**Lehrstuhl für Systeme und Informationsverwaltung**

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**Praxis der Softwareentwicklung (PSE)**
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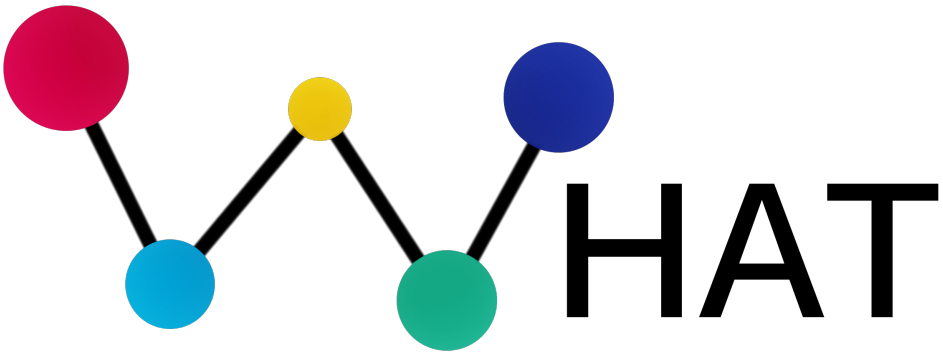
Visualizing and Statistically Analyzing Access Behavior to Scientific Databases

# Functional Specification




WareHouse Analyzing Tool

November 21, 2012

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## General Information

PSE is a mandatory course for students of computer science bachelor at the Karlsruhe Institute of Technology (KIT). Therefor groups of five to six students are formed to write programs of 'medium size' (about 5000 Lines of Code). The task given in this course consists of analyzing and visualizing the server log of a database.

This specification is the one of PSE Group #10 in the winter semester 2012/13.

## What this specification does

The purpose of this document is an outline of the functional specifications and requirements for the WHAT application. It tries to give a complete and exact model of the future system. In the course of this it wants to give the developers answers to all possible question concerning what should be implemented.

## What this specification does not

This specification does not give any information on how the system should be implemented. Also it doesn't contain any project planning or deadlines.

## A 'Living Document'

Software development is a dynamic process. So with proceeding development the content of this specification will change continuously.

## Skyserver

The concept of the system described in this specification should work with any database storing it's query-log. The SkyServer will function as an example and testing reference for this system. SkyServer is one of the biggest databases for astronomical data.

## About us

Because no one of us speaks English as his first language, we can't guarantee that our documentation doesn't contain simple or incorrectly used language. Our focus lies more on having an easy-to-understand and correct documentation than on perfect English.

If you have any questions or comments regarding this document feel free to send us an E-Mail.

# Contents

# 1 Goals

With this program the user should be put in the position to visualize the prepared data of queries, made into his data base.

To structure the criteria the system has to fulfill, it is divided into three parts for this and other sections.

- Web page
- parser
- Analyzer

See 8.1 for an overview of these parts and their relationships. In the following section their specific goals and criteria are described.

## 1.1 Web page

### 1.1.1 Core criteria

- The web page is the graphical user interface (GUI) for users and administrators.
- Users can choose the charts they want to see and also choose and filter the dimensions and measures for those. It has to support at least scatter plots, histograms and bubble charts.
- The web page provides help for how to use the diagrams and variables (dimensions and measures). Also the navigation on the page is easy to use and straight forward.
- An admin-login provides administrative rights, which are needed to use the parser.

### 1.1.2 Optional criteria

- The language of the web page can be changed (e.g. German).
- The administrator gets the ability to handle the data warehouse and load new log files.
- A little history of the last requested charts is stored and viewable.

### 1.1.3 Exclusion criteria

- The web page does not allow normal users to load new data into the data warehouse.
- The web page does not provide statistical tables.

## 1.2 Parser

### 1.2.1 Core criteria

- The parser is able to perform the ETL-process on .csv log files (from SkyServer). This means it extracts the data it needs from the files, transforms them and loads them into the data-warehouse. dimension and measures are specified in 5.2.
- The parser will recognize invalid logs and won't add them to the data warehouse. Every log with a mistake won't be accepted, because an error-message is not as bad as a corrupted data warehouse.
- The parser will be fed with log files from the administrator via web page.

### 1.2.2 Exclusion criteria

- This parser is only able to operate on .csv log files from SkyServer. It can neither read logs in another formats nor logs from another source.
- There is no way to avoid using this parser when adding data to the data warehouse. This prevents corrupting the data warehouse and guarantees correct data in it.
- The parser doesn't correct mistakes in the log files.

## 1.3 Analyzer

### 1.3.1 Core criteria

- The analyzer is the gate to the data warehouse. It extracts the specific data, needed for the diagrams, passing them to the java-script front-end.
- The analyzer can take information filtered by user-selected criteria, to use only certain data for the charts.
- The charts that are supported are at least:
  - scatter plots
  - histograms
  - bubble charts

### 1.3.2 Optional criteria

- The analyzer will support more chart-types, for example the combination of a histogram and a scatter plot.
- The analyzer does a little bit of data mining, and presents some potentially interesting information.

# 2 Usage

## 2.1 Area of Application

The application area of this product is scientific databases that need to be analysed, understood and visualised. The program has been designed with the Skyserver in mind, so that is the primary application area. However, as the only major requirement is the existence of correct access logs of the database. The software may also be used with many other scientific databases, although minor modifications may be needed.

## 2.2 Target groups

The target group of this application is people that want to analyse and visualize queries made against a database. Specifically, in our case, the SkyServer.

This includes

- the owners of the database who want to optimize the access to their data,
- people that are interested in what others use the database for,
- people new to the database, who want to understand it or discover interesting information.

To summarize, WHAT will be of interest for many people, whether they want to see how their database is used, analyse current trends, or just love statistics and diagrams.

We expect a rather technical audience.

## 2.3 Operating conditions

The program is mainly used as a website, with the primary difference being that the server has to be started, if the capacity for it to run all the time on a dedicated machine doesn't exist. The program needs a server to run.

If a dedicated server exists, the program can be used from anywhere with a decent network connection to it.

If not, the program can still be run on the same computer as the server (on localhost), but the server will have to be started first.

# 3 Operating environment

Whereas the program and the data warehouse run on a server, the access to it will be via a web browser on the users computer. This implies that the webpage will need to be hosted on a webserver. However, a dedicated server machine is not required, as the clients computer can host both the client and the webserver, and then access the webpage locally.

## 3.1 Software

- The server hosting the data warehouse needs SQL support.
- The server hosting the web server needs a recent version of the Java VM

Following software is required on the users computer:

- Latest version of a modern browser
  - Though Chrome and Firefox will be officially supported, other browsers might work as well.
- JavaScript (enabled)

## 3.2 Hardware

The server has to be fast enough to support all clients. This depends on the expected number of clients. Most computations will be done on the server.

The client needs to be fast enough to visualize the data received from the server, as that's almost all it does. The required hardware thus depends greatly on the amount of data that needs to be visualized. That said, any recent computer, with for example, an Intel® Core™2 Duo CPU E8400 @ 3.00GHz × 2 processor, 4GB(2x2GB) of 667Mhz DDR2 SDRAM, running Ubuntu Linux 12.10 Quantal Quetzal, as a point of reference, should be able to visualize about 50.000 data points on a scatter plot with ease.

## 3.3 Orgware

The server needs to be able to connect to the client with a reasonable latency. Also it has to be set up before the client is able to connect to it.

To fulfill optional requirements, the program must be able to run queries against the origin database.

# 4 Functional requirements

## 4.1 Main functions

This functions are required to fulfill the core criteria.

### General

/F010/ Provide access via web page
/F020/ Provide option for chart types
/F030/ Show diagrams
/F040/ Show histograms
/F050/ Provide option to select and filter variables for histograms
/F060/ Show scatter plots
/F070/ Provide option to select and filter variables for scatter plots
/F080/ Show bubble charts
/F090/ Provide option to select and filter variables for bubble charts
/F100/ Show information about chart types
/F110/ Show information about selectable variables

### Administrator specific

This functions are required for the administrative business.

/F120/ Provide access via web page with administrator rights
/F130/ Provide the opportunity to pass log files to the parser

### Parser specific

The functions required from the parser are mainly to execute the ETL-process.

/F140/ Extract specific data from the log files
/F150/ Extract access database, access time and user information (dimensions)
/F160/ Extract number of rows, elapsed time, busy time (measures)
/F170/ Extract type of data requested from the WHERE-part
/F180/ Transform the data to fit into the data warehouse schema
/F190/ Load the data into the data warehouse

### Analyzer specific

/F200/ Run specific queries against data warehouse

/F210/ Transform received data serving the web page

## 4.2 Extending functions

To fulfill the optional goals the following functions are required.

### General

/F220/ Select language on web page

/F230/ Show bubble map

/F240/ Show combination of histogram and scatter plot

/F250/ Show other charts

/F260/ Show history of the 5 last requested charts

/F270/ Show interesting attribute combinations

/F280/ Show clusters in the data

/F290/ Add background clustering

### Administrator specific

/F300/ Provide the opportunity to initialize the data warehouse

/F310/ Provide the opportunity to request new log file for specific time intervals from the database

/F320/ Provide the opportunity to clean the data warehouse

# 5 Data

## 5.1 Static data

/D10/ Language files

/D20/ Manual

/D30/ Source Code

/D40/ Documentation

/D50/ Graphics for GUI

/D60/ HTML backbone

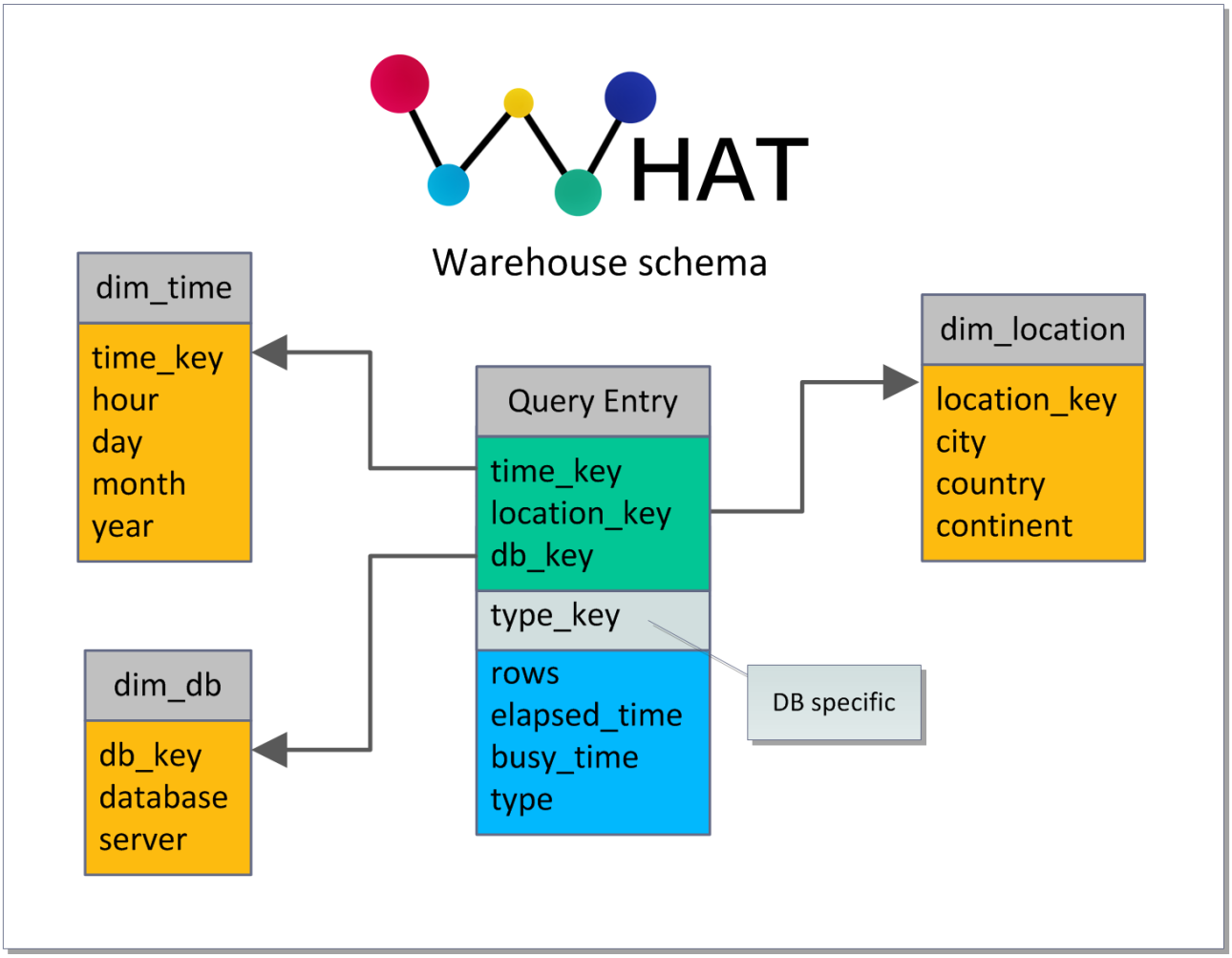
/D70/ Javascript files

/D80/ Stylesheet files

## 5.2 Data-Warehouse data

The data warehouse stores all the data, coming from from the databases (SkyServer) server logs. They were subject of the ETL-process in the parser. If optional criteria are fulfilled they can be replaced by clearing the data warehouse and loading new data via web page as administrator.

The data warehouse may use a star schema.




The column 'type_key' can either be just a measure or refer to a new dimension. This depends on the database on which is operated.

See rows, elapsed time and busy time in the glossary (10) for descriptions.

# 6 Nonfunctional requirements

## 6.1 Usability

/N10/ Minimalistic GUI design

/N20/ Responsive GUI

/N30/ GUI that is easy to get used to

/N40/ The data warehouse can store more than 1000000 entries

## 6.2 Swiftness

/N50/ Parse 1000 log rows in 10 seconds

/N60/ Visualize scatter plot of 50000 points in 10 seconds

## 6.3 Maintainability

/N70/ Easy translating in other languages

/N80/ Reasonably commented, clean code

## 6.4 Optional

/N90/ Show a nice loading screen while visualizing a diagram.

# 7 Test Cases

## 7.1 General

These test-cases are necessary for the web page to work properly and succeed in serving basic requests.

/T010/ Access web page (/F010/)

/T012/ via Google Chrome,

/T014/ via Mozilla Firefox.

/T020/ Navigate swiftly through the web page. (/N30/)

/T030/ Open page for scatter plot-creation and create an example with x-Axis date and y-Axis number of rows per request. (/F020/, /F030/, /F060/, /F070/)

/T040/ Open page for histogram-creation and create an example with x-Axis year and y-Axis number of requests. (/F020/, /F030/, /F040/, /F050/)

/T050/ Open page for bubble chart-creation and create an example with x-Axis year, y-Axis Country and size number of requests. (/F020/, /F030/, /F080/, /F090/)

/T060/ Call the information about chart types. (/F100/)

/T070/ Request information about selectable variables. (/F110/)

## 7.2 Administrator specific

These test cases check the correct admin-login.

/T080/ Enter loginname and password for admin-login. (/F120/)

/T090/ Log-in and get administrative rights. (/F120/)

/T100/ Try to log in with wrong loginname. (/F120/)

/T110/ Try to log in with wrong password. (/F120/)

/T120/ Pass example log file to the parser. (/F130/)

## 7.3 Parser specific

The following test cases ensure the correct work of our parser.

/T130/ Parse example log file and extract valuable information correctly. (/F140/)
More specifically:

- /T132/ Extract correct database, time, user information and type, (/F150/)
- /T134/ Extract correct number of rows, elapsed time, busy time from the log file, (/F160/)
- /T136/ Extract the type requested. (/F170/)

/T140/ Load the extracted information into the data warehouse correctly. (/F180/, /F190/)

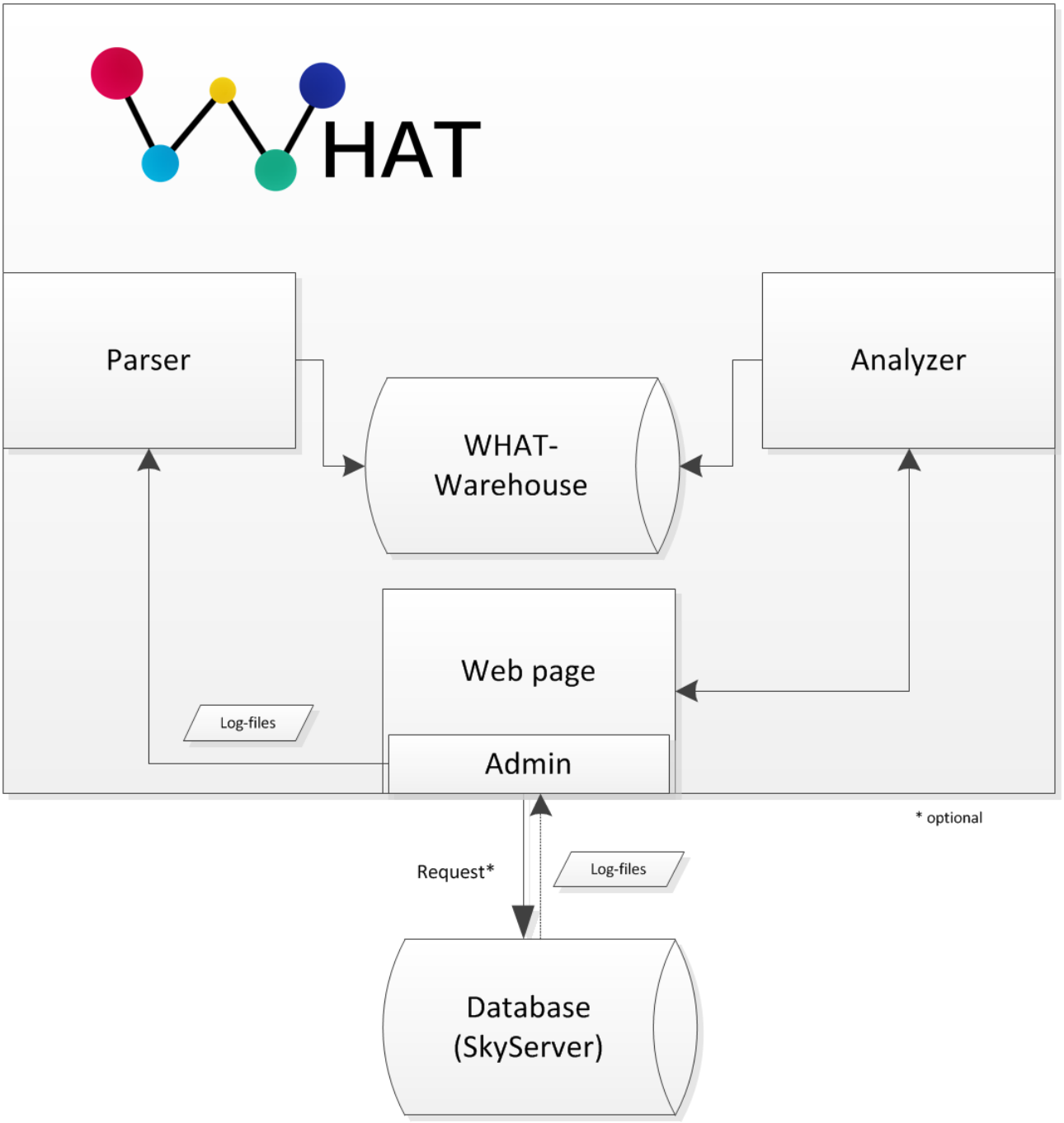
## 7.4 Analyzer specific

The functions /F200/ and /F210/ of the analyzer are already tested in the general test-cases /T030/ to /T050/.

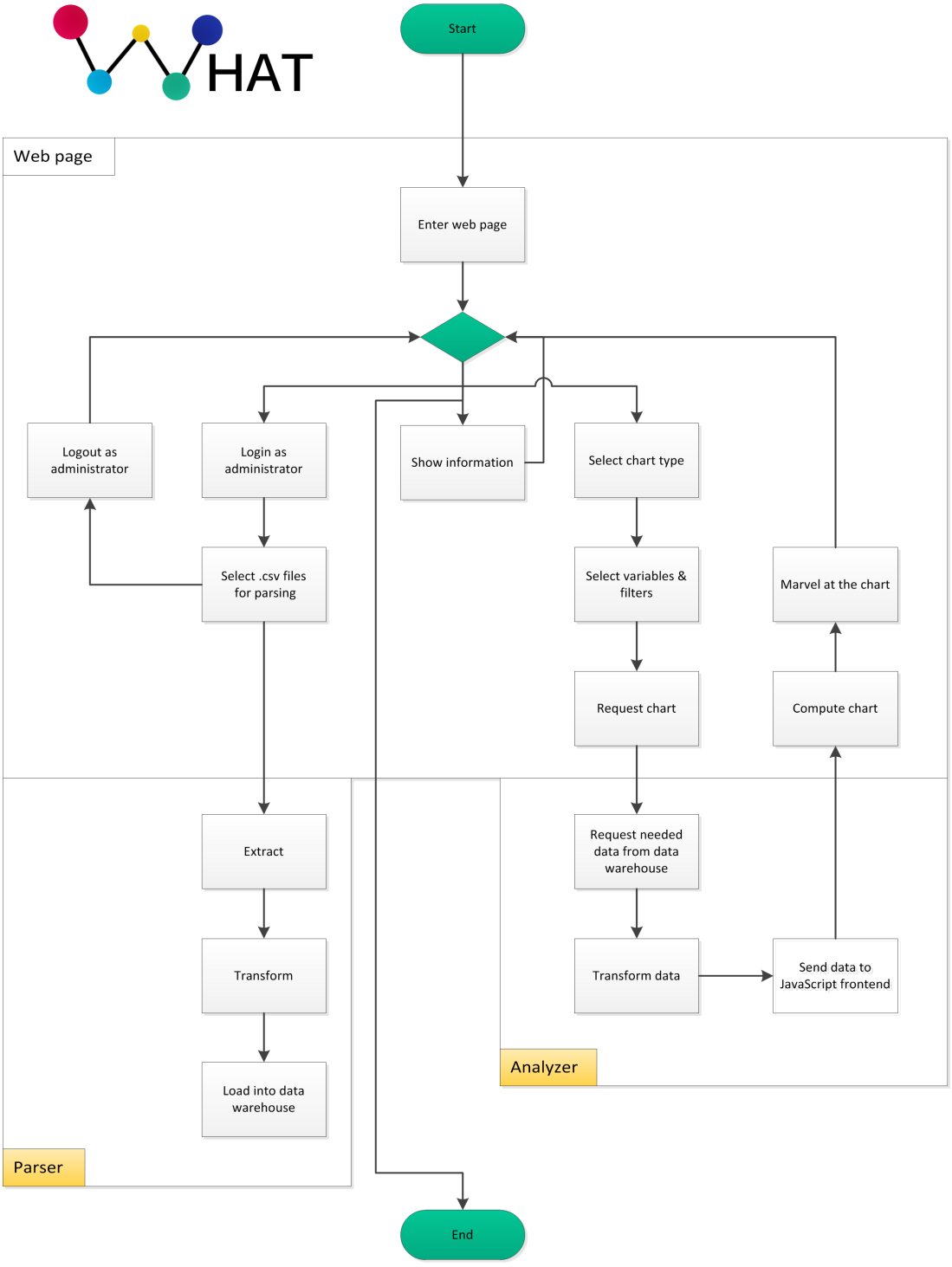
# 8 Models

## 8.1 Overview

This picture describes the general concept of WHAT.



## 8.2 Dynamic models



## 8.3 Web interfaces

The start page of the web page.

An example for a diagram page.

# 9 Development Environment

## Operating System

- Windows 7
- Fedora 17
- Ubuntu 12.10

## Object Models

- Microsoft Visio

## Version Control

- Git

## Miscellaneous

- Github (Hosting of Repository, Issue Tracking)
- Travis (Integration)
- LaTeX (Documents)
- Gradle (Building)

# 10 Glossary

**.csv** .csv is a file format which is used for log files, saving them in a standardized formatting schema. [6]

**bubble chart** A bubble chart is a type of chart that displays three dimensions of data. Two values are expressed through the disk's xy location and the third through its size. Bubble charts can facilitate the understanding of social, economical, medical, and other scientific relationships. (Wiki) [5, 6, 9, 14]

**busy time** Busy time can also be refered to as CPU time and is the amount of time which a central processing unit (CPU), in our case the Skyserver, needed to process instructions, e.g. to serve the requested data. (Wiki) [9, 12, 15]

**chart** Used with the same meaning as diagram. [9, 10, 14, 21]

**data warehouse** A data warehouse is a database used for reporting and data analysis. It is a central repository of data which is created by integrating data from multiple disparate sources. (Wiki) [5, 6, 8–10, 12, 13, 15, 21, 22]

**database** A database is a structured collection of data. It's main task is storing a huge amount of data efficiently, without inconsistens and over a long period of time. (Wiki) [2, 7–10, 12, 15, 21, 22]

**diagram** A diagram is a symbolic representation of informations according to some visualization technique. The term diagram is used with the same meaining as chart. (Wiki) [5, 7, 9, 13, 19, 21]

**dimension** A dimensions describes either a dimension of a diagram or a dimension in a data warehouse. [5, 6, 9, 12]

**elapsed time** Elapsed (real) time is the time taken from start of computer program to the end. Elapsed real time includes I/O time and all other types of wait. (Wiki) [9, 12, 15]

**ETL-process** ETL - extract, transform, load - refers to a process in a data warehouse usage. This involves extracting data from the outside, transforming it to fit oprational needs and loading it into the end target. (Wiki) [6, 9, 12]

**GUI** A graphical user interface, short GUI, is a type of user interface that allows users to interact with electronic devices using images rather than text commands.(Wiki) [5, 13]

**histogram** A histogram is a graphical representation showing a visual impression of the distribution of data. (Wiki) [5, 6, 9, 10, 14]

**Java VM** A Java virtual machine (JVM) is a virtual machine that can execute Java bytecode. (Wiki) [8]

**KIT** is a technological university in Karlsruhe, Baden-Württemberg, Germany (Karlsruhe Institute of Technology) [2, 22]

**log file** The server log file records information about queries run against a database. [5, 6, 9, 10, 14, 15]

**measure** A measure is a variable in a model with a specific value rang. [9]

**parser** A parser describes the program, which just has the function of analyzing a text, to determine its grammatik structure with respect to a given formal grammar. Or in other words, he extracts parts of a text respectivly to their function or meaning. (Wiki) [5, 6, 9, 14, 15]

**PSE** PSE stand for practice of software engineering (germ. Praxis der Software-Entwicklung). It is part of the computer science bachelor at the KIT. [2]

**query** A query is a request into a database or data warehouse. [5, 22]

**row** In the context of a database, a row represents a single, implicitly structured data item in a table. Each row in a table represents a set of related data, and every row in the table has the same structure.(Wiki) [9, 13, 15]

**scatter plot** A scatter plot or scattergraph is a type of mathematical diagram. The data is displayed as a collection of points, each having the value of one variable determining the position on the horizontal axis and the value of the other variable determining the position on the vertical axis. (Wiki) [5, 6, 8–10, 13, 14]

**SkyServer** is a big database for astronomical data. It contains pictures and other information concerning astronomy and tries to 'form a map of the universe [2, 6, 7, 12]

**SQL** SQL -Structured Query Language - is a special-purpose programming language designed for managing data in relational database management systems. (Wiki) [8]

**WHERE-part** The `WHERE`-part is a part of a query specific the request with aggregate functions or value ranges. [9]