
Technical Documentation

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Part I

The Emotions Tool

QUICK START

1.1 Installation

To use the tool, download its compiled binary from the repository and execute it from a console.

Important: The tool has been tested on **Ubuntu Xenial 16.04**.

The **Affdex SDK** is only available on Windows and Ubuntu Xenial 16.04, so compatibility with other Operative Systems is not guaranteed.

1.1.1 From source with CMake

Clone and open the [GitHub repository](#) in a console, using the following commands:

```
git clone https://github.com/espositoandrea/Bachelor-Thesis.git
cd Bachelor-Thesis
```

Open the directory containing the tool's source code:

```
cd emotions
```

Finally, create and compile the CMakeProject:

```
mkdir bin
cd bin
cmake -G "CodeBlocks - Unix Makefiles" ..
make
```

1.2 Usage

Important: To use the tool you must have the **Affdex SDK** installed on your machine. Then, you have to add `/path/to/affdex-sdk/lib` to the variable `$LD_LIBRARY_PATH` (on Ubuntu).

```
export LD_LIBRARY_PATH=$LD_LIBRARY_PATH:/path/to/affdex-sdk/lib/
```

The tool will then search, in its folder, for the folder `lib/affdex-sdk/data/` (that has to contain the data used by Affdex).

The tool can be used through CLI (or executed by another script).

```
./emotions [<option>...] IMAGE...  
./emotions [<option>...] --file FILE
```

Where IMAGE is a *data URI*. The available options are:

- h, --help** Get the help message
- f FILE, --file FILE** The file containing the images to be analyzed (as a data URI)

CODE DOCUMENTATION

2.1 The Entry Point

The main file.

This file is the main file of the tool.

Author Andrea Esposito <github.com/espositoandrea>

Functions

int **main** (int *argc*, char ***argv*)

The main entry point.

This is the entry point of the tool.

Return An *exit code* based on the execution.

Parameters

- *argc*: The length of *argv*.
- *argv*: The array of arguments given through the command line.

2.2 The CLI

exit_codes **setup_options** (int *argc*, char ***argv*, std::vector<std::string> &*images*)

Set up the tool's options and arguments.

This function is responsible of the CLI API of the tool. It sets and handles the available options and arguments.

Return An *exit code*:

- *exit_codes::OK* If the given arguments are valid and no errors occurred.
- *exit_codes::HALT* If the given arguments are valid but the argument combination stops the execution.
- *exit_codes::ARGUMENT_ERROR* If the given arguments are invalid
- *exit_codes::UNKNOWN_ARGUMENT_ERROR* If an unknown error occurred.

Parameters

- `argc`: The length of `argv`.
- `argv`: The array of arguments passed via CLI.
- `images`: A variable that will contain the images passed through the CLI API.

2.3 The Exit Codes

enum exit_codes

A collection of all the exit codes of the tool.

This enum contains all the (expected) exit codes of the tool.

Values:

OK = 0

The tool exited with no error completing its tasks.

HALT = 1

The tool exited with no error, but without completing its tasks.

ARGUMENT_ERROR = 2

The tool exited due to errors in the given arguments.

UNKNOWN_ARGUMENT_ERROR = 3

The tool exited due to unknown errors while parsing the arguments.

2.4 The Data URI

class data_uri

A utility class to handle data URIs.

This class represents a data URI. A data URI is defined by [MDN](#) as a string with the following syntax: `data:[<mediatype>][;<base64>],<data>`.

Public Functions

data_uri (**const** std::string &*s*)

The class constructor.

This constructor creates a *data_uri* from a string.

Parameters

- *s*: The string representing the data uri.

Exceptions

- `data_uri::string_not_uri`: if *s* is not a valid data URI.

std::string **get_type** () **const**

Get the media type.

This function returns the media type of the data URI.

Return The media type (`<mediatype>` in `data:<mediatype>;base64,<data>`).

`std::string get_data () const`

Get the data.

This function returns the data contained in the data URI.

Return The data (`<data>` in `data:<mediatype>;base64,<data>`).

`std::string get_uri () const`

Get the URI.

This function returns the entire URI as a string.

Return The URI as a string.

Public Static Functions

`bool is_data_uri (const std::string &s)`

Check if a string is a data URI.

The function checks if a string is in the format `data:<mediatype>;base64,<data>`.

Return True if `s` is a data URI, false otherwise.

Parameters

- `s`: The string to be checked

`class string_not_uri : public exception`

An exception raised if a string is not an URI.

This exception is thrown if a string, assumed to be one, is not a data URI.

2.5 The Base64 Utilities

namespace base64

Namespace for dealing with *base64* strings.

This namespace contains utilities to deal with *base64* strings.

Functions

`std::string encode (const std::string &s)`

Encode a string to *base64*.

This function encodes a string to a *base64* string.

Return The encoded string.

Parameters

- `s`: The string to be encoded.

`std::string encode (unsigned char const *s, unsigned int len)`

Encode a string to *base64*.

This function encodes a string to a *base64* string.

Return The encoded string.

Parameters

- `s`: The string to be encoded.
- `len`: The length of the string `s`.

`std::string decode (std::string const &s)`

Decode a *base64* string.

This function decodes a *base64* string to a binary string.

Return The decoded string.

Parameters

- `s`: The string to be decoded.

Part II

The Browser Extension

THE BROWSER EXTENSION

Part III

The Server

INTRODUCTION

4.1 Folder Structure

The `server/` folder contains all the source code of the developed server. Its structure is the following (all described folders are subfolders of `server/`).

views/ This folder contains all the views developed for the server.

views/layouts/ This folder contains the layouts used to define the views.

survey/ This folder contains all the required data for the survey.

assets/ This folder contains all the static files that will be served without any modification.

assets/images/ A folder that contains all the images and illustrations used.

assets/js/ A folder that contains all the external JavaScript files (needed by the extension).

assets/style/ A folder that contains all the stylesheets of the server (written in [SASS](#)).

THE DATA PROCESSOR

THE SURVEY

The survey is generated using the exported object defined in the module `survey-data.js`. Here is documented the structure of that object.

class Survey()

The survey configuration object.

Arguments

- **introduction** (*string*) – The introduction to the survey. Treated as raw HTML.
- **sections** (*Array.<Section>*) – The survey's sections.

class Section()

A section of the survey.

Arguments

- **title** (*string*) – The section's title.
- **questions** (*Array.<Question>*) – The section's questions.

class Question()

A question of the survey. @extends BasicQuestion.

Arguments

- **type** (*string*) – The type of question.
- **rules** (*Object*) – Various additional rules. Can be any HTML attribute accepted by the current input type.
- **placeholder** (*string*) – The input placeholder.
- **choices** (*Array.<string>*) – A list of choices. Used only if type is 'choice'.
- **question** (*string|Array.<BasicQuestion>*) – If it's a string, the same as BasicQuestion.question. If an array of BasicQuestion, a list of questions used if type is 'likert'.

class BasicQuestion()

A basic question of the survey. This class contains all the required field of a question.

Arguments

- **question** (*string*) – The question that will be asked to the user.
- **name** (*string*) – The name of the GET/POST parameter.

- **required** (*boolean*) – Whether or not the input is required.

Part IV

The Data Analyzer

QUICK START

7.1 Installation

To install the tool, download the tool's folder and execute the following commands (replace `/path/to/analyzer/` with the path to the downloaded folder).

Listing 1: How to install the tool

```
cd /path/to/analyzer
python3 -m pip install .
```

7.2 Usage

7.2.1 The Command Line Interface

Once installed you can use this tool from your terminal using the command `analyzer`.

Listing 2: The tool's CLI

```
analyzer [-h] [--version] [-v] file users
```

Note: You can execute the tool as a Python module, without installing it first. Download the tool's folder and execute the following commands (replace `/path/to/analyzer/` with the path to the downloaded folder).

Listing 3: How to execute the tool as a Python module

```
cd /path/to/analyzer  
python3 -m analyzer --help
```

Process the JSON file

Positional Arguments

file The file

users A JSON file containing the users

Optional Arguments

-h, --help	show this help message and exit
--version	output version information and exit
-v, --verbose	increase output verbosity

7.2.2 The Code API

Once installed you can use the tool as a Python module. Read the [code documentation](#) for more information on the API.

CODE DOCUMENTATION

8.1 Module: cli

This module defines the CLI of the tool.

This module contains the definition of the Command Line Interface (CLI) of the tool and its entry point.

```
analyzer.cli.main()
```

The main entry point.

8.2 Module: data

A module to deal with the data stored on the server.

This module is a collection of classes, functions, etc to deal with the collected data that's stored on the server.

Examples

Listing 1: How to create an object from a JSON.

```
from data_processor.data import CollectedData, User
user_string = "[YOUR_USER_LIST]"
user_set = set(User.from_json(user_string))
json_string = "[YOUR_OBJECT]"
CollectedData.from_json(user_set, json_string)
# [CollectedData(...), ...]
```

```
class analyzer.data.CollectedData (data_id: str, user: analyzer.data.user.User, timestamp: int =
None, url: str = None, mouse: analyzer.data.common.MouseInformation
= None, scroll: analyzer.data.common.ScrollInformation
= None, window: analyzer.data.common.ScreenCoordinates
= None, keyboard: analyzer.data.common.KeyboardInformation
= None, emotions: analyzer.data.common.Emotions = None)
```

The collected data.

This class represents the data collected from the server.

data_id

The object's id.

Type str

user

The user that produced this data.

Type *User*

timestamp

The timestamp on which this data was produced.

Type int

url

The visited URL.

Type string

mouse

Various data regarding the mouse.

Type *MouseInformation*

scroll

Various data about the scroll position.

Type *ScrollInformation*

window

Data about the browser's window's dimensions.

Type ScreenCoordinates;

keyboard

Data about the pressed keys.

Type *KeyboardInformation*

emotions

The emotions value, fetched from Affectiva.

Type *DotMap*

static from_json (*users*: *Set[analyzer.data.user.User]*, *data*: *str*) → *List[analyzer.data.collected_data.CollectedException]*

Create a list of data from a JSON string.

This method can be used to generate a list of data starting from a JSON string.

Parameters

- **users** (*set [User]*) – The set of users that generated this data.
- **data** (*str*) – The JSON string. It must represent a valid JSON array.

Returns The list of users represented by the JSON array.

Return type *list [CollectedException]*

static to_dataframe (*data*: *List[CollectedException]*)

Convert a list of CollectedException to a DataFrame.

This function converts a list of CollectedException to a pandas DataFrame.

Parameters data (*list [CollectedException]*) – The list of data to be converted.

Returns The data converted into a DataFrame

Return type *pandas.DataFrame*

class analyzer.data.Emotions (*joy*: *float = None*, *fear*: *float = None*, *disgust*: *float = None*, *sadness*: *float = None*, *anger*: *float = None*, *surprise*: *float = None*, *contempt*: *float = None*, *valence*: *float = None*, *engagement*: *float = None*)

Encapsulates all the information extracted by Affectiva [1].

joy

The joy value. May be *None* if no value was registered.

Type *float*

fear

The fear value. May be *None* if no value was registered.

Type *float*

disgust

The disgust value. May be *None* if no value was registered.

Type *float*

sadness

The sadness value. May be *None* if no value was registered.

Type *float*

anger

The anger value. May be *None* if no value was registered.

Type float

surprise

The surprise value. May be *None* if no value was registered.

Type float

contempt

The contempt value. May be *None* if no value was registered.

Type float

valence

The valence value. May be *None* if no value was registered.

Type float

engagement

The engagement value. May be *None* if no value was registered.

Type float

References

class analyzer.data.Gender

A gender enumerator.

An enumerator of all the valid gender values.

class analyzer.data.KeyboardInformation (*alpha: bool, numeric: bool, symbol: bool, function: bool*)

Encapsulates various information regarding the keyboard's state.

alpha

Is an alphabetic key pressed?

Type bool

numeric

Is a numeric key pressed?

Type bool

symbol

Is a symbol key pressed?

Type bool

function

Is a function key pressed?

Type bool

class analyzer.data.MouseInformation (*position: analyzer.data.common.ScreenCoordinates, buttons: dotmap.DotMap*)

Encapsulates various data regarding the mouse.

position

The mouse position

Type *ScreenCoordinates*

buttons

The mouse buttons. The keys are the following.

l Is the left button pressed?

m Is the middle button pressed?

r Is the right button pressed?

bN Is the button N ($N \in \mathbb{N}, N \geq 4$) pressed?

Type `DotMap [str, bool]`

buttons_list () \rightarrow `List[int]`

Convert the mouse button objects to a list.

This function converts the data on the mouse buttons to a list of ID. The ID are assigned as in the HTML's `MouseEvent` [\[1\]](#).

Returns A list of mouse buttons' IDs.

Return type `list [int]`

References

class `analyzer.data.ScreenCoordinates`

Represents a pair of screen coordinates.

x

The coordinate on the x axis.

Type `int`

y

The coordinate on the y axis.

Type `int`

x

Alias for field number 0

y

Alias for field number 1

class `analyzer.data.ScrollInformation` (*relative:* *analyzer.data.common.ScreenCoordinates,*
absolute: *analyzer.data.common.ScreenCoordinates*)

Encapsulates various information regarding the scroll state of the window.

absolute

The absolute scroll position.

Type *ScreenCoordinates*

relative

The relative scroll position (from the bottom right of the screen).

Type *ScreenCoordinates*

class analyzer.data.**User** (*user_id: str, age: int = None, gender: analyzer.data.common.Gender = None, internet: int = None*)

A user.

This class represents a user as seen for this study.

user_id

The user's ID.

Type int

age

The user's age.

Type int

gender

The user's gender.

Type *Gender*

internet

The average time the user spend a day on the internet.

Type int

static from_json (*data: str*) → List[analyzer.data.user.User]

Create a list of users from a JSON string.

This method can be used to generate a list of users starting from a JSON string.

Parameters **data** (*str*) – The JSON string. It must represent a valid JSON array.

Returns The list of users represented by the JSON array.

Return type list [*User*]

8.3 Module: plotting

A module to plot data.

This module contains various definition of various function that plot the data on various graph types.

analyzer.plotting.**convert_collection** (*collection: List[analyzer.data.collected_data.CollectedException]*)
 → Dict[analyzer.data.user.User,
 List[Dict[str, Any]]]

Convert a collection to a dictionary.

This function converts a collection of CollectedData to a dictionary that has users as key and all their related data (grouped by URL and visit) as values.

Returns A dictionary that, for each user, holds all the collected data grouped by URL an time of visit. This means that two visit in two different times to the same website, will result in two different objects in this dictionary's value.

Return type dict [*User*, list [dict [str, any]]]

`analyzer.plotting.get_common_urls` (*collection*: List[*analyzer.data.collected_data.CollectedException*])
→ Set[str]

Get all the urls visited by all the users in a collection.

Parameters *collection* (list [*CollectedException*]) – A list of data.

Returns A set of URLs visited by all the users in the *collection*.

Return type set [str]

`analyzer.plotting.plot_mouse_on_common_websites` (*collection*:
List[*analyzer.data.collected_data.CollectedException*])
→ None

Plot various graph containing the mouse movement on websites commonly used by all users.

Parameters

- **user** (set [*User*]) – The users.
- **collection** (list [*CollectedException*]) – The collected data.

Part V

License

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```
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