Web Engineering Project Documentation

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1 Introduction

The decisions we make in the design of our API are based on RESTful Design principles. REST design is in general based upon the following principles:

1. Resources, which are any kind of object, data, or service that can be accessed by the client.
2. Resource has an identifier, which is a URI that uniquely identifies that resource.
3. Client interacts with a service by exchanging representation of resources.
4. Use a uniform interface, which helps to decouple the client and service implementations.

Furthermore there are four level of "Maturity" that have been defined in such a design. Our goal is to design an API as close as possible to Maturity level 3.

2 Milestone 1: API Design

2.1 Resources

Resources refers to the information that can be returned by an API. In our case, the various resources that can be returned are the following:

1. **Airports object**: represents all the airports that are available in the USA, which has parameters such as `code` and `name`.
2. **Statistics object**: returns statistics about flights. It has the following parameters: `flights`, `number of delays` and `minutes delayed`.
   - 2.1. **Flights object**: returns information about the number of `cancelled`, `on time`, `delayed`, `diverted` flights and their `total`.
   - 2.2. **Number of delays object**: returns the number of delays categorized by reasons such as: `late aircraft`, `weather`, `security`, `national aviation system` and `carrier`.
   - 2.3. **Minutes delayed object**: returns the number of minutes delayed per reason of delay: `late aircraft`, `weather`, `security`, `national aviation system` and `carrier`.
3. **Time object**: returns information about time based on the following parameters: `year`, `month` and `label`
4. **Carriers object**: returns the carriers that have flights in the USA, which have a `code` and a `name` parameter.

2.2 Endpoints

Endpoints represent the entries that give access to the resource. Currently, the endpoints presented below refer strictly to the ones given in the Project Description document, but they may modify in the future.

1. **GET** the list of all airports available in the USA

   `/airports`

2. **GET** the list of all carriers operating in US airports

   `/carriers`

3. **GET** the list of all carriers operating at a specific US airport

   `/airports/{airport_code}/carriers`

4. **GET, POST, PUT & DELETE** statistics about flights of a carrier from/to an US airport for a given year and month

   `/airports/{airport_code}/carriers/{carrier_code}/stats?year={year}&month={month}`

   GET, POST, PUT & DELETE all statistics about flights of a carrier from/to an US airport for all months available

   `/airports/{airport_code}/carriers/{carrier_code}/stats`

5. **GET** the number of on-time, delayed, and cancelled flights of a carrier from/to an US airport for a given year and month

   `/airports/{airport_code}/carriers/{carrier_code}/stats/flights?year={year}&month={month}`

   GET the number of on-time, delayed, and cancelled flights of a carrier from/to an US airport for all months available

   `/airports/{airport_code}/carriers/{carrier_code}/stats/flights`

6. **GET** the number of minutes of delay per carrier attributed to carrier-specific reasons, for a given year and month and for a specific airport

   `/airports/{airport_code}/carriers/stats/delay-times?reason=carrier,late-aircraft&year={year}&month={month}`

   GET the number of minutes of delay per carrier attributed to carrier-specific reasons, for a given year and month and for all US airports

   `/airports/carriers/stats/delay-times?reason=carrier,late-aircraft&year={year}&month={month}`

GET the number of minutes of delay per carrier attributed to all reasons, for a given year and month and for a specific airport

`/airports/{airport_code}/carriers/stats/delay-times?year={year}&month={month}`

GET the number of minutes of delay per carrier attributed to all reasons, for a given year month and for all US airports

`/airports/carriers/stats/delay-times?year={year}&month={month}`

All four endpoints above can be used without the *year* and *month* attribute to **GET** the data for all available months.

7. **GET** the descriptive statistics, mean, median, and standard deviation, for carrier-specific delays for a flight between any two airports in the USA for a specific carrier serving this route.

   `/airports/{airport_code_1}/{airport_code_2}/carriers/{carrier_code}/extra-stats/delay-times`

   GET the descriptive statistics, mean, median, and standard deviation, for carrier-specific delays for a flight between any two airports in the USA for all carriers serving this route.

   `/airports/{airport_code_1}/{airport_code_2}/carriers/extra-stats/delay-times`

3 Server Responses

3.1 Status Codes

When the client raises a request to the server through an API, the client should know the feedback, whether it failed, passed or the request was wrong. HTTP status codes are bunch of standardized codes which has various explanations in various scenarios. The server should always return the right status code. The following are the important categorization of HTTP codes:

1. 200 OK. The standard HTTP response representing success for GET, PUT or POST.
2. 201 Created. This status code should be returned whenever the new instance is created. E.g on creating a new instance, using POST method, should always return 201 status code.
3. 204 No Content. Represents the request is successfully processed, but has not returned any content. DELETE can be a good example of this.
4. 400 Bad Request. Indicates that the request by the client was not processed, as the server could not understand what the client is asking for.
5. 404 Not Found. Indicates that the requested resource is not available now.
6. 500 Internal Server Error. Indicates that the request is valid, but the server is totally confused and the server is asked to serve some unexpected condition.
7. 503 Service Unavailable. Indicates that the server is down or unavailable to receive and process the request. Mostly if the server is undergoing maintenance.

3.2 Data

The requested data will be served in JSON format. Next follow some examples of data in JSON returned by the server for a **GET** request to each endpoint:

1. **GET** request to:

   `/airports`

   JSON response example:

   `[ATL, CLT, SAN]`

2. **GET** request to:

   `/carriers`

   JSON response example:

   `[CO, VX, SAN]`

3. **GET** request to:

   `/airports/{airport_code}/carriers`

   JSON response example:

   `[CO, VX, SAN]`

4. **GET** request to:

   `/airports/{airport_code}/carriers/{carrier_code}/stats?year={year}&month={month}`

   JSON response example:

```
{
    "flights": {
        "cancelled": 5,
        "on time": 561,
        "total": 752,
        "delayed": 186,
        "diverted": 0
    },
    "# of delays": {
        "late aircraft": 18,
        "weather": 28,
        "security": 2,
        "national aviation system": 105,
        "carrier": 34
    },
    "minutes delayed": {
```

```
        "late aircraft": 1269,
        "weather": 1722,
        "carrier": 1367,
        "security": 139,
        "total": 8314,
        "national aviation system": 3817
    }
}
```


GET request to:

`/airports/{airport_code}/carriers/{carrier_code}/stats`

JSON response example:


```
[
    {
        "flights": {
            "cancelled": 5,
            "on time": 561,
            "total": 752,
            "delayed": 186,
            "diverted": 0
        },
        "# of delays": {
            "late aircraft": 18,
            "weather": 28,
            "security": 2,
            "national aviation system": 105,
            "carrier": 34
        },
        "minutes delayed": {
            "late aircraft": 1269,
            "weather": 1722,
            "carrier": 1367,
            "security": 139,
            "total": 8314,
            "national aviation system": 3817
        },
        "time": {
            "label": "2003/6",
            "year": 2003,
            "month": 6
        }
    },
    {
        "flights": {
            "cancelled": 7,
            "on time": 1034,
```

```
            "total": 1266,
            "delayed": 225,
            "diverted": 0
        },
        "# of delays": {
            "late aircraft": 46,
            "weather": 24,
            "security": 2,
            "national aviation system": 84,
            "carrier": 69
        },
        "minutes delayed": {
            "late aircraft": 3043,
            "weather": 1783,
            "carrier": 4201,
            "security": 45,
            "total": 12139,
            "national aviation system": 3067
        },
        "time": {
              "label": "2003/10",
              "year": 2003,
              "month": 10
        }
    }
]
```


5. **GET** request to:

   `/airports/{airport_code}/carriers/{carrier_code}/stats/flights?year={year}&month={month}`

   JSON response example:


```
{
    "on time": 561,
    "delayed": 186,
    "cancelled": 5
}
```


   GET request to:

   `/airports/{airport_code}/carriers/{carrier_code}/stats/flights`

   JSON response example:


```
[
    {
        "on time": 561,
        "delayed": 186,
```

```
        "cancelled": 5,
        "time": {
            "label": "2003/6",
            "year": 2003,
            "month": 6
        }
    },
    {
        "on time": 1034,
        "delayed": 225,
        "cancelled": 7,
        "time": {
              "label": "2003/10",
              "year": 2003,
              "month": 10
        }
    }
]
```


6. **GET** request to:

   `/airports/{airport_code}/carriers/stats/delay-times?reason=carrier,late-aircraft&year={year}&month={month}`

   JSON response example:


```
[
    {
        "minutes delayed": {
            "carrier": 1367,
            "late aircraft": 1269
        },
        "carrier": {
            "code": "AA",
            "name": "American Airlines Inc."
        }
    },
    {
        "minutes delayed": {
            "carrier": 69,
            "late aircraft": 277
        },
        "carrier": {
            "code": "XE",
            "name": "ExpressJet Airlines Inc."
        }
    }
]
```


   GET request to:

`/airports/carriers/stats/delay-times?reason=carrier,late-aircraft&year={year}&month={month}`

JSON response example:


```
[
    {
        "carrier-delays": [
            {
                "minutes delayed": {
                    "carrier": 1367,
                    "late aircraft": 1269
                },
                "carrier": {
                    "code": "AA",
                    "name": "American Airlines Inc."
                }
            },
            {
                "minutes delayed": {
                    "carrier": 69,
                    "late aircraft": 277
                },
                "carrier": {
                    "code": "XE",
                    "name": "ExpressJet Airlines Inc."
                }
            }
        ],
        "airport": {
          "code": "ATL",
          "name": "Atlanta, GA: Hartsfield-Jackson Atlanta International"
        }
    },
    {
        "carrier-delays": [
            {
                "minutes delayed": {
                    "carrier": 5,
                    "late aircraft": 0
                },
                "carrier": {
                    "code": "AA",
                    "name": "American Airlines Inc."
                }
            },
            {
                "minutes delayed": {
                    "carrier": 690054684655,
                    "late aircraft": 15699900
```

```
                },
                "carrier": {
                    "code": "AL",
                    "name": "AlwaysLate Airlines Inc."
                }
            }
        ],
        "airport": {
          "code": "SEA",
          "name": "Seattle, WA: Seattle/Tacoma International"
        }
    }
]
```


GET request to:

`/airports/{airport_code}/carriers/stats/delay-times?year={year}&month={month}`

JSON response example:


```
[
    {
        "minutes delayed": {
            "late aircraft": 775,
            "weather": 155,
            "carrier": 1478,
            "security": 0,
            "national aviation system": 3343
        },
        "carrier": {
            "code": "AA",
            "name": "American Airlines Inc."
        }
    },
    {
        "minutes delayed": {
            "late aircraft": 456,
            "weather": 658,
            "carrier": 1414,
            "security": 2,
            "national aviation system": 3543
        },
        "carrier": {
            "code": "XE",
            "name": "ExpressJet Airlines Inc."
        }
    }
]
```


GET request to:

/airports/carriers/stats/delay-times?year={year}&month={month}

JSON response example:


```
[
    {
        "carrier-delays": [
            {
                "minutes delayed": {
                    "late aircraft": 775,
                    "weather": 155,
                    "carrier": 1478,
                    "security": 0,
                    "national aviation system": 3343
                },
                "carrier": {
                    "code": "AA",
                    "name": "American Airlines Inc."
                }
            },
            {
                "minutes delayed": {
                    "late aircraft": 123,
                    "weather": 321,
                    "carrier": 213,
                    "security": 312,
                    "national aviation system": 0
                },
                "carrier": {
                    "code": "XE",
                    "name": "ExpressJet Airlines Inc."
                }
            }
        ],
        "airport": {
          "code": "ATL",
          "name": "Atlanta, GA: Hartsfield-Jackson Atlanta International"
        }
    },
    {
        "carrier-delays": [
            {
                "minutes delayed": {
                    "late aircraft": 721,
                    "weather": 462,
                    "carrier": 5555,
                    "security": 10,
                    "national aviation system": 3343
                },
```

```
                "carrier": {
                    "code": "AA",
                    "name": "American Airlines Inc."
                }
            },
            {
                "minutes delayed": {
                    "late aircraft": 0,
                    "weather": 0,
                    "carrier": 0,
                    "security": 1000000000,
                    "national aviation system": 0
                },
                "carrier": {
                    "code": "AL",
                    "name": "AlwaysLate Airlines Inc."
                }
            }
        ],
        "airport": {
          "code": "SEA",
          "name": "Seattle, WA: Seattle/Tacoma International"
        }
    }
]
```


GET request to:

`/airports/{airport_code_1}/{airport_code_2}/carriers/{carrier_code}/extra-stats/delay-times`

JSON response example:


```
{
    "carrier": {
        "mean": 775,
        "median": 155,
        "standard deviation": 1478
    },
    "late aircraft": {
        "mean": 775,
        "median": 1554,
        "standard deviation": 1235
    }
}
```


GET request to:

`/airports/{airport_code_1}/{airport_code_2}/carriers/extra-stats/delay-times`

JSON response example:

```
[
    {
        "carrier delay": {
            "mean": 775,
            "median": 155,
            "standard deviation": 1478
        },
        "late aircraft": {
            "mean": 775,
            "median": 1554,
            "standard deviation": 1235
        },
        "carrier": {
            "code": "DL",
            "name": "Delta Air Lines Inc."
        }
    },
    {
        "carrier delay": {
            "mean": 775,
            "median": 155,
            "standard deviation": 1478
        },
        "late aircraft": {
            "mean": 775000,
            "median": 1589,
            "standard deviation": 1458
        },
        "carrier": {
            "code": "AL",
            "name": "AlwaysLate Airlines Inc."
        }
    }
]
```


4 ER Model

This is an alpha version of our ER model. We identify three main entities in our model: **Airports, Carries and Flights**. The first two entities are pretty straight forward. Each of contains a name and a code as their identifiers. For the third entity things are a bit more complicated. Flights are mainly identified by the flight code. However we also need to keep track of the statistics of all flights. To do that we decided to split the Flight entity into 4 sub-entities. **On-time, Cancelled Delayed and Diverted.** For each of those sub categories we keep track of the statistics. We have a large number of statistics. First of all we need to keep track the reason a flight has been delayed due to different reasons(N.A.S,aircraft,weather,carrier),which are provided to us in both json and csv files. Secondly we also need to keep track of the total time(in minutes) of each of those reason seperately and the combined time of all those reasons.

Since this is an Alpha version of our ER model, some of the entities and identifiers might change

in the future. However we feel its important to provide a starting point for a visual representation of our thought process.