A Bidirectional Pipeline for Semantic Interaction Supplementary Material

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Abstract

Throughout the main paper for "A Bidirectional Pipeline for Semantic Interaction," we reference a number of figures to exemplify our newly proposed visual analytics pipeline to capture the necessary features and complexity involved in semantic interaction. Although we could not provide larger version of the images in the main paper due to space constraints, we do so here for those who prefer printed copies of the paper to zooming in on the figures on their computer screens.

Index Terms: Human-centered computing—Visualization—Visualization systems and tools; Human-centered computing—Interaction design—Interaction design process and methods

1 Introduction

References

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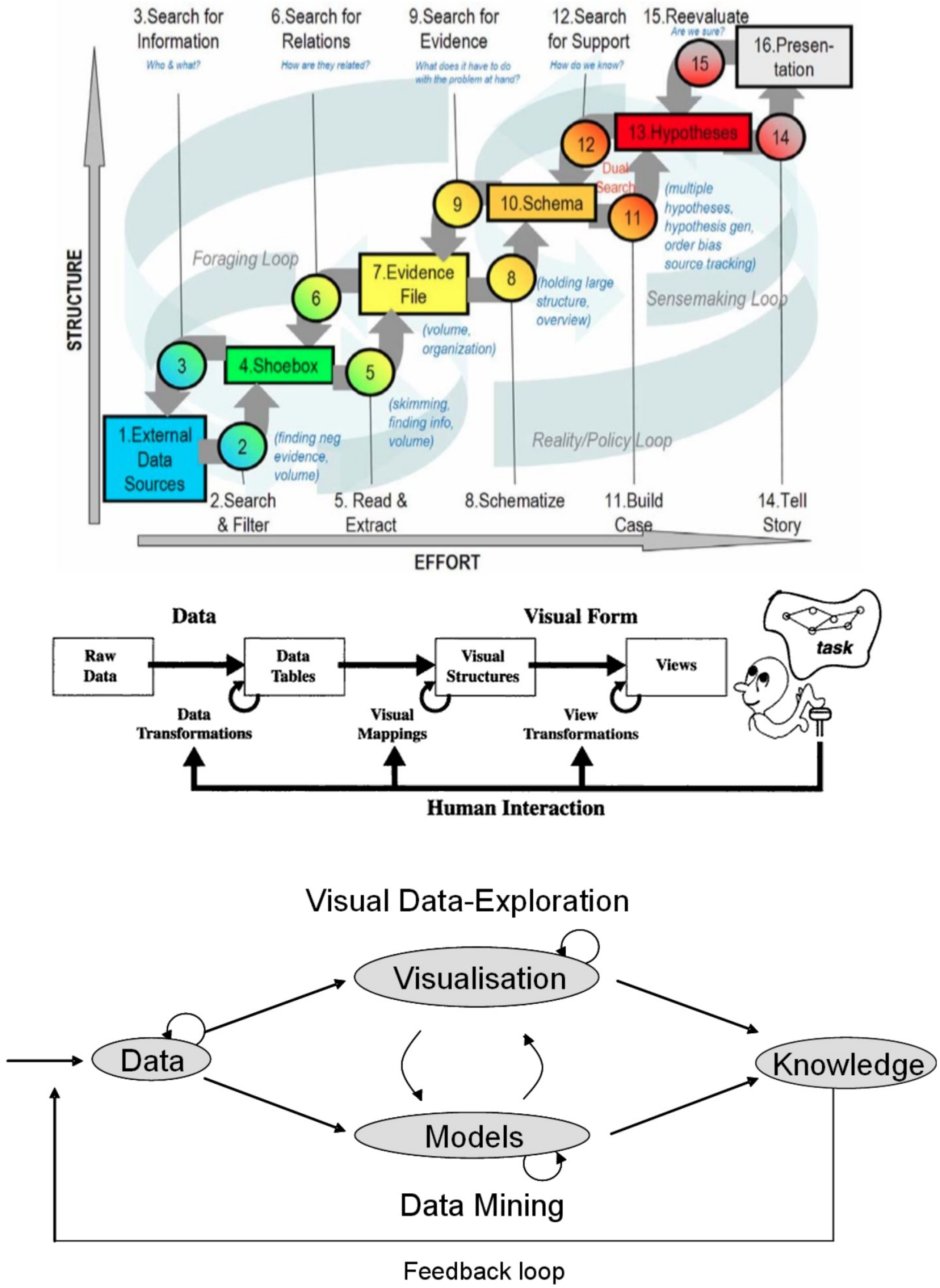


Figure 1: **(top)** In the Sensemaking Loop [8], sensemaking contains a backward (or inverse) process for each forward step. Chaining these combined forward/inverse processes as composable processes yields a full bidirectional cognitive pipeline. **(middle)** The information visualization pipeline presented by Card et al. [3] does not specifically model semantic interactions. **(bottom)** The visual analytics model provided by Keim et al. [4] provides a high-level overview of the structure of visual analytics knowledge discovery, but lacks detail in defining how mathematical models are used to interpret semantic interactions. In order to support semantic interaction, a different pipeline structure is necessary.

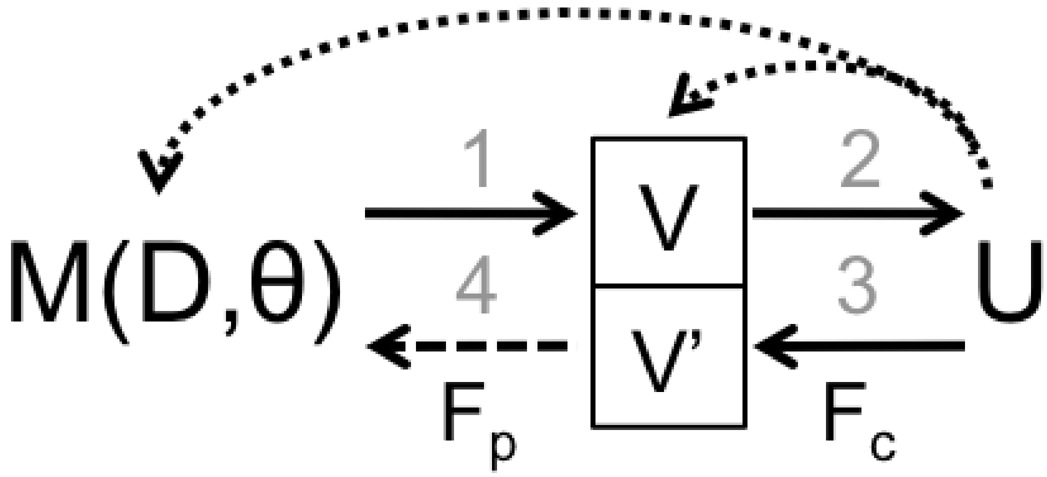
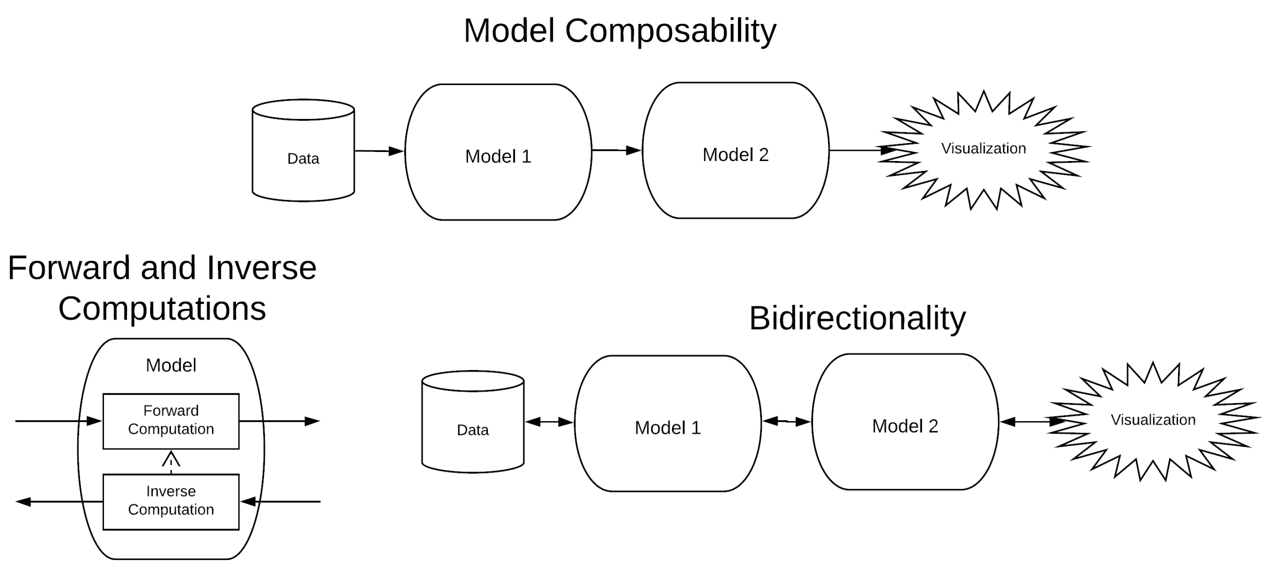


Figure 2: V2PI [5] is a mathematical representation of semantic interaction. This framework supports the creation of a visualization V. When the analyst U manipulates V to form V' via a semantic interaction, this triggers a manipulation of the parameters θ that influence model M. The parameterized feedback (F_p) represents an inverse process similar to what is described by the Sensemaking Loop, in which the interaction is interpreted as a set of updates to model parameters.



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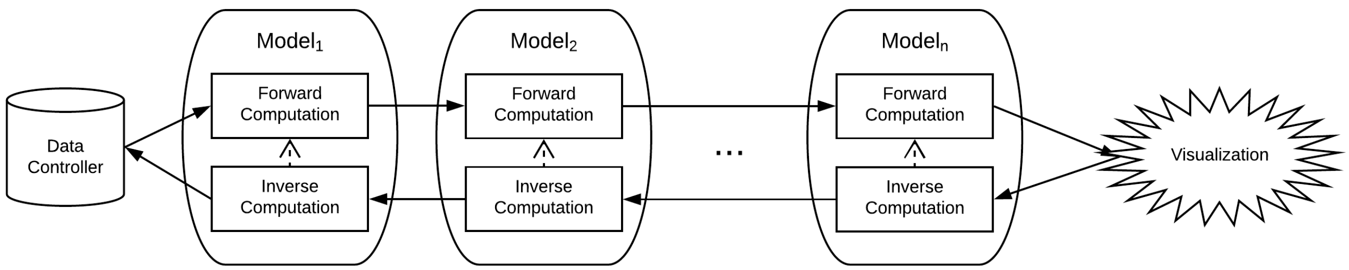

Figure 4: Our new pipeline for semantic interaction in visual analytics tools, created from the combination of the three characteristics shown in Figure 3. Model composability is shown through the chaining of a series of models horizontally in the pipeline. Bidirectionality results from the separated forward (top) and inverse (bottom) paths through the models. Model inversion is shown through the pairing of a forward computation and an inverse computation in each of the models. This representation also shows short circuiting arrows that connect the inverse and forward computations in the Models. The resulting structure captures how data is transformed into a Visualization and how semantic interactions are interpreted to update the parameters of the forward computations of the different Models.

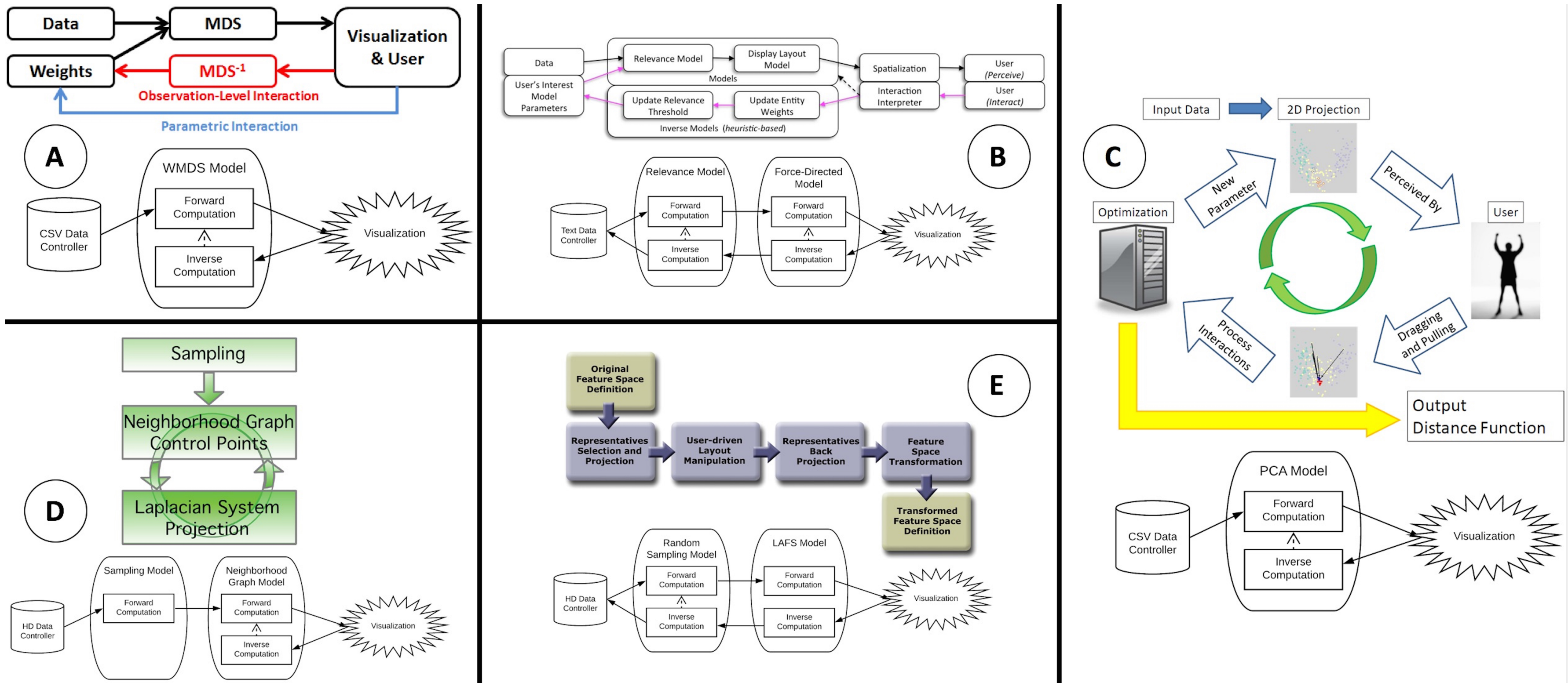

Figure 5: Using the proposed semantic interaction pipeline shown in Figure 4, we can now model the behavior of existing semantic interaction tools like (A) Andromeda [9], (B) StarSPIRE [1], and (C) Dis-Function [2], (D) Piecewise Laplacian Projection [7], and (E) Mamani et al. [6]).

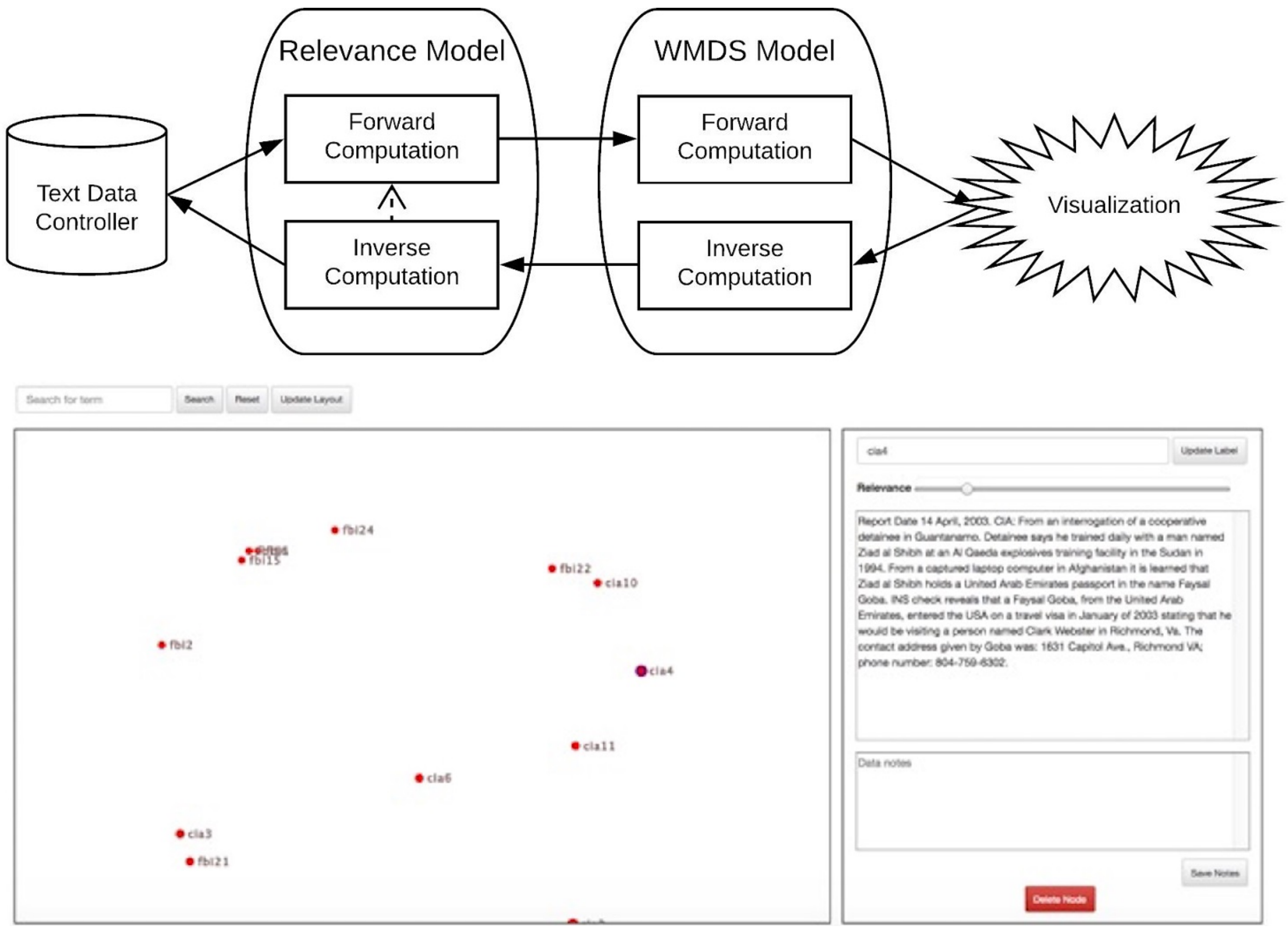

Figure 6: **(top)** Our pipeline representation of Cosmos consists of a Text Data Controller, Relevance Model, WMDS Model, and a Visualization. The Relevance and Similarity models each handle a different component of manipulating the data to create the Visualization. **(bottom)** The Cosmos interface allows analysts to interact with documents, manipulating their similarity and relevance throughout the exploration of the dataset.

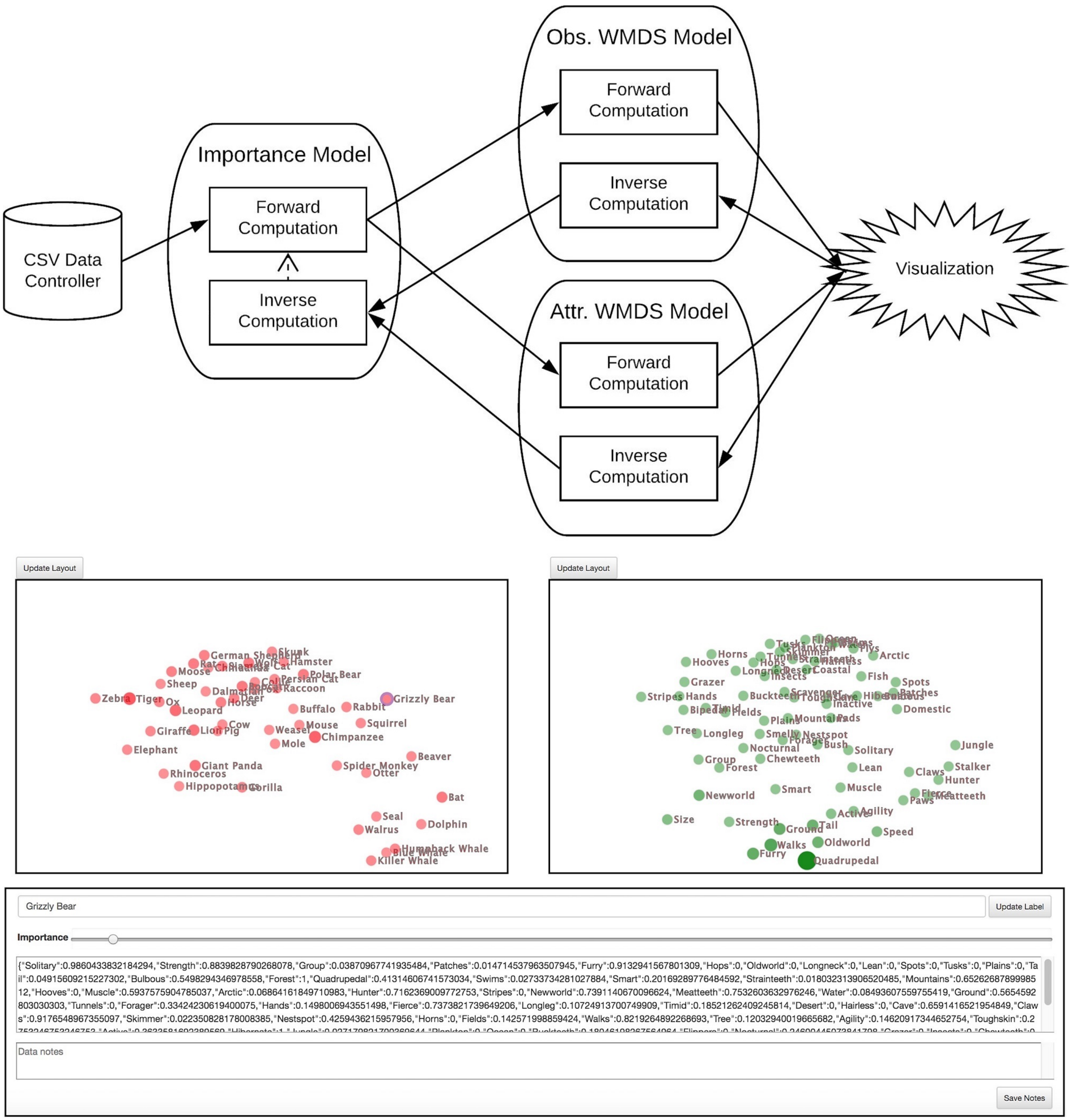

Figure 7: **(top)** Our pipeline representation of how SIRIUS produces the observation and attribute WMDS projections and how this tool interprets semantic interactions therein using our new proposed pipeline. This is accomplished using a CSV Data Controller, Importance Model, two WMDS Models, and a Visualization. **(bottom)** This Visualization consists of two interconnected, interactive WMDS projections: one for the observations and one for the attributes of a high-dimensional dataset.

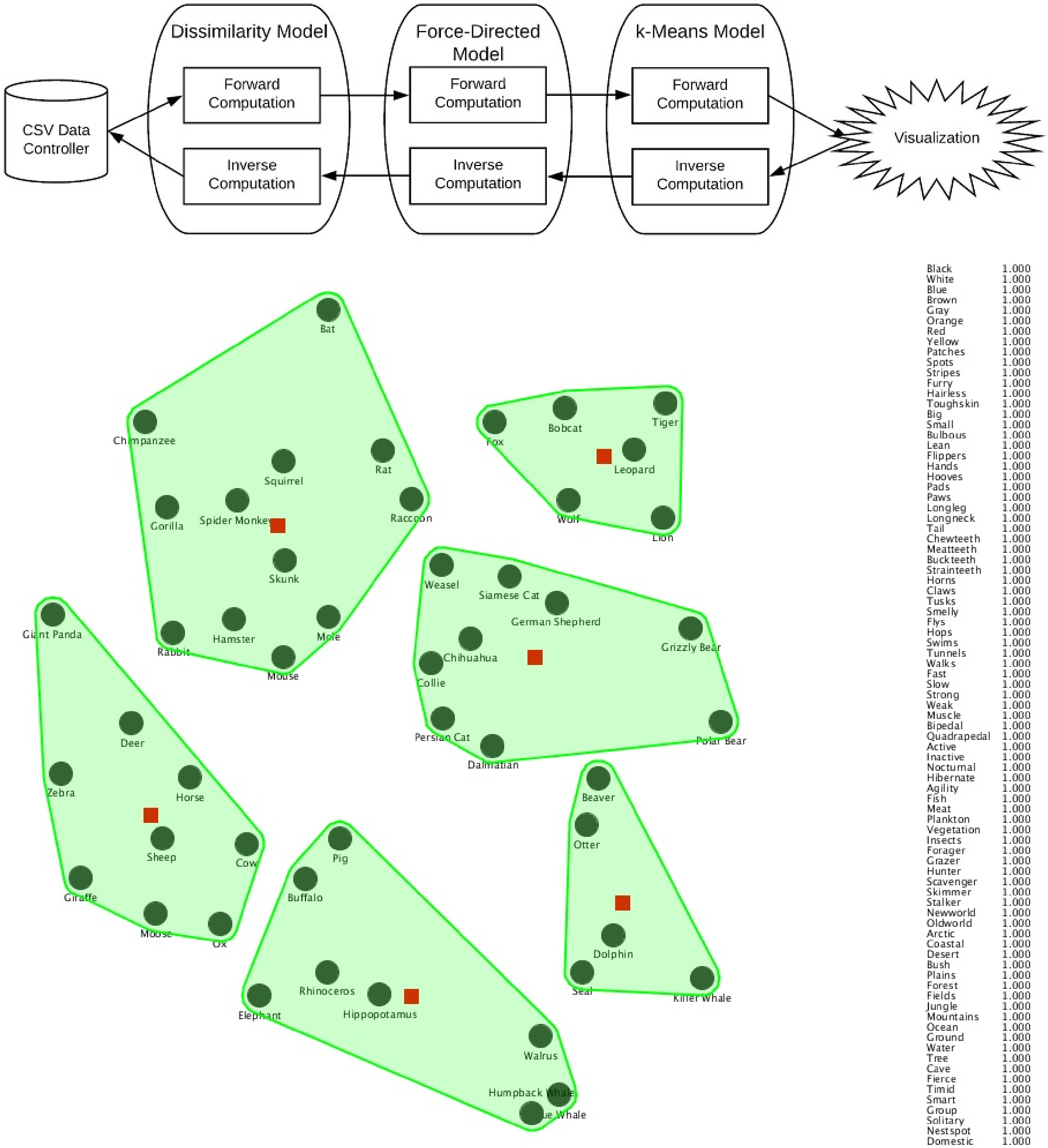

Figure 8: **(top)** Our pipeline representation for how the cluster-based visualization by Wenskovitch and North is created and semantic interactions therein are interpreted. This is accomplished using a CSV Data Controller, Dissimilarity Model, Force-Directed Model, k-Means Model, and Visualization. **(bottom)** The clustering interface allows analysts to explore related groups of observations depending on the learned attribute weights.