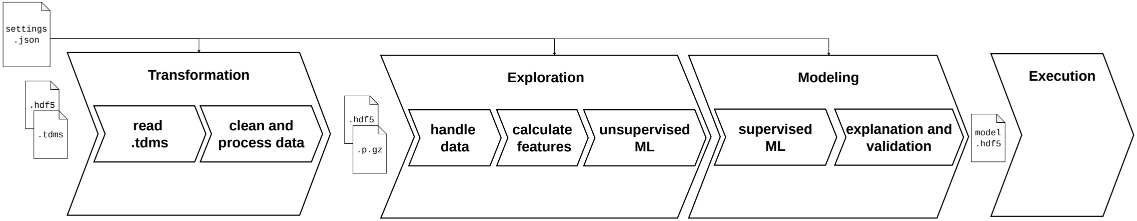
CERN

Transformation ML Framework

on basis of the XBox2 Data Set

Lorenz Fischl

Introduction



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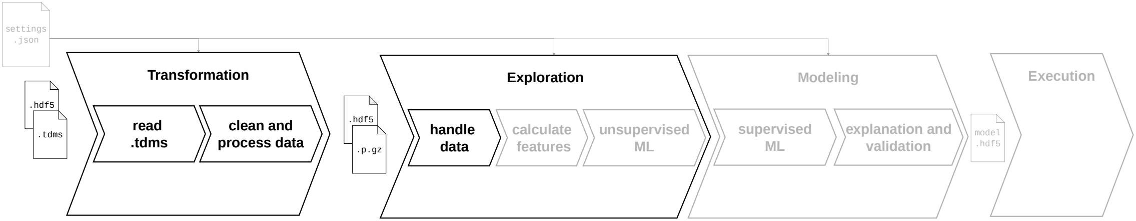

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XBox2 File Structure

- Event-&TrendData

Choosing a Data Format

- reading tdms files
- pandas + compressed pickle
- Conclusion

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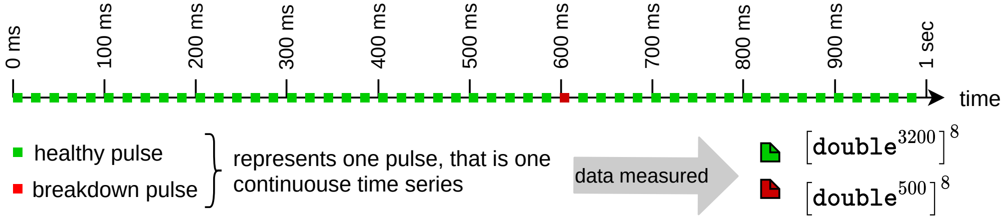
0 ms
100 ms
200 ms
300 ms
400 ms
500 ms
600 ms
700 ms
800 ms
900 ms
1 sec
time
🟩 healthy pulse
🟥 breakdown pulse
represents one pulse, that is one continuouse time series
data measured
$\left[\texttt{double}^{3200}\right]^{8}$
$\left[\texttt{double}^{500}\right]^{8}$

XBox2 EventData

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When a breakdown happens the corresponding log group + the two prior log groups are stored.

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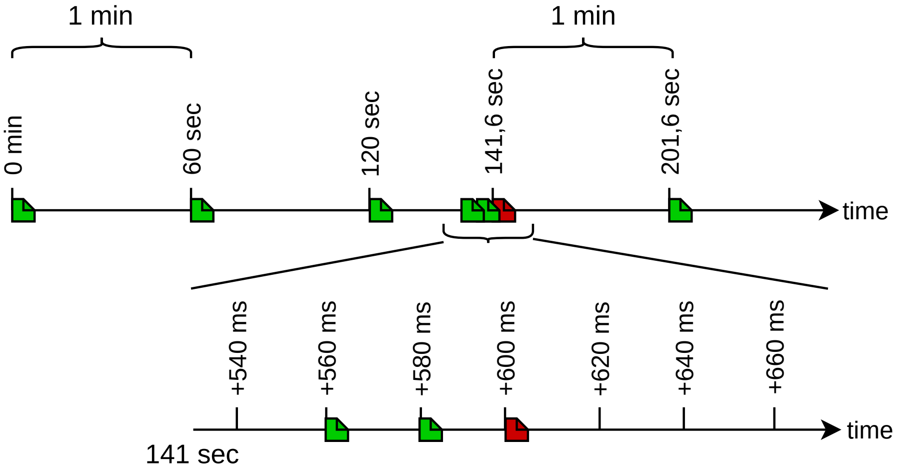

XBox2 TrendData

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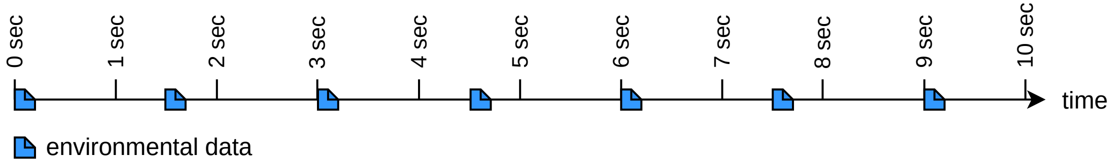

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nptdms

nptdms

- package nptdms can read and handle .tdms files

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- package `nptdms` can read and handle `.tdms` files
- very slow (ex.: read of a 100MB file can take >30sec)
- very space inefficient (ex. TrendData: 20,5 GB in .tdms → 2.8 GB of data)

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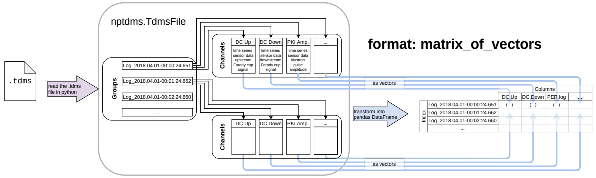
Transformation

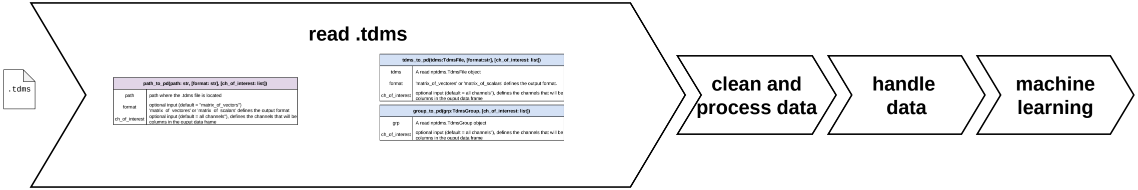
Transformation

`.tdms` ⟶ `pd df/ dictionary` ⟶ `pickle` ⟶ `.gzip`

Transformation: read.tdms


.tdms
read the .tdms file in python
nptdms.TdmsFile
Groups
Log_2018.04.01-00:00:24.651
Log_2018.04.01-00:01:24.662
Log_2018.04.01-00:02:24.660
...
Channels
DC Up
time series sensor data upstream Farady cup signal
DC Down
time series sensor data downstream Farady cup signal
PKI Amp.
time series sensor data klystron pulse amplitude
...
Channels
DC Up
DC Down
PKI Amp.
...
format: matrix_of_vectors
as vectors
as vectors
transform into pandas DataFrame

Index	Columns			
	DC Up	DC Down	PER log	...
Log_2018.04.01-00:00:24.651	(...)	(...)	(...)	
Log_2018.04.01-00:01:24.662				
Log_2018.04.01-00:02:24.660				
...				



read .tdms

path_to_pd(path: str, [format: str], [ch_of_interest: list])	
path	path where the .tdms file is located
format	optional input (default = "matrix_of_vectors") 'matrix of vectores' or 'matrix of scalars' defines the output format
ch_of_interest	optional input (default = all channels"), defines the channels that will be columns in the ouput data frame

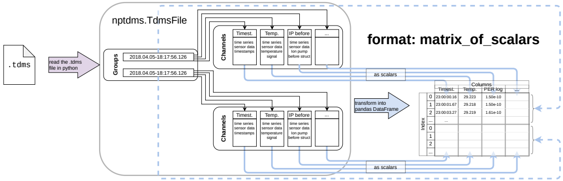
tdms_to_pd(tdms:TdmsFile, [format:str], [ch_of_interest: list])	
tdms	A read nptdms.TdmsFile object
format	'matrix_of_vectores' or 'matrix_of_scalars' defines the output format.
ch_of_interest	optional input (default = all channels"), defines the channels that will be columns in the ouput data frame

group_to_pd(grp:TdmsGroup, [ch_of_interrest: list])	
grp	A read nptdms.TdmsGroup object
ch_of_interest	optional input (default = all channels"), defines the channels that will be columns in the ouput data frame

clean and process data

handle data

machine learning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Groups
2018.04.05-18:17:56.126
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Channels
Timest.
time series sensor data timestamps
Temp.
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IP before
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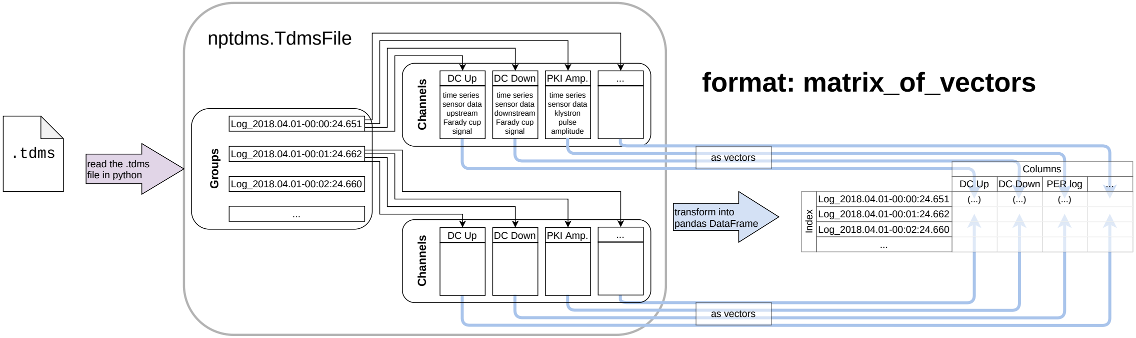
Index		Columns			
		Timest.	Temp.	PER log	...
	0	23:00:00.16	29.223	1.50e-10	
	1	23:00:01.67	29.218	1.50e-10	
	2	23:00:03.27	29.219	1.61e-10	
	...	...			
	0				
	1				
	2				
	...				

Transformation: read.tdms



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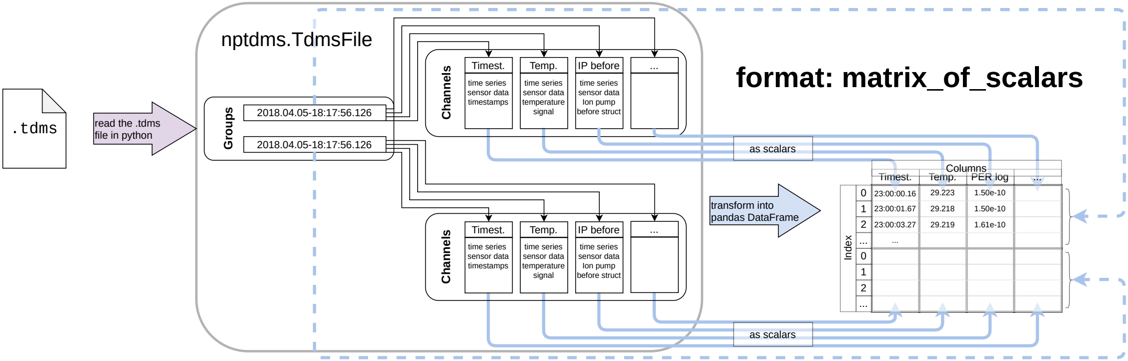
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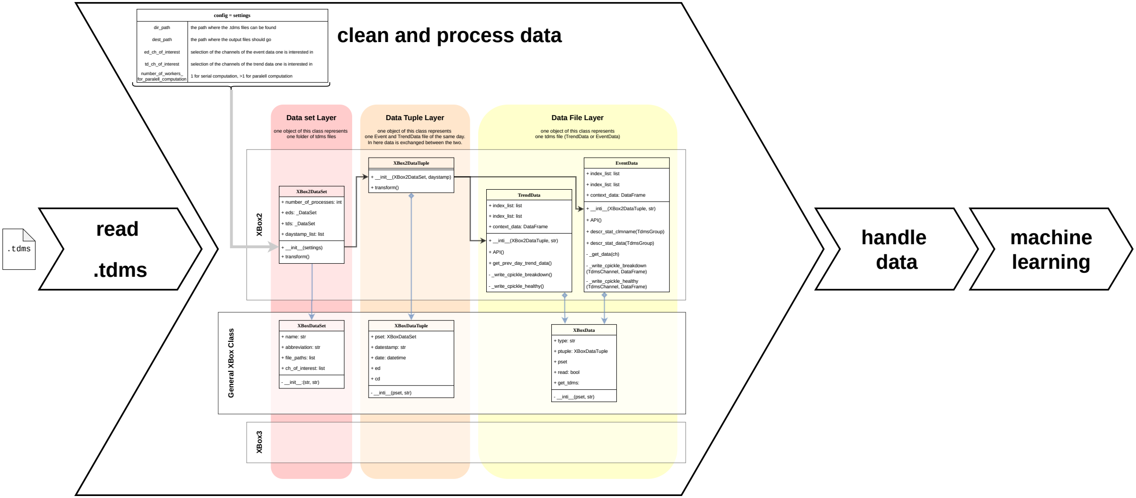
...	...			
0				
1				
2				
...				

Transformation: Clean and Process data with classes



.tdms

read

.tdms

clean and process data

config = settings	
dir_path	the path where the .tdms files can be found
dest_path	the path where the output files should go
ed_ch_of_interest	selection of the channels of the event data one is interested in
td_ch_of_interest	selection of the channels of the trend data one is interested in
number_of_workers_for_paralell_computation	1 for serial computation, >1 for paralell computation

Data set Layer

one object of this class represents one folder of tdms files

Data Tuple Layer

one object of this class represents one Event and TrendData file of the same day. In here data is exchanged between the two.

Data File Layer

one object of this class represents one tdms file (TrendData or EventData)

XBox2

XBox2DataSet
+ number_of_processes: int
+ eds: _DataSet
+ tds: _DataSet
+ daystamp_list: list
+ __init__(settings)
+ transform()

XBox2DataTuple
+ __init__(XBox2DataSet, daystamp)
+ transform()

TrendData
+ index_list: list
+ index_list: list
+ context_data: DataFrame
+ __inti__(XBox2DataTuple, str)
+ API()
+ get_prev_day_trend_data()
- _write_cpickle_breakdown()
- _write_cpickle_healthy()

EventData
+ index_list: list
+ index_list: list
+ context_data: DataFrame
+ __inti__(XBox2DataTuple, str)
+ API()
+ descr_stat_clmname(TdmsGroup)
+ descr_stat_data(TdmsGroup)
- _get_data(ch)
- _write_cpickle_breakdown (TdmsChannel, DataFrame)
- _write_cpickle_healthy (TdmsChannel, DataFrame)

General XBox Class

XBoxDataSet
+ name: str
+ abbreviation: str
+ file_paths: list
+ ch_of_interest: list
- __init__:(str, str)

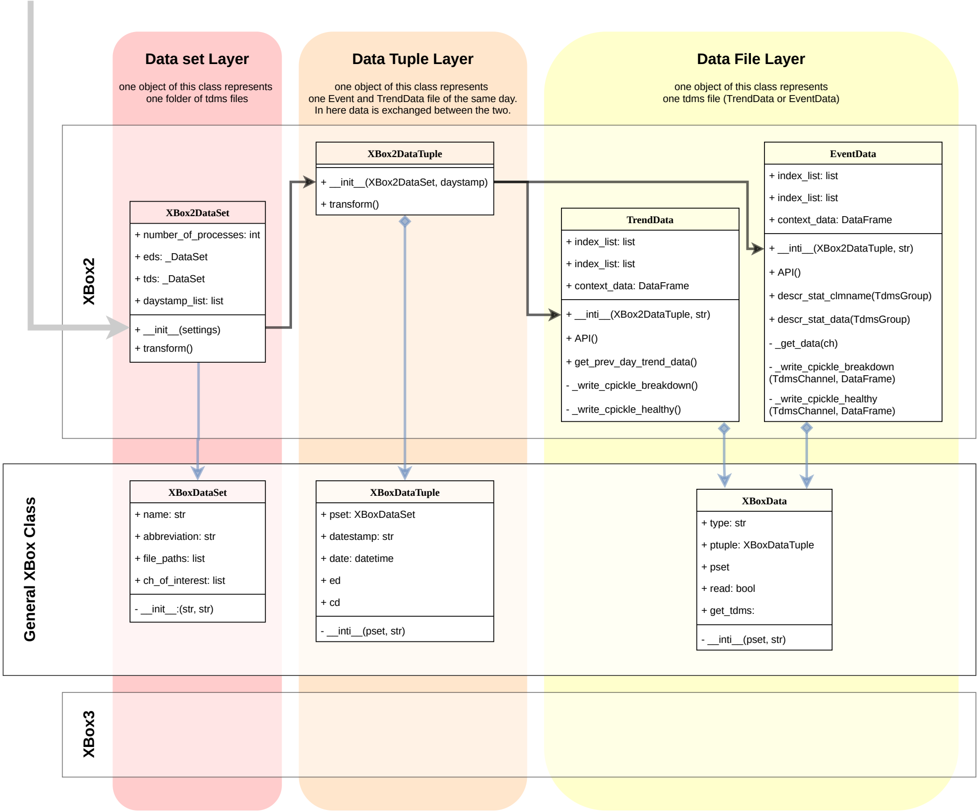
XBoxDataTuple
+ pset: XBoxDataSet
+ datestamp: str
+ date: datetime
+ ed
+ cd
- __inti__(pset, str)

XBoxData
+ type: str
+ ptuple: XBoxDataTuple
+ pset
+ read: bool
+ get_tdms:
- __inti__(pset, str)

XBox3

handle data

machine learning



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XBoxData
- + type: str
- + ptuple: XBoxDataTuple
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- + read: bool
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XBox3

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- data was changed in place in notebooks in retrospect

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	`nptdms`	`pd.df+cpickle`		`.hdf5`	
		w/o zip	w zip	w/o zip	w/ zip
space (GByte)	20.5GB	2.8GB	1GB	2.8GB	1GB
read (TD 1 channel)	$\sim$ 60min	4sec	12sec	0.5 sec	
read (TD 3 channels)	$\sim$ 60min	4sec	12sec	1 sec	
read (TD 15 channels)	$\sim$ 60min	4sec	12sec	4 sec	
feature calc. (ED)	$>$ 15min		7sec	8 sec	

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