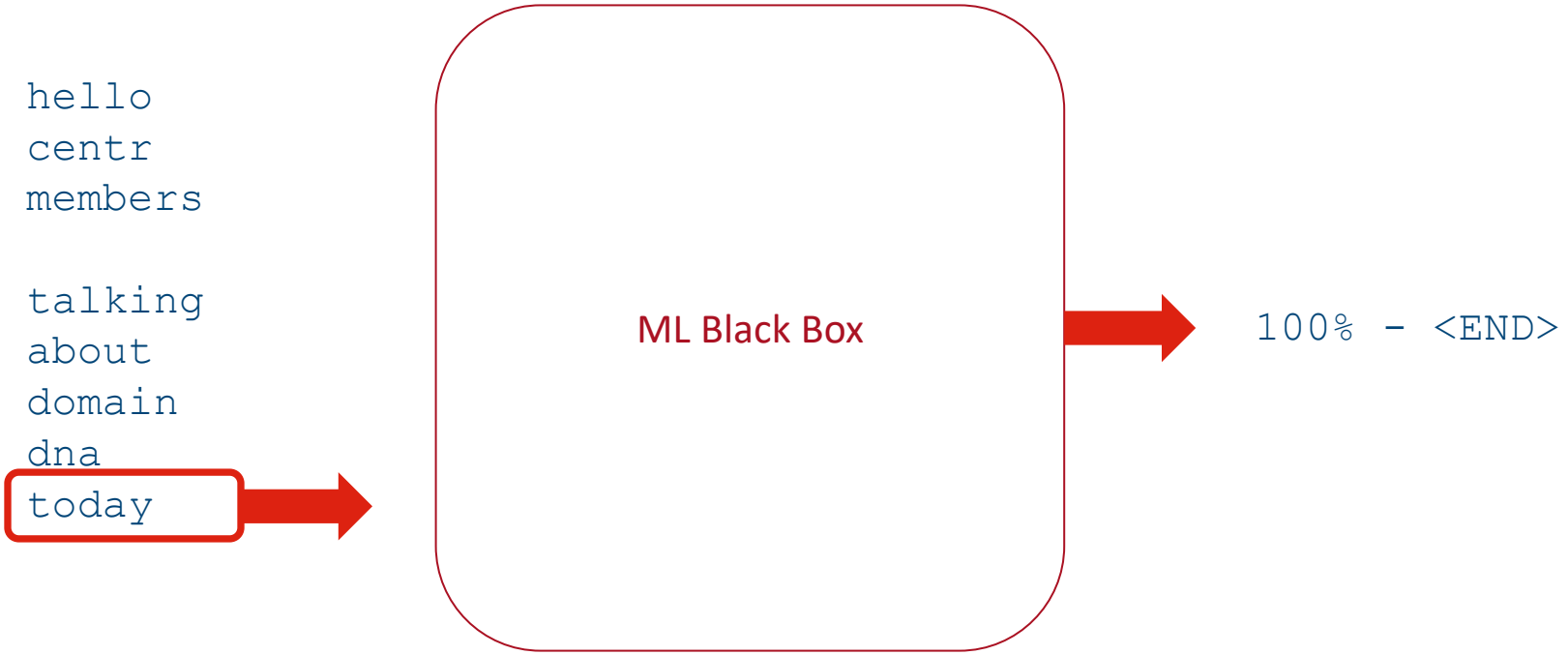

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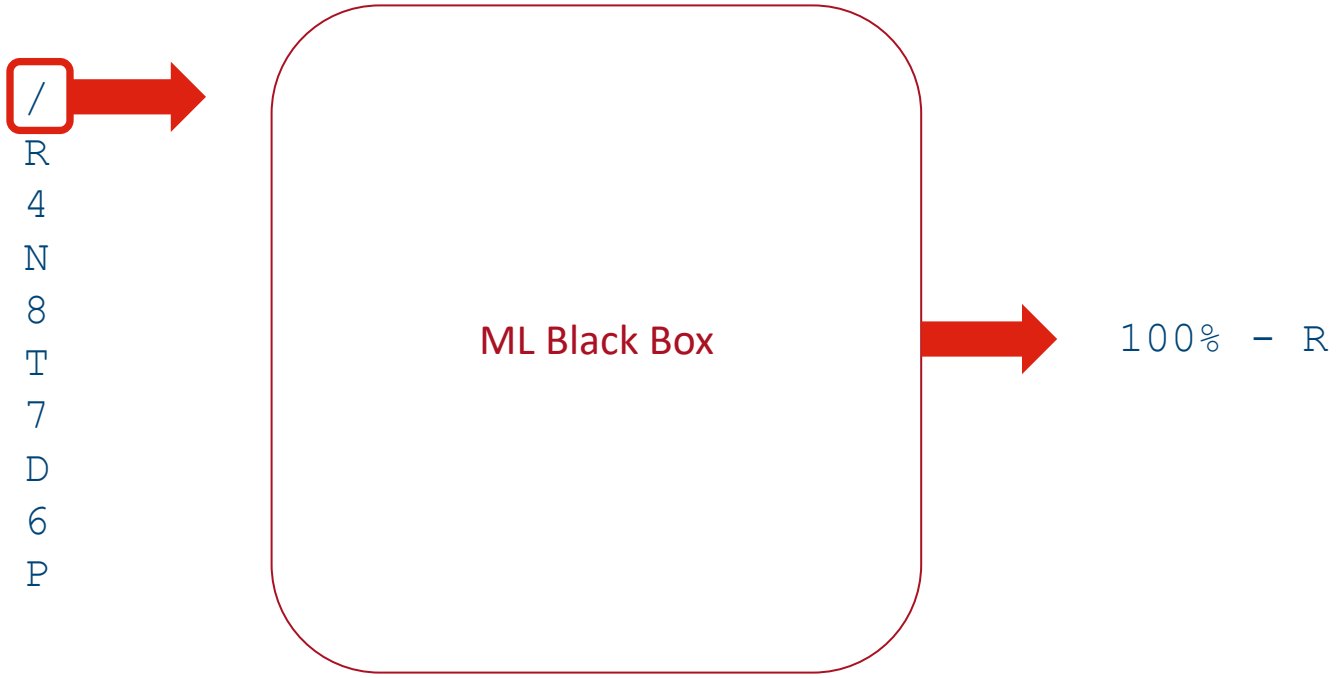

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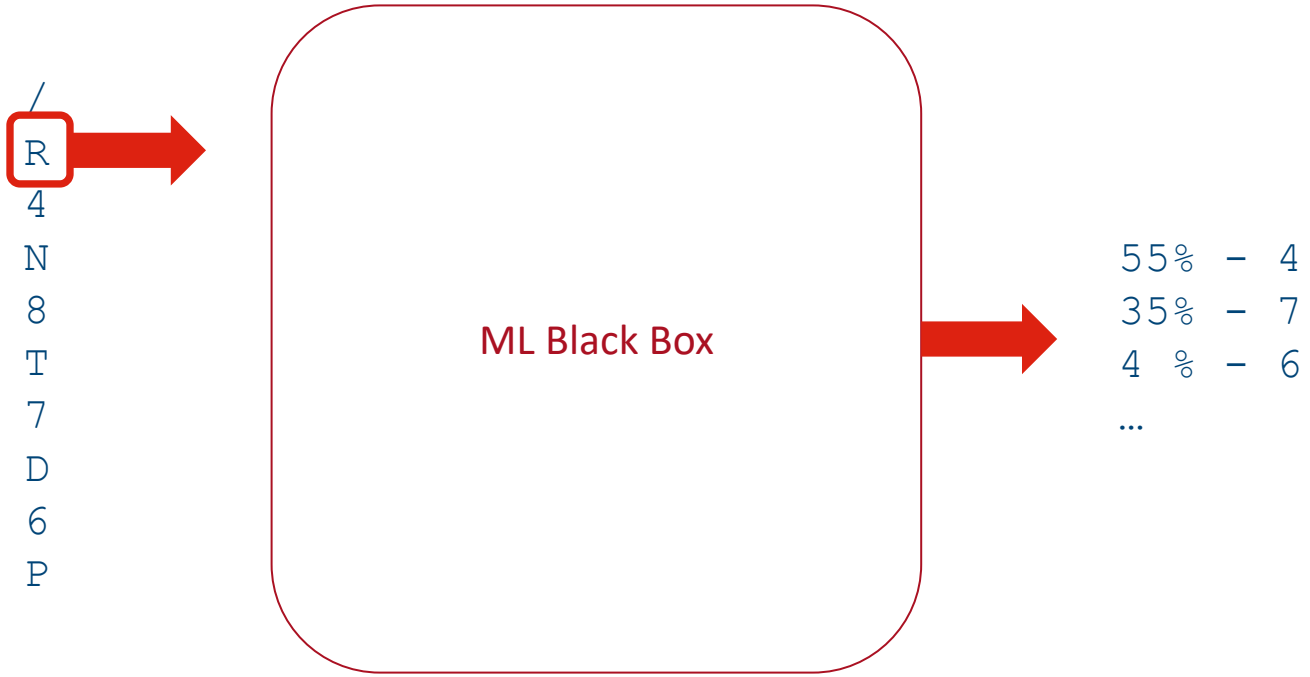

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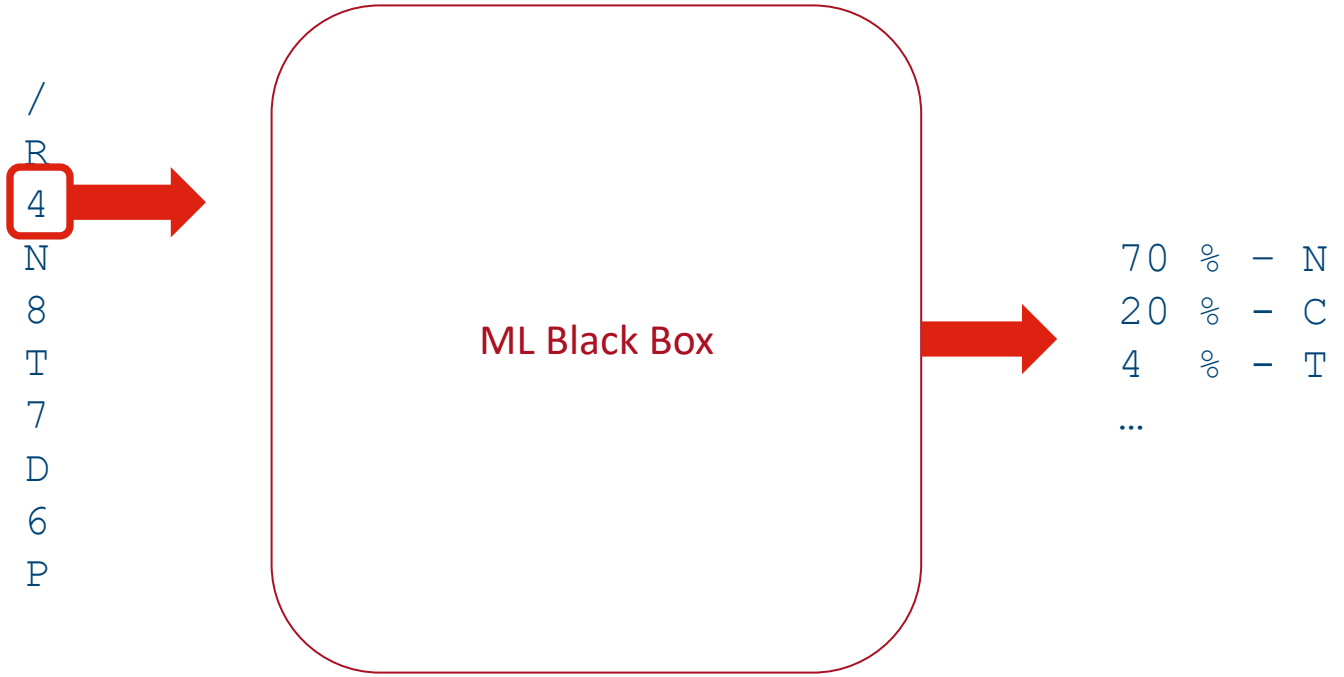

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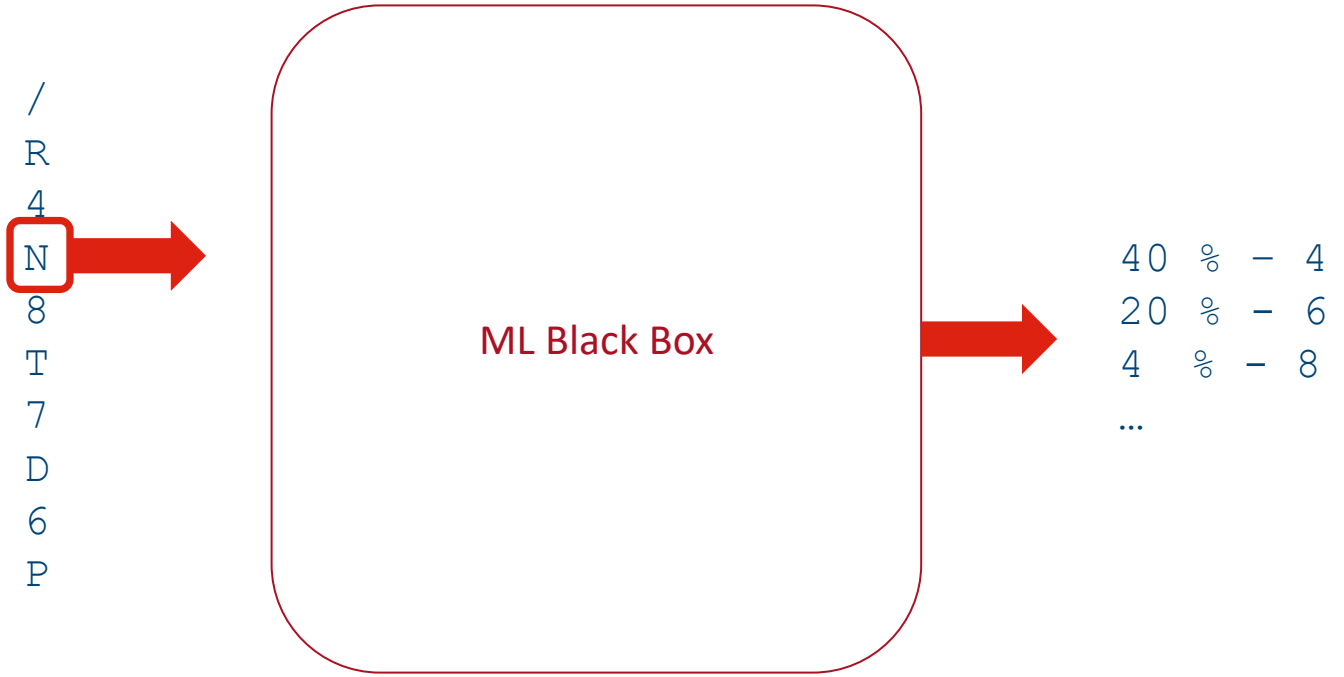

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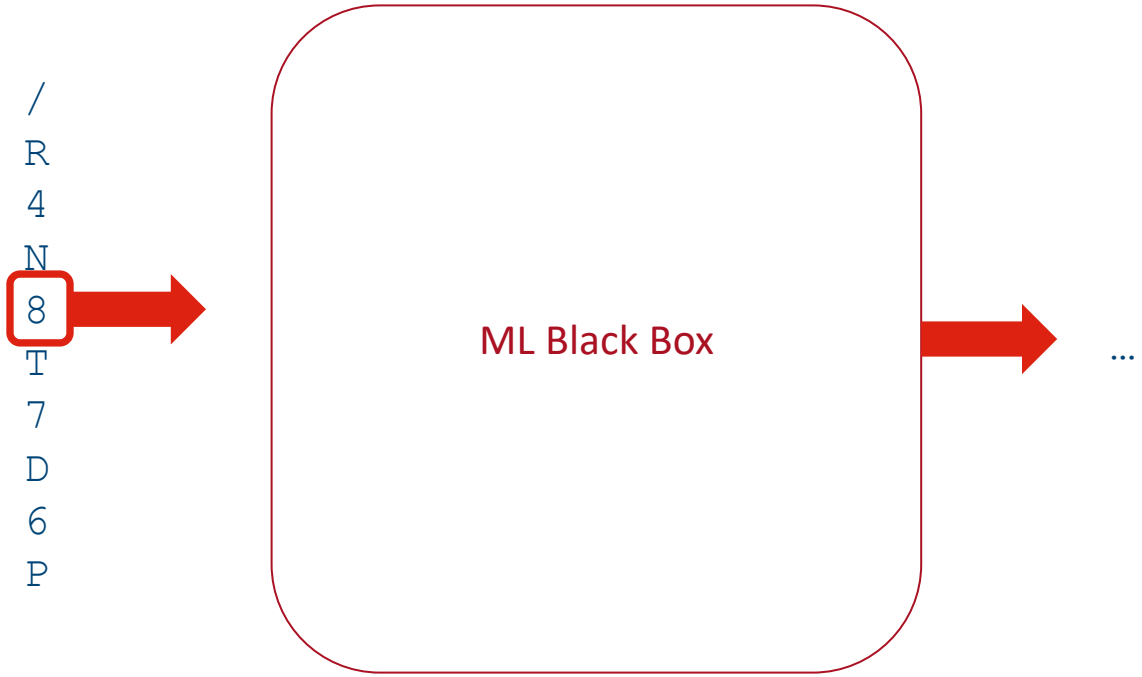
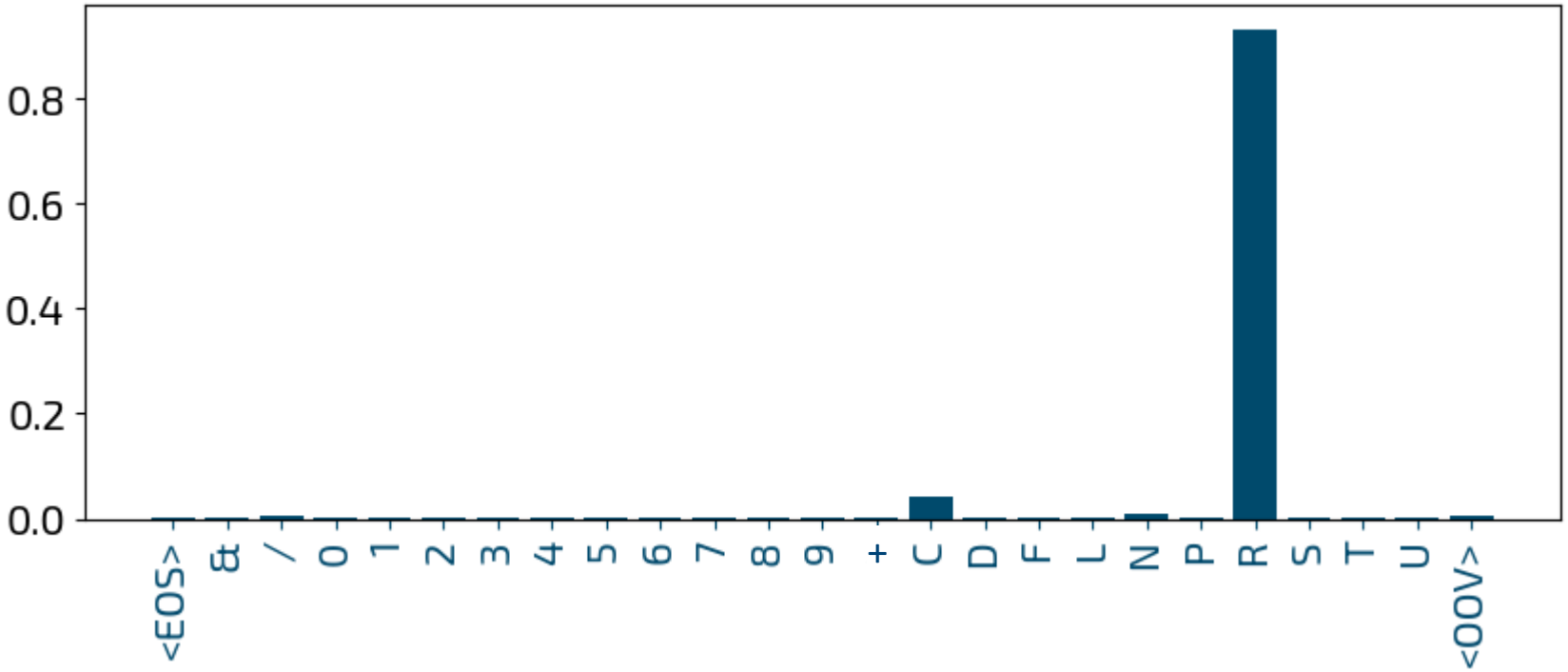


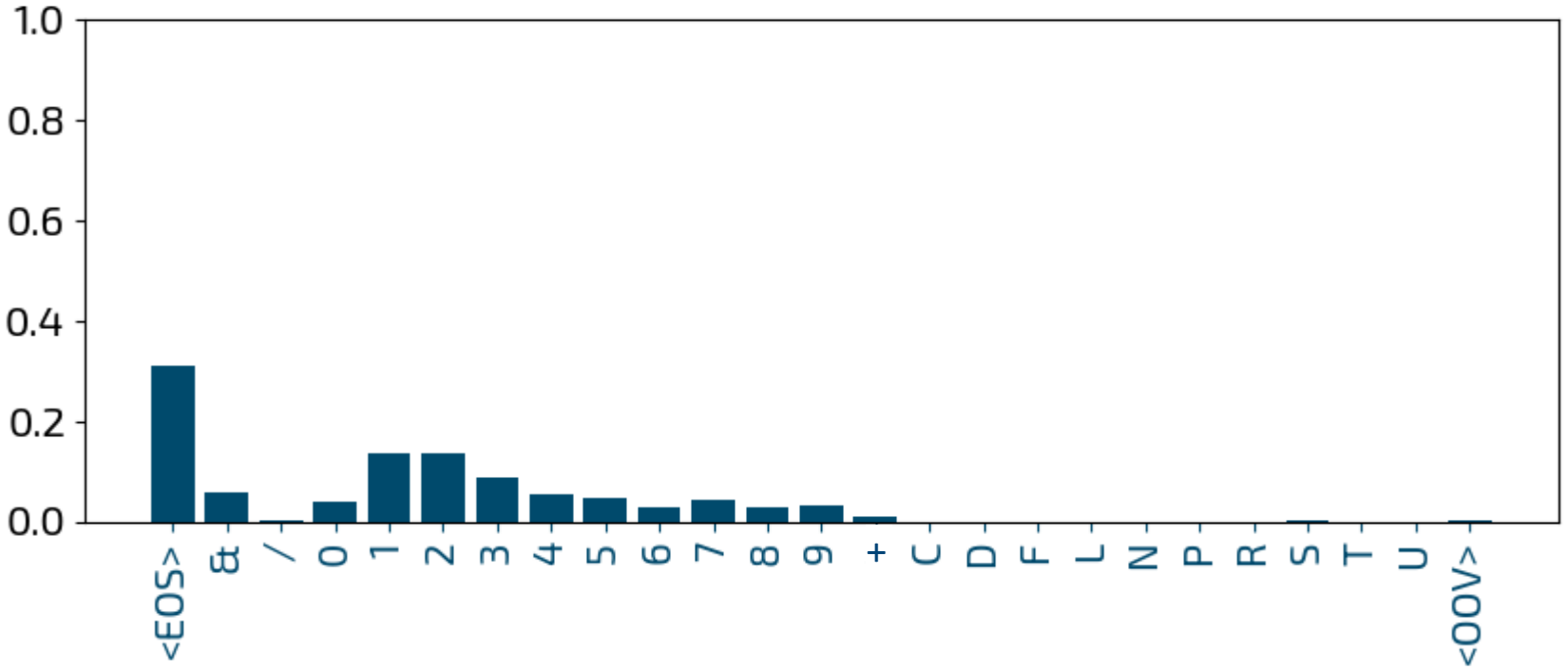
Example 3: Domain-Doings-Oracle

/



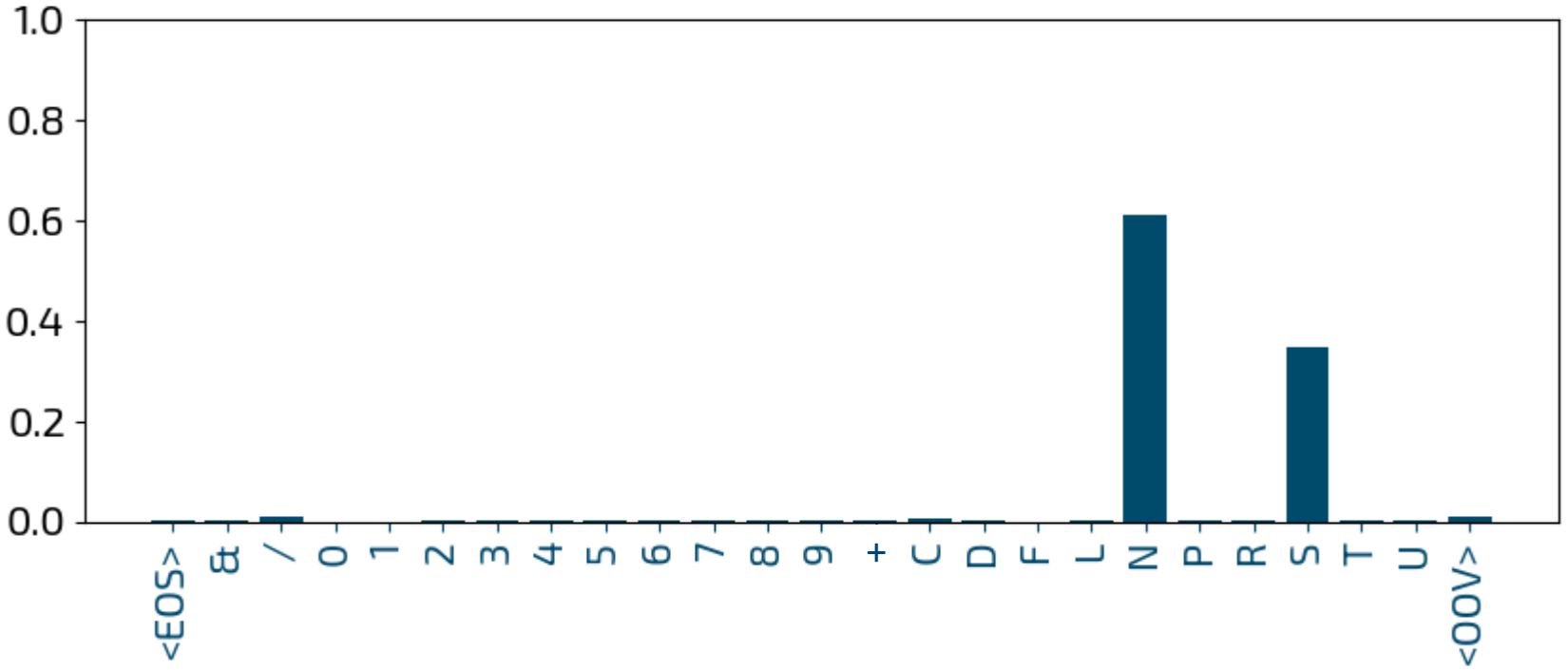
Example 3: Domain-Doings-Oracle

/R



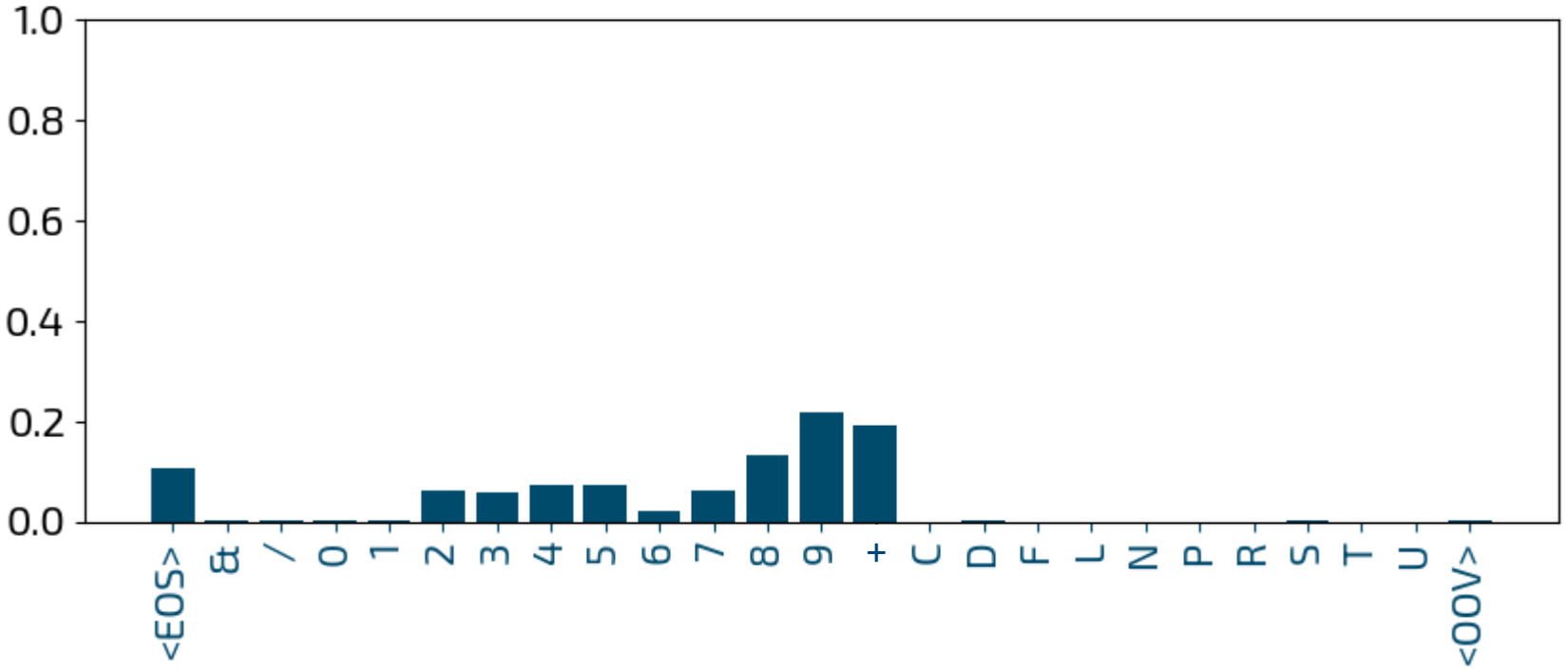
Example 3: Domain-Doings-Oracle

/R:1



Example 3: Domain-Doings-Oracle

/R:1N



Example 3: Domain-Doings-Oracle

- Input: /
- Most Likely: /R
- Synthetic samples:
  - /R:2S
  - ~~/RLS9<OOV>1C6N8D7F5P&R~~
  - /R:3S
  - /R:2N
  - /R
  - /R:6C
  - /R
  - /R:1N:5T:2S:3N

Specs & Code

https://github.com/nic-at/DomainDNA

- Written specification (Markdown)
- Visualization Code (SVG-generating Javascript)

Future / Ideas / Suggestions

- Outlier detection to find „new behaviour“
- Deletes model with behaviour input
- Wait time buckets / List of Doings – do they work for your TLD?
  - Example: ~65 day cooldown period is .at specific
  - We have „implicit auto-renewals“ – trying to minimize „transaction noise“
- List
- Schema extensibility? (NS Change to specific providers?)
  - 7{Nr} „Nameserver change to Rcode0“

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R&D

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