HL7® FHIR® DevDays

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Hands on with FHIR Data Pipes for enabling scalable FHIR Analytics

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Who am I?

- Bashir Sadjad
- Software Engineer, Google (13 yrs)
  - Healthcare data (mostly open-source)
  - Data-engineering and ML models for Display Ads
- Prior to Google: Rational Drug Design

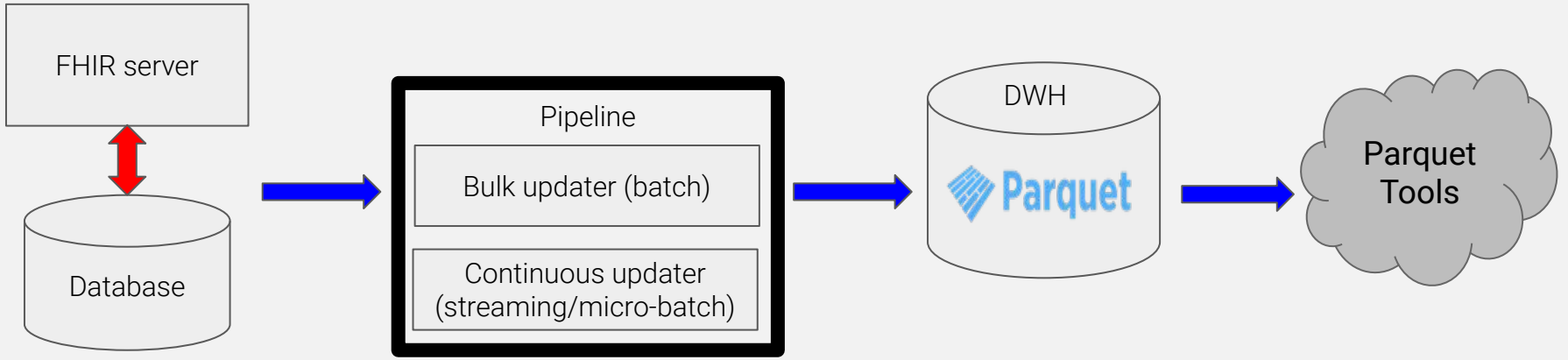
Learning Objectives

Same objectives as the morning tutorial talk with a hands-on focus:

- Doing *"Analytics"* on FHIR data
  - How to do it efficiently
  - How to make it *horizontally scalable*
- Transforming FHIR resources to Analytics friendly formats
  - The usual dilemma of analytical vs transaction processing
- Querying transformed data

The big picture

- Transform FHIR resources into Parquet files
  - Initial bulk transform
  - Continuous updates
- Query using Parquet-aware query engines



Prerequisites

- Attending the morning talk: “Transforming FHIR Data for horizontally scalable analytics”

- Access to a machine with docker, docker compose, git, and python
  - Depending on docker version, compose might be a sub-command not a separate tool; in that case replace `docker-compose` with `docker compose`
  - A variation of Unix/Linux is preferred but not required.
  - Java and Maven are needed if you want to build from source (not needed if you are okay using docker images).
  - [optional] Install DBeaver free community edition as the SQL console.

- [optional] Having a look at this Wiki page

The main doc and code

- We will mostly follow this Wiki page (summary below).
  - Set up everything on a single machine
  - Showing options how to run on a cluster

- Clone the repository: https://github.com/google/fhir-data-pipes
  - HTTPS (each shell command is indicated with a $ prefix):
    ```
    $ git clone https://github.com/google/fhir-data-pipes.git
    ```
  - SSH:
    ```
    $ git clone git@github.com:google/fhir-data-pipes
    ```

- After cloning, make sure `docker/dwh` is world readable:
  - `$ chmod a+rx docker/dwh`
  - This is where your generated Parquet files will be stored.

Set up a local FHIR server

- Go to the `docker` directory and run the following docker compose:
  - `$ cd docker`
  - `$ docker network create cloudbuild`
  - `$ docker-compose -f hapi-compose.yml up`
  - This brings up a HAPI FHIR server on port 8091 backed by a PostgreSQL DB.
  - Add `sudo` if you have not made your docker sudoless.
  - To test the FHIR server, from a separate terminal, try:

```
$ curl -H "Content-Type: application/json; charset=utf-8" \
  'http://localhost:8091/fhir/Patient' -v
```

  - This should return with a HTTP status code 200 and a FHIR Bundle containing zero resources.

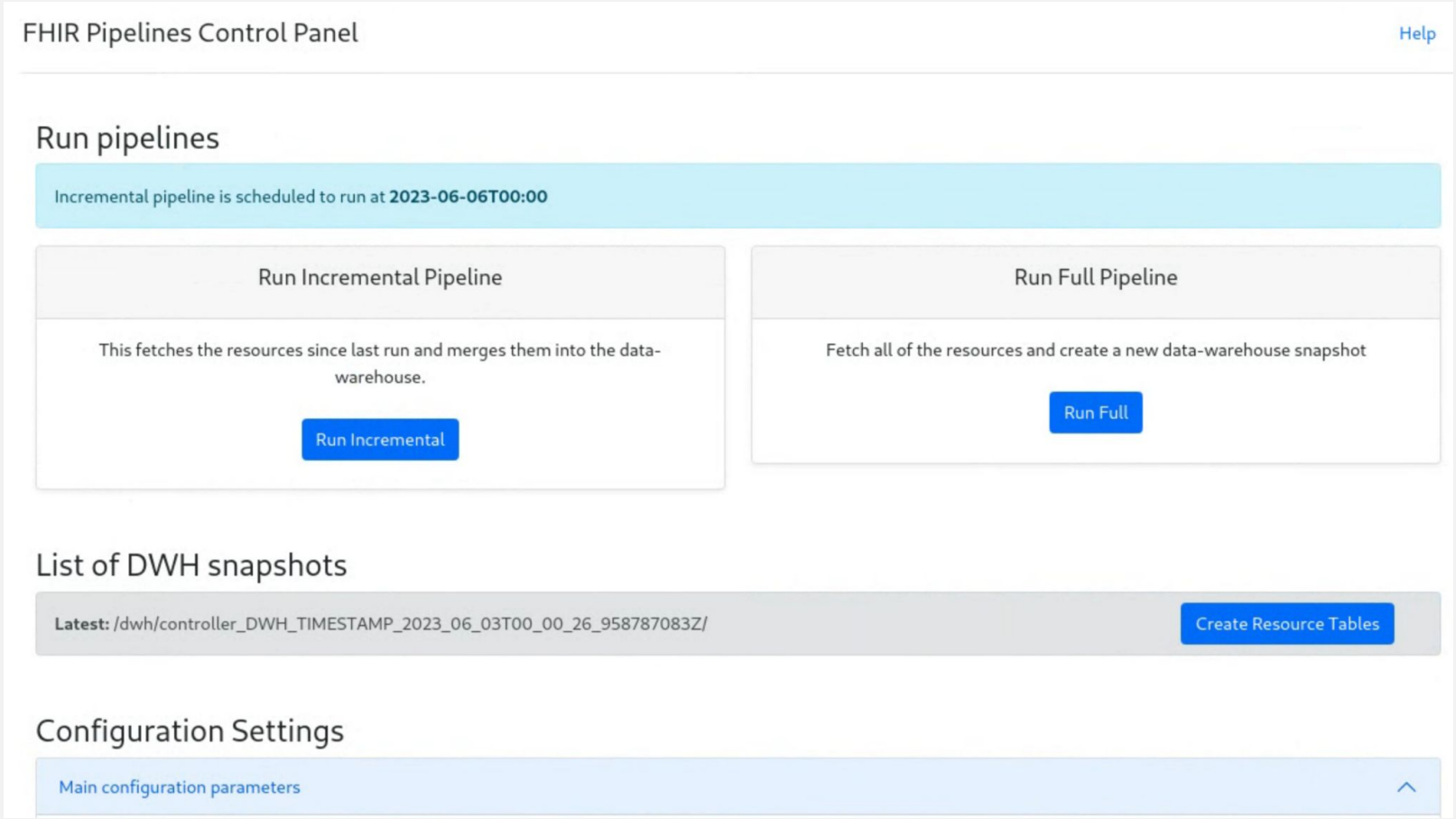
Loading synthetic data

- There is a generator tool for synthetic HIV data at synthea-hiv.
- We use the already generated data in synthea-hiv/sample_data.
- To upload this data to our FHIR server we need Python:
  - [optional] Create a virtualenv to protect the system wide Python installation:
    ```
    $ virtualenv -p python3.10 venv; source ./venv/bin/activate
    ```
  - Upload the sample data; from the repository root[1]:
    ```
    $ pip install -r ./synthea-hiv/uploader/requirements.txt
    $ python3 synthea-hiv/uploader/main.py HAPI \
      http://localhost:8091/fhir --input_dir \
      ./synthea-hiv/sample_data/ --cores 4
    ```
  - Check that there are now 79 Patient resources on the FHIR server:
    - ```
      curl -H "Content-Type: application/json; charset=utf-8" \
        'http://localhost:8091/fhir/Patient?_summary=count&_total=accurate'
      ```

1) Depending on your Python installation, you may need to install “pip” as well, e.g.: `apt install python3-pip` on a Debian based system.
      ```

Running the pipelines

- We are now at the Run the Single Machine configuration stage of the Wiki page:
  - Follow the instructions to run the controller interface and Spark Thrift-server; we use a slightly different version to skip the “build” stage:
    ```
    $ docker-compose -f compose-controller-spark-sql-released.yaml up
    ```
  - You can check controller’s status at: http://localhost:8090/
  - The above setup, depends on `PIPELINE_CONFIG` and `DWH_ROOT` config environment variables (defaults here).
  - Pipelines write into `DWH_ROOT` (default `./dwh`) and Spark queries read from it.



Note that initially, “Run Incremental” is disabled and there are no DWH in the list.

Running the pipelines

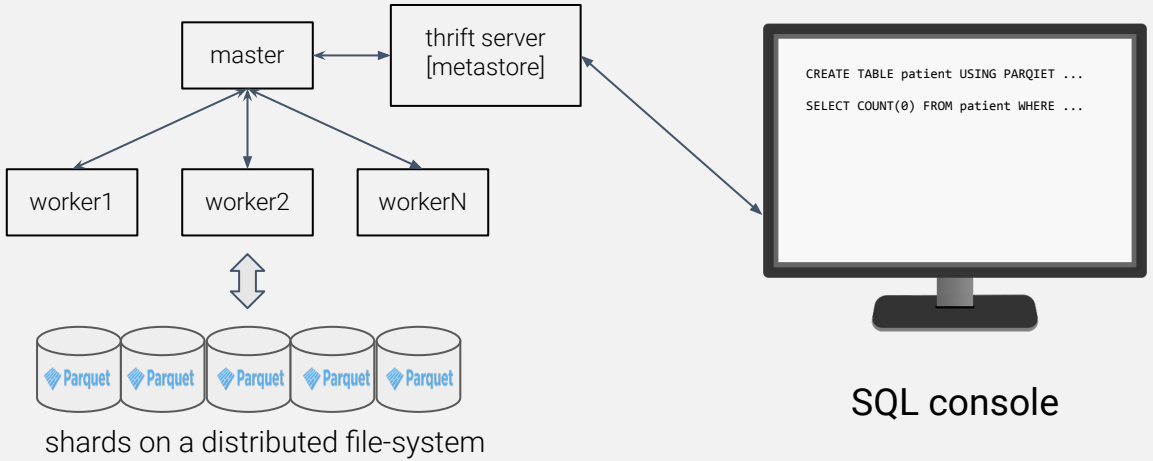
- We are now at the Run the Single Machine configuration stage of the Wiki page:
  - Follow the instructions to run the controller interface and Spark Thrift-server:
    `$ docker-compose -f compose-controller-spark-sql-single.yaml up`
  - From localhost:8090 do a “Run Full” (we skip the “incremental” part today).
  - Note what the controller interface does is similar to running the Beam pipeline directly, e.g., (with caveats re. `FLINK_CONF_DIR` and other defaults):

```
$ java -jar ./pipelines/batch/target/batch-bundled-0.1.0-SNAPSHOT.jar
--outputParquetPath=./PATH --runner=FlinkRunner
--fhirDatabaseConfigPath=utils/hapi-postgres-config_local.json
--jdbcModeHapi --fhirServerUrl=http://localhost:8091/fhir
```

  - To run on a Dataflow cluster, we just need to change the `--runner` value and add a few other Dataflow specific command line options.

How to query: the engine

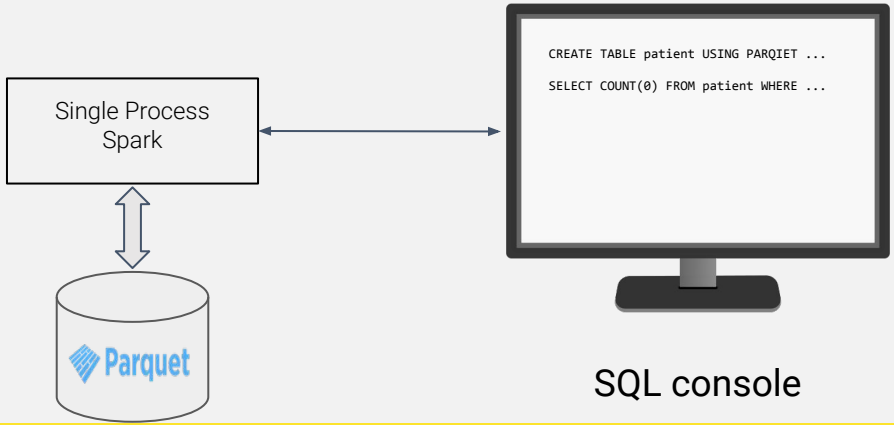
- Any query engine that understands Parquet (there are many).
  - A subset of these can scale horizontally.
  - Picked Spark as an example (sample setup)



How to query: the engine

- For this codelab:
  - A very simple local spark with just one process using [this setup].
  - This is what we have already set up by running:

```
$ docker-compose -f compose-controller-spark-sql-single.yaml up
```



SQL queries

- You can use any tool that can connect to a Spark Thrift-server (or Hive Metastore).
  - DBeaver is one example with a free community edition.
  - Alternatively you can use the built-in beeline tool:

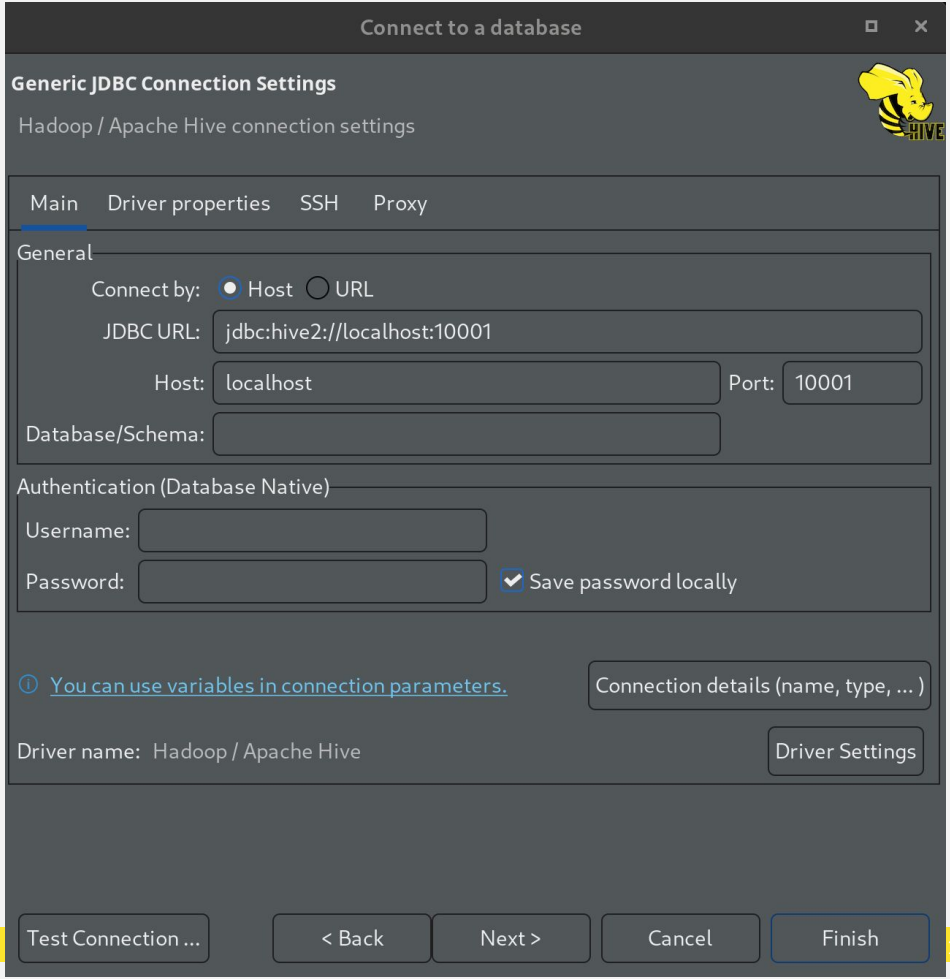
```
$ docker exec -it spark-thriftserver bin/beeline -u \
  jdbc:hive2://localhost:10000
```

- Follow the example queries in this section of the Wiki page; but first:
  - `SELECT COUNT(0) FROM patient;`
  - `SELECT COUNT(0) FROM observation;`

- Exact same SQL queries can be submitted to a Spark cluster.
  - You can set up one quickly and easily on Dataproc.

DBeaver connection

- Use the “Hive” option
- Port: 10001
- Download the required drivers at prompt



More to do

- If you have more time, try FHIR-views on Spark through this notebook.
  - We have already done the Prerequisites section of that notebook.
- You can follow instructions on this Wiki page for integrating a dashboard tool.