An Iterative Approach to Synthesize Data Transformation Programs

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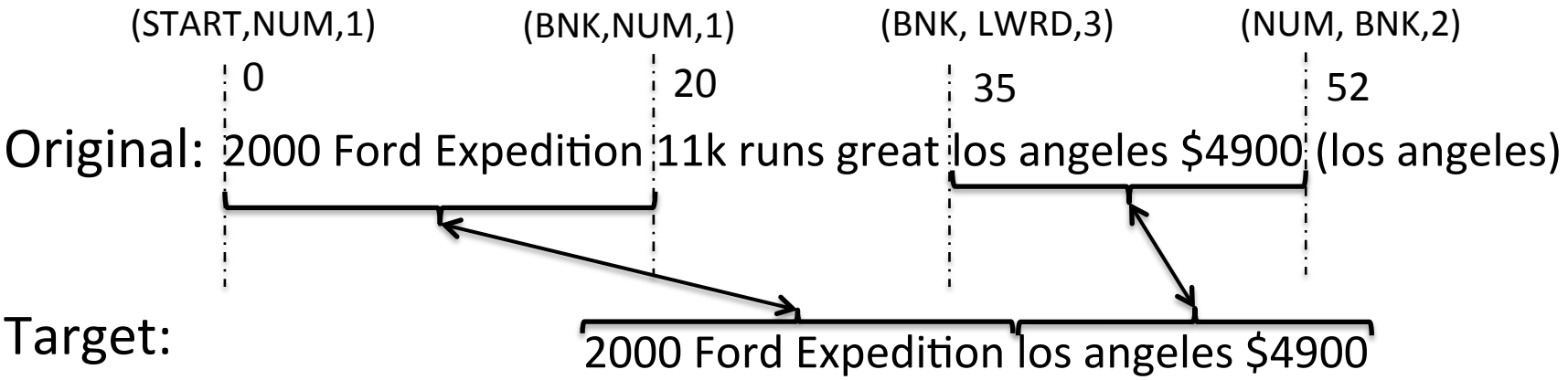
Learning Transformation Programs by Example

Input Data	Target Data
2000 Ford Expedition 11k runs great los angeles $4900 (los angeles)	2000 Ford Expedition los angeles $4900
1998 Honda Civic 12k miles s. Auto. - $3800 (Arcadia)	2008 Mitsubishi Galant Sylmar CA $7500
2008 Mitsubishi Galant ES $7500 (Sylmar CA) pic	1998 Honda Civic Arcadia $3800
1996 Isuzu Trooper 14k clean title west covina $999 (west covina) pic	1996 Isuzu Trooper west covina $999
…	…

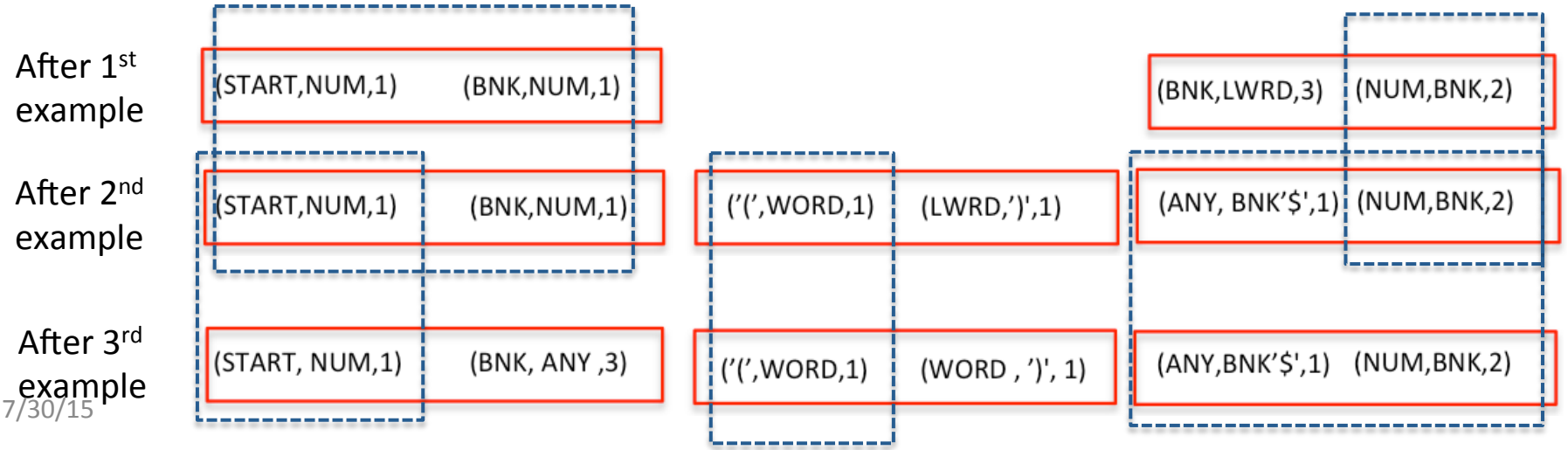
Time complexity is **exponential** in the **number** and a **high polynomial** in the **length** of examples

Reuse subprograms



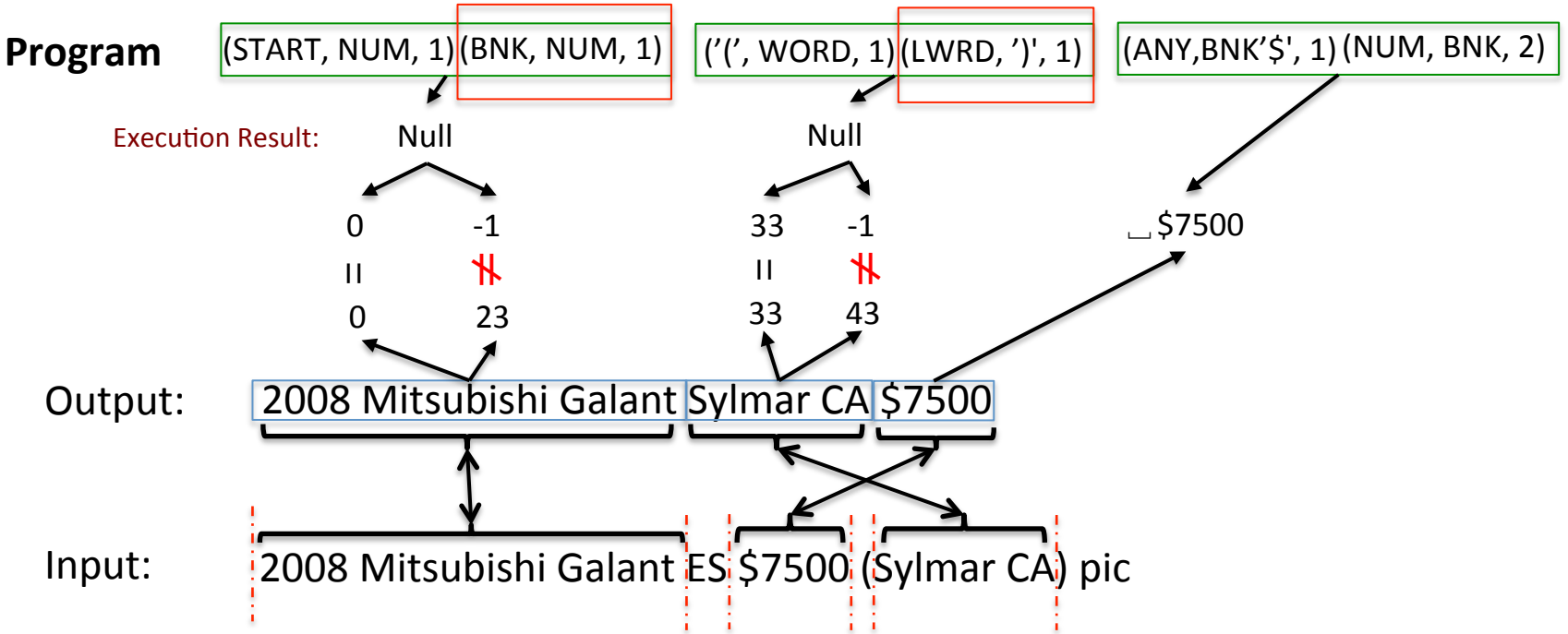
Position program= (left context, right context, occurance)

Learned Programs



Identify incorrect subprograms

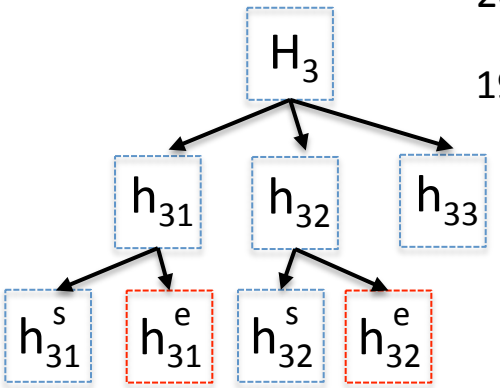
Input	Output
2000 Ford Expedition 11k runs great los angeles $4900 (los angeles)	2000 Ford Expedition los angeles $4900
1998 Honda Civic 12k miles s. Auto. - $3800 (Arcadia)	2008 Mitsubishi Galant Sylmar CA $7500



Update hypothesis spaces

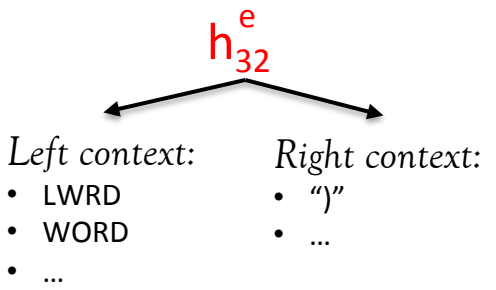
Program (START, NUM, 1) (BNK, NUM, 1) ('(', WORD, 1) (LWRD, ')', 1) (ANY,BNK'$', 1)

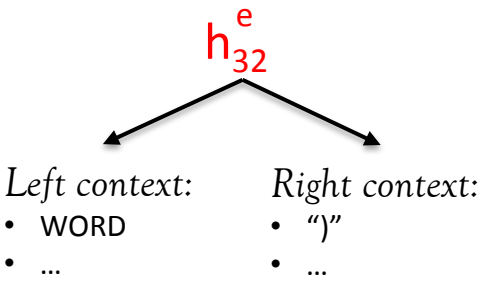
Hypothesis H_3



2000 Ford Expedition 11k runs great los angeles $4900 (los angeles)

1998 Honda Civic 12k miles s. Auto. - $3800 (Arcadia)





2008 Mitsubishi Galant ES $7500 (Sylmar CA) pic

Evaluation

- Dataset
  - **D1**: 17 scenarios used in (Lin et al., 2014)
    - 5 records per scenario
  - **D2**: 30 scenarios collected from student data integration projects
    - about 350 records per scenario
  - **D3**: synthetic dataset
    - designed to evaluate scale-up
- Alternative approaches
  - **Our implementation of Gulwani's approach**: (Gulwani, 2011)
  - **Metagol:** (Lin et al., 2014)
- Metric
  - Time (in **seconds**) to generate a transformation program

Program generation time comparisons

Table: time (in seconds) to generate programs on D1 and D2 datasets

		Min	Max	Avg	Median
D1	IPBE	0	5	0.34	0
	Gulwani's approach	0	8	0.59	0
	Metagol	0	213.93	55.1	0.14
D2	IPBE	0	1.28	0.20	0
	Gulwani's approach	0	17.95	4.02	0.33
	Metagol	~	~	~	~

D3

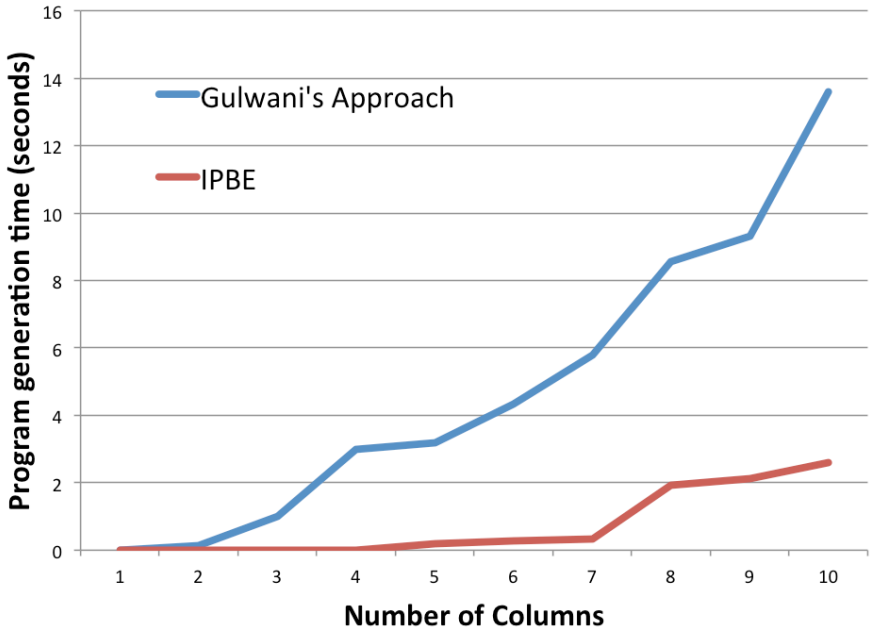


Figure: scalability test on D3

Discussion

- Our iterative PBE approach significantly reduces time in synthesizing programs

  Future work

- Extend to domains with only partial traces
- Help user to determine when to stop transforming on large datasets.

Thanks

Please come to my poster #23 for more details

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References

[Lin et al., 2014] Dianhuan Lin, Eyal Dechter, Kevin Ellis, Joshua Tenenbaum, and Stephen Muggleton. Bias reformulation for one-shot function induction. In ECAI, 2014.

[Gulwani, 2011] Sumit Gulwani. Automating string processing in spreadsheets using input-output examples. In POPL, 2011.

Different number of segments