

Overview of scenario and details about different classes and run script.

ASignalMonitor

Contains ML model, SQLite DB to collect training data and operational mode for classification.

States:

- 'collecting_good' – collecting signal data in normal state
- 'collecting_bad' - collecting signal data in critical state
- 'collecting_additional' - collecting signal data of slight variation of the normal state
- 'check_stored_data' – check amount of collected data in SQLite DB
- 'train' – train ML model with all available signal data (using test_train_split parameter)
- 'save_model' – save trained ML model
- 'load_model' – load trained ML model
- 'evaluate' – operational mode classifying incoming signal data with trained ML model
- 'purge_db' – delete all collected data
- 'purge_db_good' - delete collected data of class “good”
- 'purge_db_bad' - delete collected data of class “bad”
- 'purge_db_add' - delete collected data of class “additional”

Methods:

- onSignal – triggered by incoming signal data
- onStateChange – used to change state of ASignalMonitor

AlmonitorLogger

Simple class with “print” statements as communication interface with ASignalMonitor.

Methods:

- print - print normal message
- stateChange - print message concerning state change
- printEval- print message concerning classification result in operational mode

ASignalProducer

Class to simulate data source

States:

- 'good' – sending signal data of class “good”
- 'bad' – sending signal data of class “bad”
- 'additional' – sending signal data of class “additional”

Methods:

- onFrame – returning on signal data set
- onStateChange – used to change state of ASignalProducer

ProducerLogger

Simple class with “print” statements as communication interface with AISignalProducer.

Methods:

- print - print normal message
- stateChange - print message concerning state change

helper_functions.py

Contains functions to provide parameters and fft transformation

Functions:

- get_db_parameter- Function to provide parameter for DBs and tables
- get_AI_parameter - Function to provide parameter for ML module
- get_operational_parameter - Function to provide parameter for operational mode
- get_parameter - Function to provide parameter for data signals and generation of simulated data
- get_fft_values- Function to perform/simulate FFT module

helper_db_functions.py

Contains all “helper” functions for SQLite DB interaction

Functions:

- create_connection- Create connection to DB
- show_tables - Show all tables in DB
- show_data(db_conn, table) - Show all data of table
- show_some_data - Show data of first 10 rows of table
- delete_data - Delete all rows in table
- vacuum_db - Cleans up database and releases memory after deleting data
- trans_ndarray2blob - Transform ndarray to blob
- trans_blob2ndarray - Transform blob to ndarray
- insert_blob_data - Function to insert data signal (blob) into table of SQLite db
- get_blob_data- Function to get data signals (blob) from table of SQLite db of specific class
- commit_data - Commit all changes to DB
- close_connection - Function to close SQLite DB connection
- state_is_UTF8 - Function to check UTF-8

create_DBs_and_tables.py

Script to create DBs and tables for both AISignalMonitor and AISignalProducer

generate_simulated_data.py

Script to generate and save simulated test data.

visualize_simulated_data.py

Script to visualize some data sets for good, bad and additional data as plots

run_AISignalMonitor.py

Script to run simulated scenario using AISignalMonitor and AISignalProducer.

Collecting data, training ML model and simulating operational mode for all signal data classes.

Details of executing run script with explanations

Initialize AISignalProducer

```
ProducerLogger --- AIProd! Initialize.  
ProducerLogger state --- AIProd! Initial state set: good.  
ProducerLogger --- AIProd! Loading data from DB.  
ProducerLogger --- AIProd! Initialize completed.
```

Initialize AISignalMonitor

```
AIMonitorLogger --- AIMon! Initialize.  
AIMonitorLogger state --- AIMon! Initial state set: collecting_good.  
AIMonitorLogger --- AIMon! Create DB connection.  
AIMonitorLogger --- AIMon! Table cleared.  
AIMonitorLogger --- AIMon! DB "vacuum" completed.  
AIMonitorLogger --- AIMon! Start AI model.  
AIMonitorLogger --- AIMon! Initialize completed.
```

Check stored data and clean table of AISignalMonitor

```
AIMonitorLogger state --- AIMon! Changing state.  
AIMonitorLogger state --- AIMon! State changed: check_stored_data  
AIMonitorLogger --- AIMon! Check stored data.  
AIMonitorLogger --- AIMon! no data stored.  
AIMonitorLogger state --- AIMon! Changing state.  
AIMonitorLogger state --- AIMon! State changed: purge_db  
AIMonitorLogger --- AIMon! Table cleared.  
AIMonitorLogger --- AIMon! DB cleared.  
AIMonitorLogger --- AIMon! Collected data deleted.  
AIMonitorLogger state --- AIMon! Changing state.  
AIMonitorLogger state --- AIMon! State changed: check_stored_data  
AIMonitorLogger --- AIMon! Check stored data.  
AIMonitorLogger --- AIMon! no data stored.
```

Collecting “good” data and check DB

```
AImonitorLogger state --- AIMon! Changing state.
AImonitorLogger state --- AIMon! State changed: check_stored_data
AImonitorLogger --- AIMon! Check stored data.
AImonitorLogger --- AIMon! no data stored.
ProducerLogger state --- AIProd! Changing state.
ProducerLogger state --- AIProd! State changed: good.
AImonitorLogger state --- AIMon! Changing state.
AImonitorLogger state --- AIMon! State changed: collecting_good
ProducerLogger --- AIProd!! state change - wait 3 sec.
ProducerLogger --- AIProd!! onFrame (good) - 50.
AImonitorLogger --- AIMon! onSignal (collecting_good) - 50.
ProducerLogger --- AIProd!! onFrame (good) - 50 x.
AImonitorLogger --- AIMon! onSignal (collecting_good) - 50 x.
ProducerLogger --- AIProd!! onFrame (good) - 50.
AImonitorLogger --- AIMon! onSignal (collecting_good) - 50.
ProducerLogger --- AIProd!! onFrame (good) - 50 x.
AImonitorLogger --- AIMon! onSignal (collecting_good) - 50 x.
ProducerLogger --- AIProd!! onFrame (good) - 50.
AImonitorLogger --- AIMon! onSignal (collecting_good) - 50.
ProducerLogger --- AIProd!! onFrame (good) - 50 x.
AImonitorLogger --- AIMon! onSignal (collecting_good) - 50 x.
ProducerLogger --- AIProd!! onFrame (good) - 50.
AImonitorLogger --- AIMon! onSignal (collecting_good) - 50.
ProducerLogger --- AIProd!! onFrame (good) - 50 x.
AImonitorLogger state --- AIMon! Changing state.
AImonitorLogger state --- AIMon! State changed: check_stored_data
AImonitorLogger --- AIMon! Check stored data.
AImonitorLogger --- AIMon! Total amount: 400 good: 400 bad: 0 additional: 0.
```

Collecting “bad” data and check DB

```
ProducerLogger state --- AIProd! Changing state.
ProducerLogger state --- AIProd! State changed: bad.
AImonitorLogger state --- AIMon! Changing state.
AImonitorLogger state --- AIMon! State changed: collecting_bad
ProducerLogger --- AIProd!! state change - wait 3 sec.
ProducerLogger --- AIProd!! onFrame (bad) - 50.
AImonitorLogger --- AIMon! onSignal (collecting_bad) - 50.
ProducerLogger --- AIProd!! onFrame (bad) - 50 x.
AImonitorLogger --- AIMon! onSignal (collecting_bad) - 50 x.
ProducerLogger --- AIProd!! onFrame (bad) - 50.
AImonitorLogger --- AIMon! onSignal (collecting_bad) - 50.
ProducerLogger --- AIProd!! onFrame (bad) - 50 x.
AImonitorLogger --- AIMon! onSignal (collecting_bad) - 50 x.
ProducerLogger --- AIProd!! onFrame (bad) - 50.
AImonitorLogger --- AIMon! onSignal (collecting_bad) - 50.
ProducerLogger --- AIProd!! onFrame (bad) - 50 x.
AImonitorLogger --- AIMon! onSignal (collecting_bad) - 50 x.
ProducerLogger --- AIProd!! onFrame (bad) - 50.
AImonitorLogger --- AIMon! onSignal (collecting_bad) - 50.
ProducerLogger --- AIProd!! onFrame (bad) - 50 x.
AImonitorLogger state --- AIMon! Changing state.
AImonitorLogger state --- AIMon! State changed: check_stored_data
AImonitorLogger --- AIMon! Check stored data.
AImonitorLogger --- AIMon! Total amount: 800 good: 400 bad: 400 additional: 0.
```

Collecting “additional” data and check DB

```

ProducerLogger state --- AIProd! Changing state.
ProducerLogger state --- AIProd! State changed: additional.
AIMonitorLogger state --- AIMon! Changing state.
AIMonitorLogger state --- AIMon! State changed: collecting_additional
ProducerLogger --- AIProd!! state change - wait 3 sec.
ProducerLogger --- AIProd!! onFrame (additional) - 50.
AIMonitorLogger --- AIMon! onSignal (collecting_additional) - 50.
ProducerLogger --- AIProd!! onFrame (additional) - 50 x.
AIMonitorLogger --- AIMon! onSignal (collecting_additional) - 50 x.
ProducerLogger --- AIProd!! onFrame (additional) - 50.
AIMonitorLogger --- AIMon! onSignal (collecting_additional) - 50.
ProducerLogger --- AIProd!! onFrame (additional) - 50 x.
AIMonitorLogger --- AIMon! onSignal (collecting_additional) - 50 x.
ProducerLogger --- AIProd!! onFrame (additional) - 50.
AIMonitorLogger --- AIMon! onSignal (collecting_additional) - 50.
ProducerLogger --- AIProd!! onFrame (additional) - 50 x.
AIMonitorLogger --- AIMon! onSignal (collecting_additional) - 50 x.
ProducerLogger --- AIProd!! onFrame (additional) - 50.
AIMonitorLogger --- AIMon! onSignal (collecting_additional) - 50.
ProducerLogger --- AIProd!! onFrame (additional) - 50 x.
AIMonitorLogger --- AIMon! onSignal (collecting_additional) - 50 x.
AIMonitorLogger state --- AIMon! Changing state.
AIMonitorLogger state --- AIMon! State changed: check_stored_data
AIMonitorLogger --- AIMon! Check stored data.
AIMonitorLogger --- AIMon! Total amount: 1200 good: 400 bad: 400 additional: 400.

```

Train ML model and evaluate training result

Comment: ~ 95.7 accuracy with slight problems between “good” and “additional” class which are really close together. “bad” class clearly separated by classification.

```
AImonitorLogger state --- AIMon! Changing state.
AImonitorLogger state --- AIMon! State changed: train
AImonitorLogger state --- AIMon! train.
AImonitorLogger --- AIMon! Score of training: 95.6666666666667%.
AImonitorLogger --- AIMon! Test results for good signals. Correct: 187.0 false: 13.0.
AImonitorLogger --- AIMon! Test results for bad signals. Correct: 200.0 false: 0.0.
AImonitorLogger --- AIMon! Test results for add signals. Correct: 187.0 false: 13.0.
AImonitorLogger --- AIMon! Runtime for AI training: 0.735190s
```

Simulating operational mode

```

AIMonitorLogger state --- AIMon! Changing state.
AIMonitorLogger state --- AIMon! State changed: evaluate
ProducerLogger state --- AIProd! Changing state.
ProducerLogger state --- AIProd! State changed: good.
run-script: Evaluating good signals.
ProducerLogger --- AIProd!! state change - wait 3 sec.
AIMonitorLogger eval --- AIMon! evaluate: Good signal!
AIMonitorLogger eval --- AIMon! evaluate: Good signal!
AIMonitorLogger eval --- AIMon! evaluate: Additional signal!
AIMonitorLogger eval --- AIMon! evaluate: Good signal!
AIMonitorLogger eval --- AIMon! evaluate: Additional signal!
AIMonitorLogger eval --- AIMon! evaluate: Good signal!
AIMonitorLogger eval --- AIMon! evaluate: Good signal!
AIMonitorLogger eval --- AIMon! evaluate: Good signal!
AIMonitorLogger eval --- AIMon! evaluate: Good signal!
AIMonitorLogger eval --- AIMon! evaluate: Good signal!
AIMonitorLogger eval --- AIMon! evaluate: Good signal!
ProducerLogger state --- AIProd! Changing state.
ProducerLogger state --- AIProd! State changed: bad.

```

```

run-script: Evaluating bad signals.
ProducerLogger --- AIProd!! state change - wait 3 sec.
AImonitorLogger eval --- AIMon! evaluate: Bad signal!
AImonitorLogger eval --- AIMon! evaluate: Bad signal!
AImonitorLogger eval --- AIMon! evaluate: Bad signal!
AImonitorLogger eval --- AIMon! evaluate: Bad signal!
AImonitorLogger eval --- AIMon! evaluate: Bad signal!
AImonitorLogger eval --- AIMon! evaluate: Bad signal!
AImonitorLogger eval --- AIMon! evaluate: Bad signal!
AImonitorLogger eval --- AIMon! evaluate: Bad signal!
AImonitorLogger eval --- AIMon! evaluate: Bad signal!
AImonitorLogger eval --- AIMon! evaluate: Bad signal!
ProducerLogger state --- AIProd! Changing state.
ProducerLogger state --- AIProd! State changed: additional.
run-script: Evaluating additional signals.
ProducerLogger --- AIProd!! state change - wait 3 sec.
AImonitorLogger eval --- AIMon! evaluate: Additional signal!
AImonitorLogger eval --- AIMon! evaluate: Good signal!
AImonitorLogger eval --- AIMon! evaluate: Additional signal!
AImonitorLogger eval --- AIMon! evaluate: Additional signal!
AImonitorLogger eval --- AIMon! evaluate: Additional signal!
AImonitorLogger eval --- AIMon! evaluate: Additional signal!
AImonitorLogger eval --- AIMon! evaluate: Additional signal!
AImonitorLogger eval --- AIMon! evaluate: Additional signal!
AImonitorLogger eval --- AIMon! evaluate: Additional signal!
AImonitorLogger eval --- AIMon! evaluate: Additional signal!

```

End with deconstructor

```

=== Ende! ===
ProducerLogger --- AIProd! End.
AImonitorLogger --- AIMon! End.

```