

EXPLAINING PUBLIC BUDGETS WITH FUZZY DRIVEN SUMMARIES

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PAINS

01 OVERLY TECHNICAL

Budget reports are full of numbers, not meaning.

02 LOW ACCESSIBILITY

Data portals exist but are difficult for citizens to use.

03 LACK OF ENGAGEMENT

People feel disconnected from financial decisions.

04 CONCLUSIONS

It's hard to see what matters most in public spending.



RESEARCH QUESTIONS AND METHODS

Q1

INTERPRETABILITY

Question: Can summaries driven by fuzzy logic improve interpretability of Zürich's open budget data for non-experts?

Method: User questionnaire (6 users)

Q2

ROBUSTNESS AND REPRODUCIBILITY

Question: What mechanisms are needed to keep summaries consistent, reproducible and traceable?

Methods: Determinism-by-design, Repeatability test

USE CASES AND SCENARIOS

01 CITIZEN QUICK QUESTION (TOPIC-FOCUSED)

Goal: Understand “what’s happening” in one area.

Input: *field + optional timeline*

Output: Short statement with level + trend.

02 CITIZEN FOLLOW-UP (CITYWIDE OVERVIEW)

Goal: After a topic answer, ask “what changed most overall?”

Input: *field = all + same timeline*

Output: Biggest changes across departments.

03 JOURNALIST / STUDENT FACT-CHECK (TRACEABLE SUMMARY)

Goal: Get a stable answer that can be checked by other people for some field and year.

Input: Same request repeated / shared across people.

Output: Identical JSON + deterministic wording; references to years + slopes.

ARTIFACT (ITERATION 1)

Proof of concept

how such idea might be implemented in reality.

How is the government planning money for education?

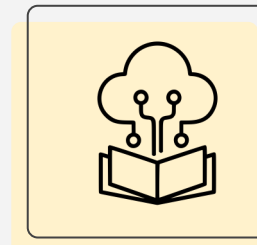
Since 2019, education spending has gradually decreased, while transport and healthcare have received more funding.

So what are they spending more on now?

The biggest increases are in digital infrastructure and energy transition programs

Let's think we don't really need module behind this square.

Guess what?



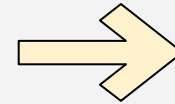
Developed module



Stadt Zürich
Open Data

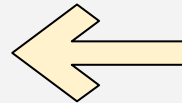
ARTIFACT

How is the government planning money for education?



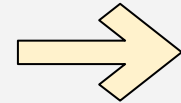
```
{ "timeline": "all", "field": "education",  
  "generalization_level": "1" ... }
```

Since 2019, education spending has gradually decreased, while healthcare have received more funding.



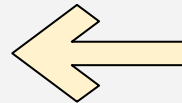
```
{ "message": "Since 2019...", "request": {...} }
```

So what are they spending more on now?



```
{ "timeline": "all", "field": "all",  
  "generalization_level": "1" ... }
```

The biggest increases are in digital infrastructure and energy transition programs



```
{ "message": "The biggest...", "request": {...} }
```

EVALUATION

6 users, stem background

Task A:

“Find out what happened with education in 2019 – 2024”

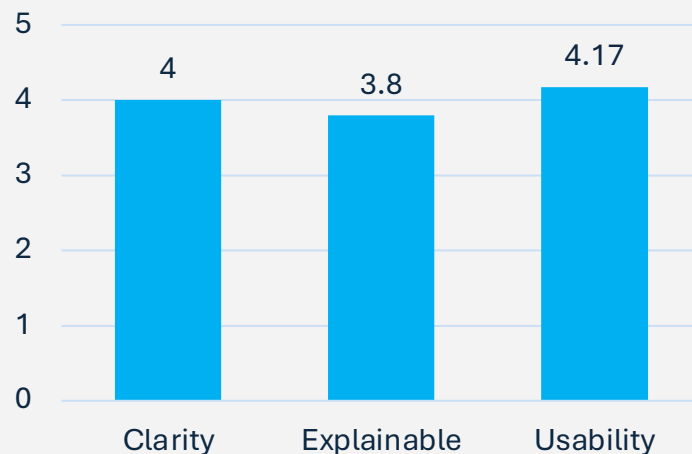
6/6 correct (5/6 first request)

Task B:

“Find which departments has the biggest changes in this years”

6/6 correct (4/6 first try)

Questionary (likert 1-5):

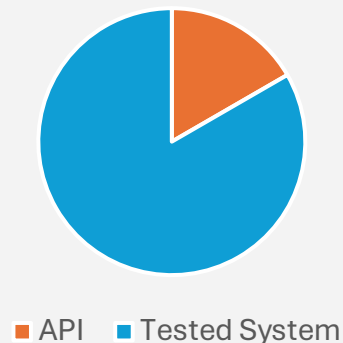


Notes:

“Quick summary is useful.”

“API should be replaced with something more user-friendly.”

Preference(forced choice):



ARTIFACT (ITERATION 2)

Proof of concept

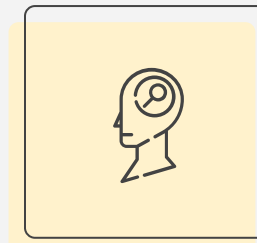
how such idea might be implemented in reality.

How is the government planning money for education?

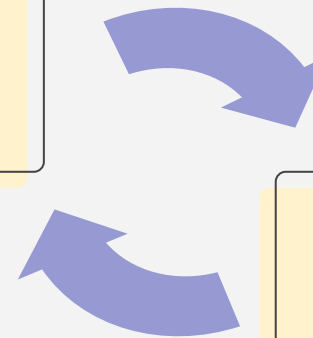
Since 2019, education spending has gradually decreased, while transport and healthcare have received more funding.

So what are they spending more on now?

The biggest increases are in digital infrastructure and energy transition programs



NLU



Developed module



Stadt Zürich
Open Data

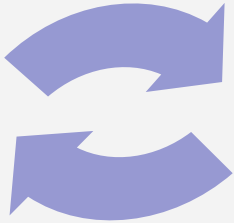
ARTIFACT (ITERATION 2)

Proof of concept

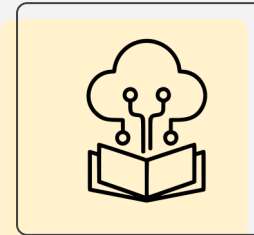
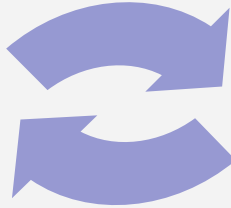
how such idea might be implemented in reality.



UI
(streamlit)



NLU



Developed module



Stadt Zürich
Open Data

CONCLUSION, LIMITATIONS AND LESSONS LEARNED

Conclusion:

1. Summaries driven by fuzzy logic CAN help make budgets more understandable for people.
2. Such system can be deterministic.

Limitations:

1. N=6 for the evaluation is small
2. Proper user studies has to be conducted
3. Cooperation with Stadt Zurich is missing
4. The system work with only past data

Lessons learned:

1. People tend to prefer interfaces which are easier to interact with.
2. We underestimated the effort needed to make a proper “computing with words” system.

Future steps:

1. Extend the answering templates.
2. Extend available requests, to support additional words
3. Make a bigger evaluation for the updated artifact
4. Present and collaborate with Stadt Zurich to make from this PoC an MVP.

DEMO (FUZZY CALIBRATION VALUES)

Level				
Low	0.0	0.0	2.75	6.37
Medium	2.75	6.37	8.06	11.05
High	8.06	11.05	27.33	100
Trend				
Falling	-100	-4.24	-2.47	-0.71
Stable	-4.24	-2.47	1.05	2.82
Rising	-0.71	1.05	2.82	100

DEMO

Zürich Budget Summaries

Ask a question in natural language to see how the NLU layer interprets it and how the summarizer responds.

Ask something about Zürich's budget

Which departments had the highest increase since 2019?



Submit

Answer received. Scroll down to inspect details.

Answer from server

Between 2019 and 2024, the biggest increases are in Departement der Industriellen Betriebe (+0.82 pp/yr), Schul- und Sportdepartement (+0.30 pp/yr). Decreases are led by Sozialdepartement (-1.21 pp/yr), Tiefbau- und Entsorgungsdepartement (-0.15 pp/yr).

Recent Queries

▼ Which departments had the highest increase since 2019?

Asked at: 2025-12-17T21:37:55+00:00

NLU interpretation

▶ {...}

API response

▶ {...}

```
{
  "message": "Between 2019 and 2024...",
  "request": {
    "timeline": {
      "since": 2019
    },
    "field": "all",
    "generalization_level": 1,
    "field_confidence": 0.2,
    "field_candidates": [
      {
        "field": "all",
        "confidence": 0.2
      }
    ]
  },
  "top_increases": [
    {
      "departement": "Departement der Industriellen Betriebe",
      "slope_pp_per_year": 0.8227695082423253,
      "last_share": 12.119783962813877
    },
    ...
  ],
  "top_decreases": [ ... ]
}
```

THANKS

Does anyone have any questions?

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NLU TEST BASE

```
{
  "schema_version": "0.2.7",
  "items": [
    {
      "id": 1,
      "utterance": "So what are they spending more on now?",
      "expected": {
        "timeline": "all",
        "field": "all",
        "generalization_level": 1
      }
    },
    {
      "id": 2,
      "utterance": "What's increasing the most since 2019?",
      "expected": {
        "timeline": {
          "since": 2019
        },
        "field": "all",
        "generalization_level": 1
      }
    },
    ...
  ]
}
```

```
...
{
  "id": 69,
  "utterance": "Detailed: fin dep changes since 2020.",
  "expected": {
    "timeline": {
      "since": 2020
    },
    "field": "finance",
    "generalization_level": 2
  }
},
{
  "id": 70,
  "utterance": "In the last 4 years, how did ... change?",
  "expected": {
    "timeline": {
      "since": 2021
    },
    "field": "finance",
    "generalization_level": 1
  }
}
]
}
```

Zürich Budget Q&A - End-to-End Flow

