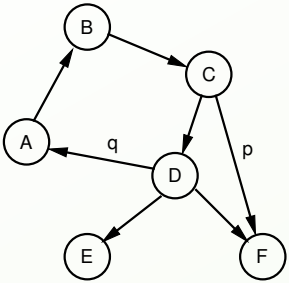
ArangoDB

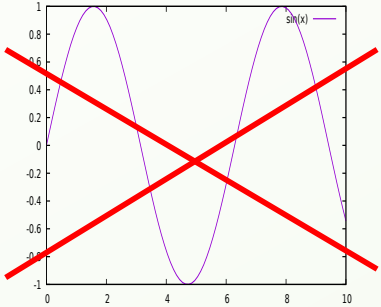
Fishing Graphs in a Hadoop Data Lake

Düsseldorf, 21 February 2018

Max Neunhöffer

What is a graph?





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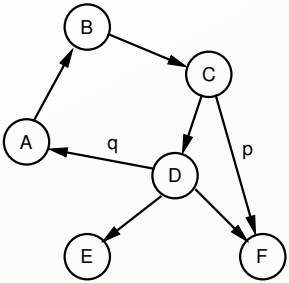

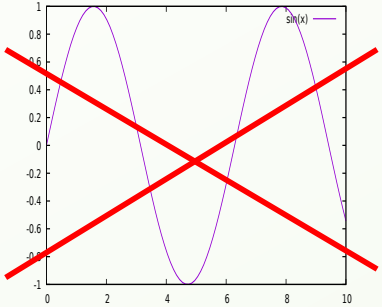

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- Dependency chains
- Computer networks
- Citations
- Hierarchies

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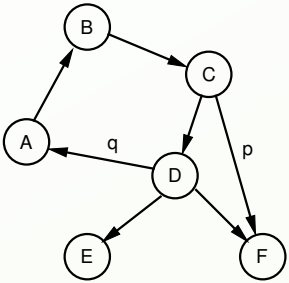

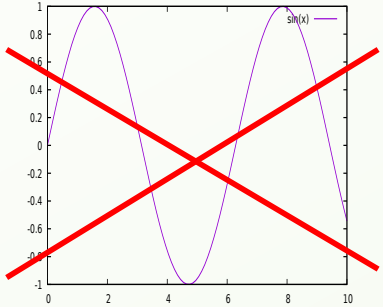

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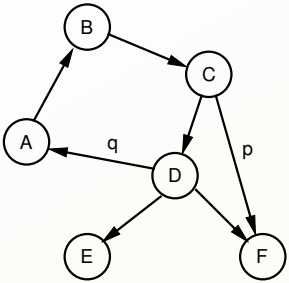

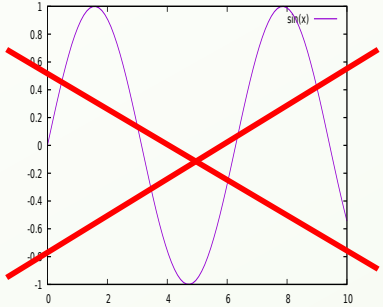

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Sometimes **directed**, sometimes **undirected**.

Usual approach: data in HDFS, use Spark/GraphFrames

```
v = spark.read.option("header",true).csv("hdfs://...")
e = spark.read.option("header",true).csv("hdfs://...")
g = GraphFrame(v,e)

g.inDegrees.show()

g.outDegrees.groupBy("outDegree").count().sort("outDegree").show(1000)

g.vertices.groupBy("GYEAR").count().sort("GYEAR").show()

g.find("(a)-[e]->(b);(b)-[ee]->(c)").filter("a.id = 6009536").count()

results = g.pageRank(resetProbability=0.01, maxIter=3)
```

Limitations/missed opportunities

Ad hoc queries

Often, one would like to perform smallish ad hoc queries on graph data.

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- friends of friends **of one person**
- find all immediate dependencies **of one item**
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IDEA: Use a **Graph Database**

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Crucial: Number of steps a priori unknown!

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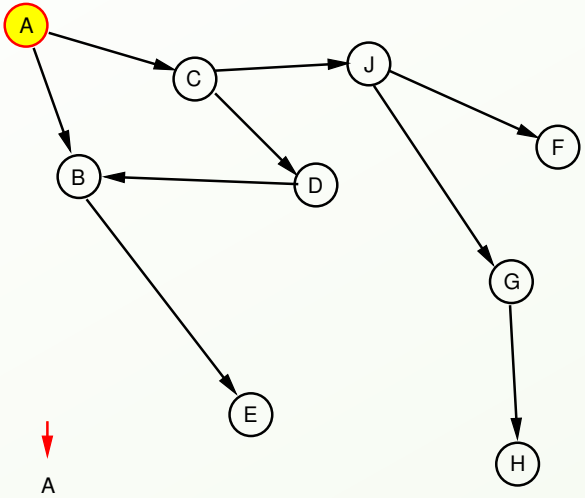

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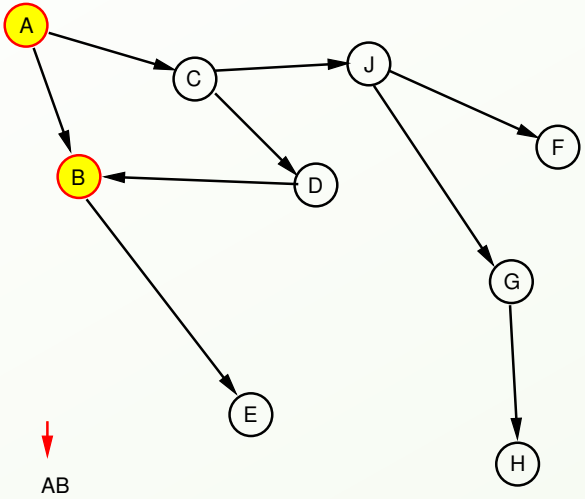

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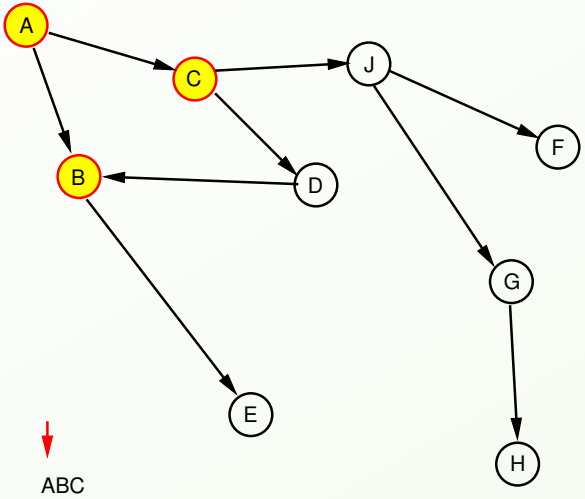

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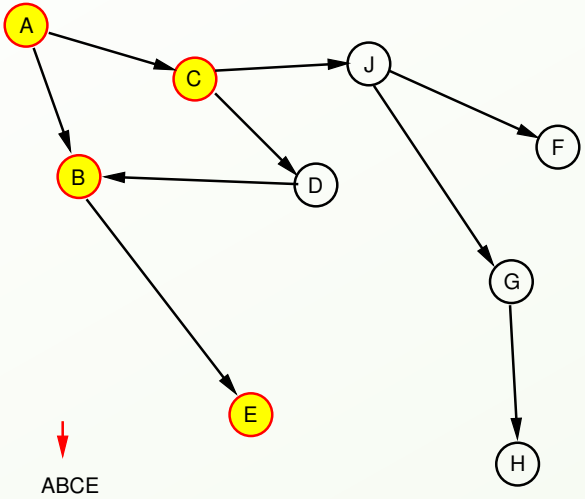

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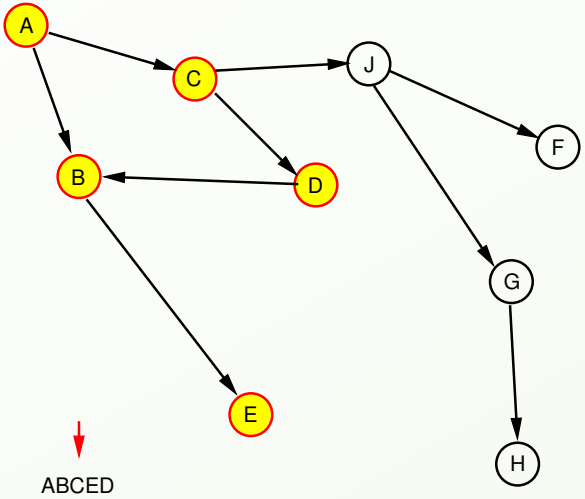

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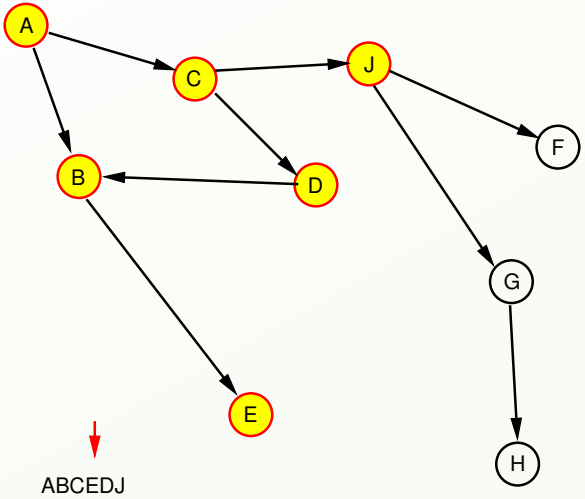

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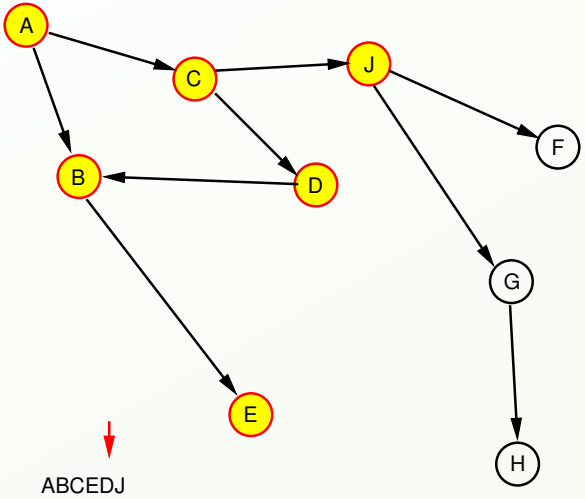

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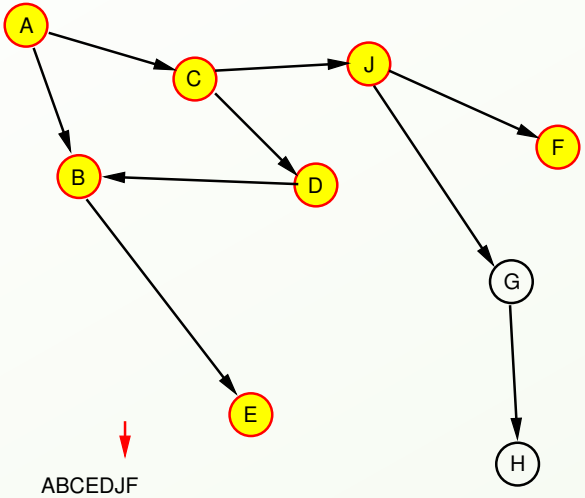

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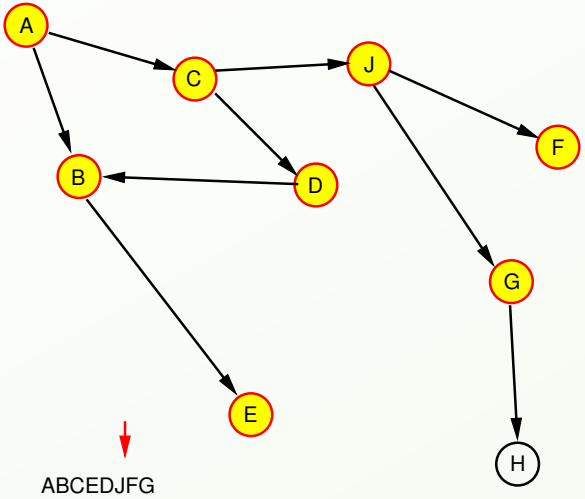

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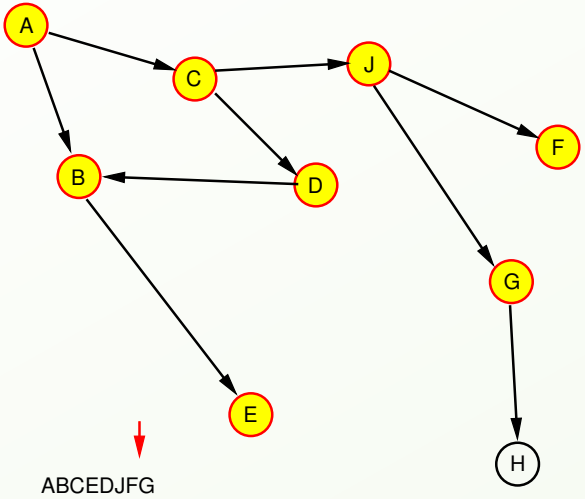

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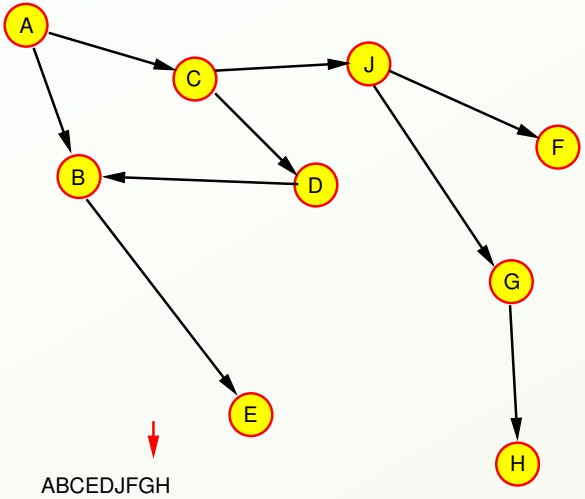

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Multi-model database

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- Allows for **polyglot persistence** using a single database technology.
- In a microservice architecture, there will be several **different** deployments.

Powerful query language

AQL

The built in Arango Query Language allows

- complex, powerful and convenient queries,

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- offers protection against injections by design.

ArangoDB is a Data Center Operating System App

These days, computing clusters run Data Center Operating Systems.

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ArangoDB runs on Apache Mesos and kubernetes clusters.

Back to topic: Cloud orchestration as infrastructure

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It manages for us:

- Software deployment
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Example: HDFS, Spark and ArangoDB

Deployment on kubernetes (work in progress)

Deploy the ArangoDB operator to k8s

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kubectl create -f arangodb-operator.yaml
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Deploy an ArangoDB cluster instance

```
kubectl create -f simple-cluster.yaml
```

simple-cluster.yaml

```
apiVersion: "database.arangodb.com/v1alpha"
kind: "ArangoDeployment"
metadata:
  name: "example-arangodb-cluster"
spec:
  mode: cluster
```

Import data into ArangoDB

```
hdfs dfs -get hdfs://name-1-node.hdfs.mesos:9001/patents.csv
hdfs dfs -get hdfs://name-1-node.hdfs.mesos:9001/citations.csv

dcos package install arangodb3

arangosh \
    --server.endpoint srv://_arangodb3-coordinator1._tcp.arangodb3.mesos

var g = require("@arangodb/general-graph");
var G = g._create("G",[g._relation("citations",["patents"],["patents"])]);

arangoimp --collection patents --file patents.csv --type csv \
    --server.endpoint srv://_arangodb3-coordinator1._tcp.arangodb3.mesos
arangoimp --collection citations --file citations.csv --type csv \
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```

Run a graph traversal

This query finds patents cited by `patents/6009503` (depth $\leq$ 3) recursively:

Recursive traversal, 500 results, 317 ms

```
FOR v IN 1..3 OUTBOUND "patents/6009503" GRAPH "G"
  RETURN v
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  RETURN v
```

This one finds all patents that cite any of those cited by `patents/6009503`:

One step forward and one back, 35 results, 59 ms

```
FOR v IN 1..1 OUTBOUND "patents/6009503" GRAPH "G"
  FOR w IN 1..1 INBOUND v._id GRAPH "G"
    FILTER w._id != v._id
    RETURN w
```

Run a graph traversal

This query finds all patents that cite `patents/3541687` directly or in two steps:

Recursive traversal backwards, 22 results, 15 ms

```
FOR v IN 1..2 INBOUND "patents/3541687" GRAPH "G"
  RETURN v._key
```

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This query finds all patents that cite `patents/3541687` directly or in two steps:

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```
FOR v IN 1..2 INBOUND "patents/3541687" GRAPH "G"
  RETURN v._key
```

This one counts all patents that cite `patents/3541687` recursively:

Deep recursion backwards, count 398, 311 ms

```
FOR v IN 1..10 INBOUND "patents/3541687" GRAPH "G"
  COLLECT WITH COUNT INTO c
  RETURN c
```

Yet another approach

If your graph data changes rapidly in a transactional fashion...

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Graph database as primary data store

You can **turn things around**:

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- Regularly dump to HDFS and **run larger analysis jobs** there.

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Or: Use ArangoDB's **Spark Connector**:

`https://github.com/arangodb/arangodb-spark-connector`

Links

Slides will be at: `https://www.arangodb.com/speakers/max-neunhoeffer/`

`http://hadoop.apache.org/`

`http://spark.apache.org/`

`https://graphframes.github.io/`

`https://www.arangodb.com`

`https://github.com/arangodb/arangodb-spark-connector`

Github: `https://github.com/arangodb/ArangoDB` **(please star us!)**

Twitter: `@arangodb` **(please follow us!)**