

RankASco Manual

This manual gives an introduction to the RankASco tool that was developed at the University of Zurich. First, a short introduction is given to multi-criteria ranking, its problems, and how RankASco can mitigate some of these problems. Second, the manual describes all interfaces of RankASco and how they should be used in order to create an attribute-based item ranking. For additional information about RankASco and the research on attribute-based item ranking at the University of Zurich, please have a look at the IVDA website: <https://www.ifi.uzh.ch/en/ivda/research/ranking-creation.html>

Multi-Criteria Ranking

In our work, multi-criteria ranking (MCR) refers to the ranking of sets of items where each item has multiple attributes (criteria). Our work focuses on human-centered MCR where rankings are created based on user preferences and inputs. The problem with MCR is that it can be hard for users to compare multiple items to each other especially if the items have a large number of attributes. We, therefore, believe that a shift from the item granularity, where users compare complete items to each other, to an attribute granularity, where users compare attribute values to each other, is a promising approach. Based on this, we have developed **Ranking based on Attribute Scores** (RankASco), a visual interactive approach that supports users in the creation of human-centered MCR.

RankASco allows users to express preferences for attribute values and attributes. It works based on **Attribute Scoring Functions** (ASFs, more information can be found at the IVDA website). Based on these preferences RankASco then calculates an item ranking and presents it to the user.

Interfaces

This section covers all visual interactive interfaces that RankASco offers and how they should be used to create an attribute-based item-ranking. For an optimal experience, please use the **Chrome browser** since some of the functionality is not yet supported with other browsers.

Data Set Overview

The first interface of RankASco shows an overview of all available data sets.

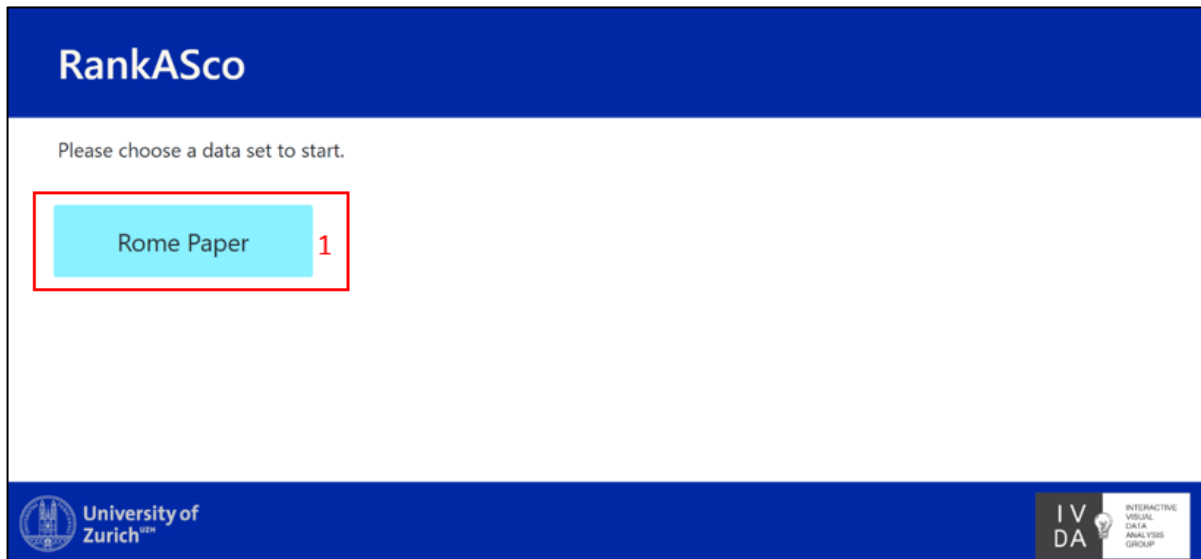


Figure 1: The data set overview interface.

For the sake of simplicity, only one data set is currently available. The data set contains information about accommodations in the city of Rome. More information about the data can be found on the IVDA website.

To start the ranking process, users should click on the *Rome Dataset* (Figure 1, 1) button to proceed to the next screen.

Data Loading

This interface lists the number of items that have been loaded.

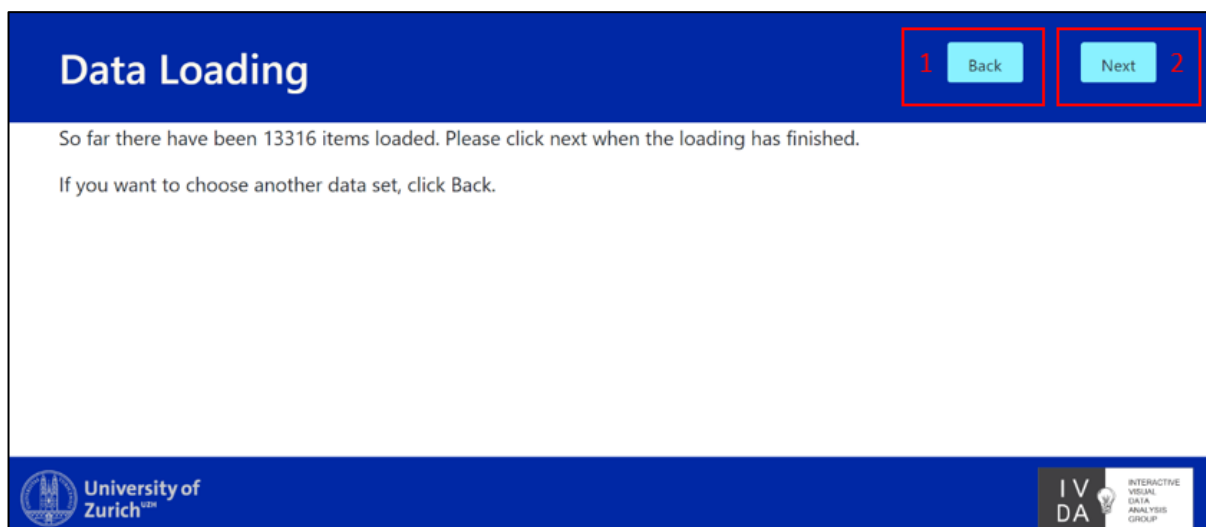


Figure 2: The data loading interface.

Users can either go back to the data set overview interface and choose a different data set by clicking on the *Back* (Figure 2, 1) button or proceed to the ranking creation by clicking on the *Next* (Figure 2, 2) button.

Attribute Overview

This interface shows all available attributes for the chosen data set. On top, all categorical attributes are listed followed by the numerical attributes.

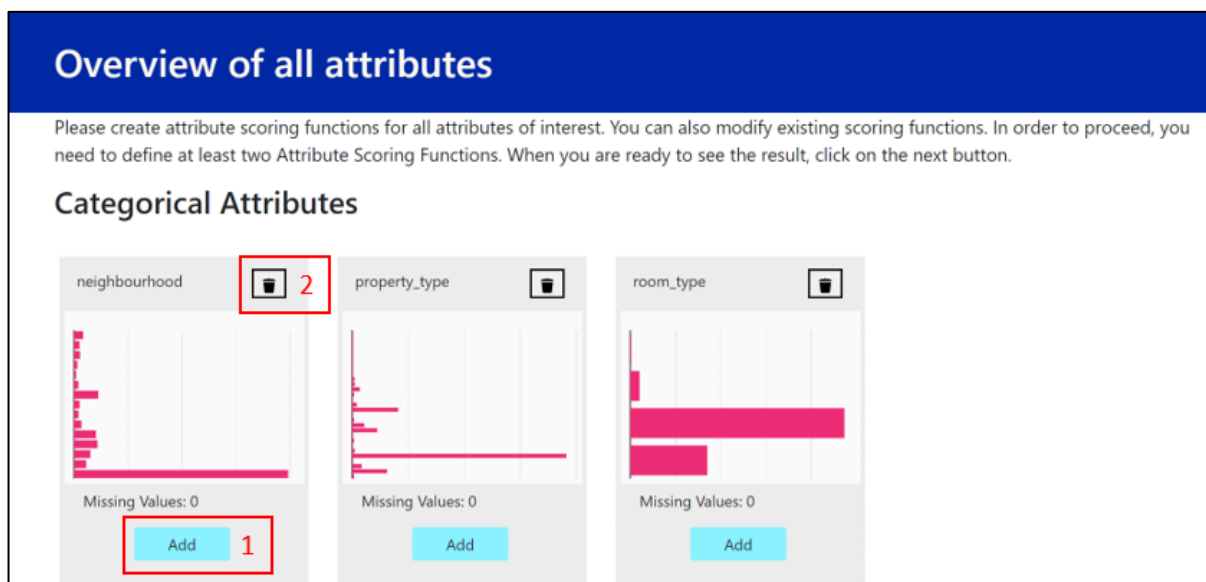


Figure 3: The attribute overview interface.

For each attribute, the interface shows a small card that contains the attribute name, an *Add* button (Figure 3, 1), a chart that shows the attribute value distribution, the number of missing values, and a *bin* icon (Figure 3, 2). Clicking on the *bin* icon removes the attribute from the data set. Be careful: Once an attribute has been removed, it cannot be restored! The number of missing values shows how many missing values exist in the whole data set for this attribute. With a click on the *Add* button, users are routed to the ASF creation interface.

After the creation of an ASF for an attribute, the attribute card does not show the *Add* button anymore but two other buttons, the *Modify* (Figure 4, 1) and *Remove* (Figure 4, 2) buttons.

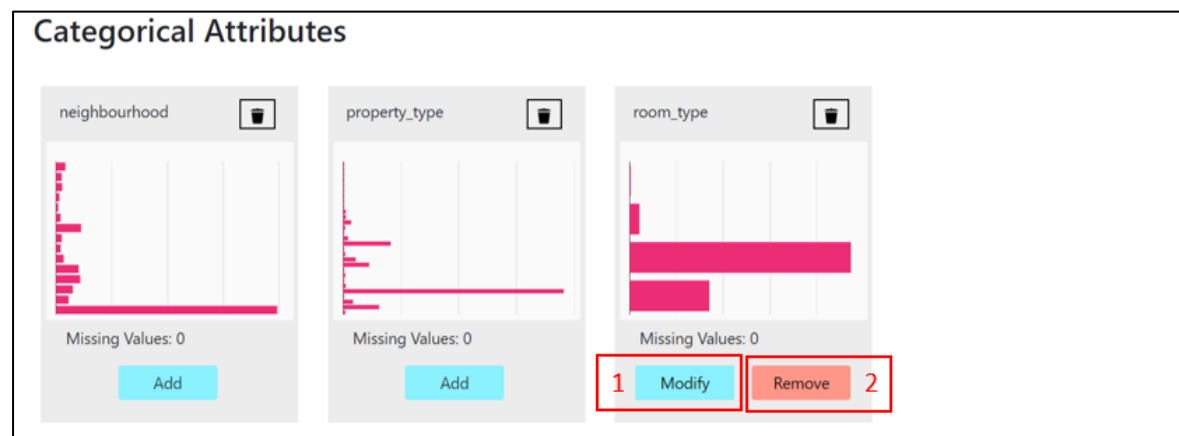


Figure 4: The attribute overview interface after the creation of a categorical ASF.

In addition, for numerical attributes, the attribute card shows a small version of the created ASF (Figure 5, 1).

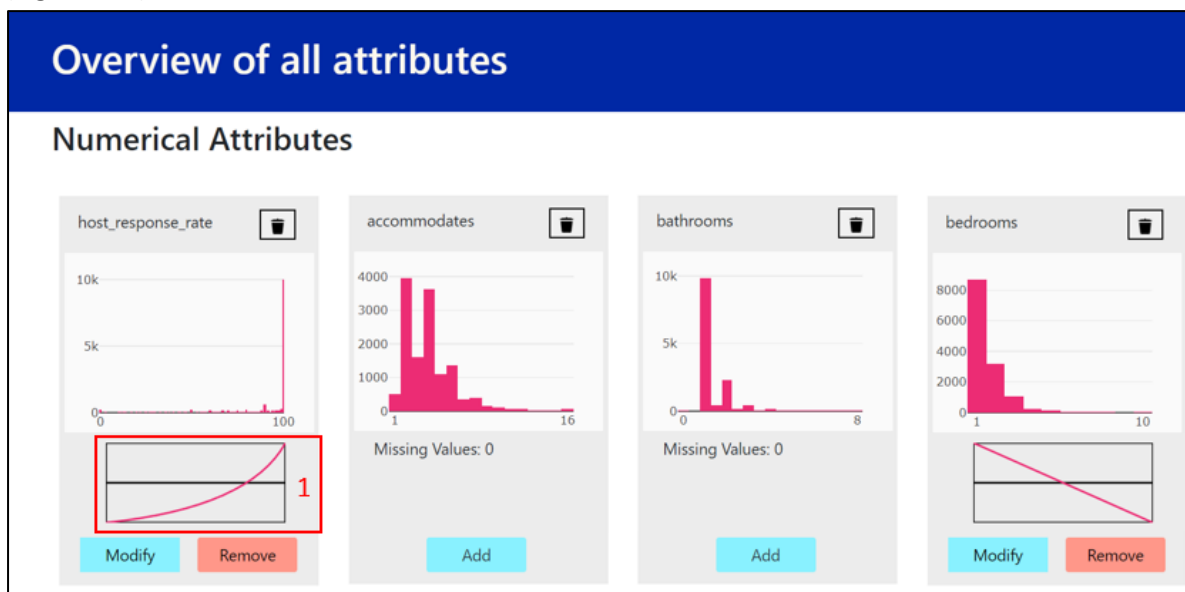


Figure 5: The attribute overview interface after the creation of numerical ASFs.

Clicking on the *Modify* button allows users to modify the created ASF. Clicking on the *Delete* button removes the ASF.

Once users have created all ASFs, they can proceed to the Ranking Refinement and Results interface by clicking on the *Next* button on top. Attention: This button is only shown if a minimum of 2 ASFs has been created since RankASco needs at least two ASFs to create a ranking.

Categorical ASF Creation

The categorical ASF creation interface is shown when a user clicks on the *Add* button for a categorical attribute in the attribute overview interface. The categorical ASF creation interface consists of the following parts: A chart showing the input distribution of attribute values (Figure 6, 1), a chart showing the output distribution of attribute scores (Figure 6, 2), radio buttons that allow the selection of an ASF type (Figure 7, 1), and the actual ASF creation interface (Figure 7, 2).



Figure 6: The ASF creation interface for a categorical attribute (top).

Figure 7: The ASF creation interface for a categorical attribute (bottom).

For categorical ASFs, three different ASF types are offered: Score Assignment, Equidistant, and Non-Equidistant. Users can choose freely which ASF type they want to use. More information about the different ASF types and their mode of operation can be found on the IVDA website.

When users have created an ASF for a chosen attribute, they can save the ASF by clicking on the *Save* (Figure 6, 3) button on top. Clicking on the *Cancel* (Figure 6, 4) button routes users back to the attribute overview screen without storing the ASF.

Numerical ASF Creation

The numerical ASF creation interface is shown when a user clicks on the *Add* button for a numerical attribute in the attribute overview interface. The numerical ASF creation interface consists of the following parts: A chart showing the input distribution of attribute values (Figure 8, 1), a chart showing the output distribution of attribute scores (Figure 8, 2), radio buttons that allow the selection of an ASF type (Figure 9, 1), and the actual ASF creation interface (Figure 9, 2).

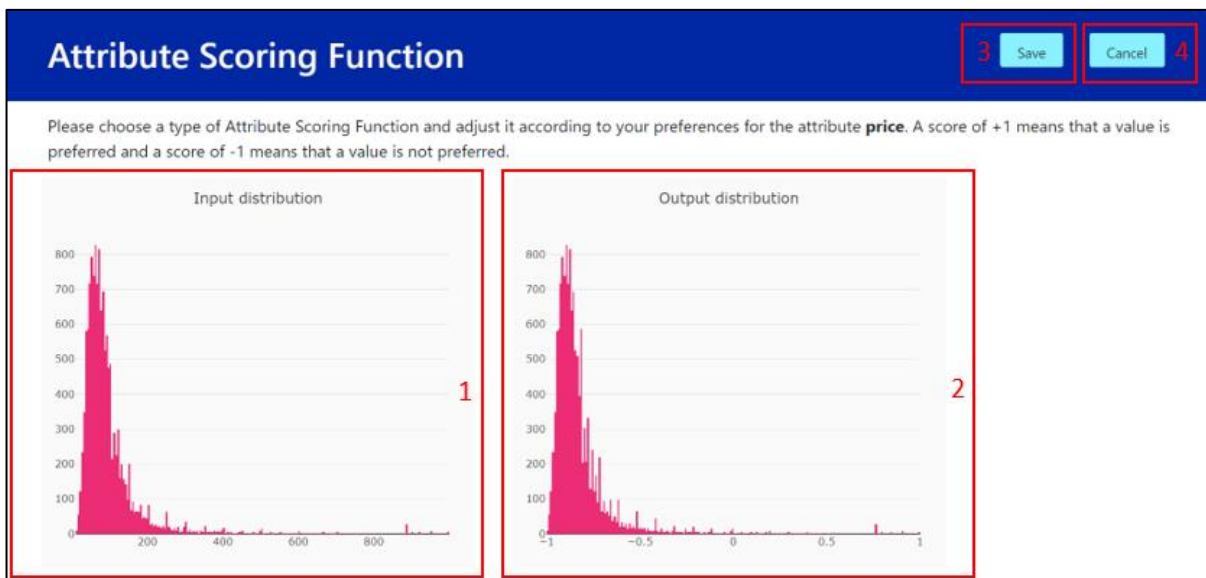


Figure 8: The ASF creation interface for a numerical attribute (top).

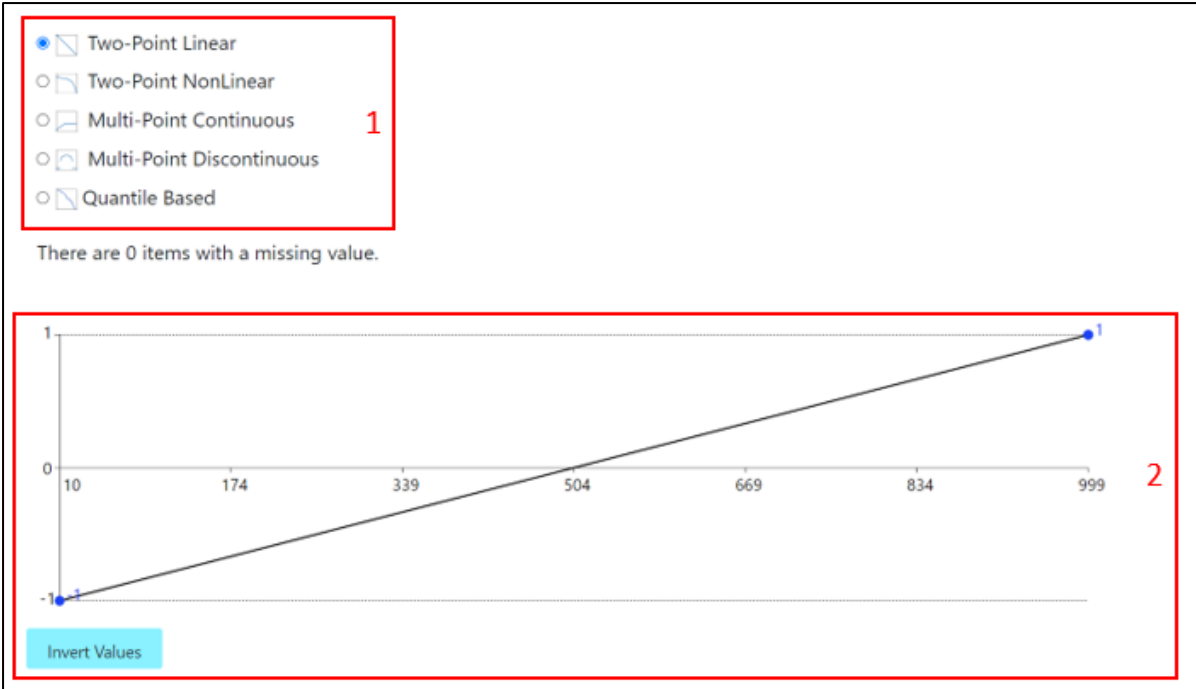


Figure 9: The ASF creation interface for a numerical attribute (bottom).

For numerical ASFs, five different ASF types are offered: Two-Point Linear, Two-Point Non-Linear, Multi-Point Continuous, Multi-Point Discontinuous, and Quantile Based. Users can choose freely which ASF type they want to use. More information about the different ASF types and their mode of operation can be found on the IVDA website.

When users have created an ASF for a chosen attribute, they can save the ASF by clicking on the *Save* button (Figure 8, 3) on top. Clicking on the *Cancel* button (Figure 8, 4) routes users back to the attribute overview screen without storing the ASF.

Ranking Refinement and Results

When a user has created enough ASFs, they can proceed to the Ranking Refinement and Results interface. In this interface, users can inspect the default item ranking that was calculated by RankASco with the created ASFs and refine the ranking through the assignment of weights. The interface consists of the following: Weight sliders for all attributes (Figure 10, 1), a ranking table showing the calculated ranking (Figure 11, 1), two scatter plots that show the characteristics of the

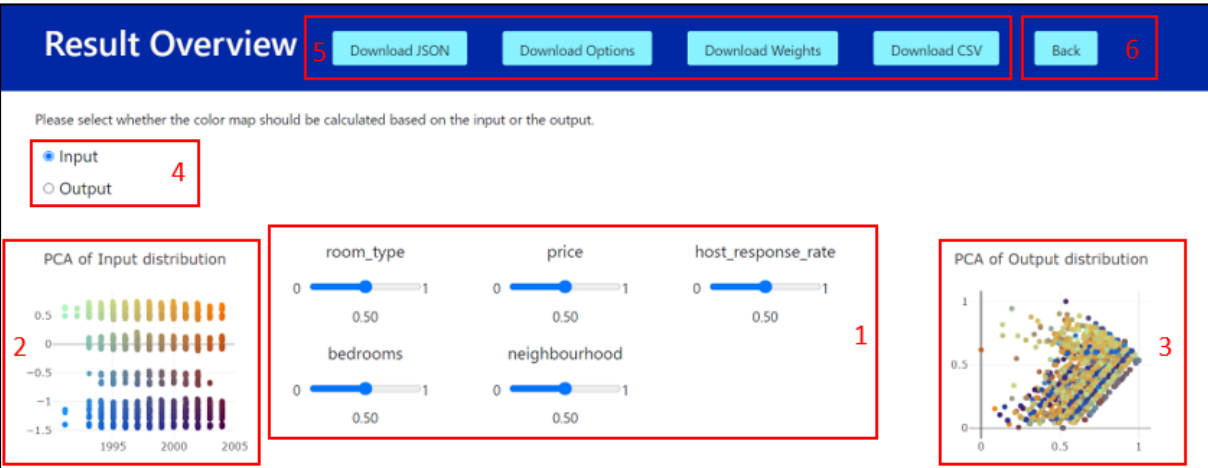


Figure 10: The ranking and refinement interface (top).

input (Figure 10, 2) and output (Figure 10, 3) data, and two radio buttons that define the base for the calculation of the color-coding (Figure 10, 4).

Rank	ID	Color	Summary Score	Score Symbol	Weighted Score	Weighted Score Symbol	Impact	Impact Symbol	room_type	price	host_response_rate	bedrooms	neighbourhood
1	2385	Light Green	2.822	[Bar]	1.800	[Bar]	2.822	[Bar]	0.342	0.279	1.000	0.333	0.868
2	16876	Light Green	2.568	[Bar]	1.616	[Bar]	2.568	[Bar]	0.342	0.377	1.000	0.555	0.293
3	22145	Light Green	2.342	[Bar]	1.565	[Bar]	4.342	[Bar]	0.342	1.000	1.000	1.000	-1.000
4	5509	Light Green	2.271	[Bar]	0.752	[Bar]	4.149	[Bar]	0.342	-0.939	1.000	1.000	0.868
5	9093	Light Green	2.242	[Bar]	0.726	[Bar]	4.178	[Bar]	0.342	-0.968	1.000	1.000	0.868
6	5712	Light Green	2.241	[Bar]	0.725	[Bar]	4.179	[Bar]	0.342	-0.969	1.000	1.000	0.868
7	7558	Light Green	2.238	[Bar]	0.722	[Bar]	4.182	[Bar]	0.342	-0.972	1.000	1.000	0.868
8	15189	Light Green	2.236	[Bar]	0.720	[Bar]	4.184	[Bar]	0.342	-0.974	1.000	1.000	0.868
9	5035	Light Green	2.234	[Bar]	0.718	[Bar]	4.186	[Bar]	0.342	-0.976	1.000	1.000	0.868
10	22918	Light Green	2.233	[Bar]	0.717	[Bar]	4.187	[Bar]	0.342	-0.977	1.000	1.000	0.868

Figure 11: The ranking and refinement interface (bottom).

The weight sliders assign a weight to each attribute, and they range from 0 to 1. Changing a weight slider results in the triggering of the ranking algorithm and the calculation of a new ranking. By default, all weights are set to 0.5.

The ranking table shows all items in the order of their rank including their summary score (as a number and graphical symbol), weighted score (as a number and graphical symbol), impact (as a number and graphical symbol), as well as all individual attribute scores. In addition, each item is assigned a color that is calculated based on the 2D color map.

The two scatter plots show the characteristics of the input and output data. Since the input data consists of non-numerical values, these values are first one-hot encoded, and a dimensionality reduction algorithm (PCA) is then applied to the data. The plot on the right shows the calculated attribute scores for each item again in a dimensionality reduced form (with PCA). For both plots, the items are color-coded based on a 2D color map. The source for the color coding can be chosen through two radio buttons. By default, the input data is used as the source for the color-coding.

If users wish to use the results of the ranking further, they can export the ranking results in a CSV or JSON format by clicking on the *Download* buttons (Figure 10, 5) at the top of the page. In addition, users can also export the ASFs and the weight by clicking on *Download Options* or *Download Weights*. If users are not satisfied with the created rankings, they can go back to the attribute overview screen and change ASFs by clicking on the *Back* button (Figure 10, 6).