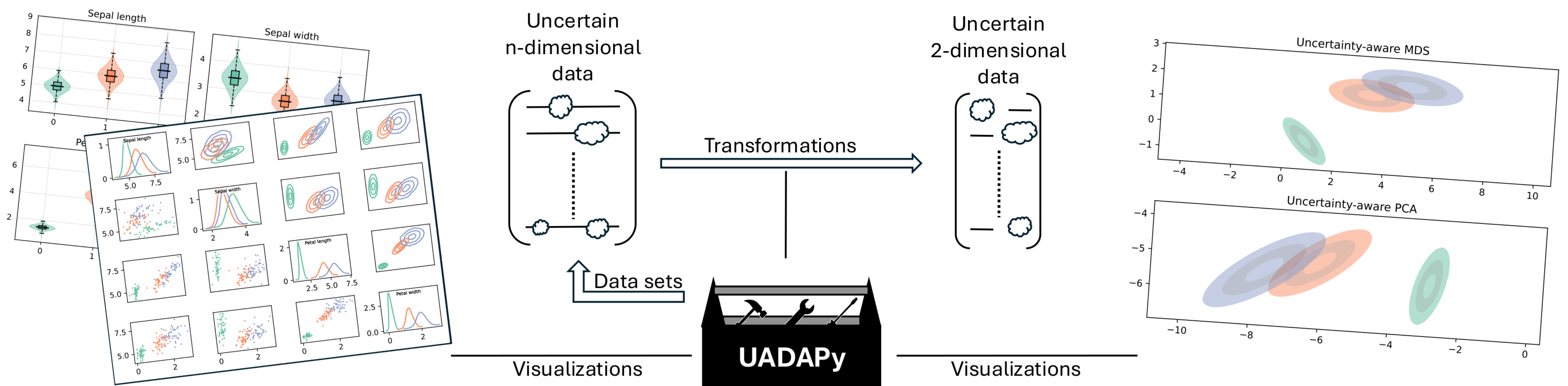


UADAPy: An Uncertainty-Aware Visualization and Analysis Toolbox

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INTRODUCTION

- Multiple visualization frameworks like D3 or VTK provide implementations for all stages of the visualization pipeline but do not focus on uncertainty
- We propose the software package UADAPy for analyzing and visualizing multivariate data
- We express uncertain data as probability distributions
- We cover multiple stages of the visualization/analysis pipeline, i.e., data modeling, data transformation, and visual mapping, supporting the propagation of uncertainty

FEATURES

Datasets:

- Example datasets used in various publications focusing on uncertainty visualization to provide easy entry to our library

Transformations:

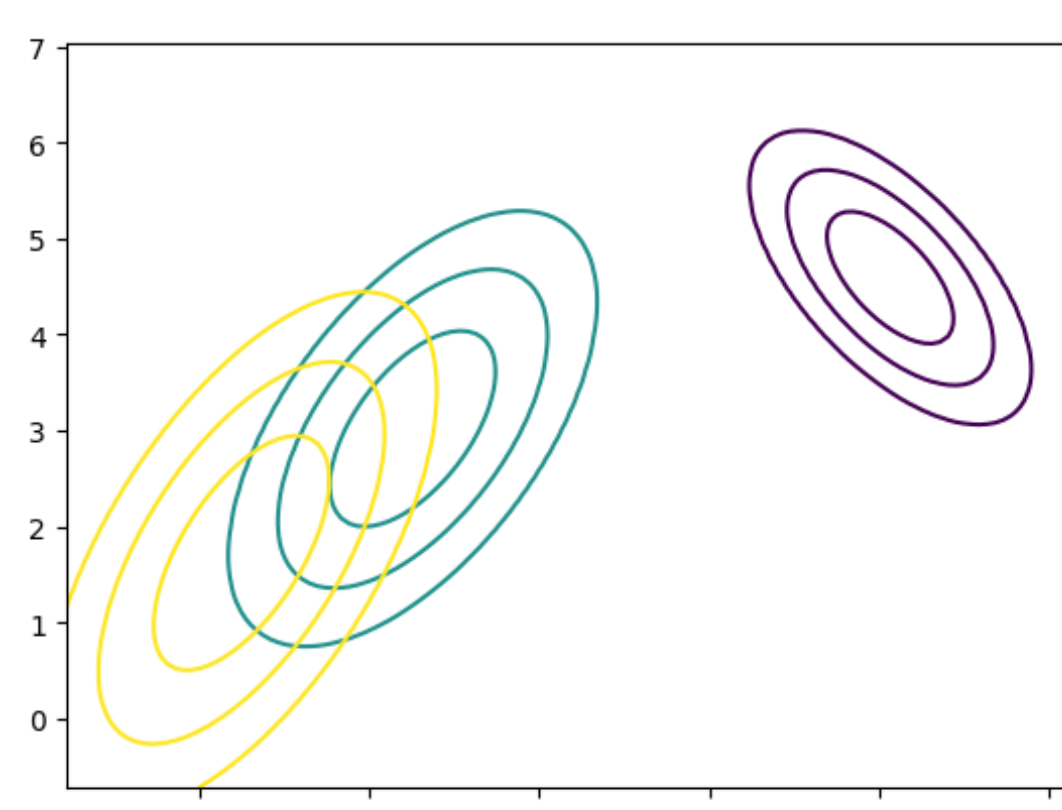
- UAPCA** is an uncertainty-aware variant of the linear dimensionality reduction method PCA
- UAMDS**, a variant of MDS that applies to Gaussian distributions

Visualization:

- Bivariate distributions
 - Techniques like scatter plots
 - Aggregated representation: isolines and isobands as visualization techniques to show specific quantiles
 - One-dimensional summary statistics of the distributions: box plots, violin plots, strip plots, and swarm plots
- Higher-dimensional distributions
 - Small multiples, such as a plot matrix showing all pairs of dimensions as bivariate plots (e.g. scatter or contour plots), or separately as univariate plots (e.g. box or violin plots)
 - Dimensionality reduction methods can be applied to get a 2-dimensional probability distribution

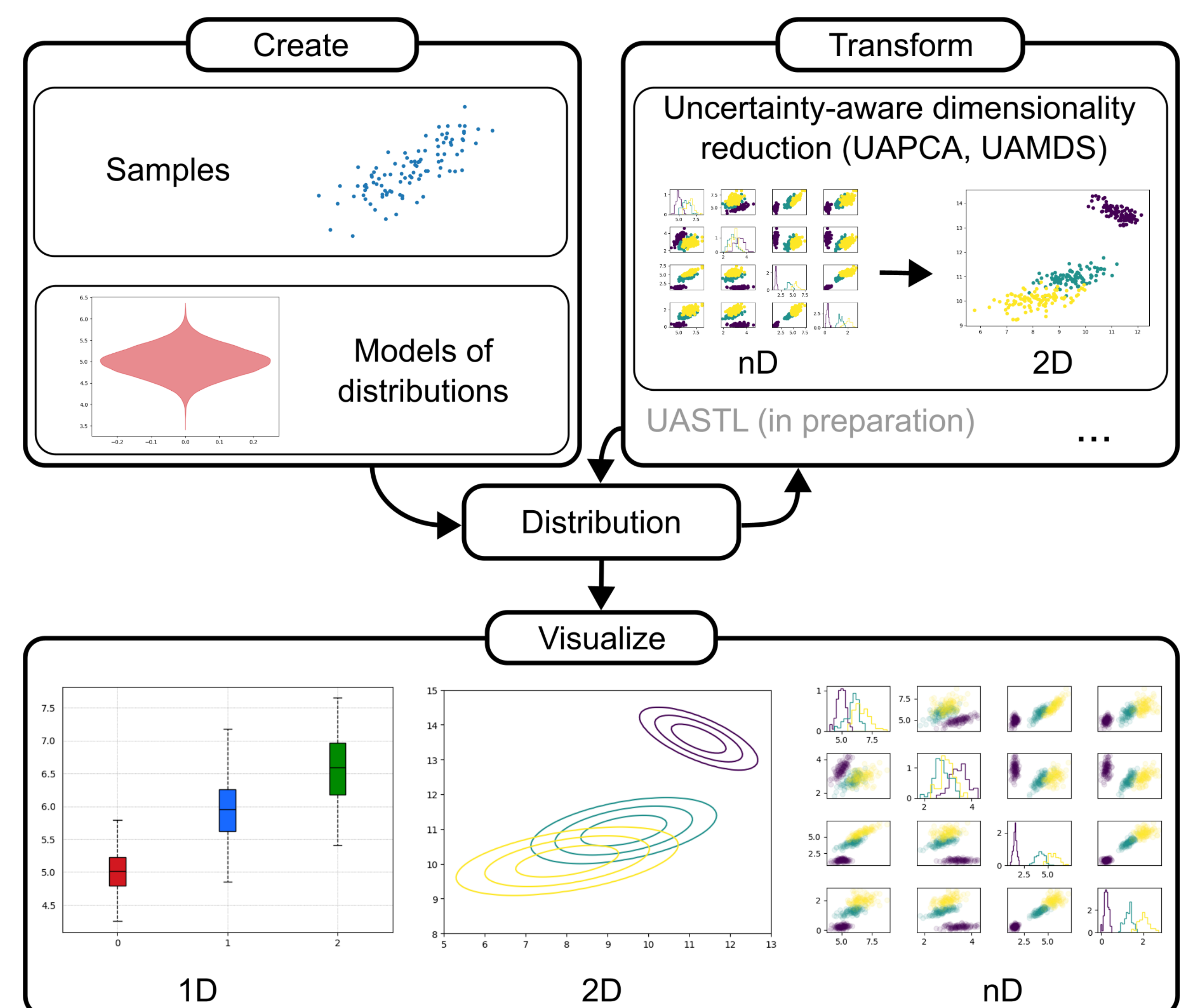
CODE EXAMPLE

- Loading data
`distrib_hi = data.load_iris_normal()`
- Applying UAMDS
`distrib_lo = uamds(distrib_hi, dims=2)`
- Visualizing data
`plots2D.plot_contour(distrib_lo, seed=0)`



GENERAL CONCEPT

- Close integration with existing libraries such as SciPy for data modeling or Matplotlib for data visualization
- Support visualization researchers who develop uncertainty-aware algorithms
 - Provide easy access to different steps of the visualization pipeline
 - Avoid the need for reimplementations
- Provide current state-of-the-art data transformation and visualization methods to end users analyzing uncertain data



DISCUSSION AND FUTURE WORK

- Support analysis and visualization of uncertain time series.
- Support interactive plotting frameworks like Bokeh or Plotly
- Establish a foundational platform where further uncertainty-aware algorithms can easily be included
- Available at <https://github.com/UniStuttgart-VISUS/uadapy>

