SQL SERVER
&
Machine Learning

Tomasz Krawczyk

Agenda

- History
- Machine Learning Server and Machine Learning Services
- SQL Server and Machine Learning Services
- SQL +R+ Python
  - Train models
  - Run models

History

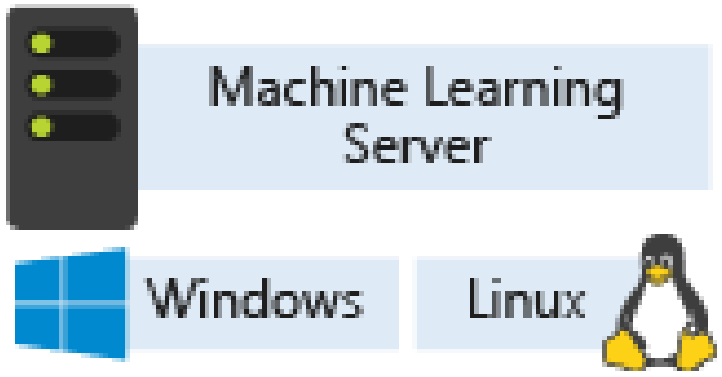
- MS SQL Server 2016
  - R in SQL Server 2016
- Microsoft R Server ScaleR
- RevoScaleR package
  - https://mran.microsoft.com/packages

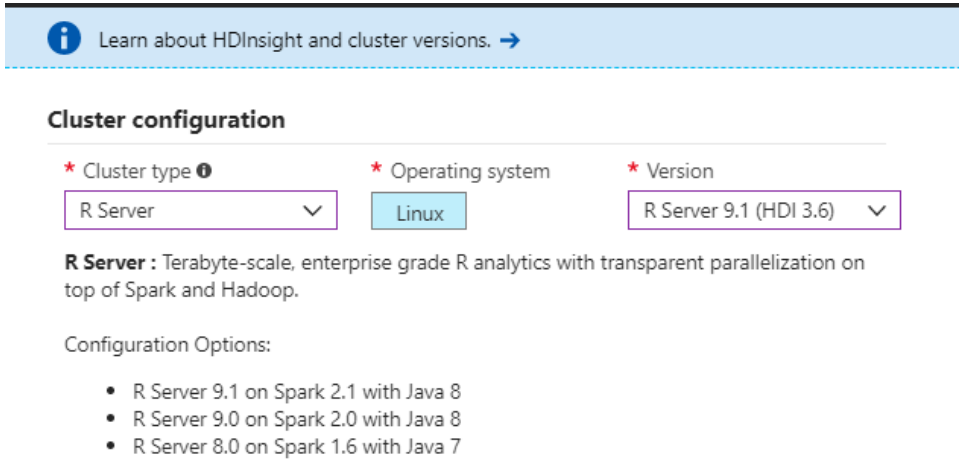
History

- MS SQL Server 2017
  - Python in SQL Server 2017
- Microsoft R Server -> Machine Learning Server (Services)
- RevoScalePy
- Microsoftml for Python

Install and configure Machine Learning Server

- Microsoft R Server 9.1
  - R Server for Hadoop
  - R Server for Linux
  - R Server for Windows
  - R Server for Teradata
  - SQL Server
- Machine Learning Server 9.2.1
  - Machine Learning Server for Hadoop
  - Machine Learning for Linux
  - Machine Learning for Windows
  - SQL Server





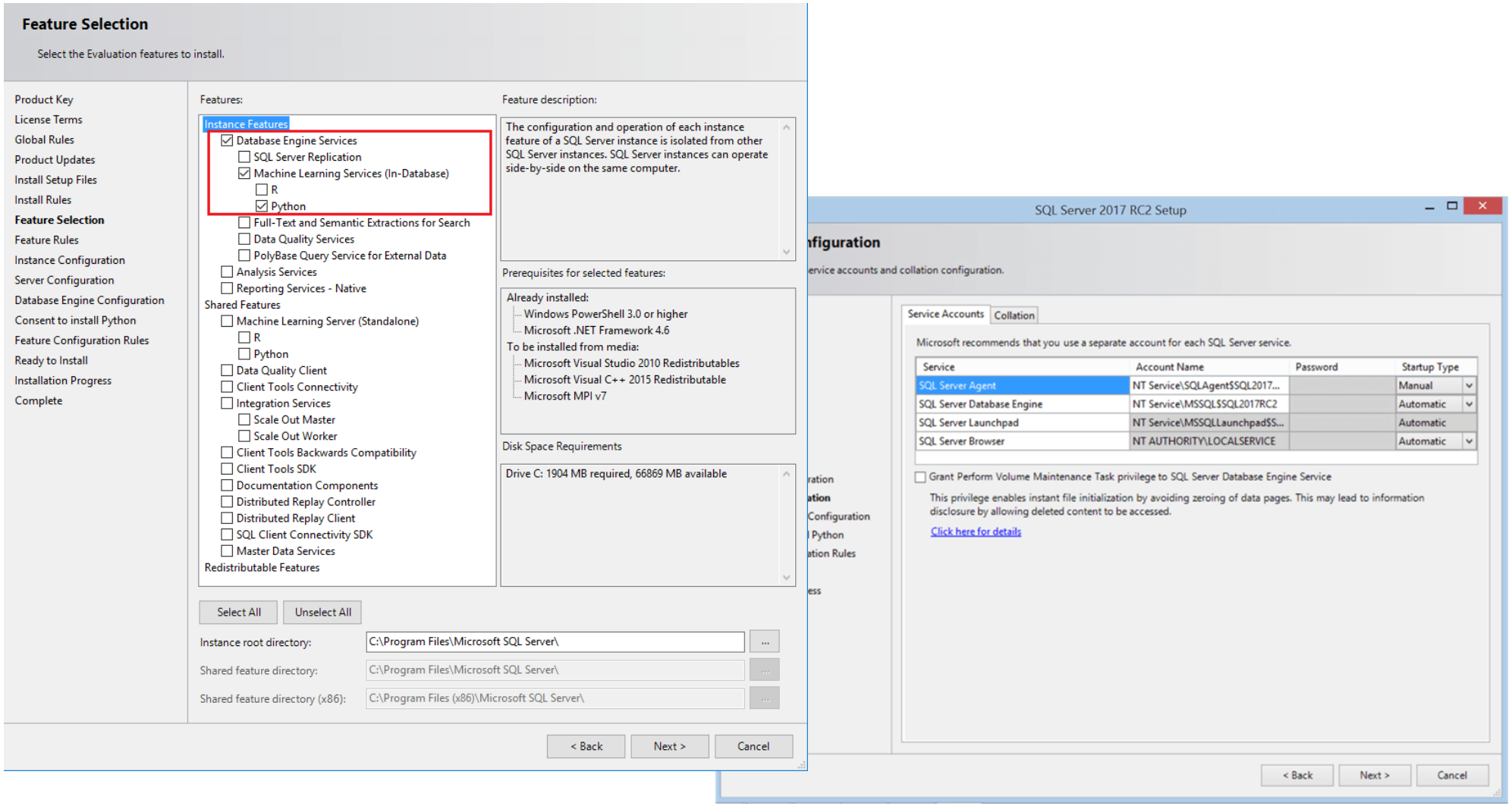
SQL Server Editions and Machine Learning Services

- Machine Learning Services
  - Express with Advanced Services (*)
  - Developer
  - Standard
  - Enterprise

(*)

- Basic R integration
- Basic Python integration

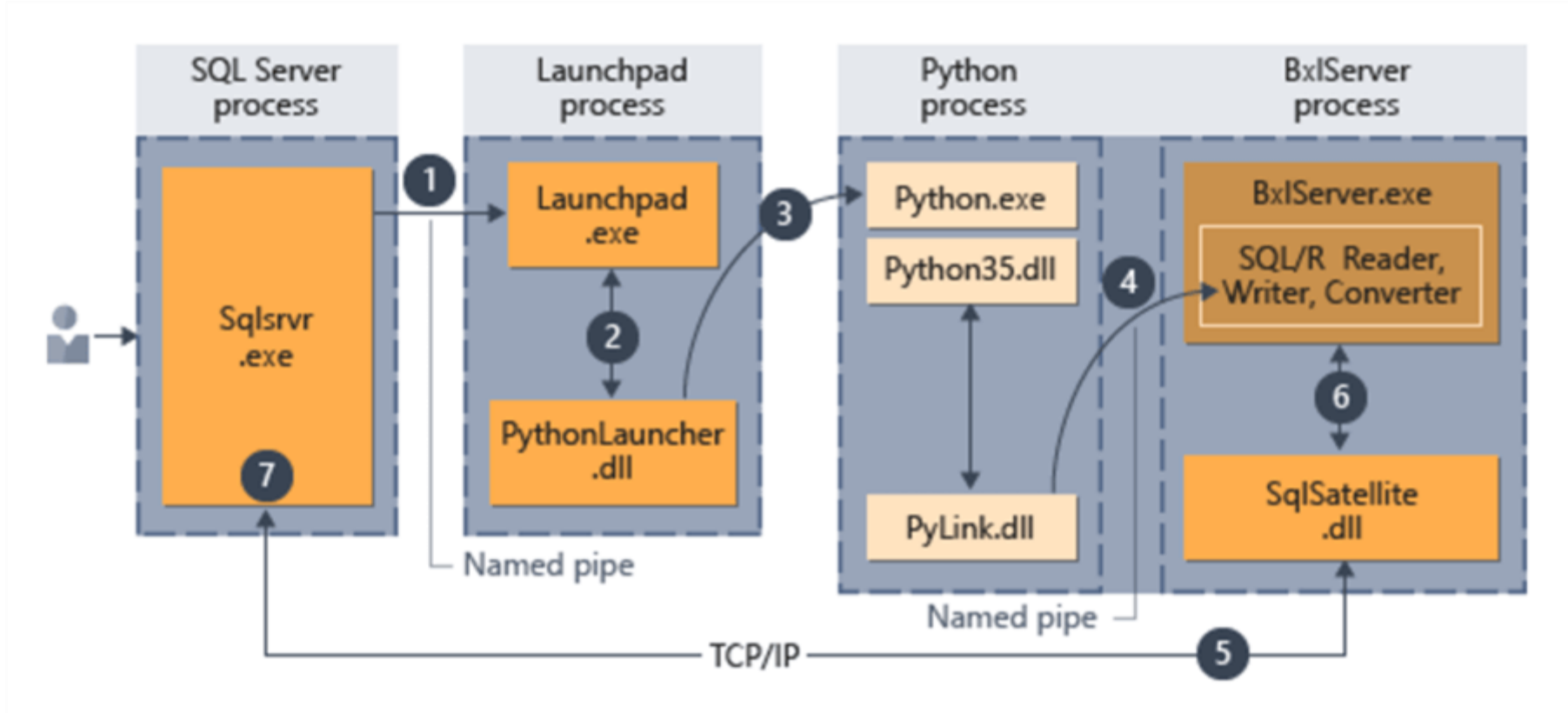
Install Machine Learning Services on SQL Server 2017



Python and SQL Server Integration Architecture

- Process
  - **Launchpad** - a service provided by SQL Server 2017 for supporting execution of external scripts
  - **Binary Exchange Language (Bxl) Server** - manages communication between SQL Server and the Python runtime
  - **SQL Satellite** - BxlServer uses SQL Satellite for communicating with SQL Server

Python and SQL Server Integration Architecture



Enable Python or (R) script execution

- Enable External Script Execution

```
EXEC sp_configure  'external scripts enabled’, 1
RECONFIGURE WITH OVERRIDE
```

- Restart the SQL Server service for the SQL Server instance.
- Verify that the external script execution feature is running

```
EXEC sp_configure  'external scripts enabled'
```

How to run Python or R Script?

```
sp_execute_external_script
    @language = N'language' ,
    @script = N'script',

    @input_data_1 = ] 'input_data_1'
    [ , @input_data_1_name = ] N'input_data_1_name' ]
    [ , @output_data_1_name = 'output_data_1_name' ]
    [ , @parallel = 0 | 1 ]
    [ , @params = ] N'@parameter_name data_type [ OUT | OUTPUT ] [ ,...n ]'
    [ , @parameter1 = ] 'value1' [ OUT | OUTPUT ] [ ,...n ]
    [ WITH <execute_option> ]
[;]

<execute_option>::=
{
      { RESULT SETS UNDEFINED }
    | { RESULT SETS NONE }
    | { RESULT SETS ( <result_sets_definition> ) }
}

<result_sets_definition> ::=
{
    (
        { column_name
          data_type
        [ COLLATE collation_name ]
        [ NULL | NOT NULL ] }
        [,...n ]
    )
    | AS OBJECT
        [ db_name . [ schema_name ] . | schema_name . ]
        {table_name | view_name | table_valued_function_name }
    | AS TYPE [ schema_name.]table_type_name
}
```

```
execute sp_execute_external_script
@language = N'Python',
@script = N'
import sys
print("**************************")
print(sys.path)
print(sys.version)
print("Hello World")
print("**************************")'
```

DEMO(s)

Demo 1,2,3

Python Env

Jupyter

Revoscale and RevoscalePy

- The **revoscalepy** module is a collection of portable, scalable and distributable Python functions used for importing, transforming, and analyzing data at scale

https://docs.microsoft.com/en-us/machine-learning-server/python-reference/revoscalepy/revoscalepy-package

Microsoftml package

- The **microsoftml** module is a collection of Python functions used in machine learning solutions. It includes functions for training and transformations, scoring, text and image analysis, and feature extraction for deriving values from existing data.

https://docs.microsoft.com/en-us/machine-learning-server/python-reference/microsoftml/microsoftml-package

Native Scoring

- **PREDICT** (Transact-SQL)

```
PREDICT
(
  MODEL = @model | model_literal,
  DATA = object AS <table_alias>
)
WITH ( <result_set_definition> )

<result_set_definition> ::=
  {
    { column_name
      data_type
      [ COLLATE collation_name ]
      [ NULL | NOT NULL ]
    }
      [,...n ]
  }

MODEL = @model | model_literal
```

Native Scoring Supported Models

- Not all models are supported - only the following models are supported:
  - rxLinMod
  - rxLogit
  - rxBTrees
  - rxDtree
  - rxdForest

DEMO(s)
Q&A

- Resources:
  https://docs.microsoft.com/en-us/machine-learning-server/
- Contact:
  tkrawczyk@future-processing.com