GIO: Generating Efficient Matrix and Frame Readers for Custom Data Formats by Example

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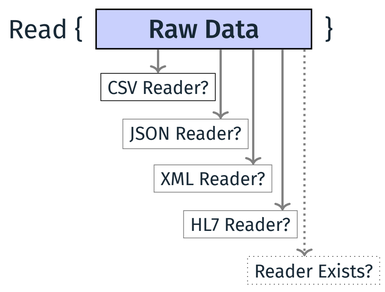
1. Motivation

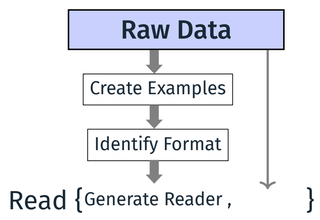
- Data formats vary ➜ structure, syntax, semantics, and compression
- Existing systems ➜ limited support for custom formats
- Custom readers require ➜ low-level programming and system knowledge
- Custom readers ➜ not portable across systems and languages

➠ Is there an automatic way to get around?

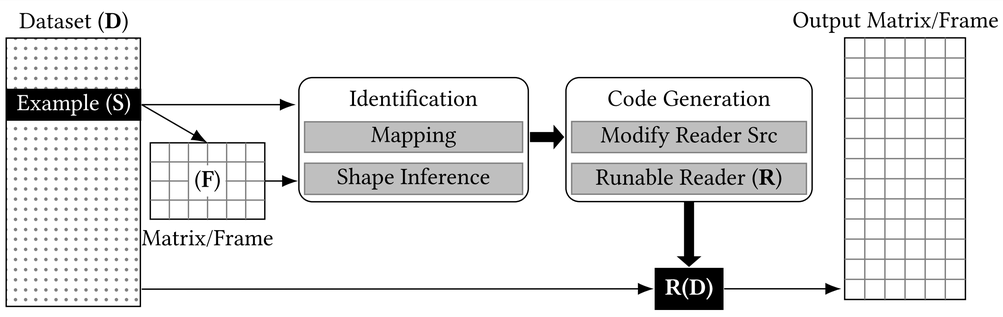
Custom text-based dataset D, and user-provided examples:

- Sample Raw (S) Input ➜ a list of input strings (i.e., selected rows of the input dataset D).
- Sample Matrix/Frame (F) Input ➜ a sample matrix or frame, corresponding to S with n records.





2. GIO Overview



3. Example Parameters

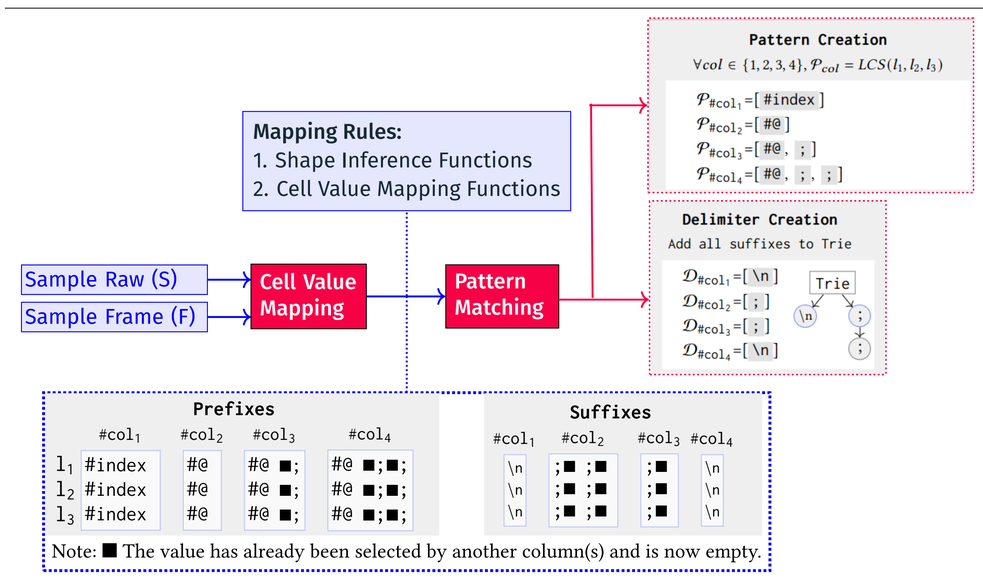
```
#index 2015101   ← beginning of record #1
#* NoDB: efficient query execution on raw data files
#@ Ioannis Alagiannis; Renata Borovica; Anastasia Ailamaki
#o EPFL Switzerland; EPFL Switzerland; EPFL Switzerland
#t 2015
#c VLDB Conference
#% ... unlimited set of references
#! As data collections become larger and larger, data loading evolves to a major bottleneck. ...
#index 2019102   ← beginning of record #2
#* Pangea: Monolithic Distributed Storage for Data Analytics
#@ Jia Zou; Arun Iyengar; Chris Jermaine
#o Rice University; Rice University; Rice University
#t 2019
#c VLDB Endowment
#% ... unlimited set of references
#! Storage and memory systems for modern data analytics are heavily layered, managing shared ...
#index 2018103   ← beginning of record #3
#* Filter Before You Parse: Faster Analytics on Raw Data
#@ Shoumik Palkar; Firas Abuzaid; Matei Zaharia
#o Stanford InfoLab; Stanford InfoLab; Databricks Inc
#t 2018
#c VLDB Endowment
#% ... unlimited set of references
#! Exploratory big data applications often run on raw unstructured or semi-structured data ...
```

Sample Raw (S)

$\#col_1$	$\#col_2$	$\#col_3$	$\#col_4$
2015101	Ioannis Alagiannis	Renata Borovica	Anastasia Ailamaki
2019102	Jia Zou	Arun Iyengar	Chris Jermaine
2018103	Shoumik Palkar	Firas Abuzaid	Matei Zaharia

Sample Raw (F)

4. Mapping Identification

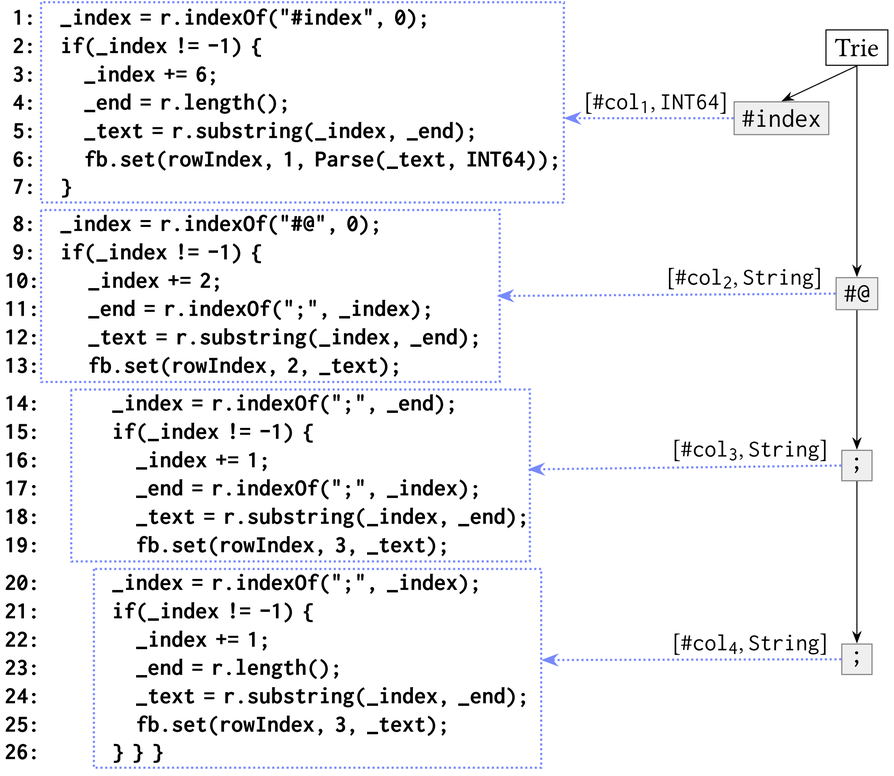


5. Code Generation

- Composed according to the passed **mapping rules**
- Template-based Code Generation:
  - pre-pass for **obtaining** additional **metadata** from data
  - **inferring the dimensions**
  - **iterate** over records of the raw dataset
- Indexing Code:
  - Row Indexing Code ➜ determine the number of rows
  - Column Index and Value Code ➜ code gets column info and values
- Cell Value Code:
  - Cell Value by Nested Conditions
  - Cell Value by Sequential String Matching
  - Cell Value by Regular Expressions

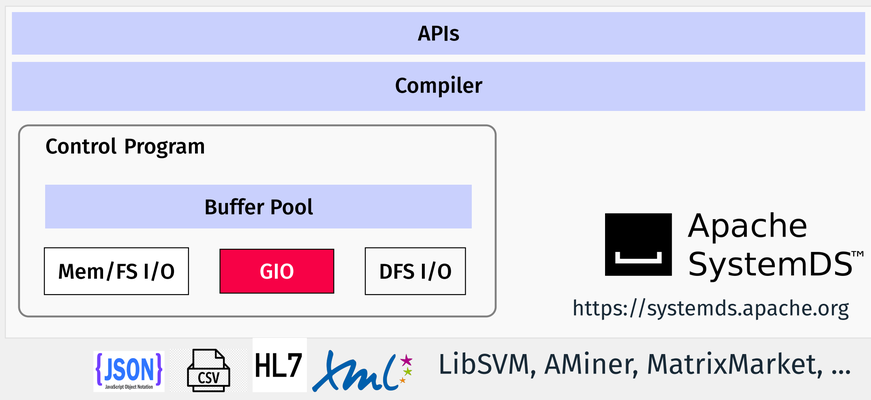
6. Reader Generation Example by Nested Conditions

```
1:  _index = r.indexOf("#index", 0);
2:  if(_index != -1) {
3:    _index += 6;
4:    _end = r.length();
5:    _text = r.substring(_index, _end);
6:    fb.set(rowIndex, 1, Parse(_text, INT64));
7:  }
8:  _index = r.indexOf("#@", 0);
9:  if(_index != -1) {
10:   _index += 2;
11:   _end = r.indexOf(";", _index);
12:   _text = r.substring(_index, _end);
13:   fb.set(rowIndex, 2, _text);
14:     _index = r.indexOf(";", _end);
15:     if(_index != -1) {
16:       _index += 1;
17:       _end = r.indexOf(";", _index);
18:       _text = r.substring(_index, _end);
19:       fb.set(rowIndex, 3, _text);
20:     _index = r.indexOf(";", _index);
21:     if(_index != -1) {
22:       _index += 1;
23:       _end = r.length();
24:       _text = r.substring(_index, _end);
25:       fb.set(rowIndex, 3, _text);
26:     } } }
```

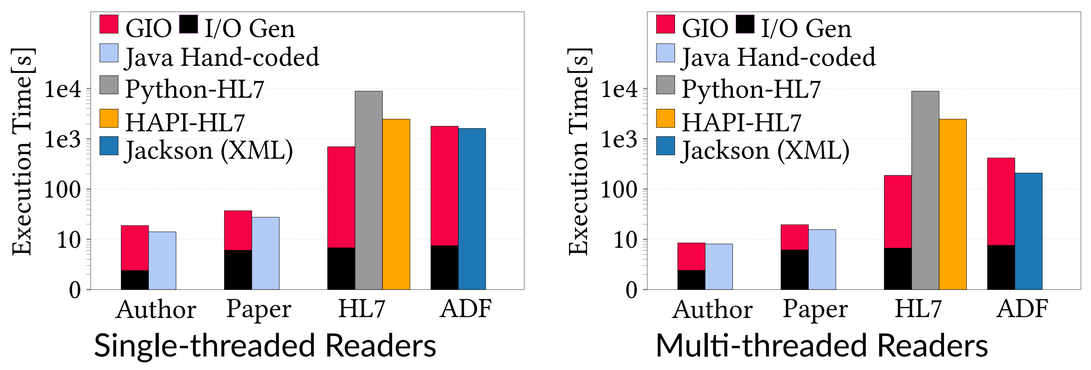


7. The user API of GIO

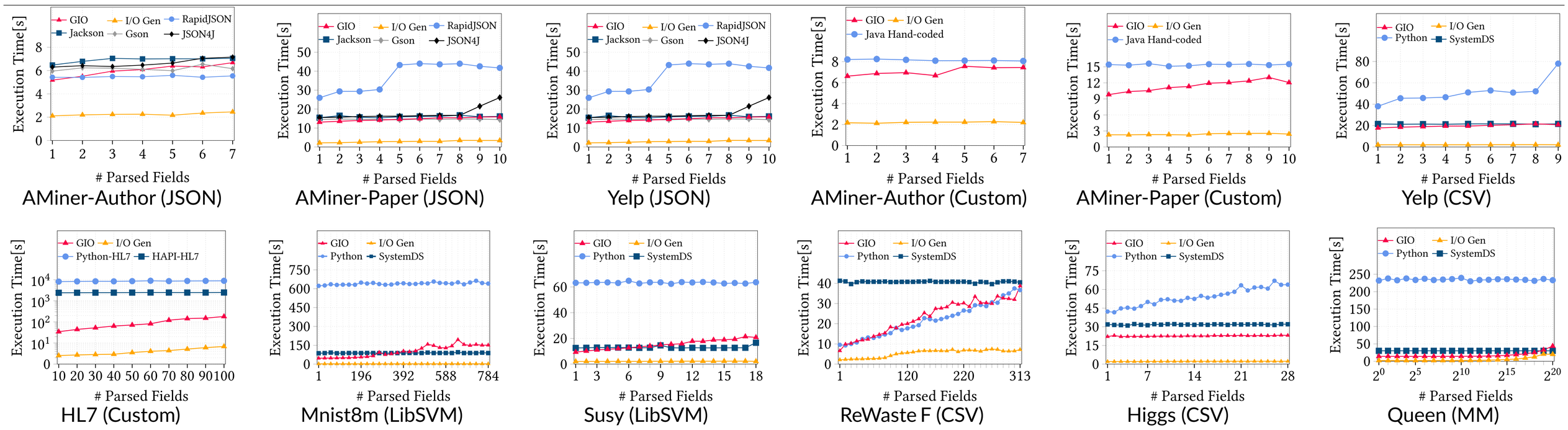
- `M = gio_identify(S,F)` ← identification,
- `R = gio_codegen(M)` ← reader generation,
- `F2 = R.read(D)` ← reader usage on full or different datasets



8. Reader Performance on Full Custom Datasets



9. Reader Runtime Comparison with Varying Number of Attributes



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