
Fuzzy SQL

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Samer Kababji @ EHIL

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INSTALLATION

The Fuzzy SQL package is currently private and can be installed by authorized personnel by:

```
(.venv) $ pip install git+ssh://git@github.com/skababji-ehil/fuzzy_sql.git#egg=fuzzy_sql
```

Check out *Usage* for further information.

The package includes the necessary dependencies.

FUNCTIONS

`fuzzy_sql.fuzzy_sql.prep_data_for_db(csv_table_path: Path, optional_table_name='None', is_child=False, metadata_dir='None', n_rows=None) → tuple`

Reads the input csv file and prepares it for importation into sqlite db for fuzzy-sql analysis. By default, the file name (without extension) will be used as a table name in the database. All values are imported as strings. Any “” found in the values (e.g. ‘1’) is deleted. Any variable (columns) that include dots in their names will be replaced by underscores.

Parameters

- **csv_table_path** – The input file full path including the file name and csv extension.
- **optional_table_name** – This is an optional name of the table when imported into the database. The default ‘None’ will use the csv file name (without extension) as the table’s name.
- **is_child** – A boolean to indicate whether the input table is child or not. This will impact the generated metadata template. Enter ‘False’ if the input table is tabular or not a child.
- **metadata_dir** – The directory where the metadata file shall be saved. No metadata file is saved if the default value of ‘None’ is used.
- **n_rows** – The number of rows to be read from the input csv file. The default of None will read all the rows in the csv file.

Returns

The pandas dataframe in ‘unicode-escape’ encoding. The corresponding metadata dictionary. The dictionary is saved to the chosen path as provided in `metadata_dir`.

`fuzzy_sql.fuzzy_sql.import_df_into_db(table_name: str, df: DataFrame, db_conn: object)`

Imports the input dataframe into an sqlite database table. The data will NOT be imported if it already exists in the database.

Parameters

- **table_name** – The intended name of the table in the database.
- **df** – The input data
- **db_conn** – Database (sqlite3) connection object

```
fuzzy_sql.fuzzy_sql.gen_queries(n_queries: int, db_conn: object, real_tbl_lst: list, metadata_lst: list,
                                syn_tbl_lst: list, max_query_time=5) → list
```

The function generates multiple twin random queries of aggregate-filter type.

Parameters

- **n_queries** – The required number of queries to be generated.
- **db_conn** – A connection to the sqlite database where all the input real and synthetic data reside.
- **real_tbl_lst** – A list of real tables to be used for generating the random queries. The list may include related tables.
- **metadata_lst** – A list of dictionaries describing the variables and relations for each input table. A single metadata dictionary is used for each real table and its counterpart synthetic table since both real and synthetic tables shall have identical variables and relations.
- **syn_tbl_lst** – A list of synthetic tables to be used for generating the random queries.
- **max_query_time** – The maximum time in seconds that is allowed to execute a randomly generated query expression before it skips it to the next random expression.

Returns

A list of dictionaries where each dictionary includes the query result for real data as a dataframe, the query result for synthetic data as a dataframe, a dictionary describing the query details, a float representing the twin query Hellinger distance and another representing Euclidean distance, whenever applicable.

```
class fuzzy_sql.fuzzy_sql.RndQry(db_conn: object, tbl_names_lst: list, metadata_lst: list)
```

Generates a random query for tabular and longitudinal datasets.

Parameters

- **db_conn** (*object*) – The connection object of the sqlite database where the data exists.
- **tbl_names_lst** (*list of str*) – A list of input table names (strings) in the database to be randomly queried.
- **metadata_lst** (*list of dict*) – A list of dictionaries comprising the types of variables and relationships pertaining to each input table. Each dictionary shall conform to the metadata schema.

fix_seed

A boolean for setting the seed. Default is False and hence the query results will vary from one object to another.

oprtns: dict

A dictionary that defines the sets of various operations to be randomly sampled along with their desired discrete probabilities. The dictionary keys are defined below:

```
'AGG_OPS': The aggregate operations that can be used with any continuous_
↳ variable, if any, in the SELECT statement.
'LOGIC_OPS': The logical operations that can be used to combine conditions in_
↳ the WHERE clause.
```

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```

'NOT_STATE': A boolean with '1' indicating that a selected variable is to be
↳negated, i.e. preceded by NOT.
'CAT_OPS': The comparison operations that can be used with categorical
↳variables.
'CNT_OPS': The comparison operations that can be used with continuous variables.
'DT_OPS': The comparison operations that can be used with date variables.
'FILTER_TYPE': Whether to use WHERE or AND as a filter condition. This is
↳ignored in the case of tabular datasets since WHERE is the only choice.
'JOIN_TYPE': The type of JOIN in the SQL Lit database. This is ignored in the
↳case of tabular datasets.

```

The default options are shown below. For any key, the sum of operation probabilities shall be 1. For instance, in the values below, the probability of sampling 'AVG' is higher than SUM, MIN and MAX, but they all sum up to 1. All these probabilities can be redefined by the user like all other attributes. However, the user needs to make sure that the assigned probabilities will always sum up to 1:

```

oprtns={
'AGG_OPS': {'AVG':0.25, 'SUM':0.25, 'MAX':0.25, 'MIN':0.25 },
'LOGIC_OPS': {'AND':0.9, 'OR':0.1},
'NOT_STATE': {'0':0.9, '1':0.1},
'CAT_OPS': {'=':0.25, '<':0.25, 'LIKE':0.15, 'IN':0.15, 'NOT LIKE':0.1, 'NOT IN
↳':0.1},
'CNT_OPS': {'=':0.2, '>':0.1, '<':0.1, '>=':0.1, '<=':0.1, '<>':0.1, 'BETWEEN':0.
↳2, 'NOT BETWEEN':0.1},
'DT_OPS': {'=':0.2, '>':0.1, '<':0.1, '>=':0, '<=':0, '<>':0.1, 'BETWEEN':0.2,
↳'IN':0.1, 'NOT BETWEEN':0.1, 'NOT IN':0.1},
'FILTER_TYPE': {'WHERE':0.5, 'AND':0.5},
'JOIN_TYPE': {'JOIN':0.5, 'LEFT JOIN':0.5}
}

```

max_in_terms: int

The maximum number of values to be used in the 'IN' operation. You can set that to np.inf if you do not want to enforce any upper bound.

no_groupby_vars: int

The fixed number of terms (vars) to be used in the GROUPBY clause. Set it to np.inf (default) if you need the number of terms to be randomly selected. If it is set to a larger number than the possible GROUPBY variables, then this number will be ignored.

no_where_vars: int

The fixed number of terms (vars) to be used in the WHERE clause. Set it to np.inf (default) if you need the number of terms to be randomly selected. If it is set to a larger number than the possible WHERE variables, then this number will be ignored.

no_join_tables: int

The fixed number of join terms (tables) to be used in the JOIN clause. It does not include the name of the master parent table (i.e. the table directly following 'FROM' in the SELECT statement). Set it to np.inf to randomly select the number of JOIN terms.

compile_agg_expr() → Tuple[str, list, str, list, tuple]

Generates random aggregate query expression.

make_single_agg_query(single_expr: str, groupby_lst: list, from_tbl: str, join_tbl_lst: list, agg_fntn_terms: tuple) → dict

Executes a single aggregate query expression and returns the result as a dataframe in a dictionary

make_twin_agg_query(*syn_tbl_name_lst: list, real_expr: str, real_groupby_lst: list, real_from_tbl: str, real_join_tbl_lst: list, agg_fntn_terms: tuple*) → dict

Executes a twin (both for real and synthetic datasets) aggregate query expression and returns the results as dataframes in a dictionary

compile_fltr_expr() → Tuple[str, str, list]

Generates random filter query expression.

make_single_fltr_query(*single_expr: str, from_tbl: str, join_tbl_lst: list*) → dict

Executes a single filter query expression and returns the result as dataframe in a dictionary

make_twin_fltr_query(*syn_tbl_name_lst: list, real_expr: str, real_from_tbl: str, real_join_tbl_lst: list*) → dict

Executes a twin filter query expression and returns the results as dataframes in a dictionary

compile_aggfltr_expr() → Tuple[str, list, str, list, tuple]

Generates a random aggregate-filter query expression.

make_single_aggfltr_query(*single_expr: str, groupby_lst: list, from_tbl: str, join_tbl_lst: list, agg_fntn_terms: tuple*) → dict

Executes a single aggregate-filter query expression and returns the result as a dataframe in a dictionary

make_twin_aggfltr_query(*syn_tbl_name_lst: list, real_expr: str, real_groupby_lst: list, real_from_tbl: str, real_join_tbl_lst: list, agg_fntn_terms: tuple*) → dict

Executes a twin aggregate-filter query expression and returns the results as dataframes in a dictionary

calc_dist_scores(*matched_rnd_query: dict*) → dict

Calculates Hellinger and Normalized Euclidean scores for the input random twin queries (i.e. real and synthetic) and updates the input dictionary with the calculated scores. The input queries shall be matched.

class `fuzzy_sql.fuzzy_sql.QryRprt`(*dataset_table_lst: list, random_queries: dict*)

Generates reports and plots for the input random queries.

Parameters

- **dataset_table_lst** (*list*) – List of table names that were used to generate the input queries.
- **random_queries** (*dict*) – A dictionary comprising multiple number of queries as dataframes with detailed description for each query.

query_to_html(*query_id: str, rnd_query: dict*) → str

print_html_mltpl(*output_file: Path*)

calc_stats() → Tuple[dict, dict]

plot_violin(*type: str, outputfile: str*)

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