



Annotation of Image Segments using Ontologies

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Some background on the new Planteome project

(NSF #1340112)

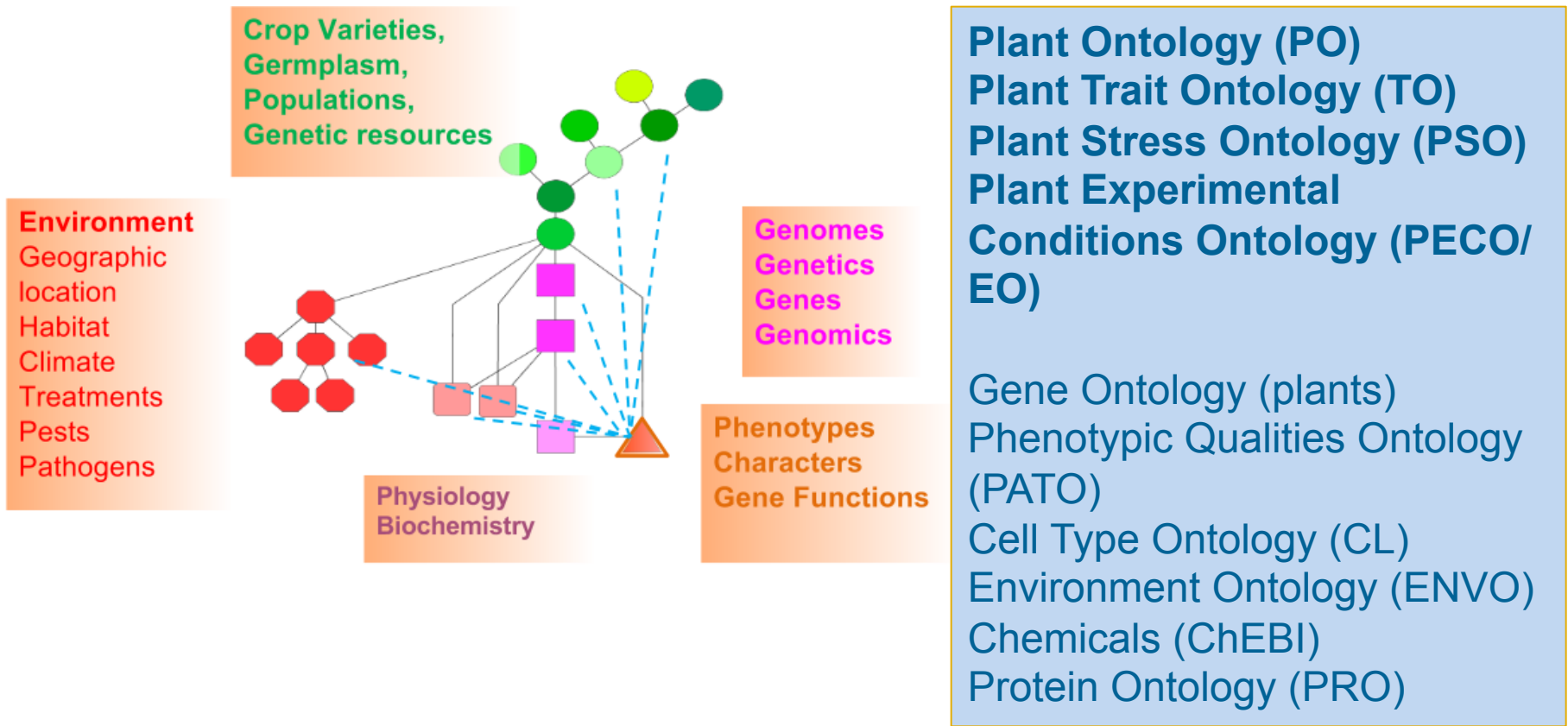


Common Reference Ontologies for Plants (cROP) & Tools for Integrative Plant Genomics

planteome.org

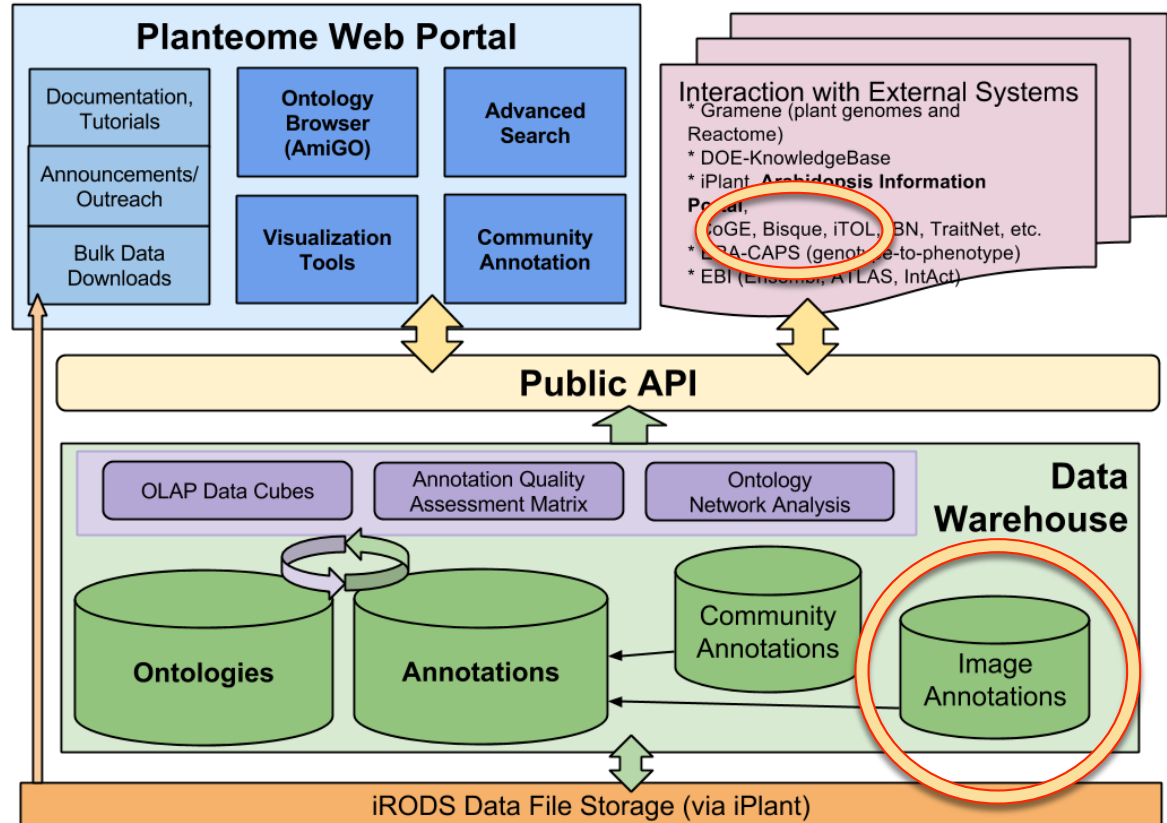
- Centralized platform where reference ontologies for plants will be developed and hosted, along with crop-specific application ontologies and analysis tools.
- Reference and crop ontologies will be used for integration and annotation of genetic, genomic and germplasm data sets, collected and managed by collaborative national and international projects.

Common Reference Ontologies for Plants (cROP)



The Planteome Informatics Portal & Data Store

- Online informatics portal for ontology-based, annotated data for plant germplasm, gene expression, and non-model genomes
- Semantic data query, analysis, visualization and community-based annotation and curation tools
- Image analysis tools and iPlant / BisQue integration





Images and Ontologies

□ **Goals:**

- Integrate ontology terms with image data.
- Label specific *portions* of images with terms (*not* just rectangular areas)
- Make it easy to use.

□ **Why?**

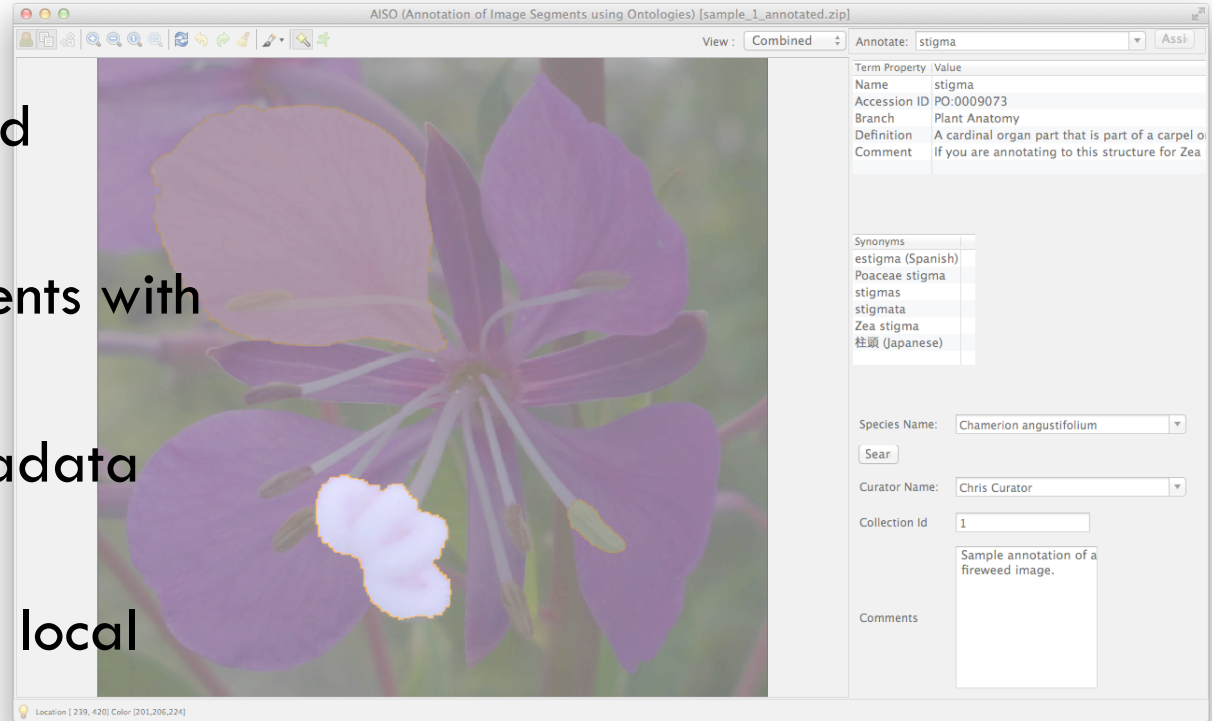
- People like to tag their image data. It's useful to label stuff.
- A database of images annotated with ontology terms can be mined for semantic relationships and associated with other annotation data (e.g. gene loci)
- Ultimately, active learning technologies can be applied to auto-annotate new images based on previous annotations.

AISO: What it does



□ Features

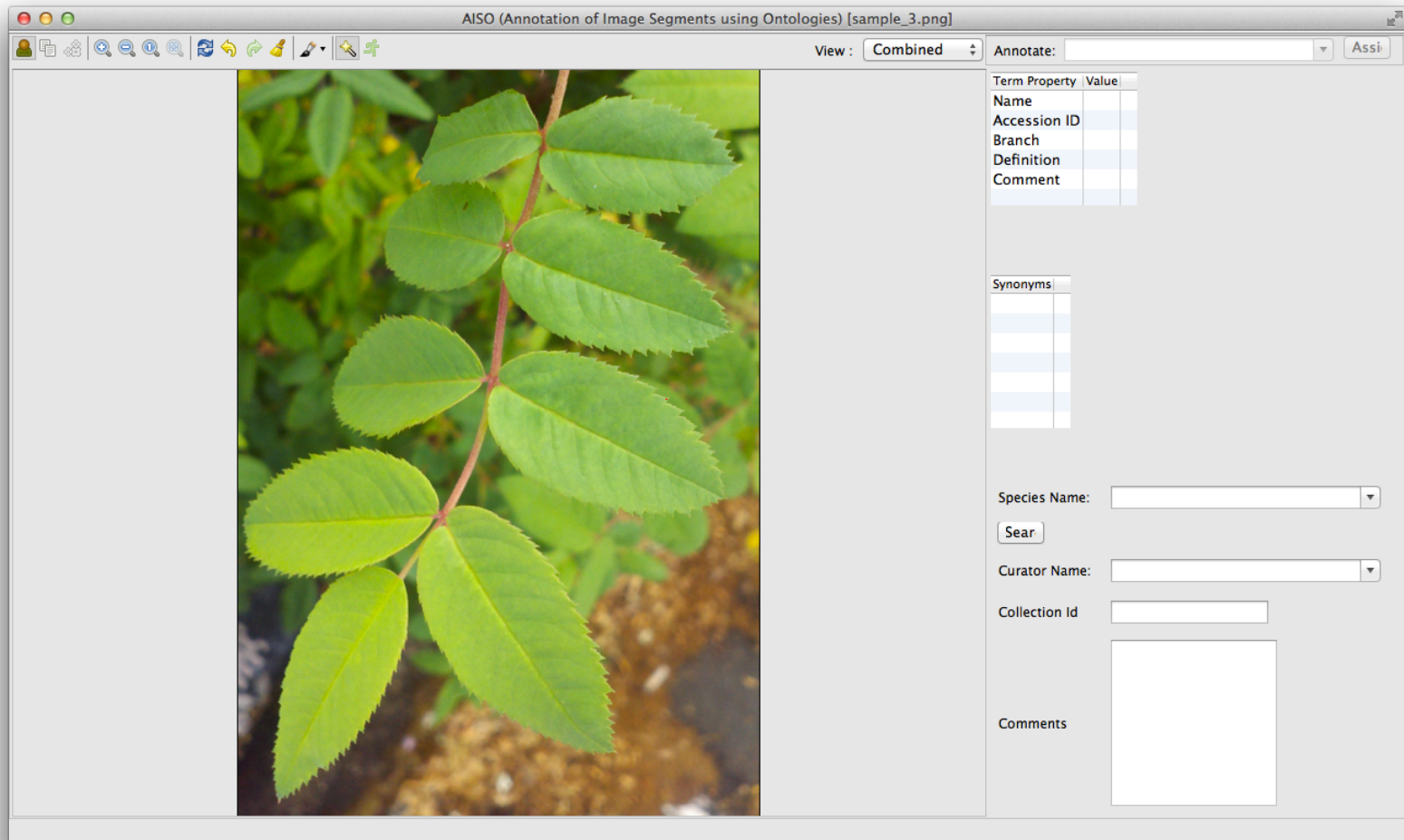
- Easily mark up and segment images
- Label those segments with ontology terms
- Add curation metadata (species, etc.)
- Save your work in local files
- Export your work in HTML for use in web sites and documents



Open an image



JPEG, PNG, GIF, and BMP accepted



Mark the “foreground”



Left-click and drag to mark the area you want to highlight

The screenshot shows the AISO software interface. The main window displays a photograph of a green leaf with a red line drawn across it to indicate a highlighted area. The interface includes a toolbar at the top, a 'View' dropdown set to 'Combined', and an 'Annotate' dropdown. Below the image, there is a status bar showing 'Location [392, 334] Color [135,184, 99]'. On the right side, there is a metadata form with the following sections:

Term	Property	Value
Name		
Accession ID		
Branch		
Definition		
Comment		

Synonyms

Species Name:

Search

Curator Name:

Collection Id

Comments

Mark the “background”



Right-click and drag to mark the area you want to ignore

The screenshot displays the AISO software interface. The main window shows a photograph of a rose branch with several green leaves. A red line is drawn across the middle leaf, and a blue line is drawn across the lower leaf. The interface includes a toolbar at the top with various icons for navigation and editing. On the right side, there is a metadata panel with the following sections:

- View:** Combined
- Annotate:** [Dropdown menu]
- Assi:** [Button]
- Term Property Value Table:**

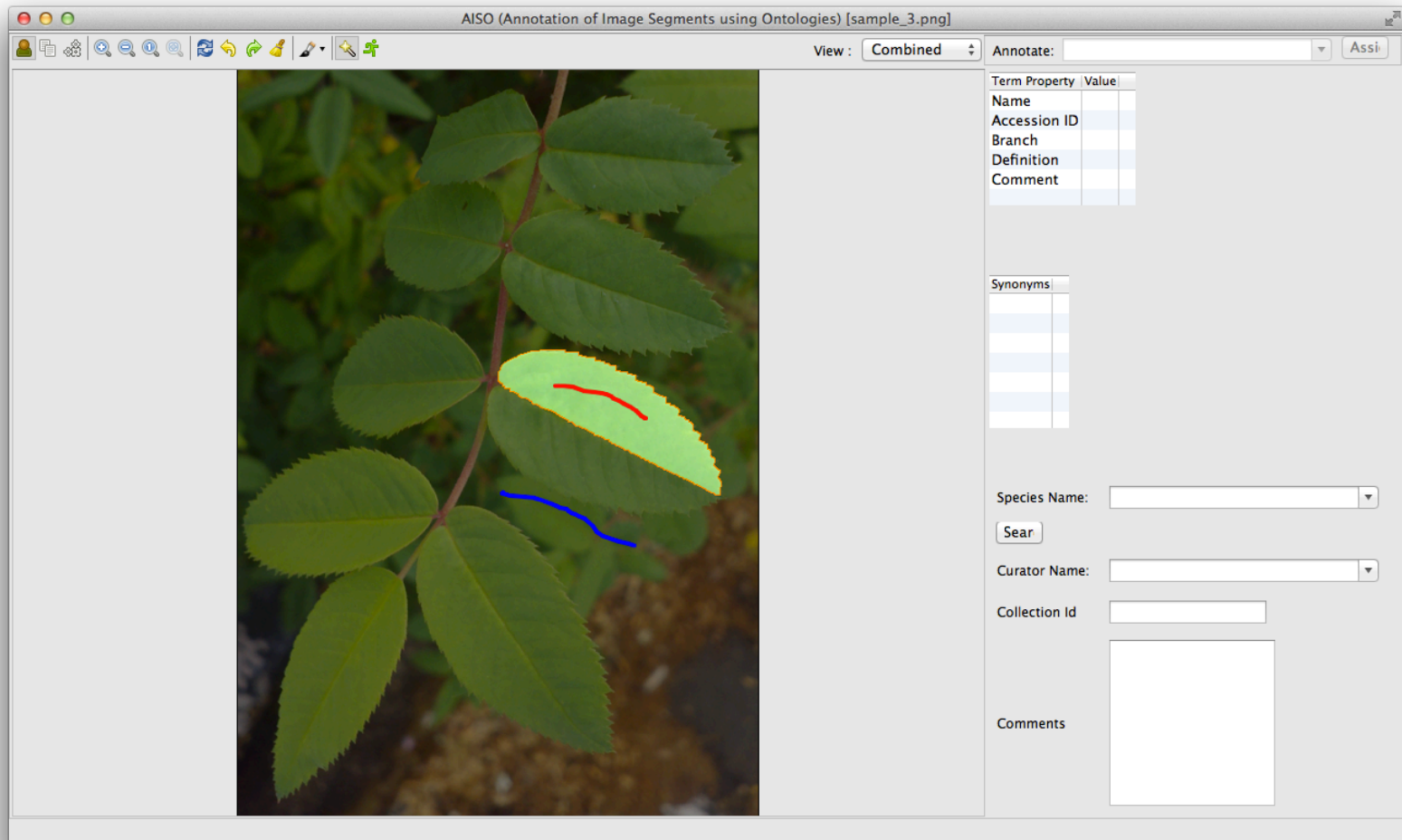
Term	Property	Value
Name		
Accession ID		
Branch		
Definition		
Comment		
- Synonyms Table:**

Synonyms
- Species Name:** [Dropdown menu]
- Search:** [Text input field]
- Curator Name:** [Dropdown menu]
- Collection Id:** [Text input field]
- Comments:** [Text area]

Interactive segmentation



AISO processes your markup and segments the image



Refine your segment



Add more markup to modify the segmentation

The screenshot displays the AISO (Annotation of Image Segments using Ontologies) software interface. The main window shows a photograph of a green leaf with a yellow segmentation mask. Red lines are drawn on the leaf, and a blue line is drawn on the stem. The interface includes a toolbar, a 'View' dropdown set to 'Combined', and an 'Annotate' dropdown. On the right side, there are several data entry fields and tables:

Term	Property	Value
	Name	
	Accession ID	
	Branch	
	Definition	
	Comment	

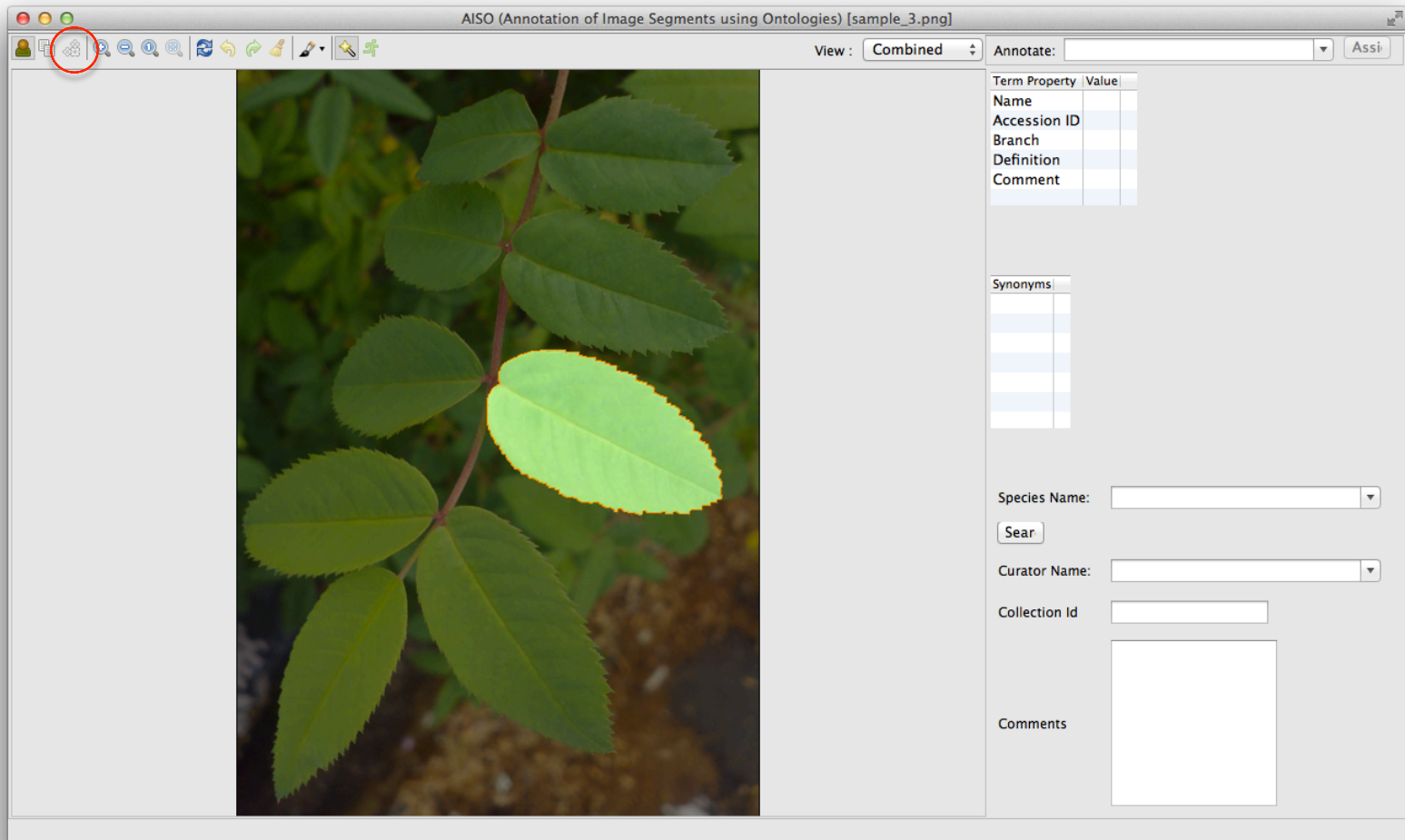
Synonyms	

Below the tables are input fields for 'Species Name', 'Curator Name', and 'Collection Id', along with a 'Search' button and a 'Comments' text area.

“Form” the segment



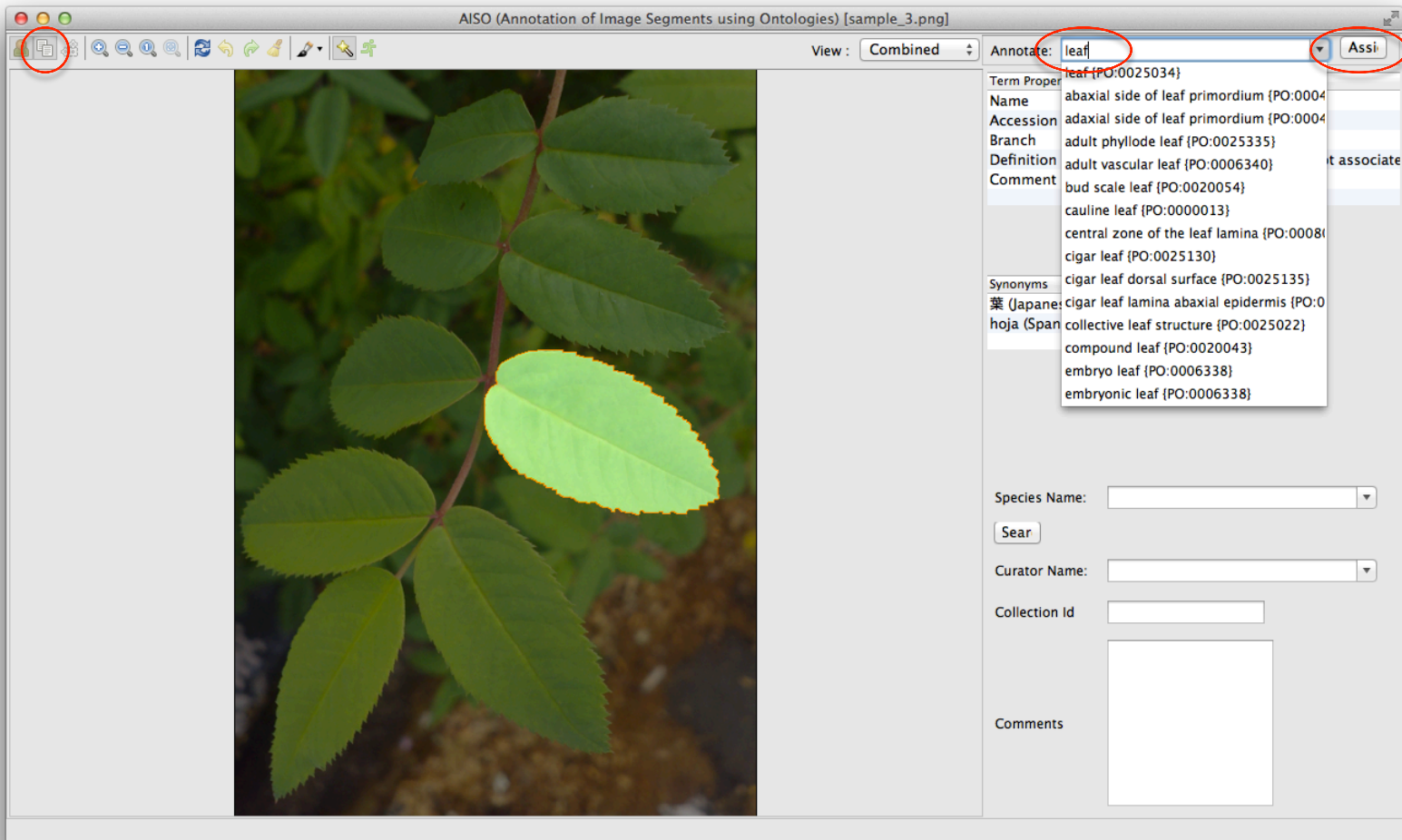
Click the segment formation icon to accept the current segmentation



Label your segment

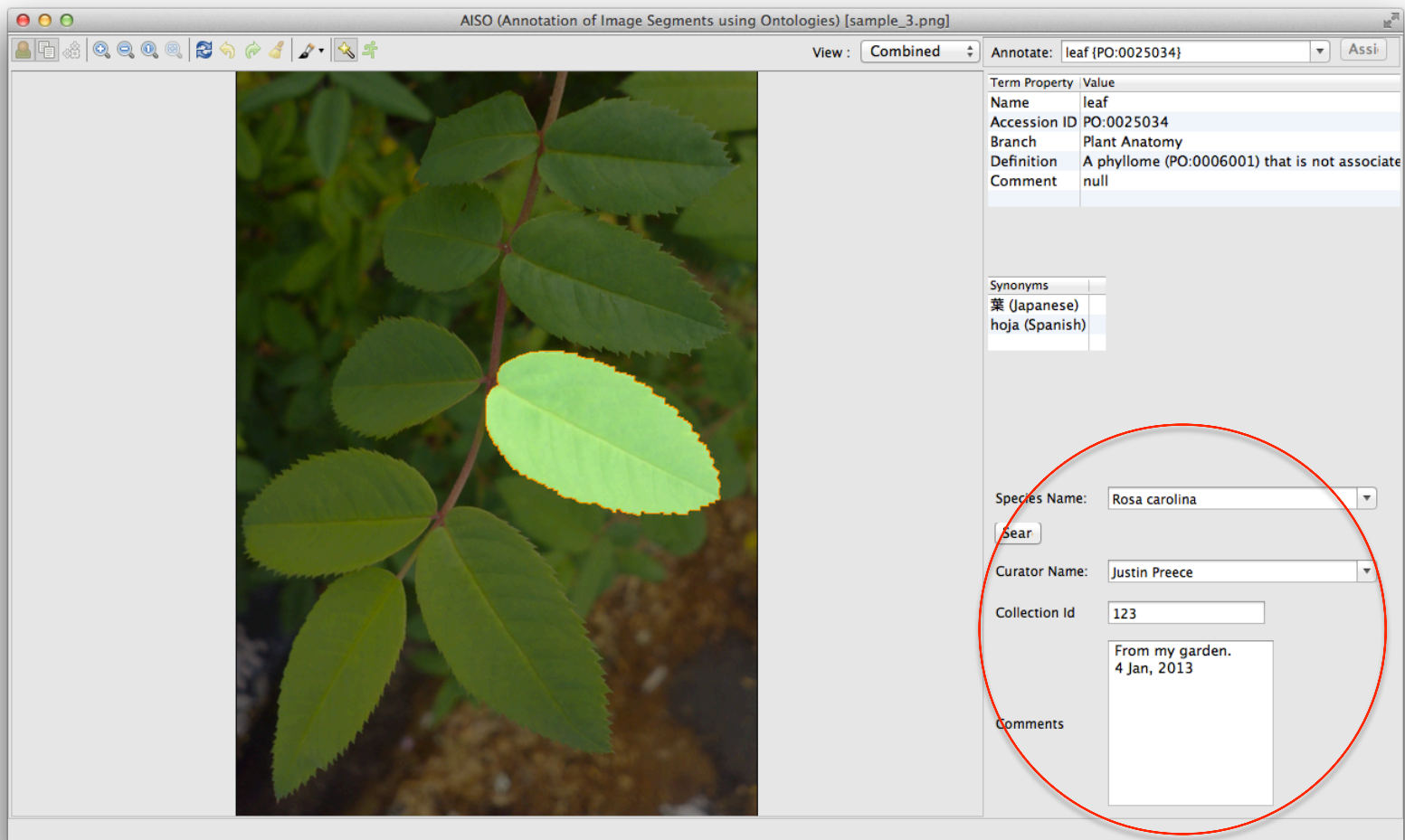


Search the ontology box for the appropriate Plant Ontology term and assign it to the new segment. NOTE: Term definitions and synonyms provided.



Add other metadata

Search for species names with the uBio web service, add a curator name, and provide collection information.



The screenshot shows the AISO (Annotation of Image Segments using Ontologies) web interface. The main window displays a photograph of a green leaf with a yellow bounding box around it. The interface includes a toolbar, a 'View' dropdown set to 'Combined', and an 'Annotate' dropdown set to 'leaf {PO:0025034}'. A table on the right lists properties for the selected term:

Term Property	Value
Name	leaf
Accession ID	PO:0025034
Branch	Plant Anatomy
Definition	A phyllome (PO:0006001) that is not associate
Comment	null

Below the table, there is a 'Synonyms' section with the following entries:

- 葉 (Japanese)
- hoja (Spanish)

The bottom right section of the interface is circled in red and contains the following fields:

- Species Name:
-
- Curator Name:
- Collection Id:
- Comments:

Save and export your work



Save your annotated image locally, and optionally export to HTML

The screenshot displays the AISO (Annotation of Image Segments using Ontologies) software interface. The main window shows an annotated image of a rose leaf with a yellow highlight. A dialog box is open for saving the work, with the following fields:

- Select folder: /Users/preecej/Desktop/AISO
- Name your .zip file: test_3_sample3
- Check box: Create HTML image map and open in browser
- Select export folder: /Users/preecej/Desktop/AISO
- Darken Background: [dropdown]
- Buttons: Cancel, Save

To the right, a metadata form is visible with the following information:

- Annotate: leaf (PO:0025034)
- Term Property: Value
- Name: leaf
- Accession ID: PO:0025034
- Branch: Plant Anatomy
- Definition: A phyllome (PO:0006001) that is not associate
- Comment: null
- Synonyms: 葉 (Japanese), hoja (Spanish)
- Species Name: Rosa carolina
- Curator Name: Justin Preece
- Collection Id: 123
- Comments: From my garden. 4 Jan, 2013

Below the metadata form, a table summarizes the information:

Species Name	Rosa carolina
Curator Name	Justin Preece
Collection Id	123
Comments	From my garden. 4 Jan, 2013

The bottom of the screenshot shows the file path for the generated HTML image map: file:///Users/preecej/Desktop/AISO demo/html3/test_3_sample3.html

Segment multiple images



You can specify and label many segments on a single image.

The screenshot displays the AISO software interface with three overlapping windows. The foreground window shows a purple flower with several segments outlined in orange. The right-hand panel contains a metadata table for the selected segment.

Term Property	Value
Name	anther
Accession ID	PO:0009066
Branch	Plant Anatomy
Definition	A collective plant organ structure (PO:002500)
Comment	Generally consists of four pollen sacs (microsp...

Synonyms	
anther (Spanish)	
葯 (Japanese)	
Poaceae anther	
Zea anther	

Species Name:

Curator Name:

Collection Id:

Sample annotation of a fireweed image.

Comments:

Location [440, 425] Color [114, 70, 69]



Current platforms

□ **Software**

- Built with Java and the SWT GUI framework
- Extends the open-source Interactive Segmentation Tool (Kevin McGuinness, Dublin City University)
- Uses an interactive graph cuts algorithm for image segmentation

□ **Web services**

- Plant Ontology term search and definitions: PHP serving MySQL data formatted as JSON
- uBio species search: namebank search service, returns XML

□ **Storage**

- Currently file-based; PNG image data and XML meta-data stored in a ZIP file

Publication, Download, & Support



- AISO paper:
Journal of Biomedical Semantics 2014, 5:50
doi: 10.1186/2041-1480-5-50
- AISO information page:
<http://jaiswallab.cgrb.oregonstate.edu/software/AISO>
- Directly download AISO for Mac, Linux, and Windows:
http://files.cgrb.oregonstate.edu/Jaiswal_Lab/AISO
- Questions, comments, suggestions, and bug reports:
aizo-support@palea.cgrb.oregonstate.edu

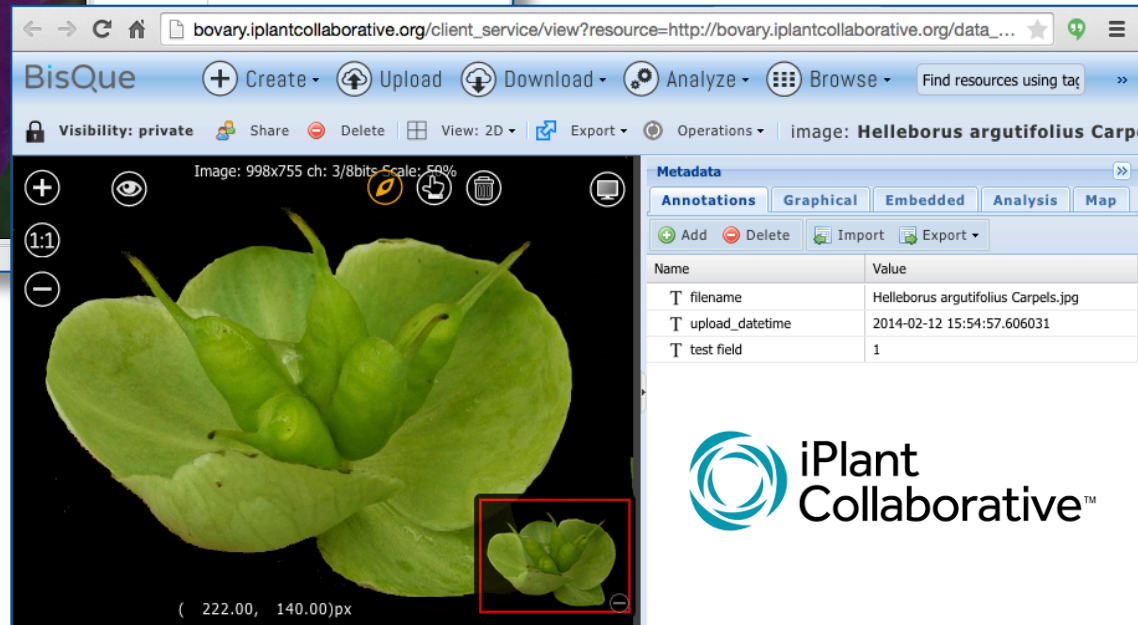
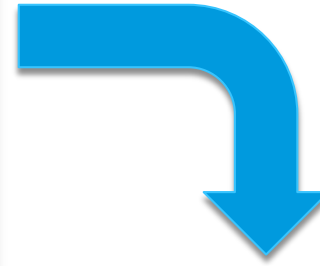
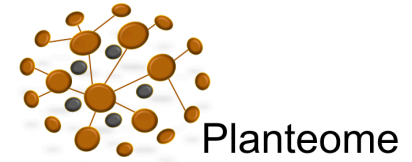
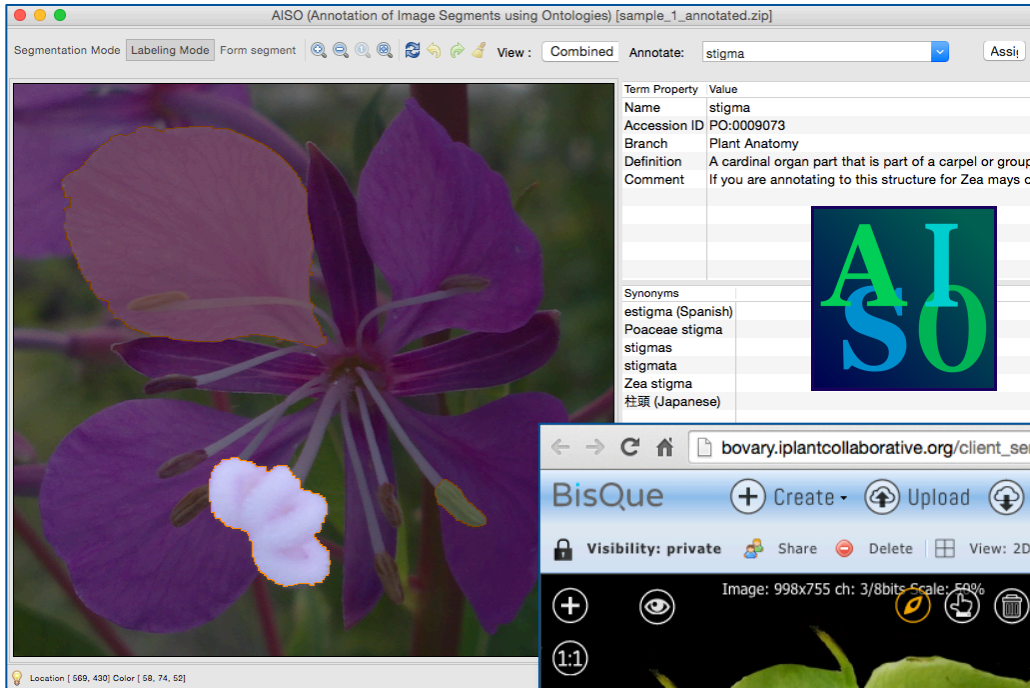
Next up: Adapt ALSO for BisQue



Current & future development

- ▣ Asynchronous user-directed graph cuts in the Bisque environment
 - Future: *Interactive* single-session graph cut segmentation of images
- ▣ Ontology metadata annotation
- ▣ Enable use of localized ontology reference data.
- ▣ Optimize for very high resolution images (10-120 MB).
- ▣ Machine-learning algorithms to optimize segmentation and to auto-annotate plant images

Port AISO into BisQue, and then add machine-enabled auto-annotation.



UCSB

+ MACHINE LEARNING ...

= AUTOMATED SEGMENTATION AND ONTOLOGY ANNOTATION

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