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# **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](https://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 API

The server exposes a simple API to get data from the database. The methods can be classified in two groups, based on the object they return. All API access is over HTTPS and accessed from `https://giuseppe-desolda.ddns.net:8080`. All data is returned as JSON.

### 5.1 Users

#### 5.1.1 Index

- `GET /api/users`
- `GET /api/users/(int:skip)-(int:limit)`
- `GET /api/user/(str:id)`

#### 5.1.2 APIs

##### **GET /api/users**

Get all the users.

**Example request:**

```
GET /api/users HTTP/1.1
HOST: giuseppe-desolda.ddns.net:8080
```

**Example response:**

```
HTTP/1.1 200 OK
Content-Type: application/json; charset=utf-8

[
  {
    "_id": "5ea18ca785df5712068595",
    "age": "2",
    "internet": "4",
    "gender": "m"
  },
  {
    "_id": "5ea1b63385df57120720c3",
    "age": "2",
    "internet": "4",
```

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```
    "gender": "m"
  }
]
```

## Status Codes

- **200 OK** – No error

**GET** `/api/users/(int: skip)` –

**int:** *limit* Get the first *limit* users starting from *skip* (included).

**Example request:**

```
GET /api/users/3-2 HTTP/1.1
HOST: giuseppe-desolda.ddns.net:8080
```

**Example response:**

```
HTTP/1.1 200 OK
Content-Type: application/json; charset=utf-8

[
  {
    "_id": "5eab3d3f348b1746eeb06a99",
    "age": "2",
    "gender": "m",
    "internet": "18"
  },
  {
    "_id": "5eb014d0348b1746eeb76c18",
    "age": "2",
    "gender": "m",
    "internet": "18"
  }
]
```

## Parameters

- **skip** – The number of users to skip
- **limit** – The number of users to return

## Status Codes

- **200 OK** – No error

**GET** `/api/user/(str: id)`

Get the user with id *id*.

**Example request:**

```
GET /api/user/5ebd67189976b12b146a2735 HTTP/1.1
HOST: giuseppe-desolda.ddns.net:8080
```

**Example response:**



```
HTTP/1.1 200 OK
Content-Type: application/json; charset=utf-8

{
  "_id": "5ebd67189976b12b146a2735",
  "age": "2",
  "gender": "f",
  "internet": "7"
}
```

### Parameters

- **id** – The id of the user

### Status Codes

- **200 OK** – No error

## 5.2 Interactions

### 5.2.1 Index

- *GET /api/interactions*
- *GET /api/interactions/(int:skip)-(int:limit)*
- *GET /api/interaction/(str:id)*
- *GET /api/user/(str:id)/interactions*
- *GET /api/user/(str:id)/interactions/(int:skip)-(int:limit)*

### 5.2.2 APIs

#### **GET /api/interactions**

Get all the interactions. **Warning:** due to the huge quantity of data it's likely that the connection will timeout.

#### **Example request:**

```
GET /api/user/5ebd67189976b12b146a2735 HTTP/1.1
HOST: giuseppe-desolda.ddns.net:8080
```

#### **Example response:**

```
HTTP/1.1 200 OK
Content-Type: application/json; charset=utf-8

[
  {
    "_id": "5ea1bc9a85dfb571207298e",
    "k": {
      "a": false,
      "f": false,

```

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```

        "n": false,
        "s": false
    },
    "m": {
        "b": {
            "l": false,
            "r": false,
            "m": false
        },
        "p": [
            0,
            0
        ]
    },
    "s": {
        "a": [
            0,
            400
        ],
        "r": [
            100,
            400
        ]
    },
    "t": 1587657878562,
    "u": "https://www.repubblica.it/",
    "ui": "5ealb63385dff57120720c3",
    "w": [
        1537,
        956
    ],
    "e": {}
},
{
    "_id": "5ealbc9a85dff571207298f",
    "k": {
        "a": false,
        "f": false,
        "n": false,
        "s": false
    },
    "m": {
        "b": {
            "l": false,
            "r": false,
            "m": false
        },
        "p": [
            0,
            0
        ]
    },
    "s": {
        "a": [
            0,
            400
        ]
    }
}

```

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```

    ],
    "r": [
        100,
        400
    ]
},
"t": 1587657878685,
"u": "https://www.repubblica.it/",
"ui": "5ealb63385dff57120720c3",
"w": [
    1537,
    956
],
"e": {}
},
{
    "_id": "5ealbc9a85dff5712072990",
    "k": {
        "a": false,
        "f": false,
        "n": false,
        "s": false
    },
    "m": {
        "b": {
            "l": false,
            "r": false,
            "m": false
        },
        "p": [
            0,
            0
        ]
    },
    "s": {
        "a": [
            0,
            400
        ],
        "r": [
            100,
            400
        ]
    },
    "t": 1587657878810,
    "u": "https://www.repubblica.it/",
    "ui": "5ealb63385dff57120720c3",
    "w": [
        1537,
        956
    ],
    "e": {}
},
{
    "_id": "5ealbc9a85dff5712072991",
    "k": {

```

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```

        "a": false,
        "f": false,
        "n": false,
        "s": false
    },
    "m": {
        "b": {
            "l": false,
            "r": false,
            "m": false
        },
        "p": [
            0,
            0
        ]
    },
    "s": {
        "a": [
            0,
            400
        ],
        "r": [
            100,
            400
        ]
    },
    "t": 1587657878857,
    "u": "https://www.repubblica.it/",
    "ui": "5eal63385dff57120720c3",
    "w": [
        1537,
        956
    ],
    "e": {}
},
{
    "_id": "5ealbc9a85dff5712072992",
    "k": {
        "a": false,
        "f": false,
        "n": false,
        "s": false
    },
    "m": {
        "b": {
            "l": false,
            "r": false,
            "m": false
        },
        "p": [
            0,
            0
        ]
    },
    "s": {
        "a": [

```

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```

        0,
        400
    ],
    "r": [
        100,
        400
    ]
},
"t": 1587657878966,
"u": "https://www.repubblica.it/",
"ui": "5eal63385dffb57120720c3",
"w": [
    1537,
    956
],
"e": {}
}
]
```

### Status Codes

- 200 OK – No error

**GET** /api/interactions/ (int: skip) –

**int:** *limit* Get the first *limit* interactions starting from the *skip*. **Warning:** due to the huge quantity of data it's likely that the connection will timeout.

**Example request:**

```
GET /api/interactions/4-2 HTTP/1.1
HOST: giuseppe-desolda.ddns.net:8080
```

**Example response:**

```
HTTP/1.1 200 OK
Content-Type: application/json; charset=utf-8

[
  {
    "_id": "5ealbc9a85dffb5712072992",
    "k": {
      "a": false,
      "f": false,
      "n": false,
      "s": false
    },
    "m": {
      "b": {
        "l": false,
        "r": false,
        "m": false
      },
      "p": [
        0,
        0
      ]
    }
  }
]
```

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```

    ]
  },
  "s": {
    "a": [
      0,
      400
    ],
    "r": [
      100,
      400
    ]
  },
  "t": 1587657878966,
  "u": "https://www.repubblica.it/",
  "ui": "5ealb63385dfb57120720c3",
  "w": [
    1537,
    956
  ],
  "e": {}
},
{
  "_id": "5ealbc9a85dfb5712072993",
  "k": {
    "a": false,
    "f": false,
    "n": false,
    "s": false
  },
  "m": {
    "b": {
      "l": false,
      "r": false,
      "m": false
    },
    "p": [
      0,
      0
    ]
  },
  "s": {
    "a": [
      0,
      400
    ],
    "r": [
      100,
      400
    ]
  },
  "t": 1587657879058,
  "u": "https://www.repubblica.it/",
  "ui": "5ealb63385dfb57120720c3",
  "w": [
    1537,
    956
  ]
}

```

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```

    ],
    "e": {}
  }
]

```

### Parameters

- **skip** – The number of interactions to skip
- **limit** – The number of interactions to return

### Status Codes

- **200 OK** – No error

**GET** `/api/interaction/` (**str:** *id*)

Get the interaction with id *id*.

### Example request:

```

GET /api/interaction/5ealbc9a85dfb5712072992 HTTP/1.1
HOST: giuseppe-desolda.ddns.net:8080

```

### Example response:

```

HTTP/1.1 200 OK
Content-Type: application/json; charset=utf-8

{
  "_id": "5ealbc9a85dfb5712072992",
  "k": {
    "a": false,
    "f": false,
    "n": false,
    "s": false
  },
  "m": {
    "b": {
      "l": false,
      "r": false,
      "m": false
    },
    "p": [
      0,
      0
    ]
  },
  "s": {
    "a": [
      0,
      400
    ],
    "r": [
      100,
      400
    ]
  }
}

```

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```

},
"t": 1587657878966,
"u": "https://www.repubblica.it/",
"ui": "5eal63385dfb57120720c3",
"w": [
  1537,
  956
],
"e": {}
}

```

## Parameters

- **id** – The id of the interaction

## Status Codes

- **200 OK** – No error

**GET /api/user/(str: *id*)/interactions**

Get all the interaction of the user with id *id*.

**Example request:**

```

GET /api/user/5eal63385dfb57120720c3/interactions HTTP/1.1
HOST: giuseppe-desolda.ddns.net:8080

```

**Example response:**

```

HTTP/1.1 200 OK
Content-Type: application/json; charset=utf-8

[
  {
    "_id": "5ealbc9a85dfb571207298e",
    "k": {
      "a": false,
      "f": false,
      "n": false,
      "s": false
    },
    "m": {
      "b": {
        "l": false,
        "r": false,
        "m": false
      },
      "p": [
        0,
        0
      ]
    },
    "s": {
      "a": [
        0,
        400
      ]
    }
  }
]

```

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```

    ],
    "r": [
      100,
      400
    ]
  },
  "t": 1587657878562,
  "u": "https://www.repubblica.it/",
  "ui": "5ealb63385dff57120720c3",
  "w": [
    1537,
    956
  ],
  "e": {}
},
{
  "_id": "5ealbc9a85dff571207298f",
  "k": {
    "a": false,
    "f": false,
    "n": false,
    "s": false
  },
  "m": {
    "b": {
      "l": false,
      "r": false,
      "m": false
    },
    "p": [
      0,
      0
    ]
  },
  "s": {
    "a": [
      0,
      400
    ],
    "r": [
      100,
      400
    ]
  },
  "t": 1587657878685,
  "u": "https://www.repubblica.it/",
  "ui": "5ealb63385dff57120720c3",
  "w": [
    1537,
    956
  ],
  "e": {}
},
{
  "_id": "5ealbc9a85dff5712072990",
  "k": {

```

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```

        "a": false,
        "f": false,
        "n": false,
        "s": false
    },
    "m": {
        "b": {
            "l": false,
            "r": false,
            "m": false
        },
        "p": [
            0,
            0
        ]
    },
    "s": {
        "a": [
            0,
            400
        ],
        "r": [
            100,
            400
        ]
    },
    "t": 1587657878810,
    "u": "https://www.repubblica.it/",
    "ui": "5ealb63385dff57120720c3",
    "w": [
        1537,
        956
    ],
    "e": {}
}
]

```

### Parameters

- **id** – The id of the user

### Status Codes

- **200 OK** – No error

**GET** /api/user/(str: *id*)/interactions/

**int:** *skip*–**int:** *limit* Get the first *limit* interactions starting from the *skip* of the user with id *id*.

**Example request:**

```

GET /api/user/5ealb63385dff57120720c3/interactions/6-2 HTTP/1.1
HOST: giuseppe-desolda.ddns.net:8080

```

**Example response:**

```

HTTP/1.1 200 OK
Content-Type: application/json; charset=utf-8

[
  {
    "_id": "5ealbc9a85dfb5712072994",
    "k": {
      "a": false,
      "f": false,
      "n": false,
      "s": false
    },
    "m": {
      "b": {
        "l": false,
        "r": false,
        "m": false
      },
      "p": [
        0,
        0
      ]
    },
    "s": {
      "a": [
        0,
        400
      ],
      "r": [
        100,
        400
      ]
    },
    "t": 1587657879177,
    "u": "https://www.repubblica.it/",
    "ui": "5ealb63385dfb57120720c3",
    "w": [
      1537,
      956
    ],
    "e": {}
  },
  {
    "_id": "5ealbc9a85dfb5712072995",
    "k": {
      "a": false,
      "f": false,
      "n": false,
      "s": false
    },
    "m": {
      "b": {
        "l": false,
        "r": false,
        "m": false
      },
      "p": [

```

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(continued from previous page)

```

        0,
        0
    ],
    },
    "s": {
        "a": [
            0,
            400
        ],
        "r": [
            100,
            400
        ]
    },
    "t": 1587657879295,
    "u": "https://www.repubblica.it/",
    "ui": "5ealb63385dffb57120720c3",
    "w": [
        1537,
        956
    ],
    },
    "e": {}
}
]
```

### Parameters

- **skip** – The number of interactions to skip
- **limit** – The number of interactions to return
- **id** – The id of the user

### Status Codes

- **200 OK** – No error

## 5.3 Websites

### 5.3.1 Index

- *GET /api/websites*

### 5.3.2 APIs

#### **GET /api/websites**

Get all the visited websites and the number of visits received.

**Example request:**

```
GET /api/websites HTTP/1.1
HOST: giuseppe-desolda.ddns.net:8080
```

**Example response:**

```
HTTP/1.1 200 OK
Content-Type: application/json; charset=utf-8

[
  {
    "count": 876,
    "url": "https://zoom.us/",
    "category": "UNKNOWN"
  },
  {
    "count": 1502,
    "url": "https://wwwapd.ict.uniba.it/",
    "category": "Università/Università di Bari"
  },
  {
    "count": 796,
    "url": "https://www.zamzar.com/",
    "category": "Data Formats/Conversion"
  }
]
```



## THE DATA PROCESSOR





## THE SURVEY

### 7.1 Rationale

To avoid the continuous editing of a verbose HTML file, the survey structure has been parametrized. This allows to edit freely the survey without editing the HTML file, and for this reason assures a consistent look to all the survey's questions.

For this, a basic schema of the survey data has been defined. Note that this schema is in no way enforced: there's no checking of your data and any properties not defined in this schema won't raise any error but will be ignored. On the other side, any defined and required property that's not defined in the configuration object could block the HTML generation or (in the worst case) generate a wrong HTML structure.

### 7.2 The Schema

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.<ChoiceDescription>/number*) – A list of choices. Used only if type is ‘choice’ or ‘radios’. If it’s a number *n*, it’s used to generate *n* ChoiceDescription objects having {label: *i*, value: *i*}, con  $1 \leq i \leq n$ .
- **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*) – Wether or not the input is required.

**class ChoiceDescription()**

A description of a Question choice.

### Arguments

- **label** (*string*) – The label of the choice. This will be seen by the user.
- **value** (*any*) – The value of the choice. This will be sent to the server.

## **Part IV**

# **The Data Analyzer**



## QUICK START

### 8.1 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 .
```

### 8.2 Usage

#### 8.2.1 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

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

### 8.2.2 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

### 9.1 Module: cli

### 9.2 Module: data

### 9.3 Module: plotting





# **Part V**

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```
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```

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