

MAAYA: Multimedia Analysis and Access for Documentation and Decipherment of Maya Epigraphy

April Morton

Gulcan Can

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The MAAYA Project



Main goal: Advance the state of the art in image description and visualization techniques, while providing support to epigraphers

		
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Outline

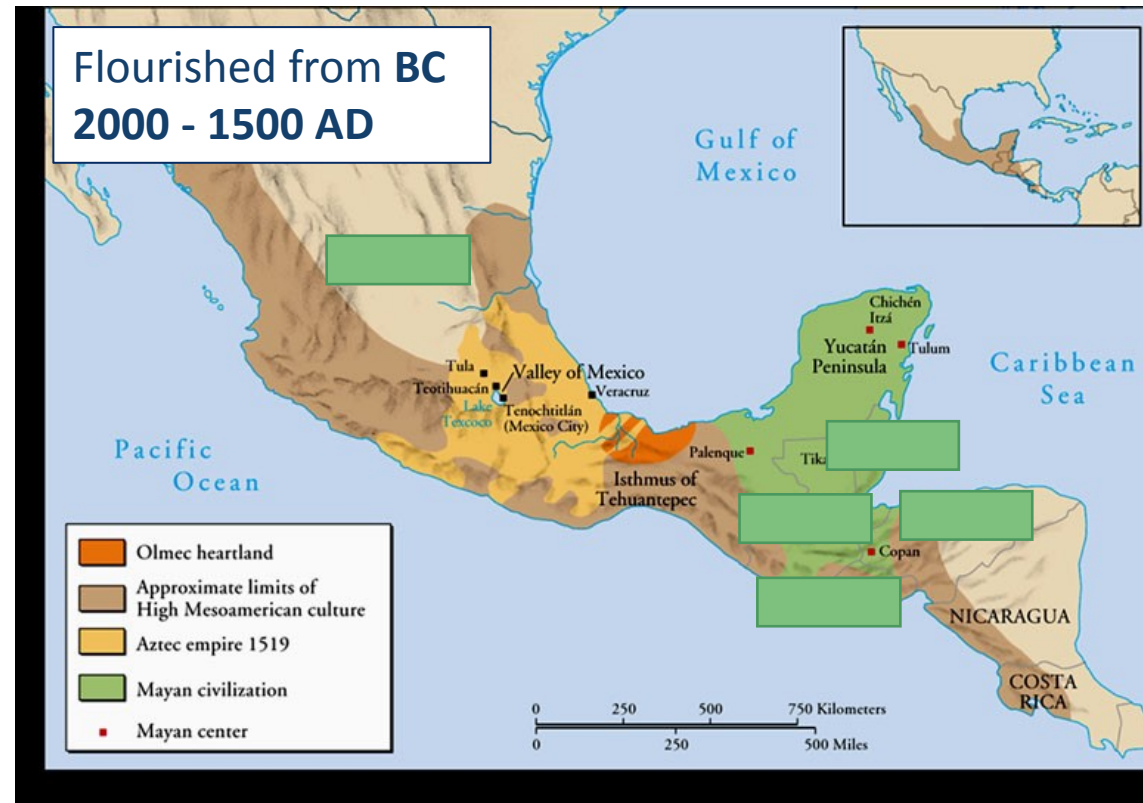


- Mayan Overview
- Project Overview
- Data Preparation/Storage
- Computer Vision Algorithms
- Using Context to Improve Glyph Recognition
- Visualization
- Conclusion

Mayan Overview



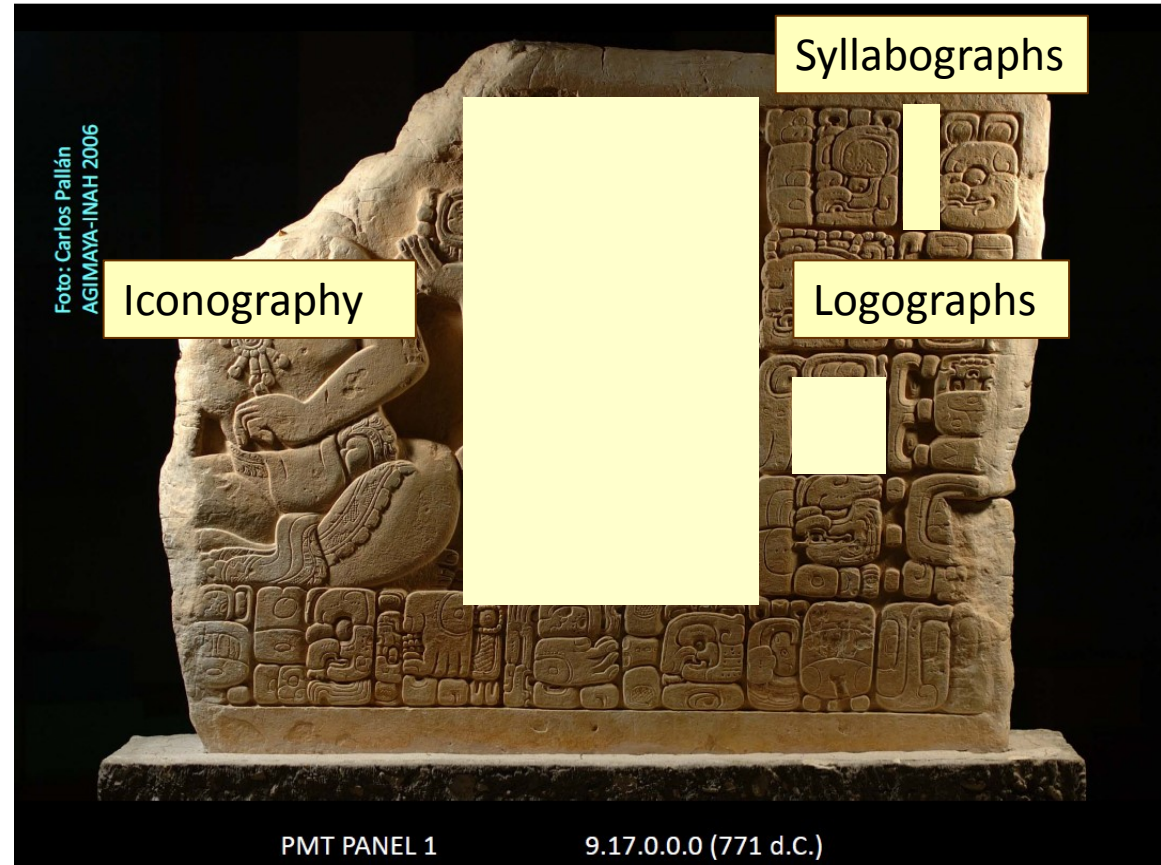
Ancient Mayan Culture



Mayan Overview



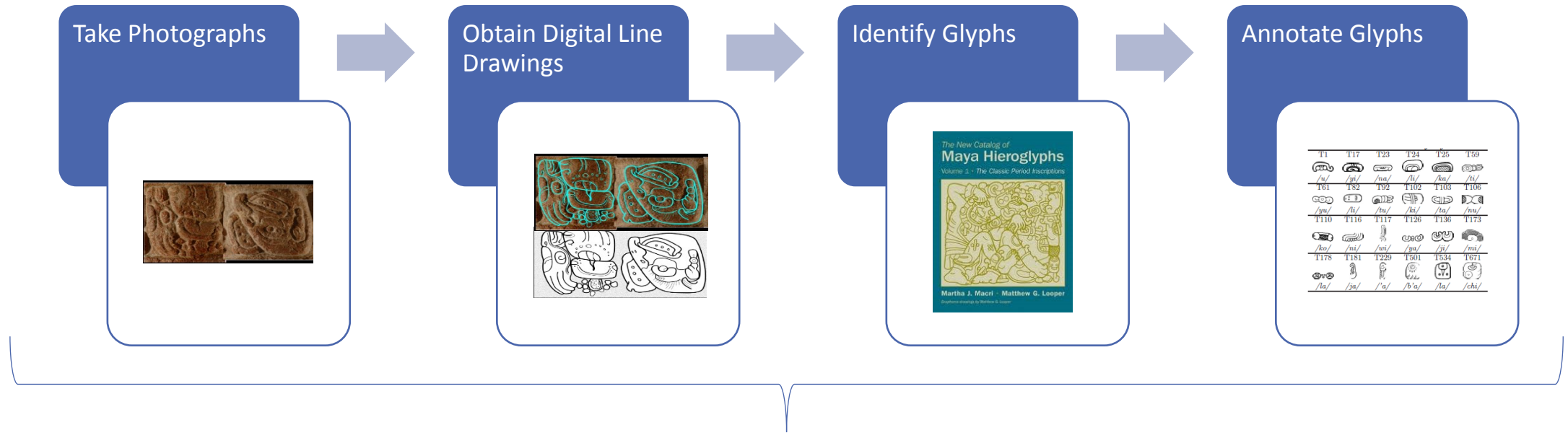
Mayan Writing System



Mayan Overview



Documentation Process

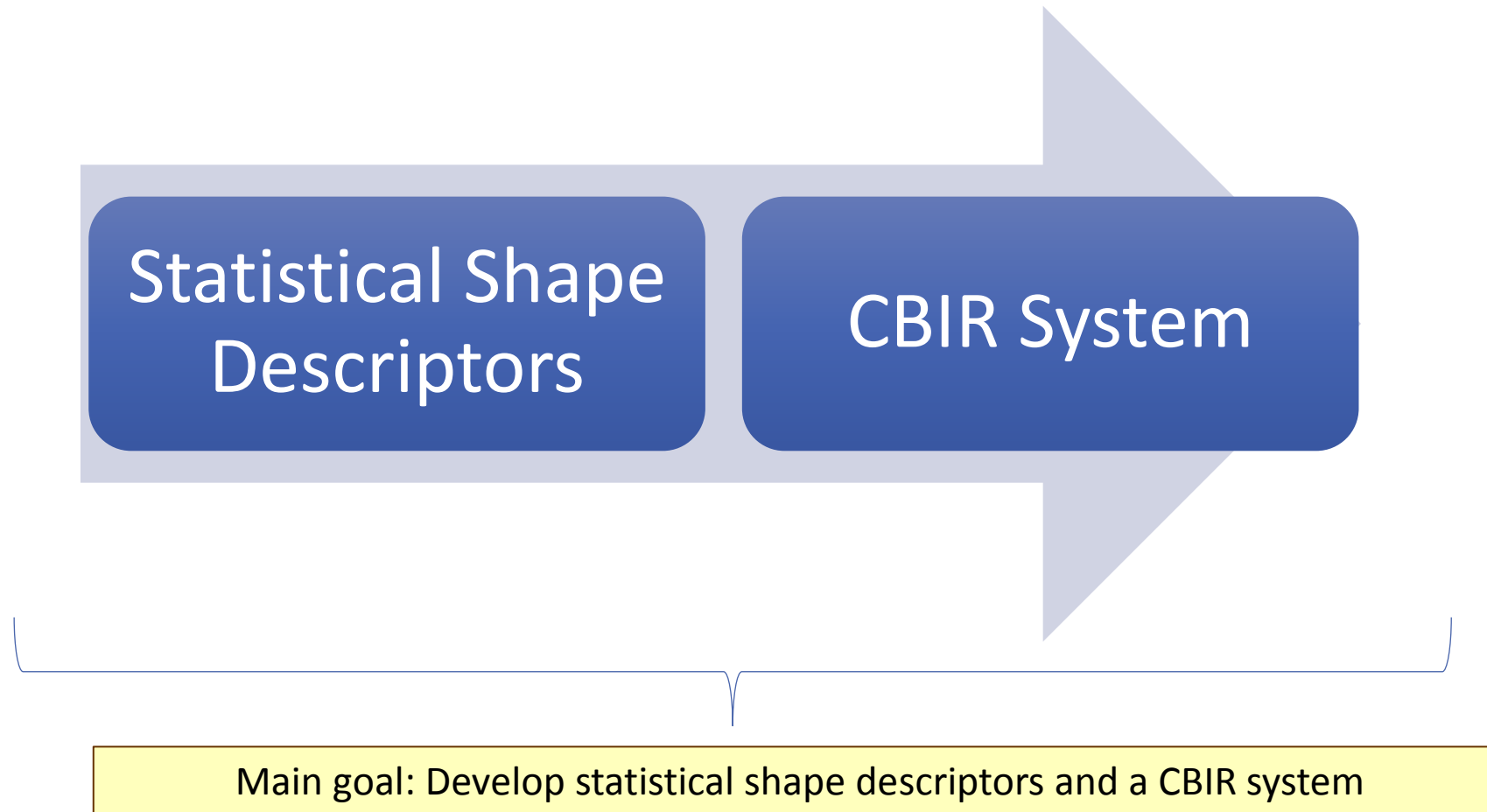


Need better digital preservation
and automatic analysis techniques

Project Overview



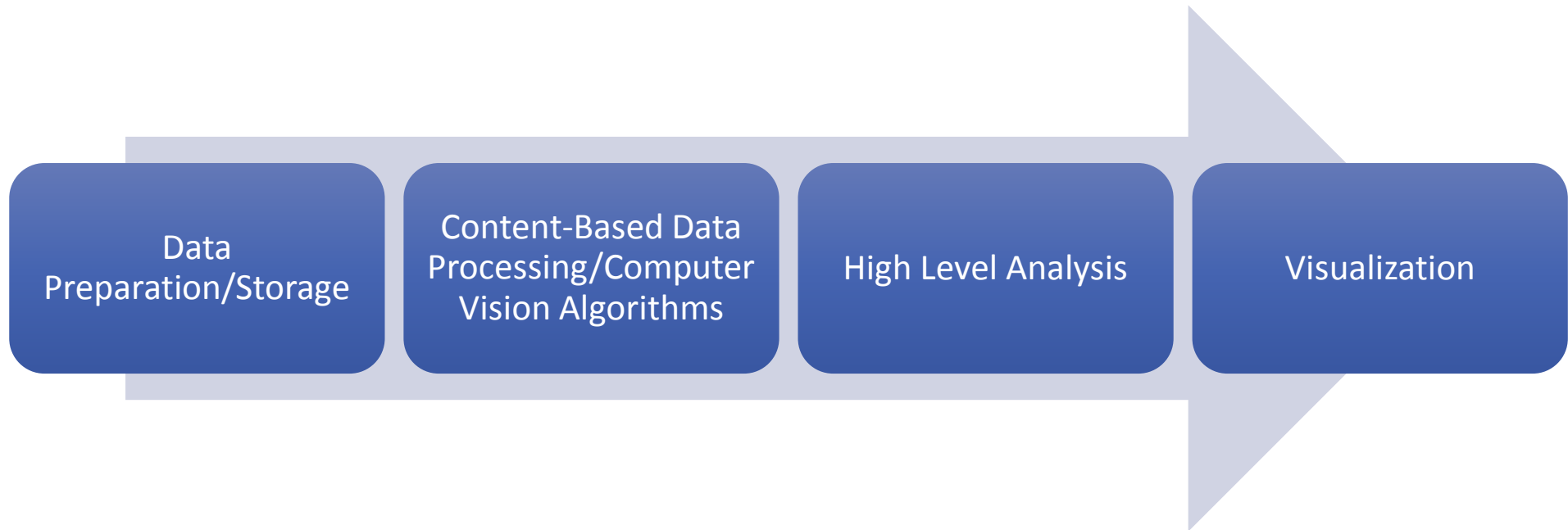
The CODICES Project



Project Overview

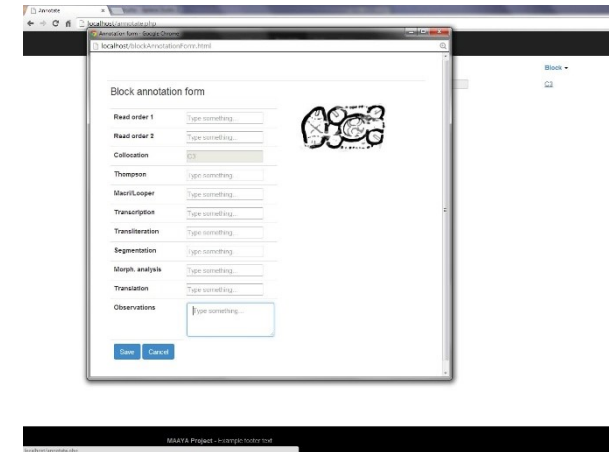


The MAAVA Project

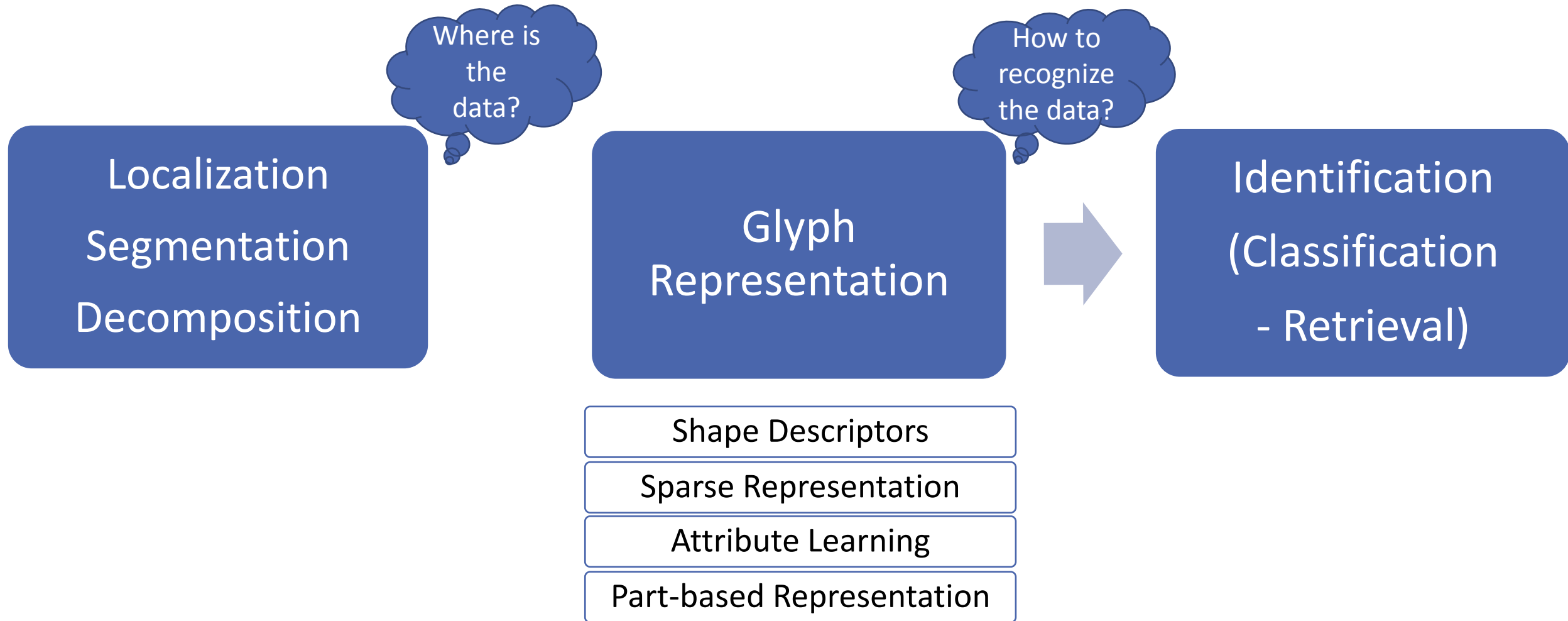


Main Goal: Advance the state of the art in image description and visualization techniques, while providing support to epigraphers

Data Preparation/Storage Process



Computer Vision Algorithms



Computer Vision Algorithms



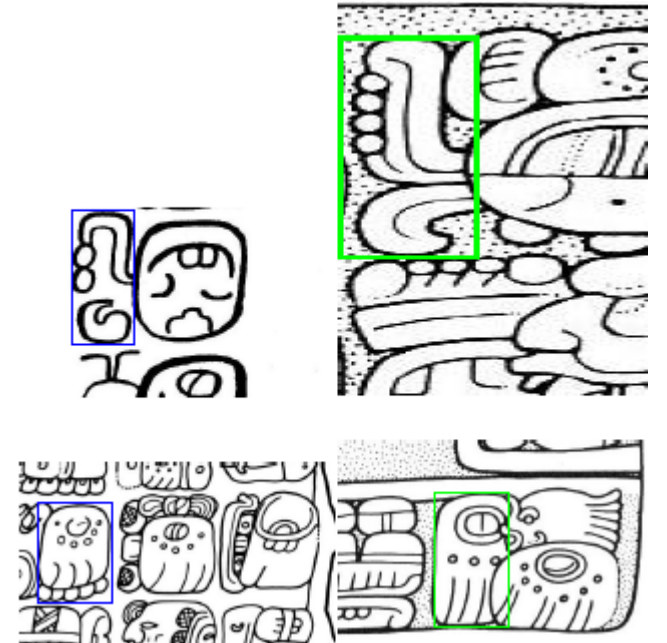
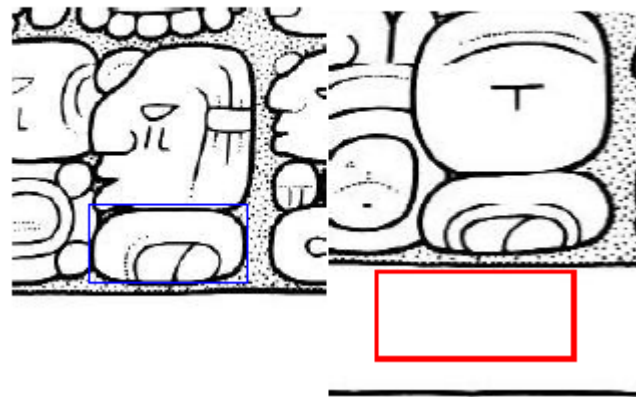
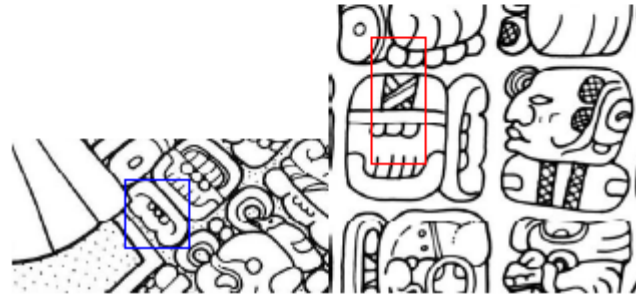
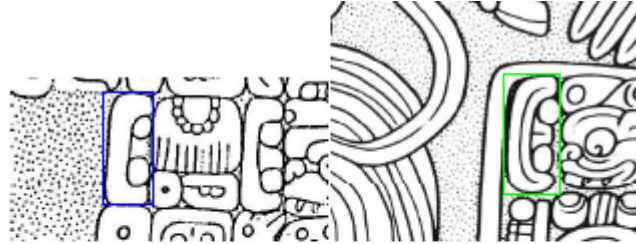
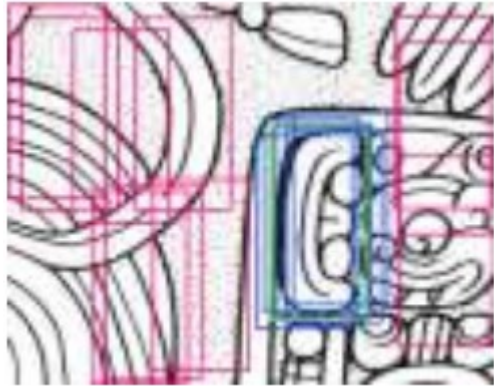
Localization



Computer Vision Algorithms



Localization



Computer Vision Algorithms



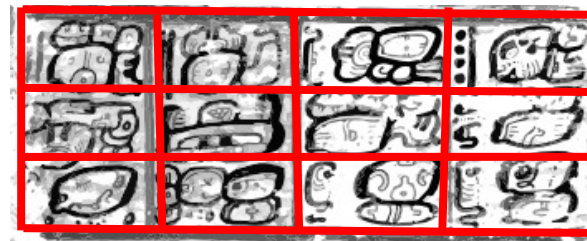
Segmentation



Computer Vision Algorithms



Hierarchical Decomposition



Codices → Page → T'ol → Row of Blocks → Block → Glyph

Computer Vision Algorithms



Recognition

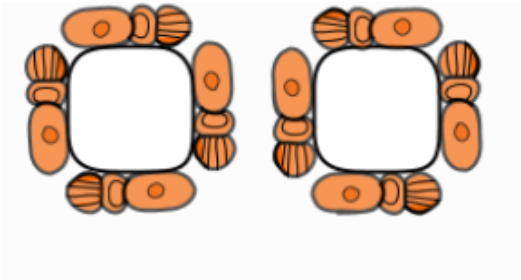
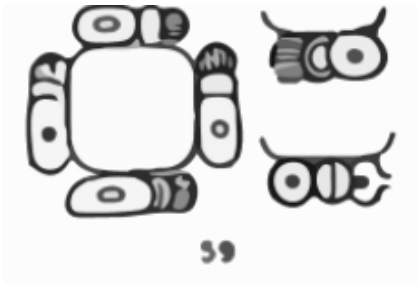
- Glyph representation + Identification
 - Can we utilize/capture diagnostic features?



Computer Vision Algorithms



Diagnostic Features



The sign T059 is always composed of three parts, resembling a torch; the upper part can vary from simple wavelike lines to peaking lines, an outline with leading edge

the middle part is either an oval shaped or circle form

The most indicative element is the circle with another dot or circle in the center

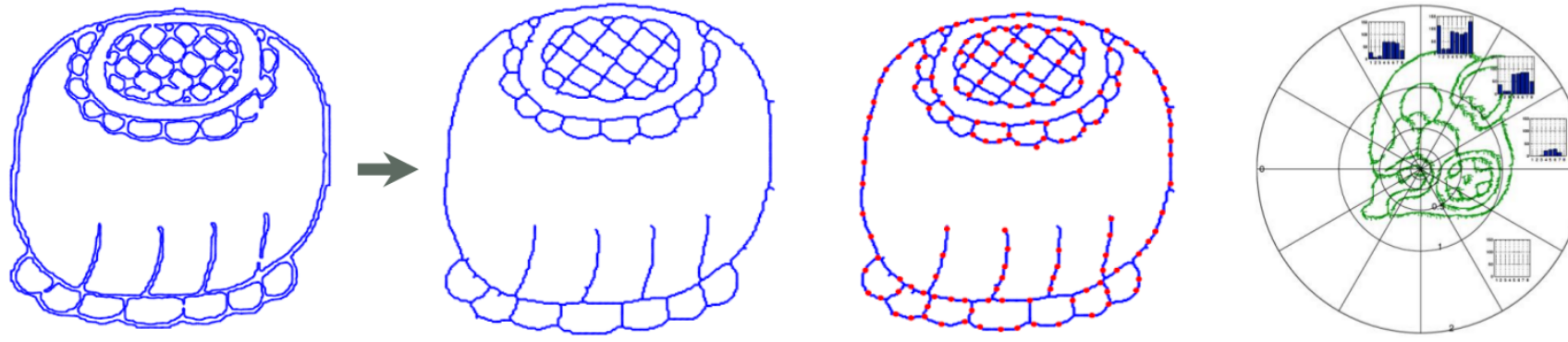
The outline varies from fully round to oval shaped; the central dot or circle is obligatory

the cross-hatching in these samples, and the dots are optional

Computer Vision Algorithms



Histogram-of-Orientations Shape Context



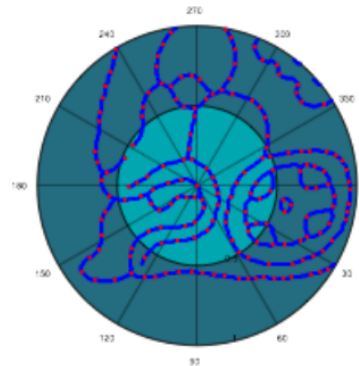
(1) Thinned shapes

(2) Describe pivots
with respect to points

(3) Histogram of
local orientations



(4) Bounded distance



(5) Per-ring normalization

$$(x_i, y_i)$$

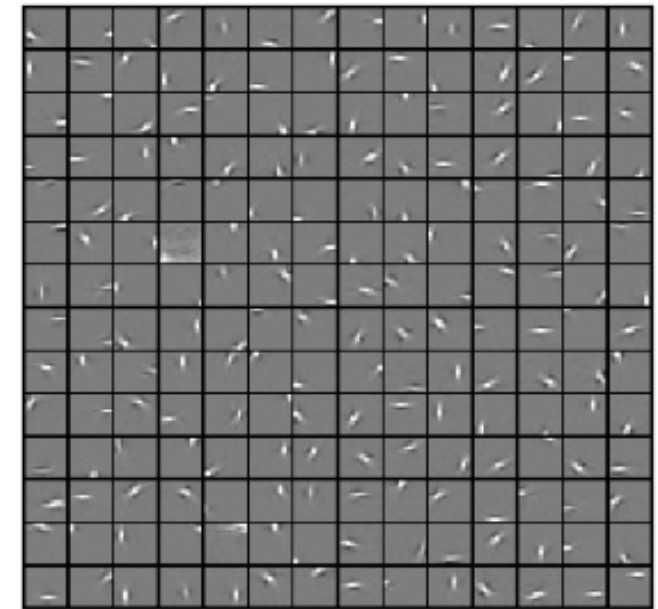
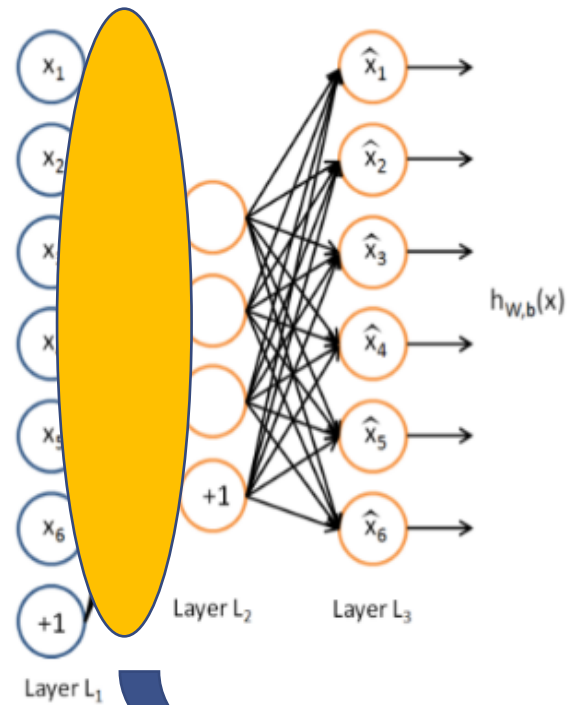
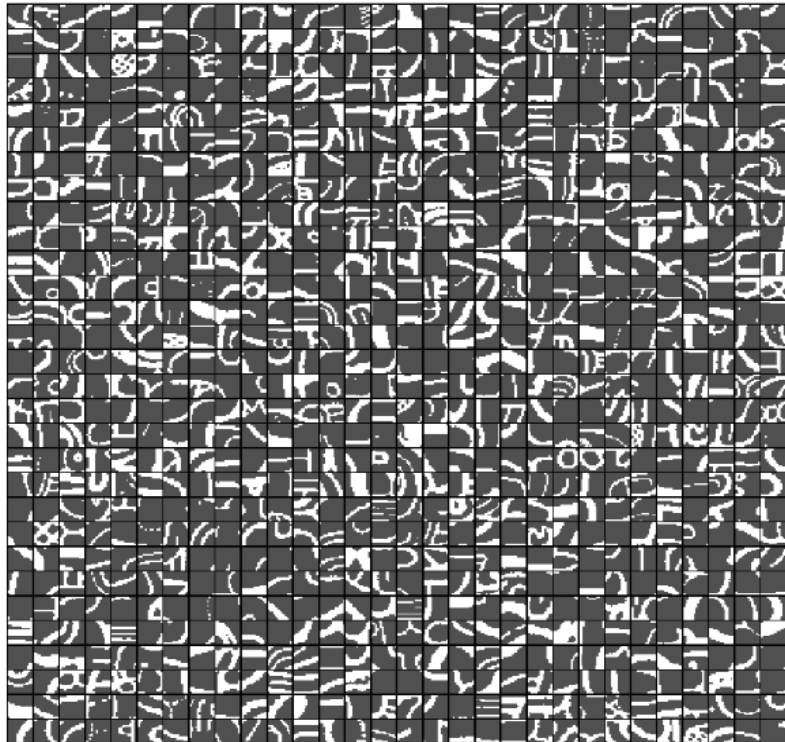
(6) Explicit relative position

194-D vector

Computer Vision Algorithms



Learning Features with Autoencoders



Computer Vision Algorithms



Identification – Glyph Retrieval

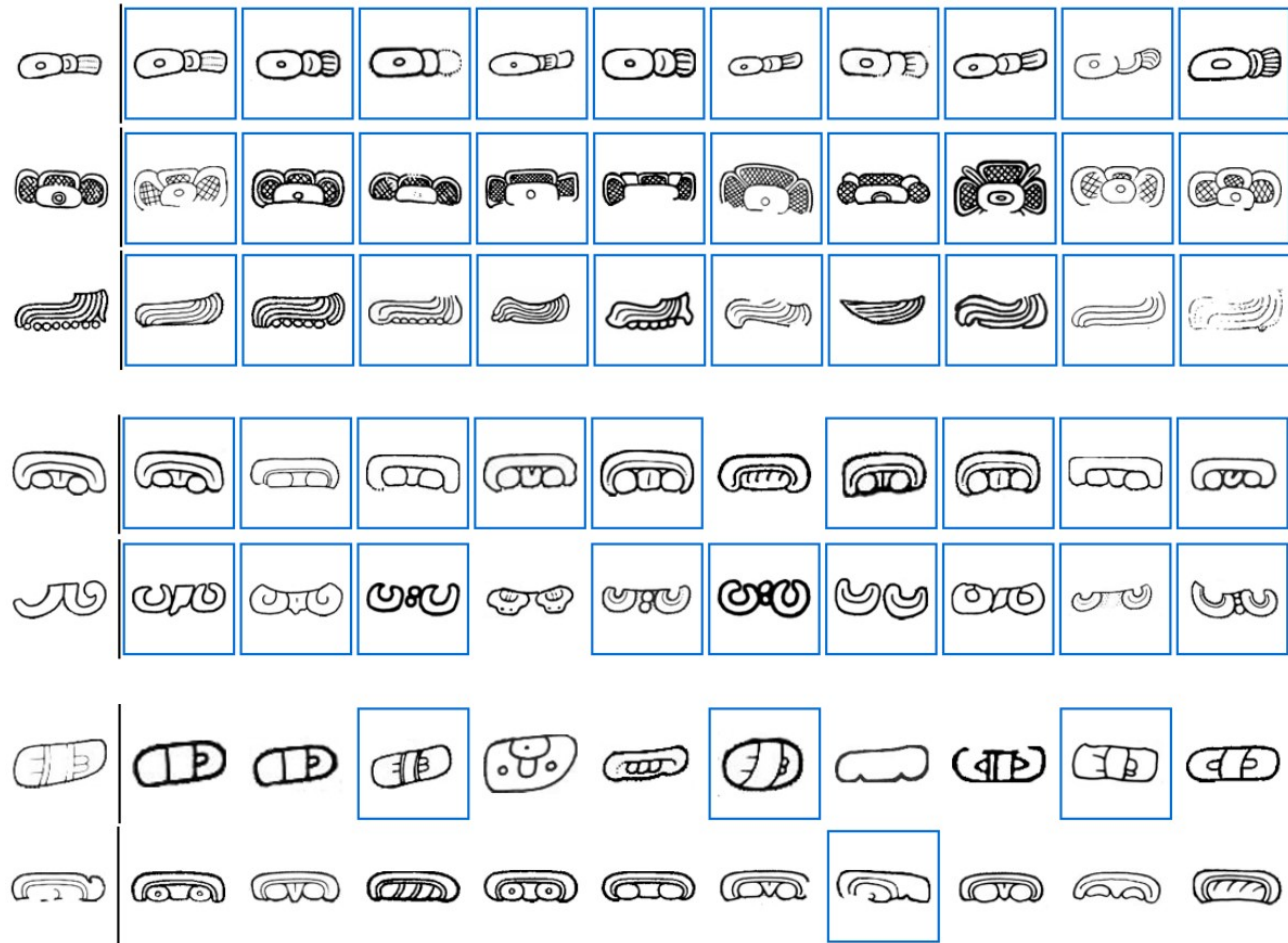
Compute pivots and HOOSC descriptors



k-means clustering & bag-of-visual-words representation



Ranking of “bov”s of each glyph



Computer Vision Algorithms



Identification - Classification

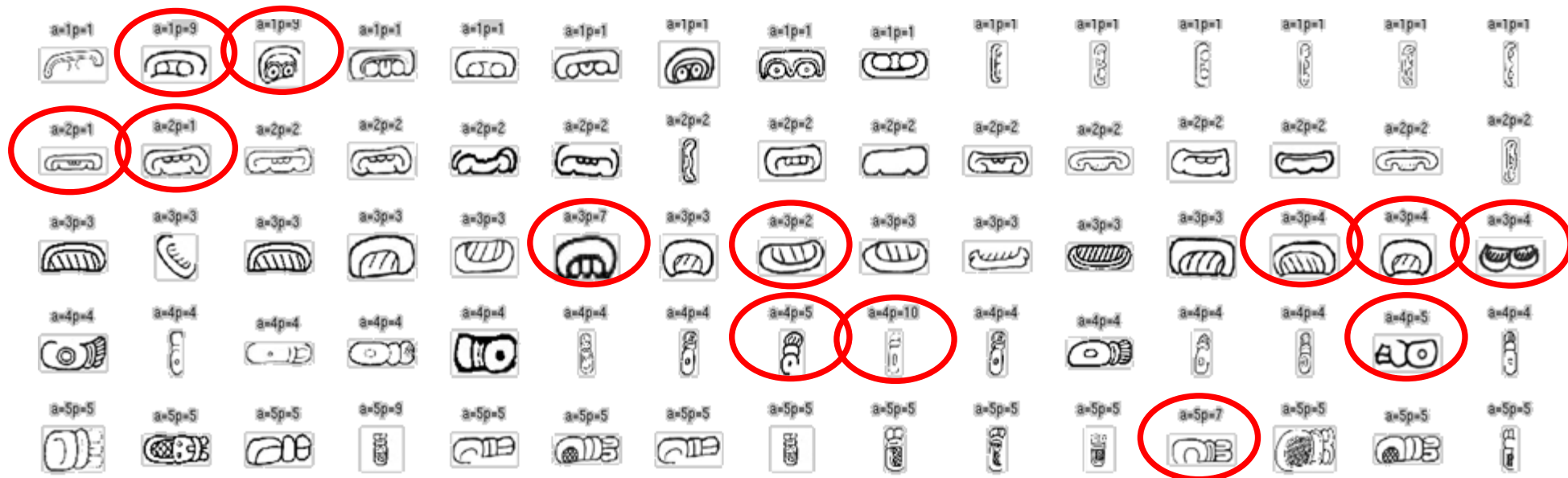
Compute pivots
and HOOSC
descriptors



Classify each
pivot



Apply voting for
glyph-level
prediction



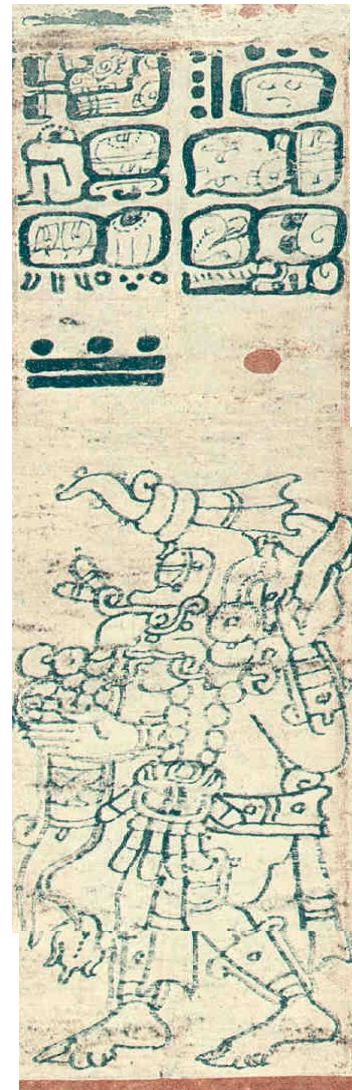
Using context to improve glyph recognition



Using context to improve glyph recognition



Using context to improve glyph recognition



Hieroglyphic Text

caption 1: k'awil-k'am//b'olon-ox-na//xib'/?/nak?-ka'an-na//chaak?/cha-ki (09 03 ?? male?/rising? sky Chaak receives K'awil.)

caption 2: ak'ab'-hi-ha'/b'a-la//muk?/mu-ka-wi'il? (Night rain, buried food?. OR Night rain; the omen is food?.)

Iconography

deity: Chaak

object: axe

glyph: "pawah-aak" 'Pawah turtle' (T63.T625)

object: cloth?

glyph: crossed bands (T552)

object: flower

object: incense bag

glyph: "yax" 'first; green/blue' (T17)

The rain god Chaak stands, holding an axe in his upraised left hand and a "pawah-aak" compound in his right hand.

Below this is a piece of cloth(?) with a crossed bands element and a flower. Chaak wears an incense bag with a T17 "yax" glyph around his neck.

Using context to improve glyph recognition



Category:T668.T102
Cha-ki
Meaning: Rain god

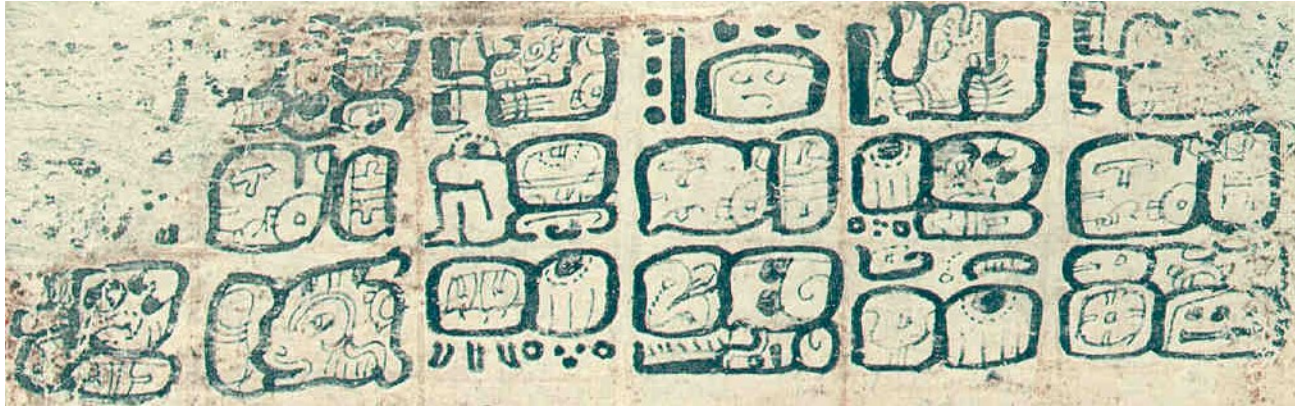


Category:T227:T561.T23
xib?-ka'an-na
Meaning: man, sky, ?

Using context to improve glyph recognition



Data preparation



Using context to improve glyph recognition



Glyph matching



Using context to improve glyph recognition



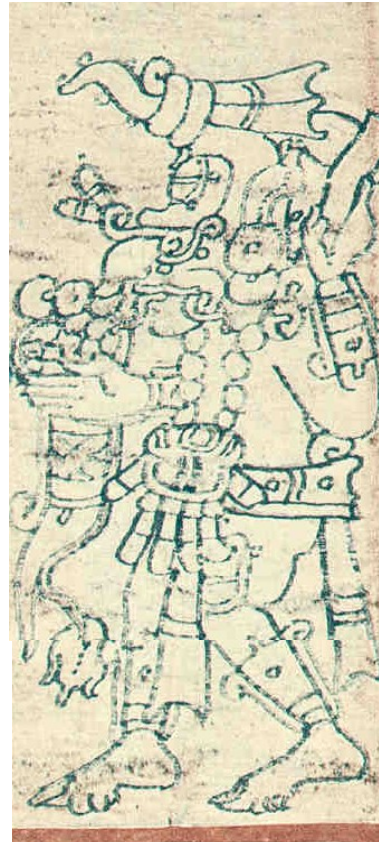
Glyph matching



Using context to improve glyph recognition



- Statistic language model
- Icon
- Translation



Category:T668.T102
Cha-ki
Meaning: Rain god

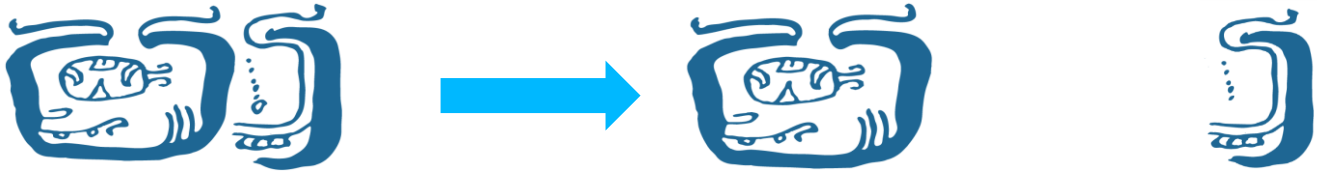


Category:T227:T561.T23
xib?-ka'an-na
Meaning: man, sky, ?

Using context to improve glyph recognition



Context Information



The diagram illustrates context information for glyph recognition. It features a grid of glyphs. The top row shows two blue glyphs. Below this are two rows of ten black glyphs each. At the bottom, there are four pairs of glyphs, each enclosed in a colored box (blue, green, red, red).

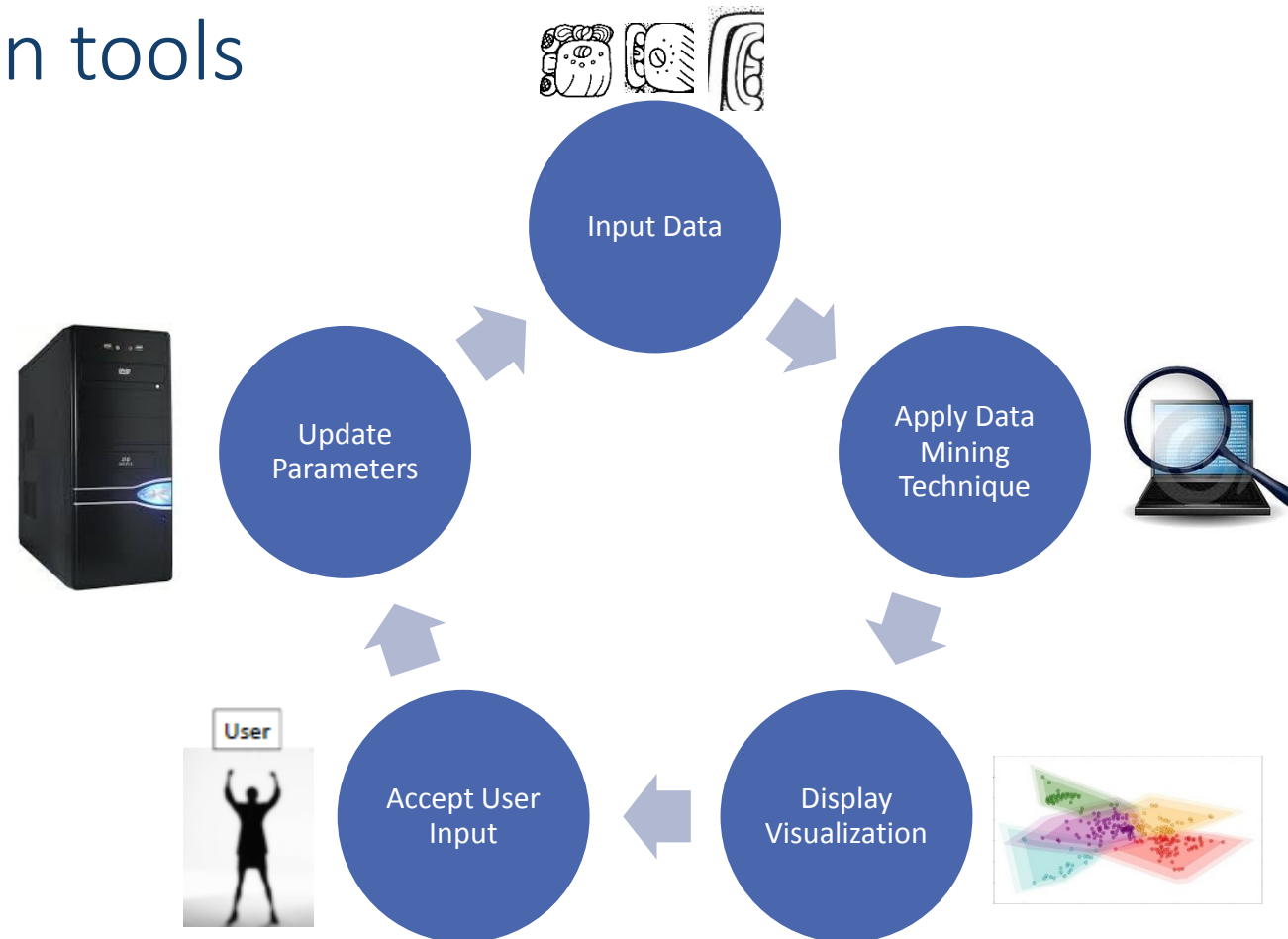


- Improve recognition accuracy
- Help with noisy and partially missing examples
- High-level translation

Visualization



A final goal is to *advance state-of-the art* in effective *interactive* visualization tools

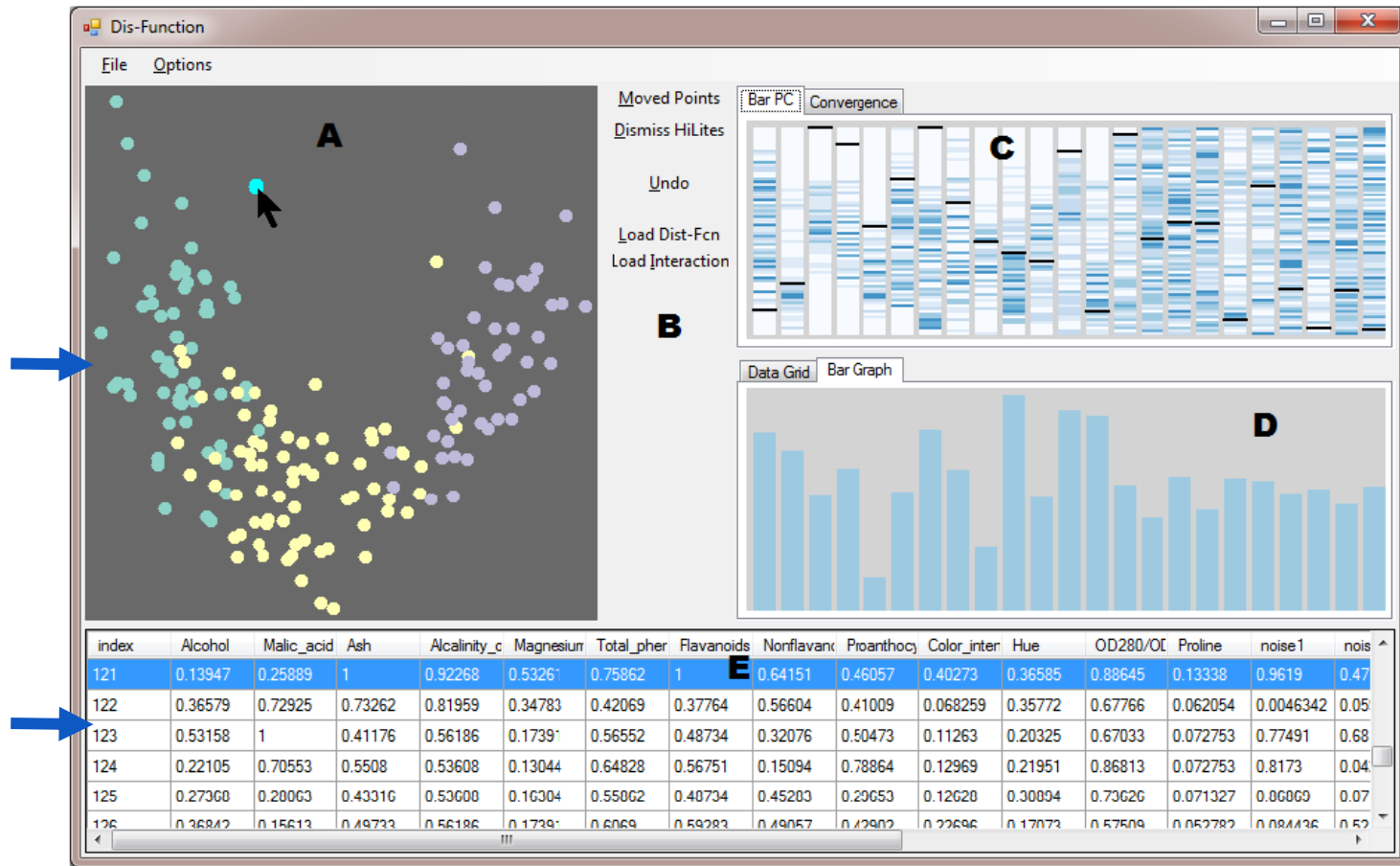


Visualization



Interactive Clustering

MDS
projection
based on
weighted
Euclidean
distance
function



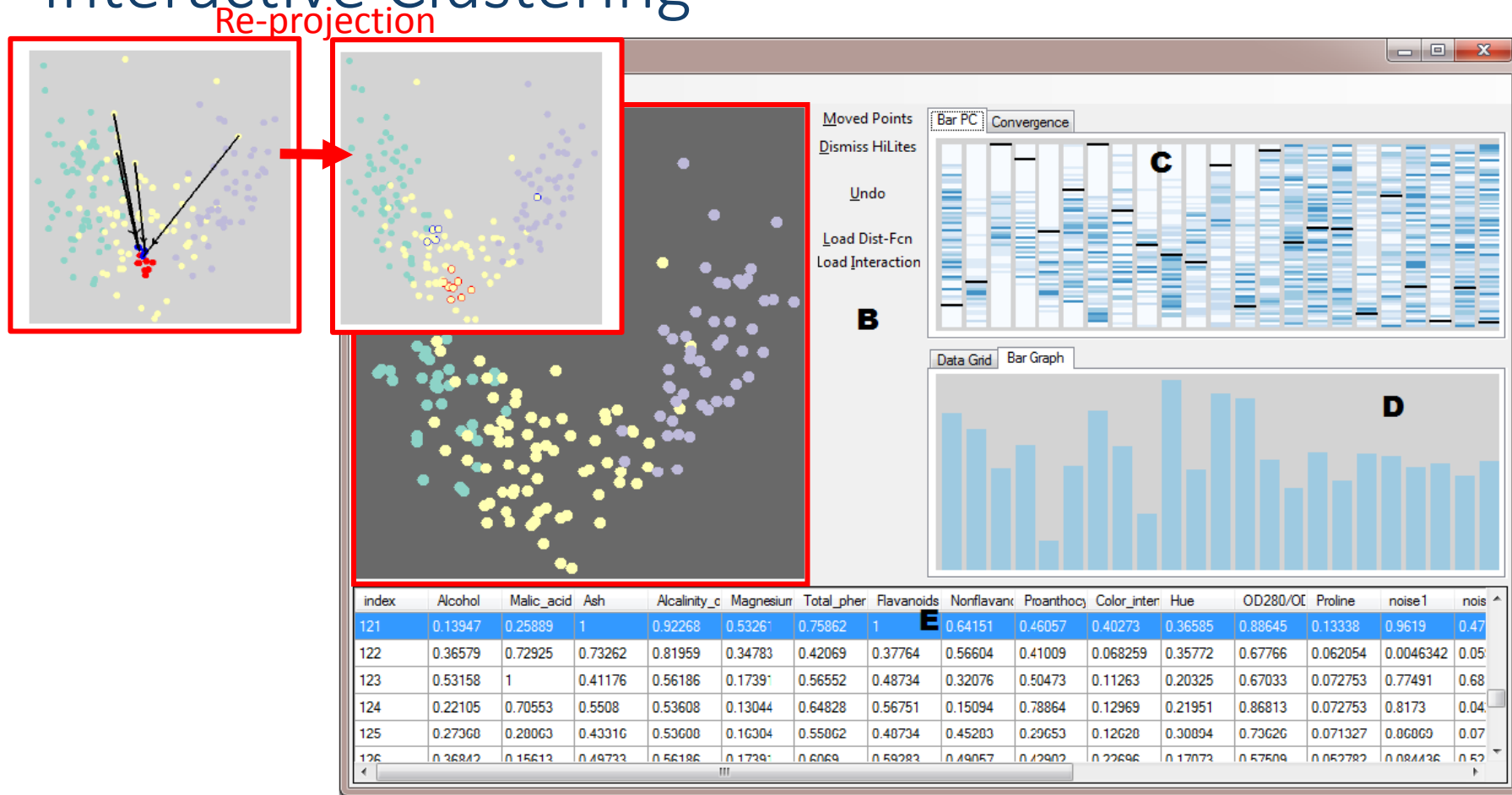
Data from UCI
wine data set

Eli T. Brown, Jingjing Liu, Carla E. Brodley, Remco Chang: Dis-function: Learning distance functions interactively. IEEE VAST 2012: 83-92

Visualization



Interactive Clustering

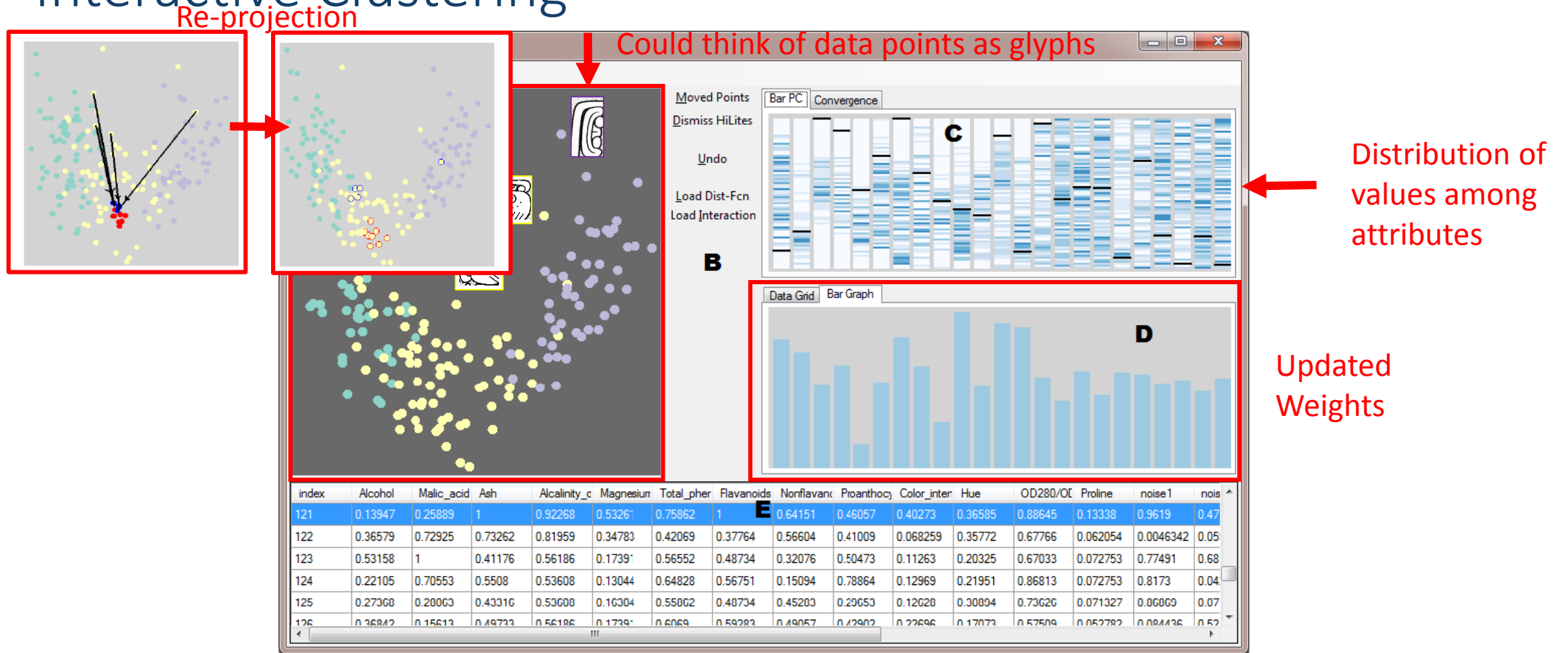


Eli T. Brown, Jingjing Liu, Carla E. Brodley, Remco Chang: Dis-function: Learning distance functions interactively. IEEE VAST 2012: 83-92

Visualization



Interactive Clustering

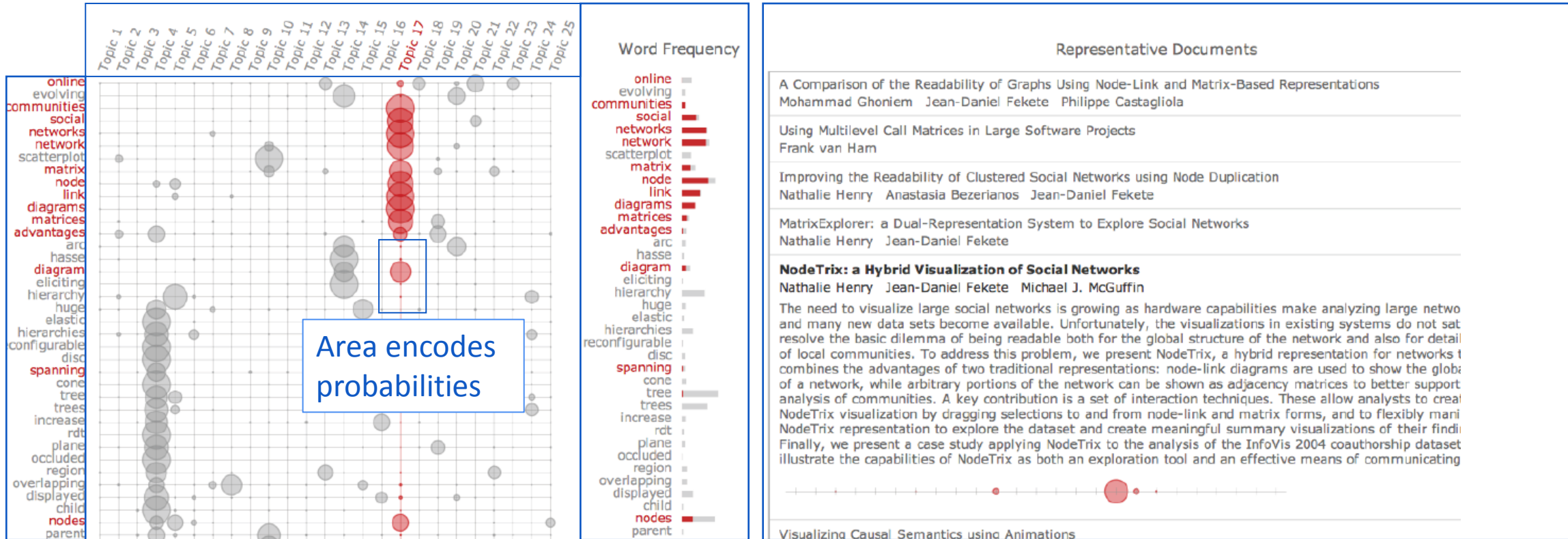


Eli T. Brown, Jingjing Liu, Carla E. Brodley, Remco Chang: Dis-function: Learning distance functions interactively. IEEE VAST 2012: 83-92

Visualization



Topic Model Visualization



Can filter and sort words based on probability of co-occurrence

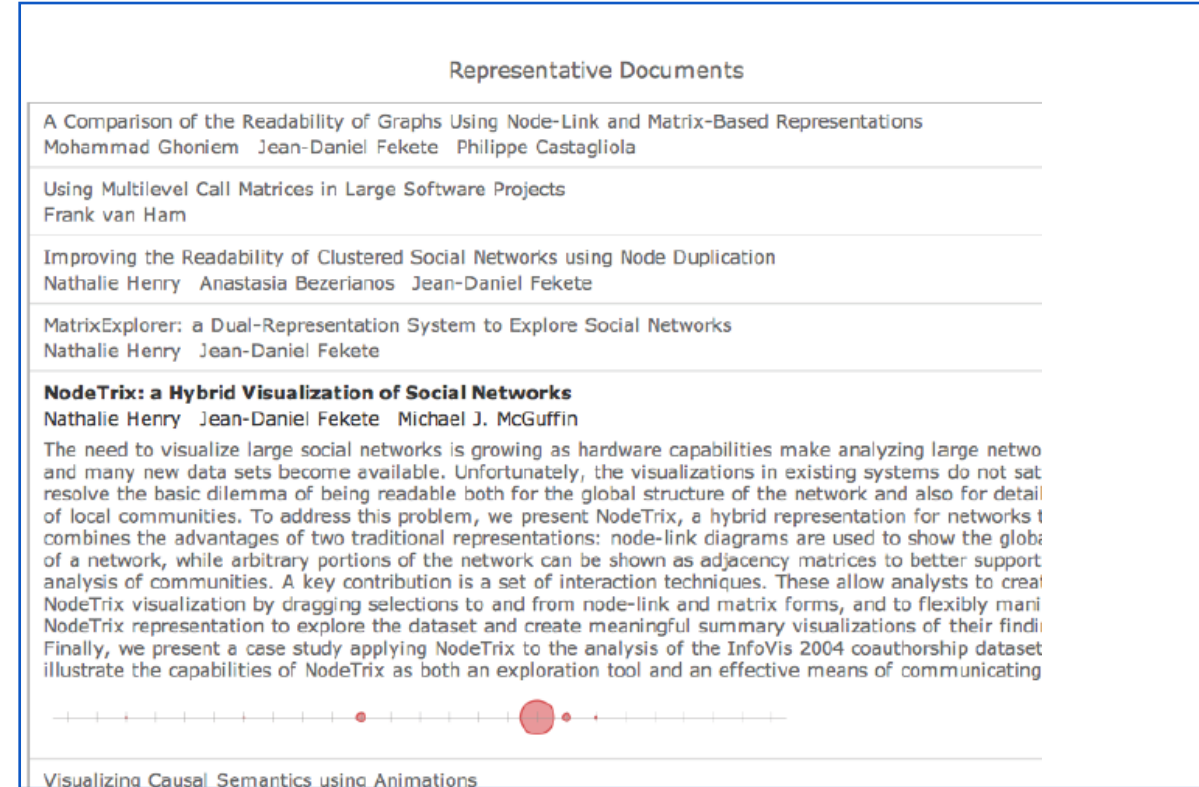
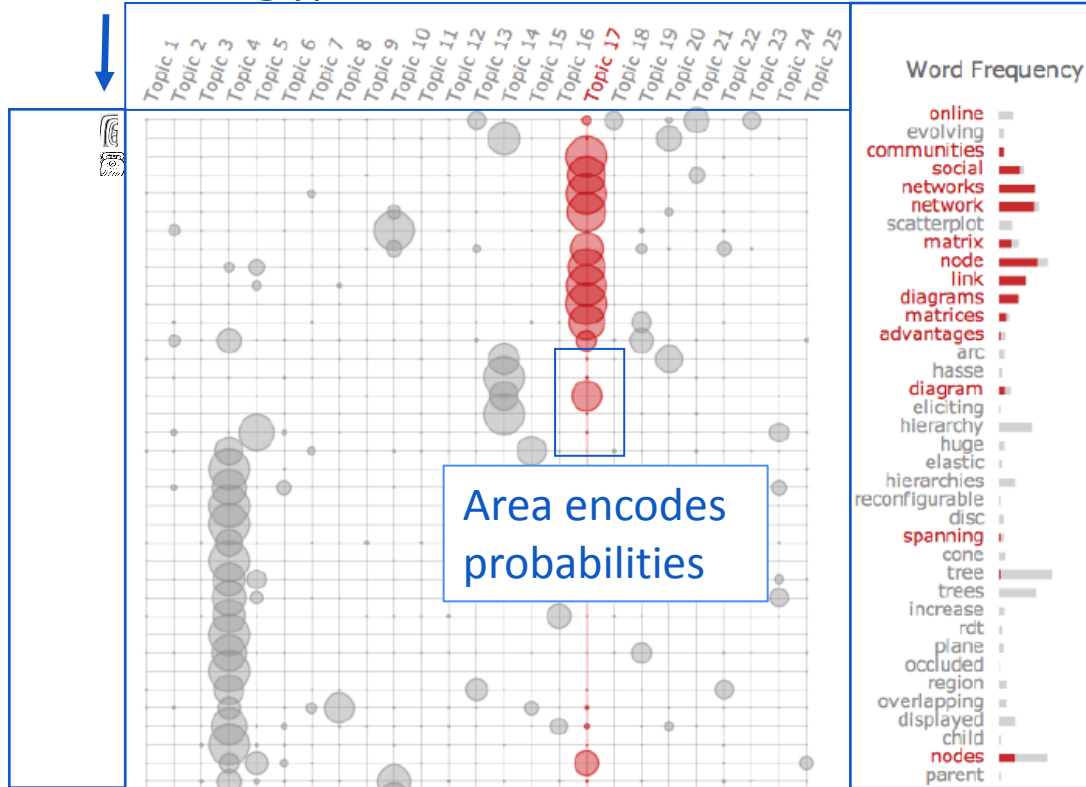
Jason Chuang, Christopher D. Manning, Jeffrey Heer: Termite: visualization techniques for assessing textual topic models. AVI 2012: 74-77

Visualization



Topic Model Visualization

Can think of terms as glyphs



Can filter and sort words based on probability of co-occurrence

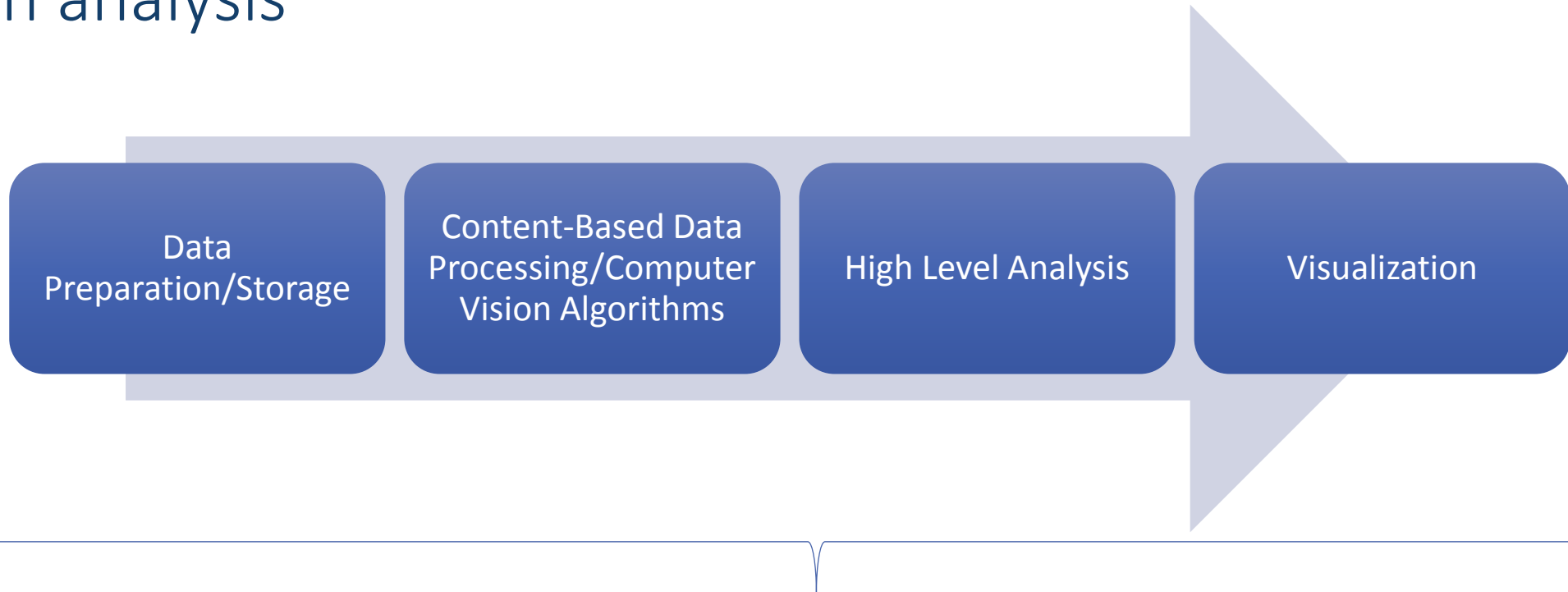
Can think of documents as codices (add)

Jason Chuang, Christopher D. Manning, Jeffrey Heer: Termite: visualization techniques for assessing textual topic models. AVI 2012: 74-77

Conclusion

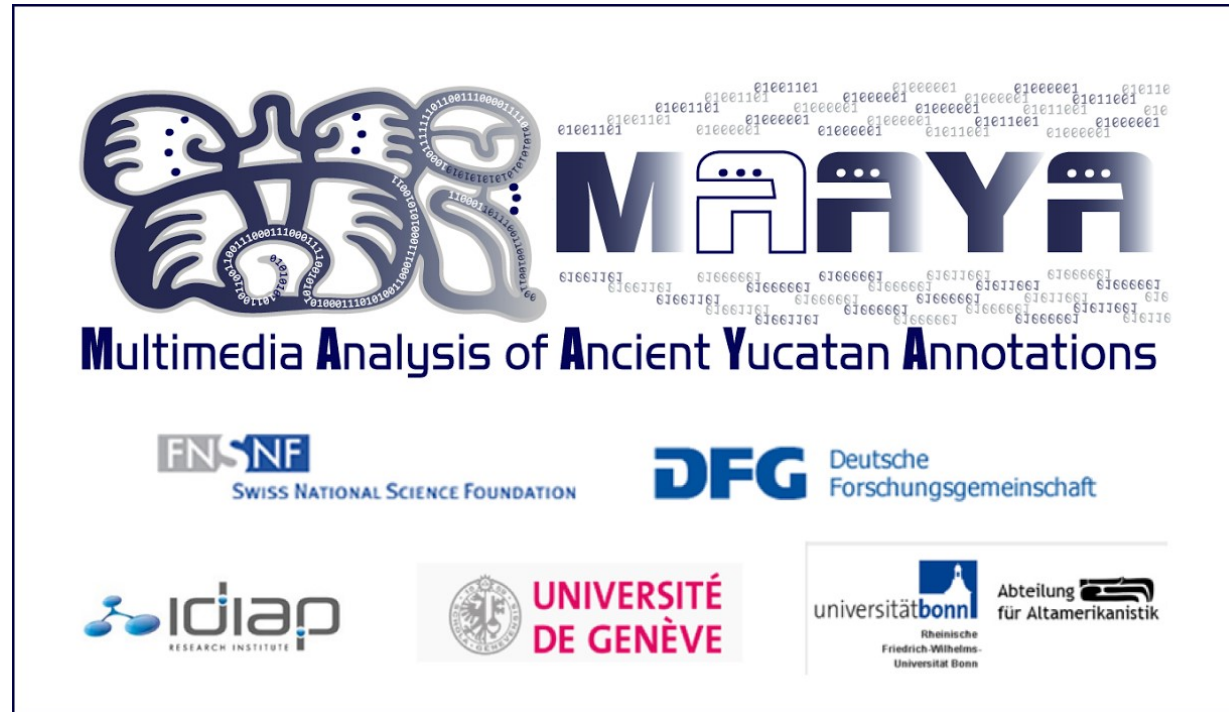


The MAAVA project aims to improve the entire process of digital glyph analysis



Main Goal: Advance the state of the art in image description and visualization techniques, while providing support to epigraphers

Acknowledgements



And a special thanks to the Swiss National Science Foundation: [Project CR21I2L_144238](#)

Questions



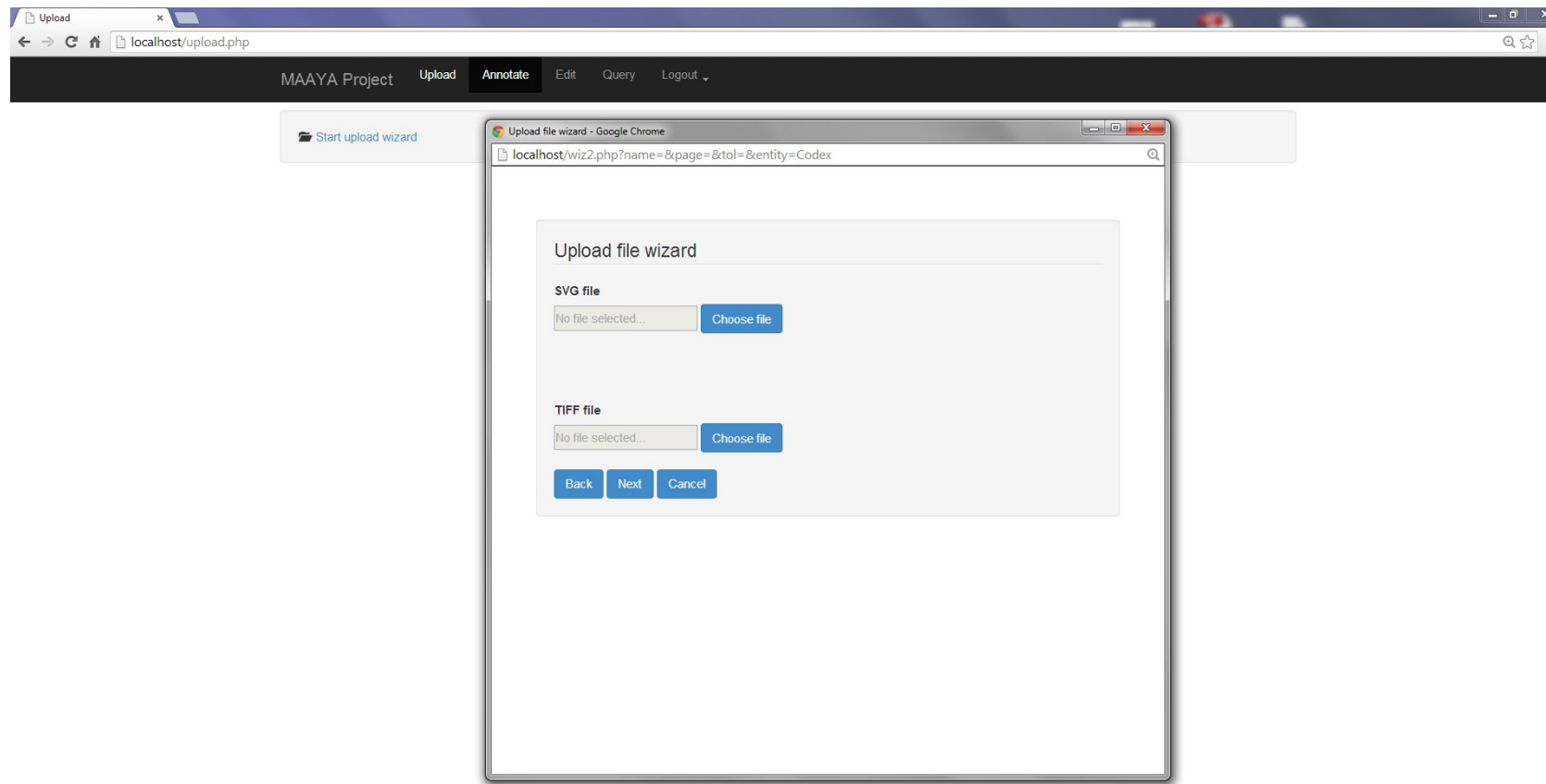
Backup Slides



The Online Wizard



The webpage includes a user friendly upload wizard for segmented files



The Data Annotation Page



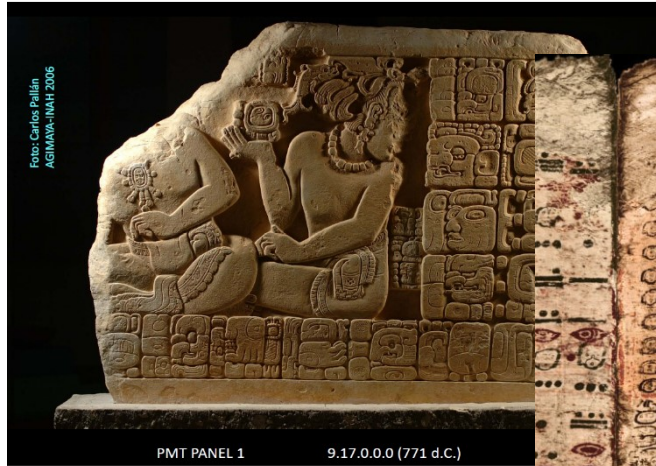
As well as a standardized data annotation page

A screenshot of a web browser displaying a data annotation page. The browser window is titled 'Annotate' and shows the URL 'localhost/annotate.php'. A modal window titled 'Annotation form - Google Chrome' is open, showing a 'Block annotation form' for 'localhost/blockAnnotationForm.html'. The form includes several input fields: 'Read order 1', 'Read order 2', 'Collocation' (with 'C3' selected), 'Thompson', 'Macri/Looper', 'Transcription', 'Transliteration', 'Segmentation', 'Morph. analysis', 'Translation', and 'Observations'. A 'Save' button and a 'Cancel' button are at the bottom. To the right of the form is a small image of a stylized character. In the background, a table with columns 'Block' and 'Instance' is visible, showing a row with 'C3' and 'C3a.C3b'.

Mayan Overview



Mayan Writing System



Mayan Overview



Mayan Writing System

