From DataFrames to Tungsten: A Peek into Spark's Future

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DataFrame

noun

Making Spark accessible to everyone (data scientists, engineers, statisticians, …)

Tungsten

noun

Making Spark faster & prepare for the next five years.

How do DataFrames and Tungsten relate to each other?

Google Trends for “dataframe”

Single-node tabular data structure, with API for

relational algebra (filter, join, …)
math and stats
input/output (CSV, JSON, …)
ad infinitum

Data frame: lingua franca for “small data”

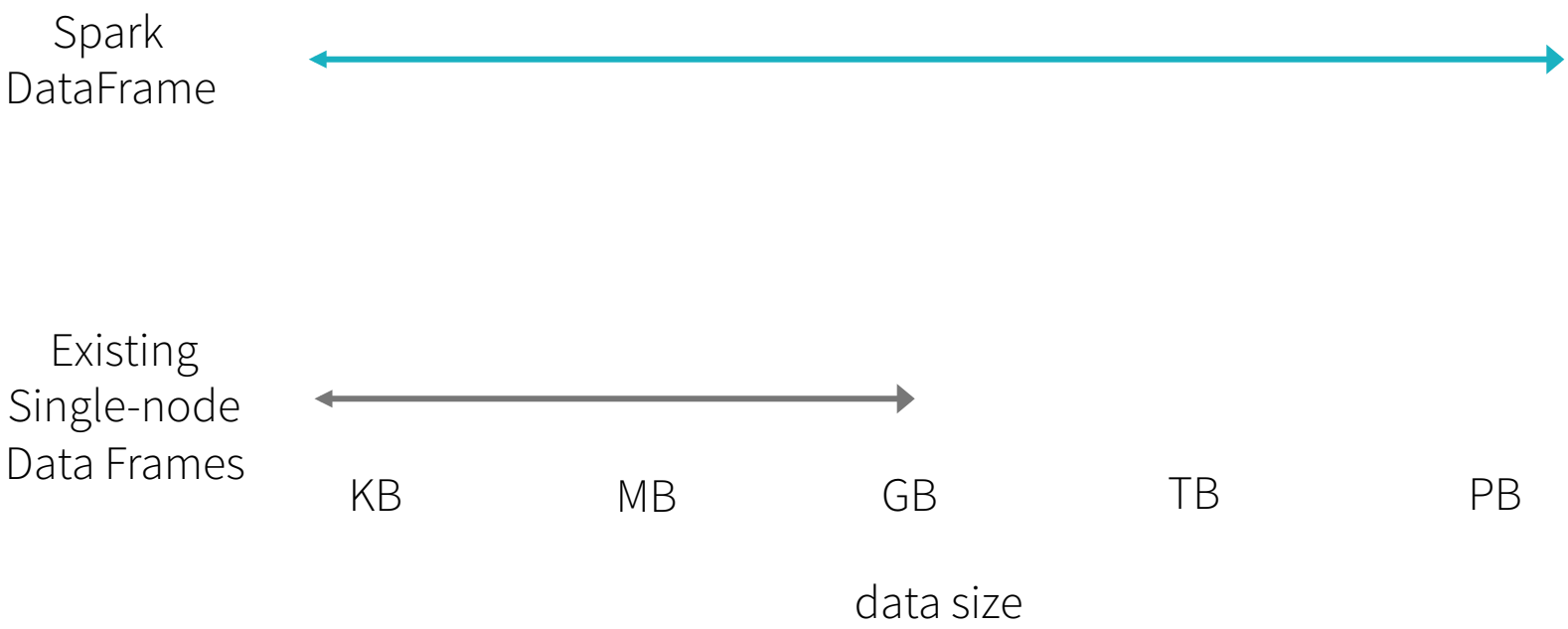
```
head(flights)
#> Source: local data frame [6 x 16]
#>
#>    year month day dep_time dep_delay arr_time arr_delay carrier tailnum
#> 1  2013     1   1      517         2      830        11      UA  N14228
#> 2  2013     1   1      533         4      850        20      UA  N24211
#> 3  2013     1   1      542         2      923        33      AA  N619AA
#> 4  2013     1   1      544        -1     1004       -18      B6  N804JB
#> ..  ...   ... ...      ...       ...      ...       ...     ...     ...
```

Spark DataFrame

Distributed data frame for Java, Python, R, Scala

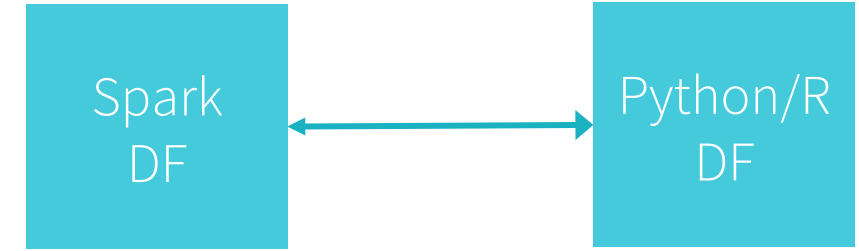
Similar APIs as single-node tools (Pandas, dplyr), i.e. easy to learn

```
> head(filter(df, df$waiting < 50))  # an example in R
##  eruptions waiting
##1     1.750      47
##2     1.750      47
##3     1.867      48
```


Spark
DataFrame
Existing
Single-node
Data Frames
KB
MB
GB
TB
PB
data size

It is not Spark vs Python/R,
but Spark and Python/R.

Spark and Python/R



scalability
multi-core
multi-machines

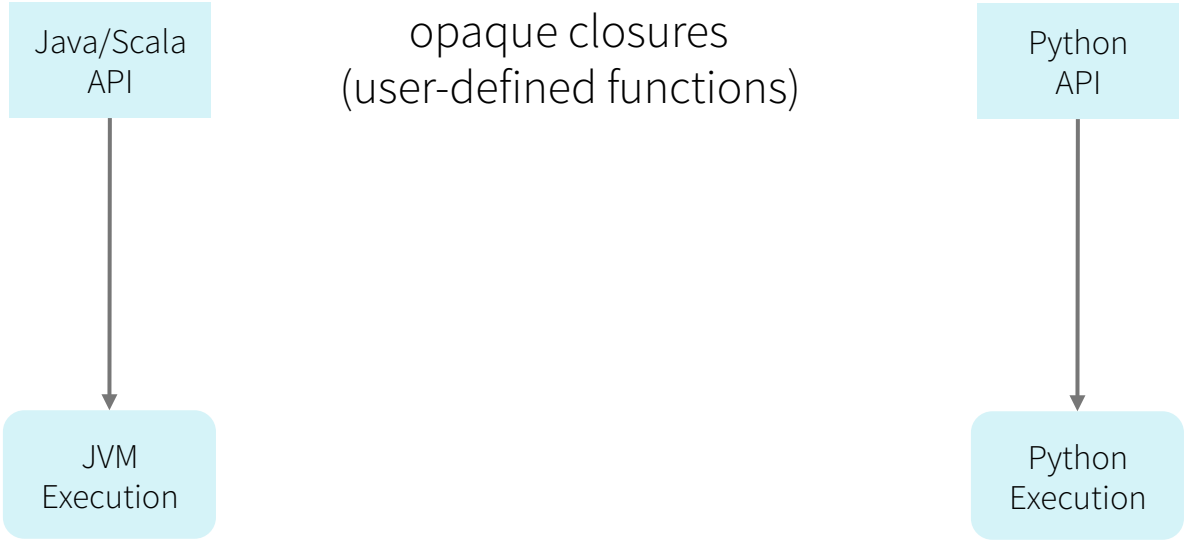
wealth
of
libraries

Viz

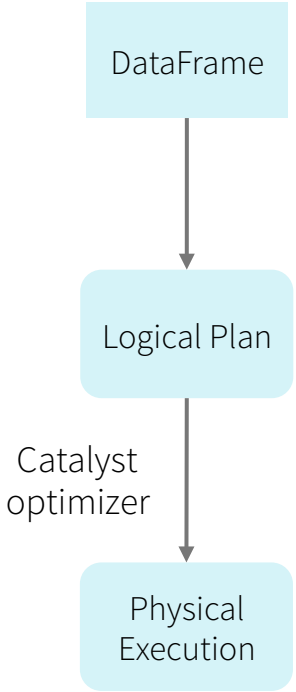
Machine
Learning

Stats

Spark RDD Execution

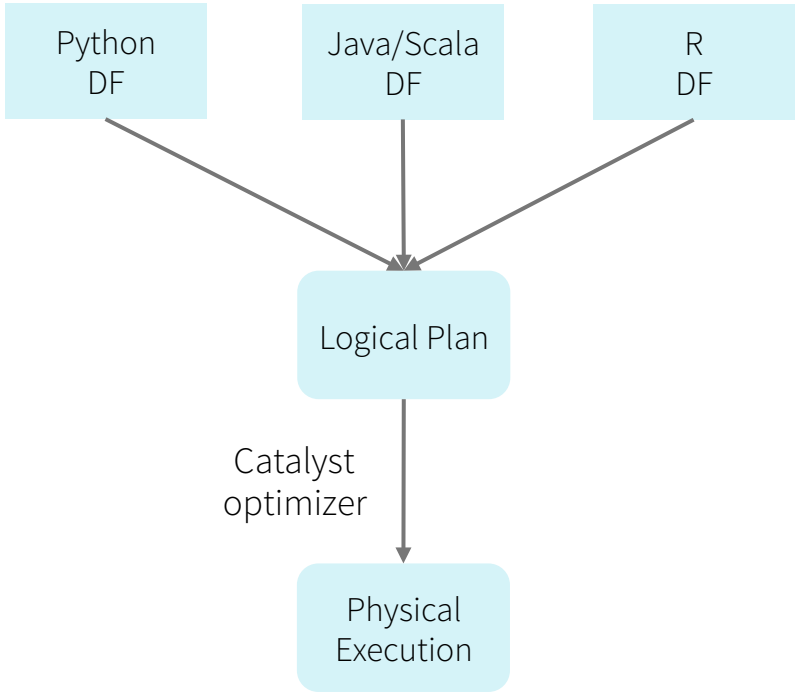


Spark DataFrame Execution



Intermediate representation for computation

Spark DataFrame Execution



Simple wrappers to create logical plan

Intermediate representation for computation

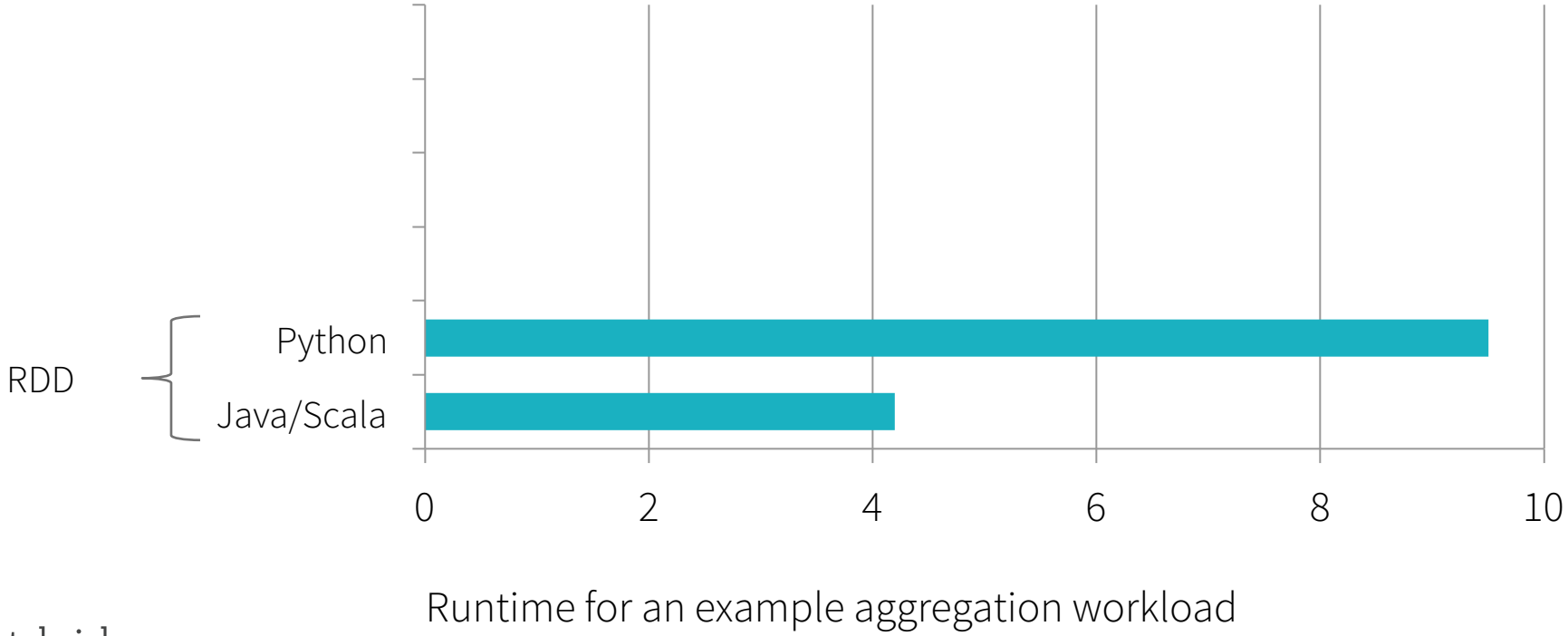
Benefit of Logical Plan: Simpler Frontend

Python : ~2000 line of code (built over a weekend)

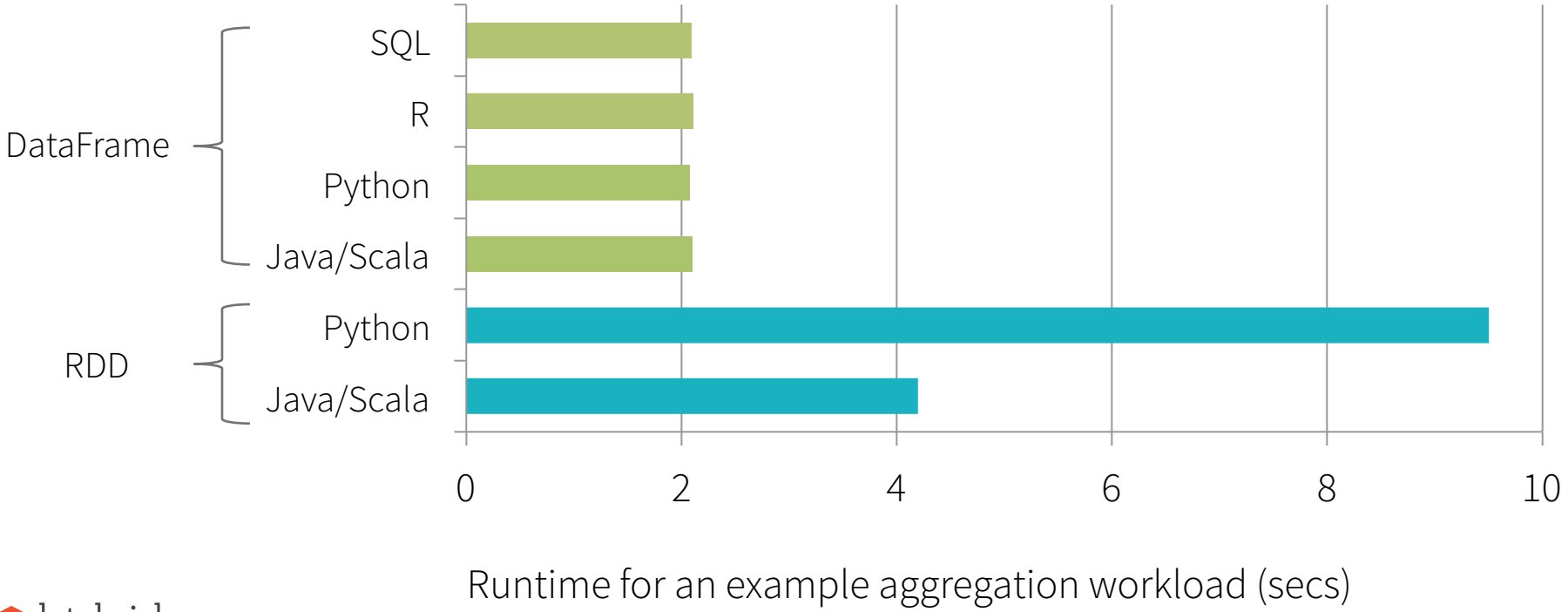
R : ~1000 line of code

i.e. much easier to add new language bindings (Julia, Clojure, …)

Performance



Benefit of Logical Plan: Performance Parity Across Languages



What about Tungsten?

Hardware Trends

Storage

Network

CPU

Hardware Trends

	2010
Storage	50+MB/s (HDD)
Network	1Gbps
CPU	~3GHz

Hardware Trends

	2010	2015
Storage	50+MB/s (HDD)	500+MB/s (SSD)
Network	1Gbps	10Gbps
CPU	~3GHz	~3GHz

Hardware Trends

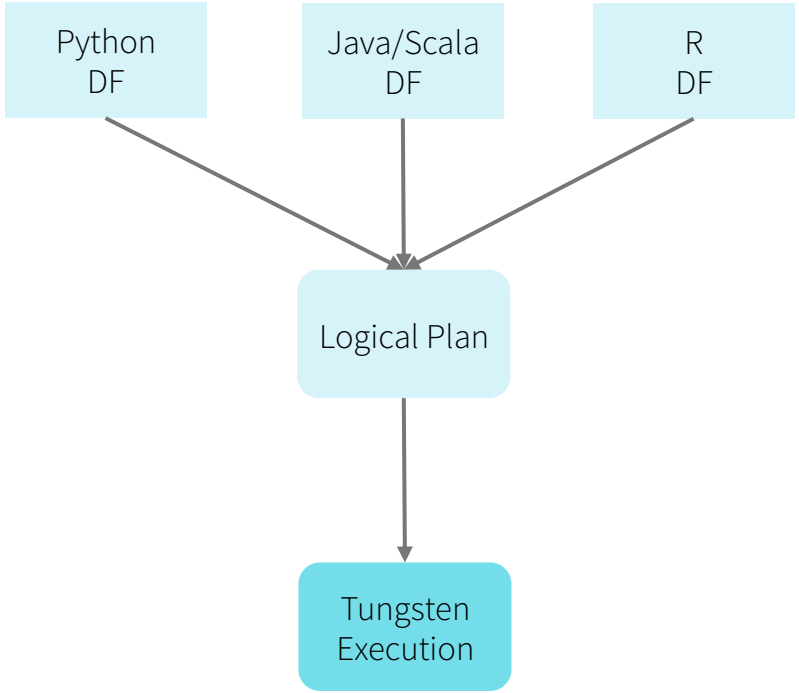
	2010	2015	
Storage	50+MB/s (HDD)	500+MB/s (SSD)	10X
Network	1Gbps	10Gbps	10X
CPU	~3GHz	~3GHz	☹

Tungsten: Preparing Spark for Next 5 Years

Substantially speed up execution by optimizing CPU efficiency, via:

(1) Runtime code generation
(2) Exploiting cache locality
(3) Off-heap memory management

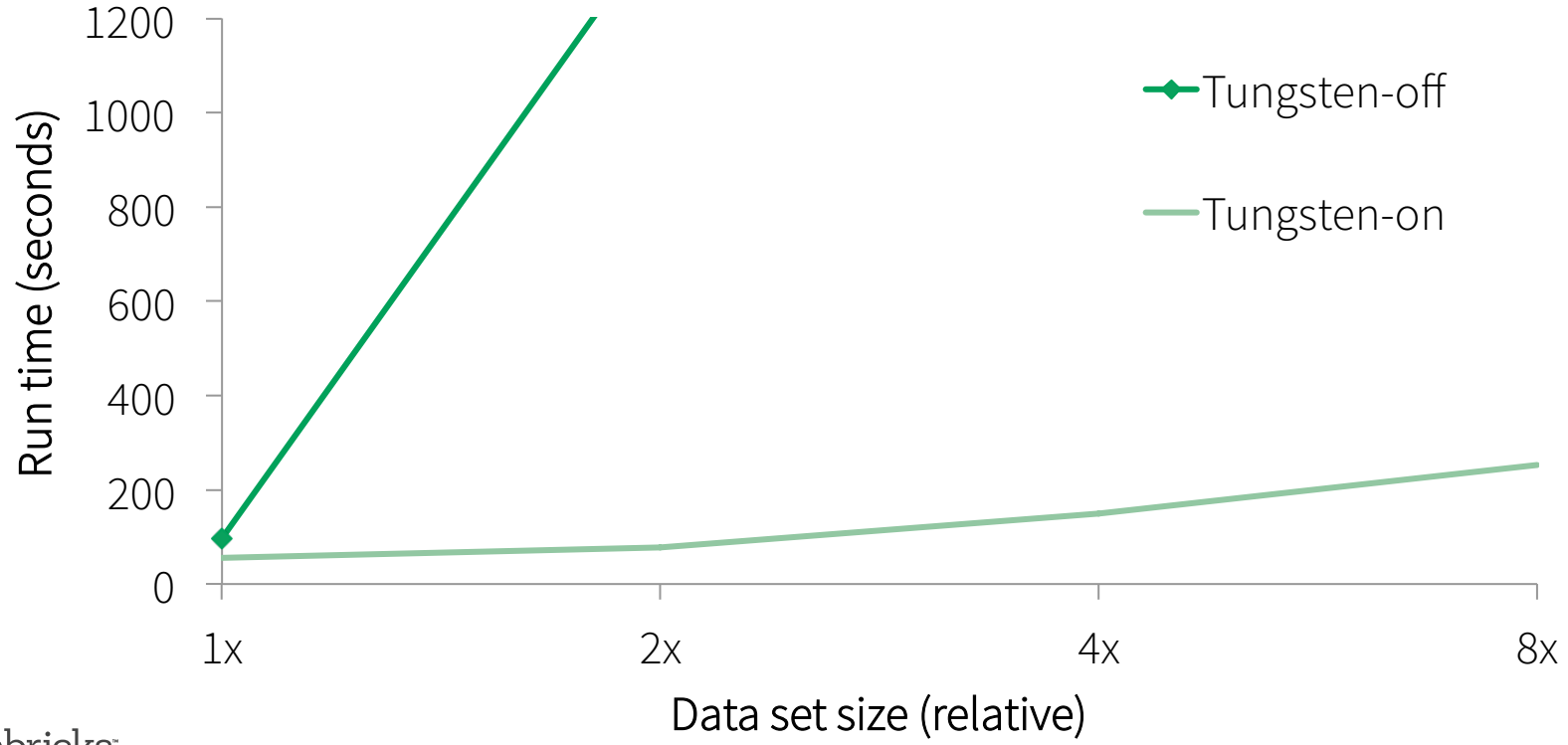
From DataFrame to Tungsten



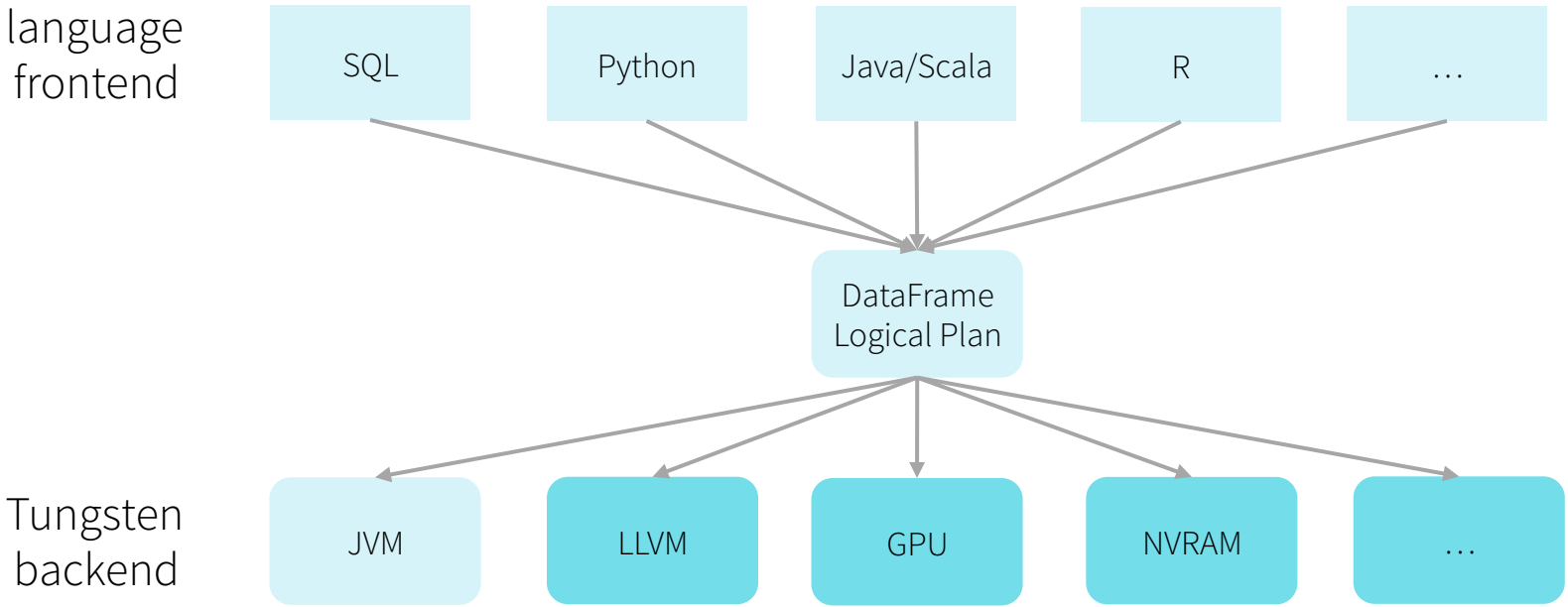
5PM

Deep Dive into Project Tungsten
Developer Track by Josh Rosen

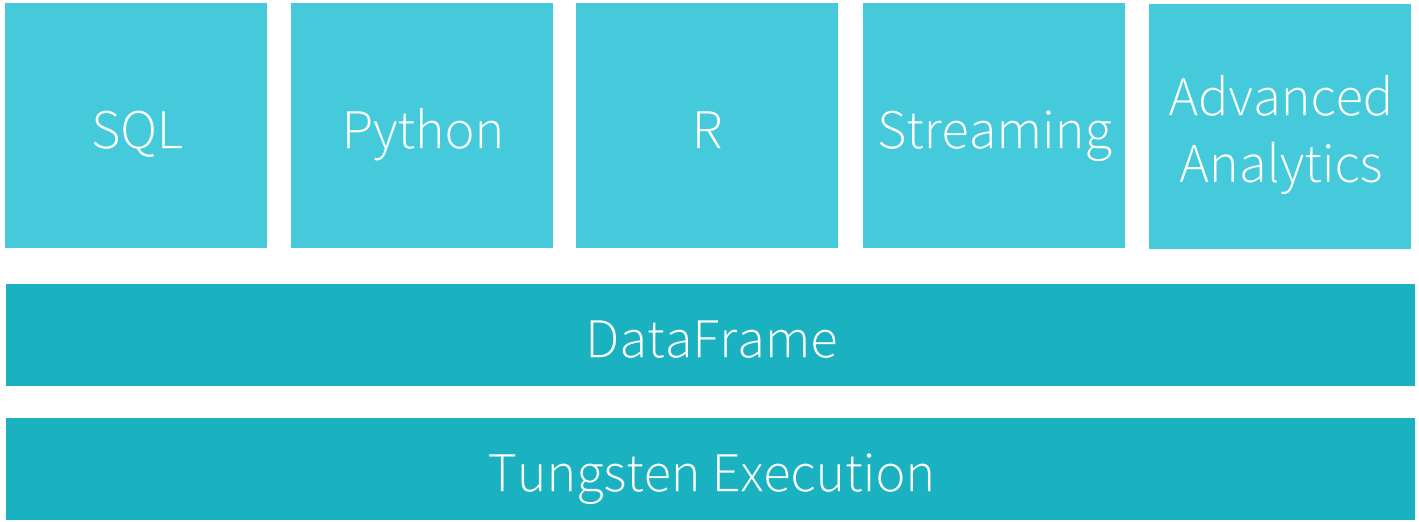
Initial Performance Results



Unified API, One Engine, Automatically Optimized



databricks


SQL
Python
R
Streaming
Advanced Analytics
DataFrame
Tungsten Execution

Spark Office Hours Today

	Topic Area
1:00-1:45	Core, YARN, Ops
1:45-2:30	Core/SQL/Data Science
3:00-3:40	Streaming
3:40-4:15	Core, Python, R
4:30-5:15	Machine Learning
5:15-6:00	Matei Zaharia

Databricks booth A1