



*Crops *in silico** Visualization update

AJ Christensen

Advanced Visualization Lab

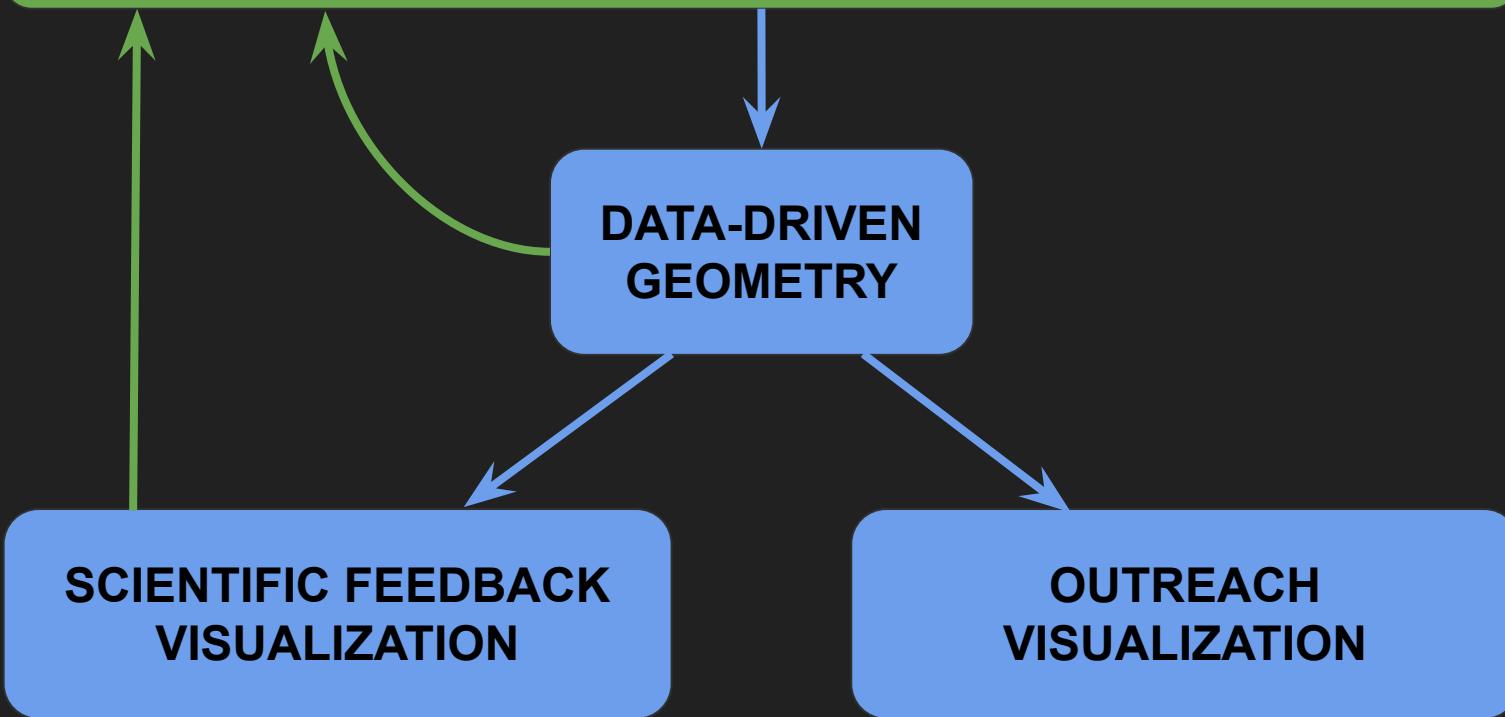
National Center for Supercomputing Applications

University of Illinois at Urbana-Champaign

GOALS

- [a] Generate data-driven geometry of plants (soy, maize)
- [b] Create cinematic outreach visualizations of geometry
- [c] Integrate geometry with external computational models
- [d] Create cinematic outreach visualizations of model output
- [e] Develop an open source visualization tool chain (L-Py)
- [f] Develop 3D assets for software feedback visualization

PLANT BIOLOGY MODELS



DATA-DRIVEN GEOMETRY

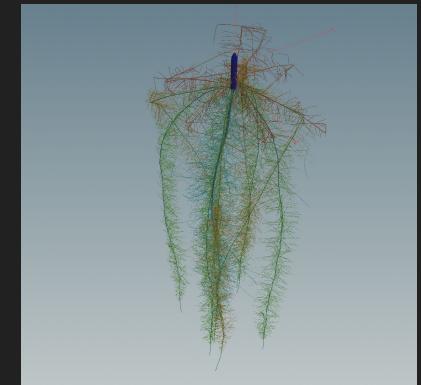
L-SYSTEMS

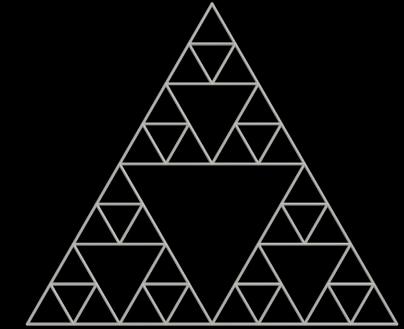
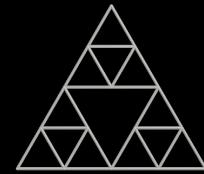


AUGMENTED
L-SYSTEMS

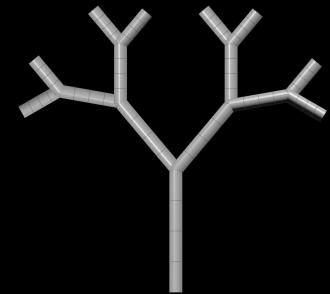
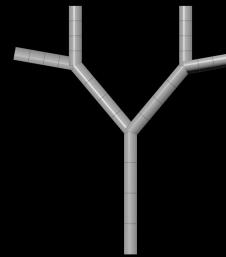


MODEL OUTPUT



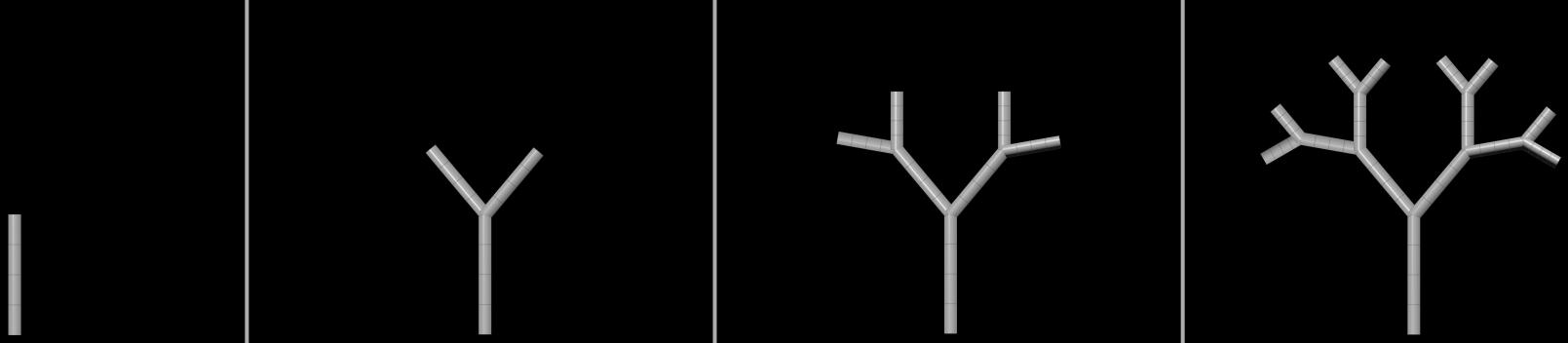


L-SYSTEMS





L-SYSTEMS



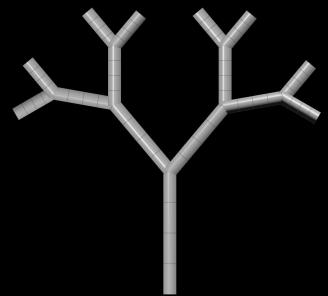
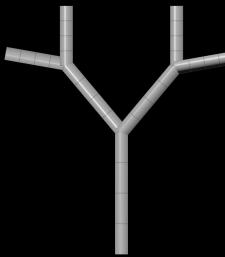
L-SYSTEMS

Rule: $A \rightarrow F [+A] [-A]$

A



A

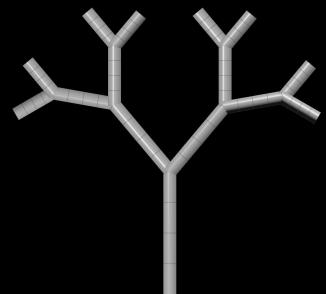
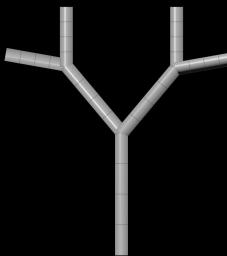
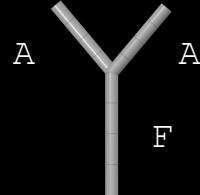


L-SYSTEMS

Rule: $A \rightarrow F [+A] [-A]$

A

F [+A] [-A]



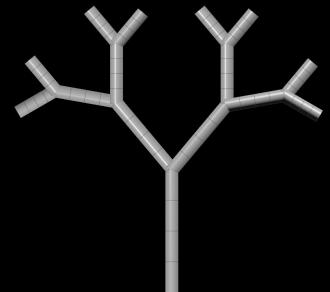
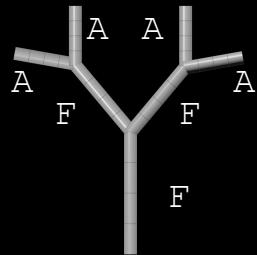
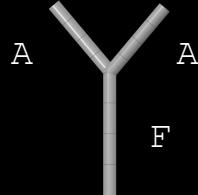
L-SYSTEMS

Rule: $A \rightarrow F [+A] [-A]$

A

F [+A] [-A]

F [+F [+A] [-A]]
[-F [+A] [-A]]

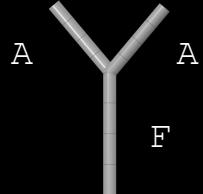


L-SYSTEMS

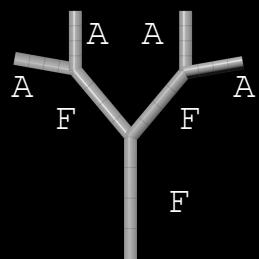
Rule: $A \rightarrow F [+A] [-A]$

A

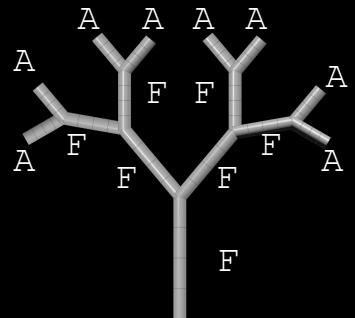
$F [+A] [-A]$



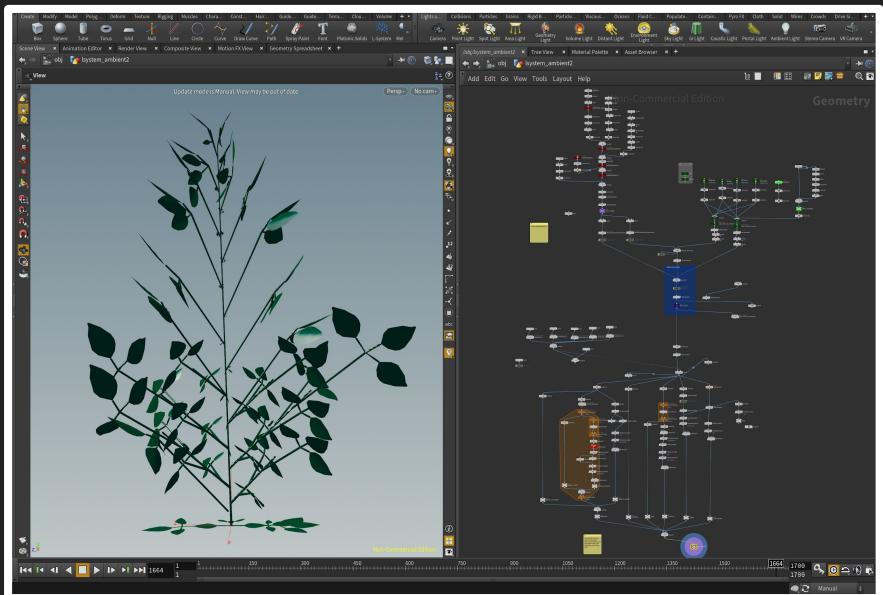
$F [+F [+A] [-A]]$
 $[-F [+A] [-A]]$



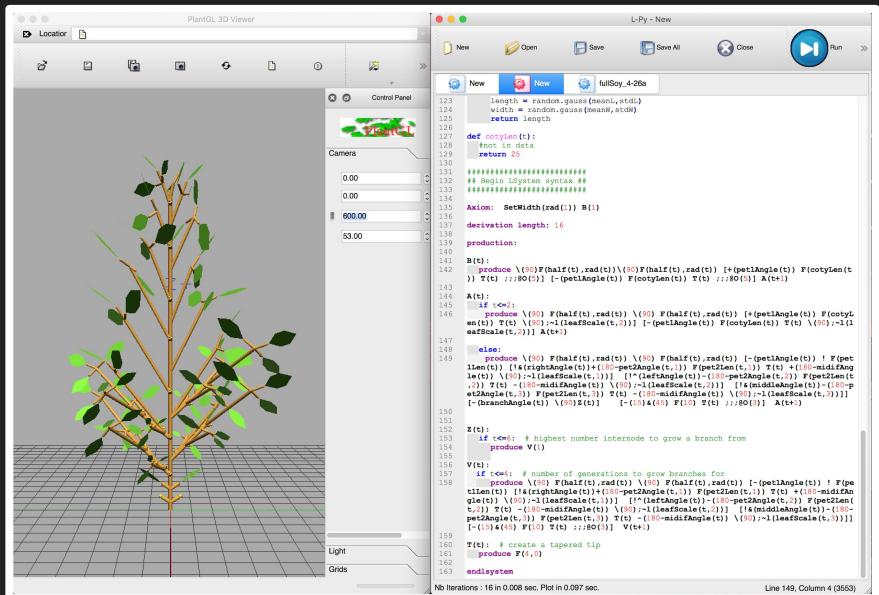
$F [+F [+F [+F [+A] [-A]]]$
 $[+A] [-A]] [-F [+F [+A] [-A]]]$
 $[+A] [-A]] [-F [+F [+A] [-A]]]$
 $[+F [+A] [-A]] [-F [+F [+A] [-A]]]$
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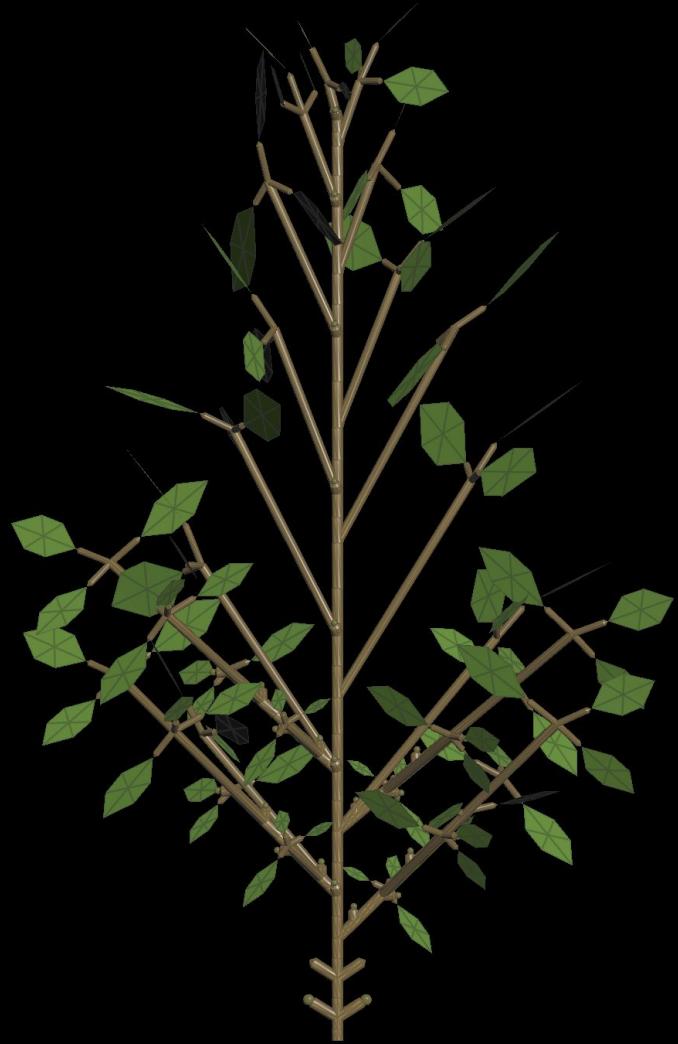


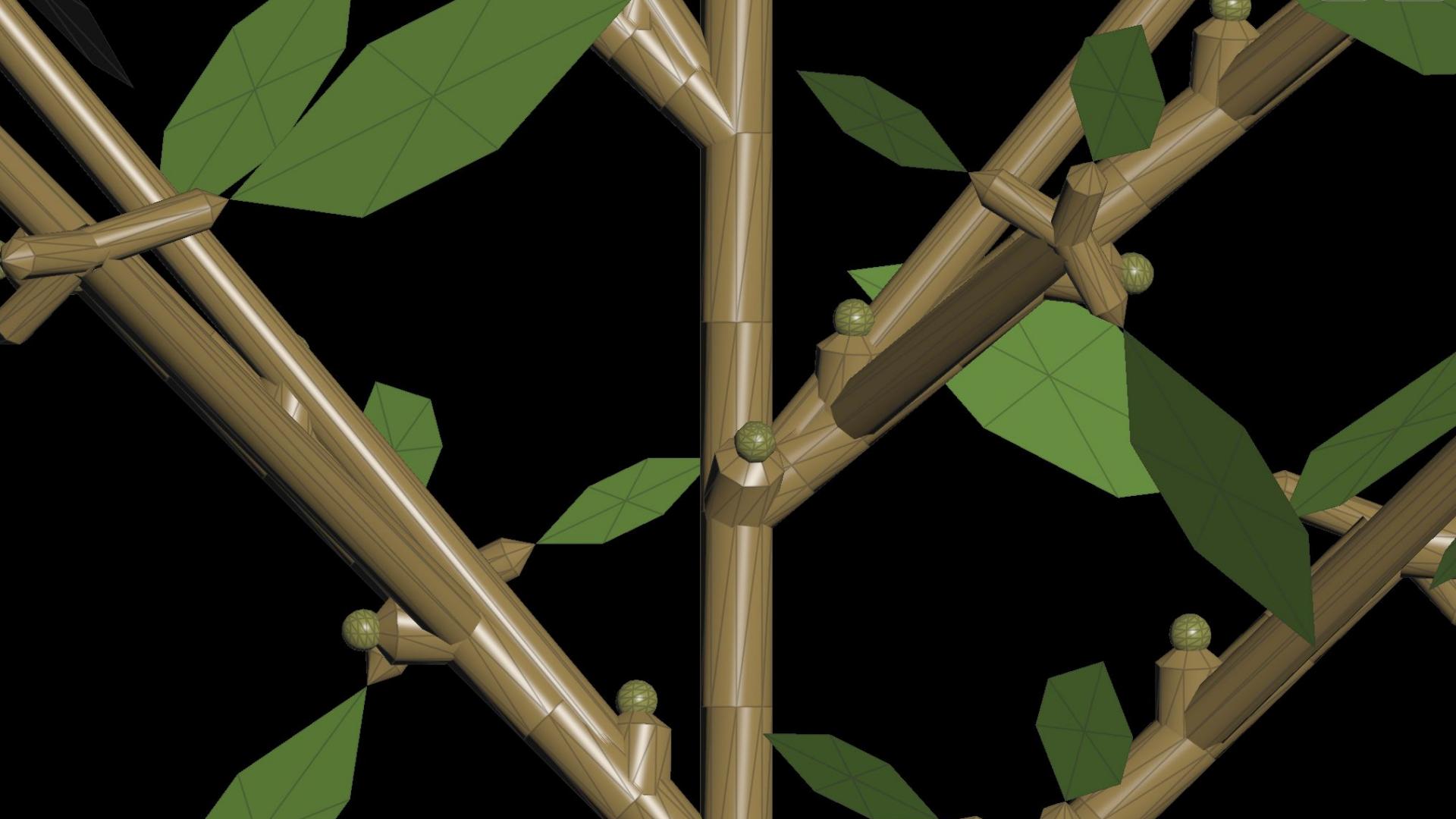
HOUDINI



L-PY



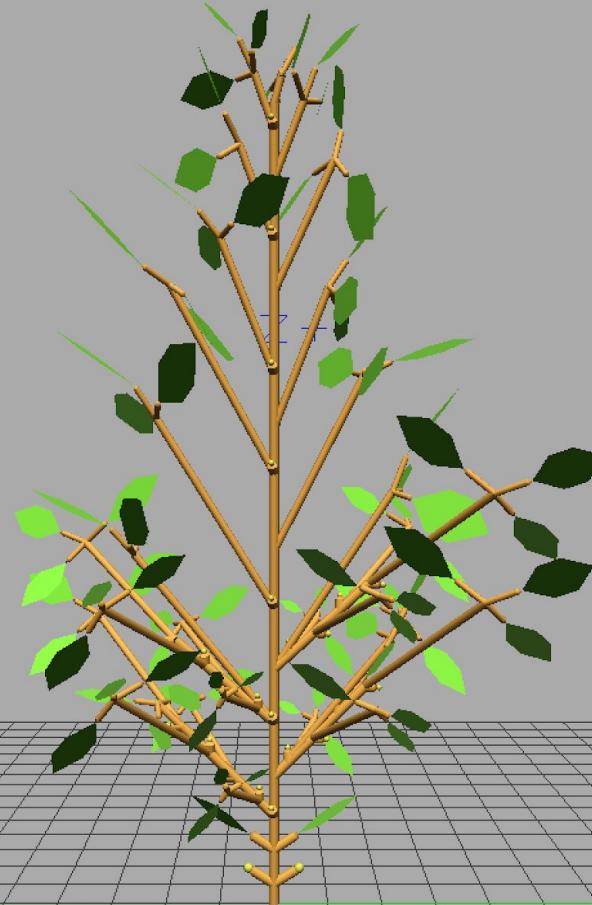




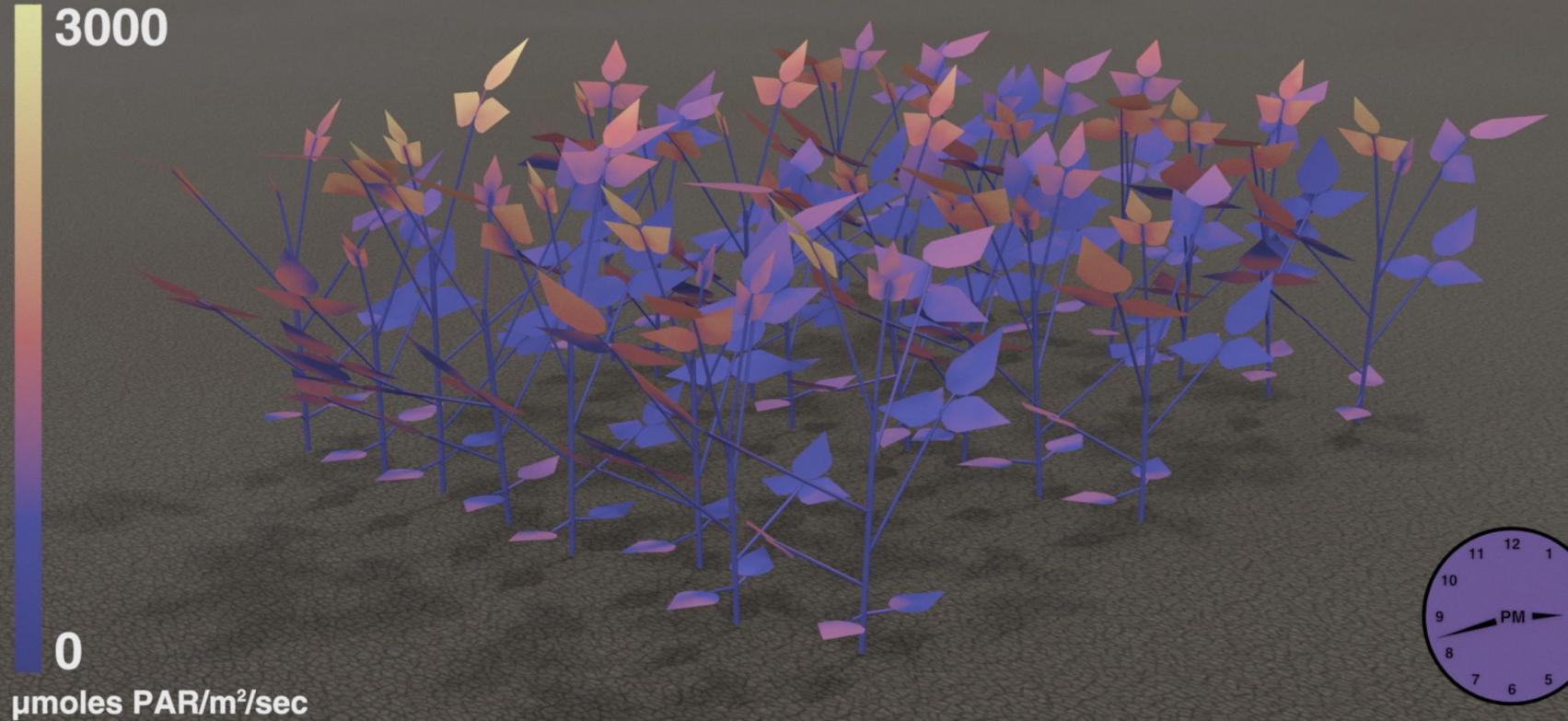


NEXT STEPS

1. Time-evolving plant
2. Animate senescence
3. Whole field of unique plants



3000

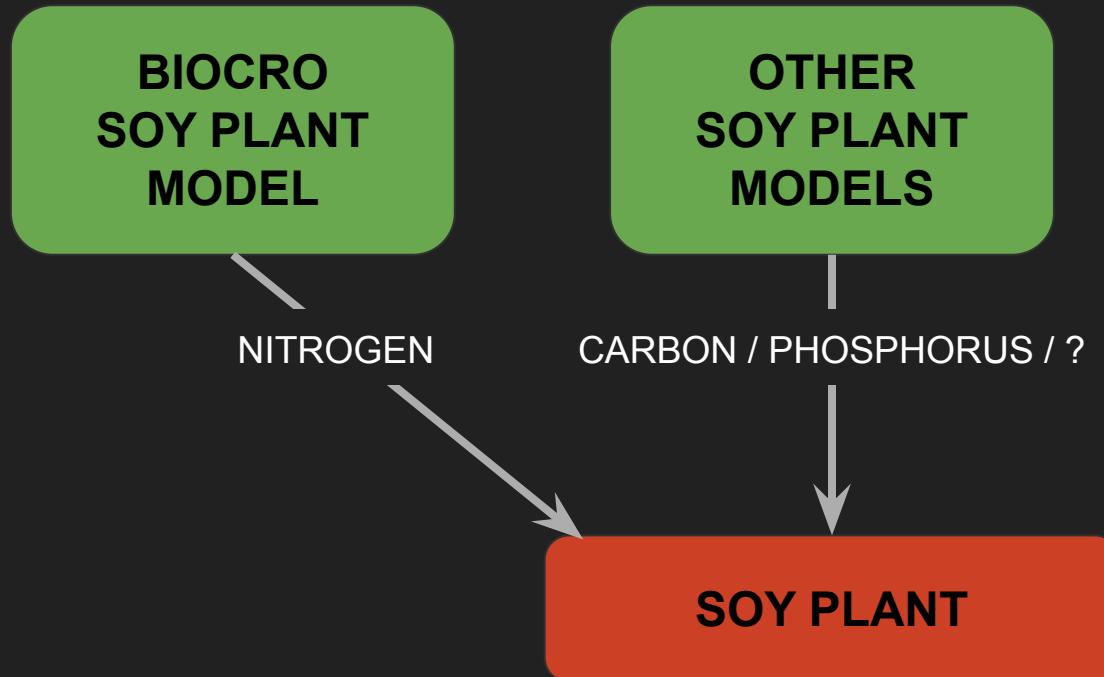


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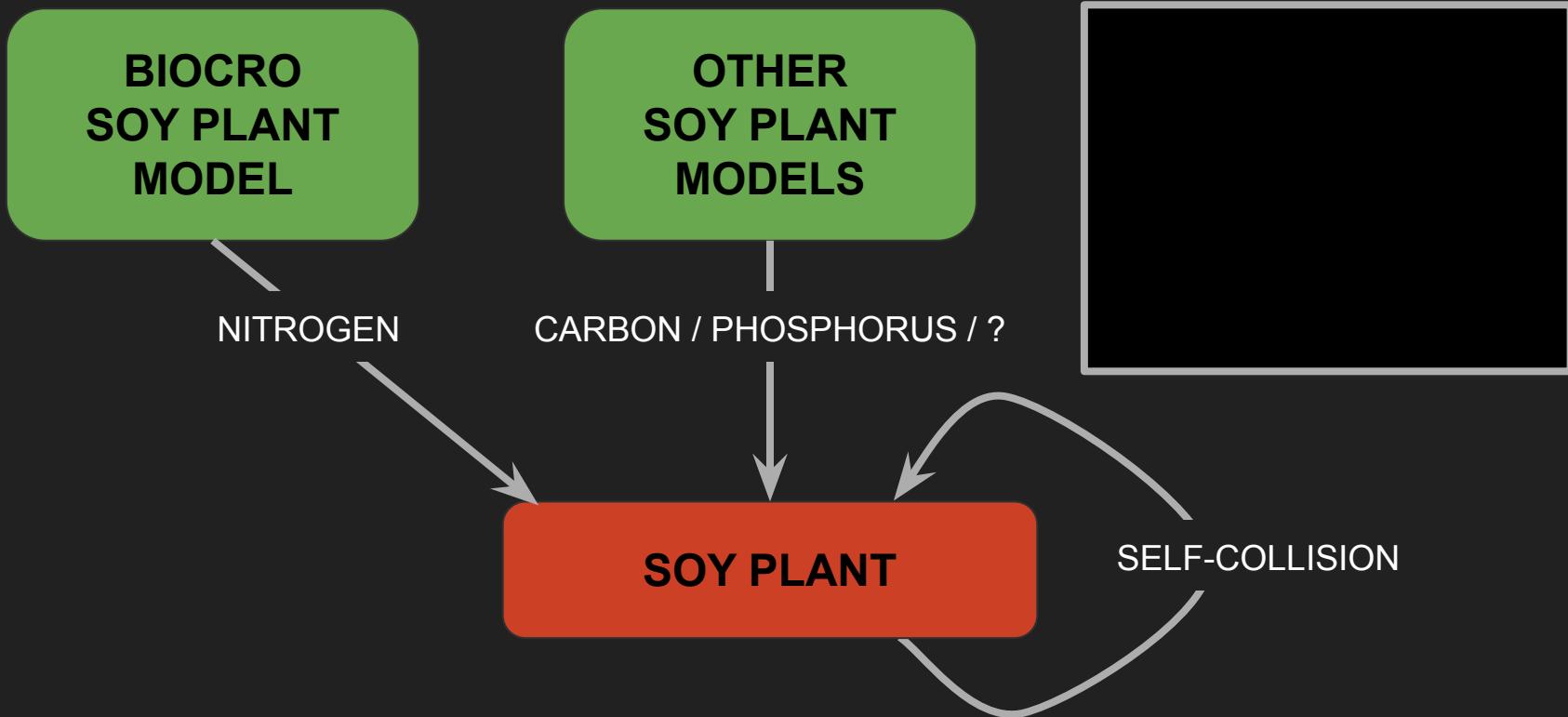
μmoles PAR/m²/sec



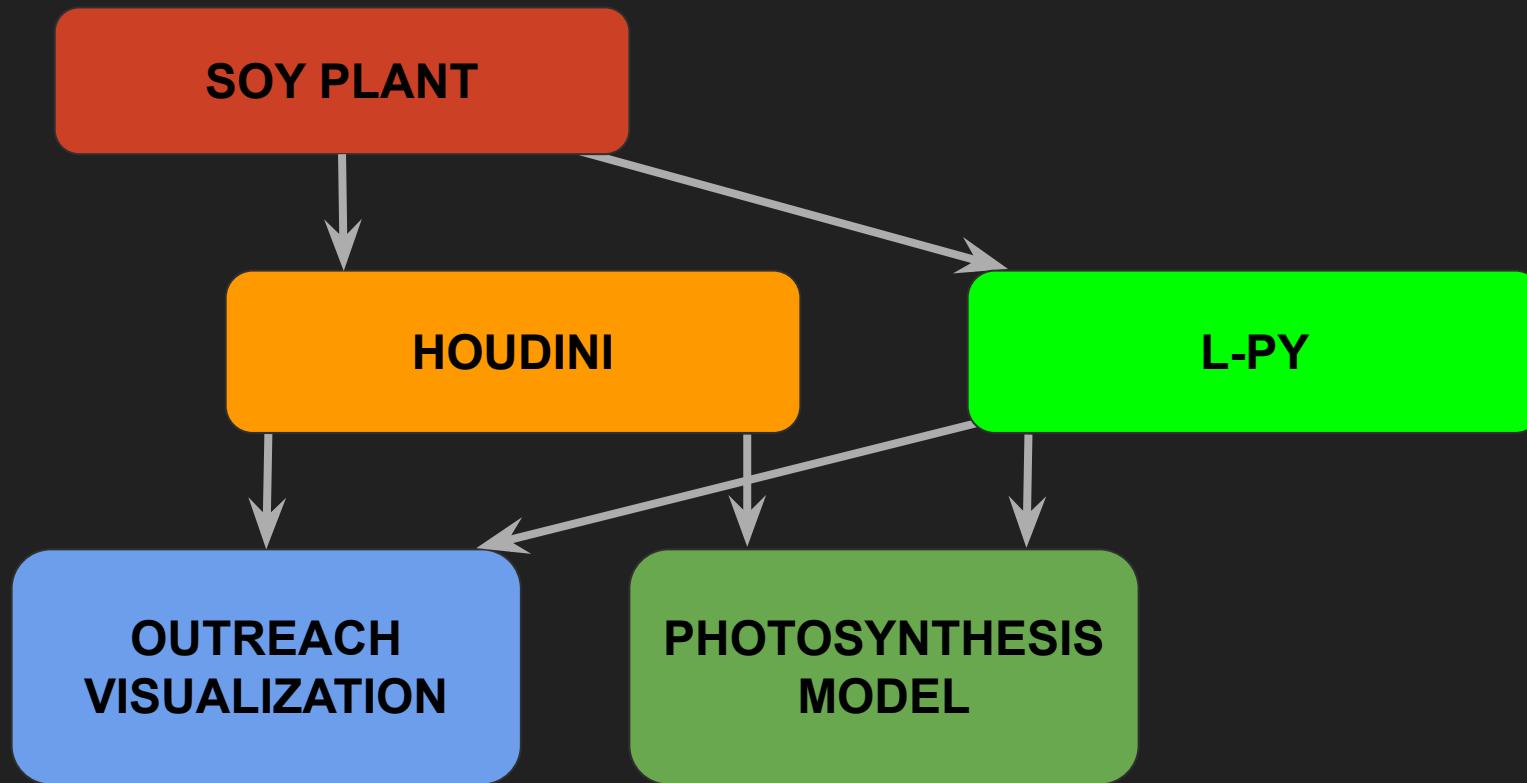
FUTURE STEPS: FEEDBACK



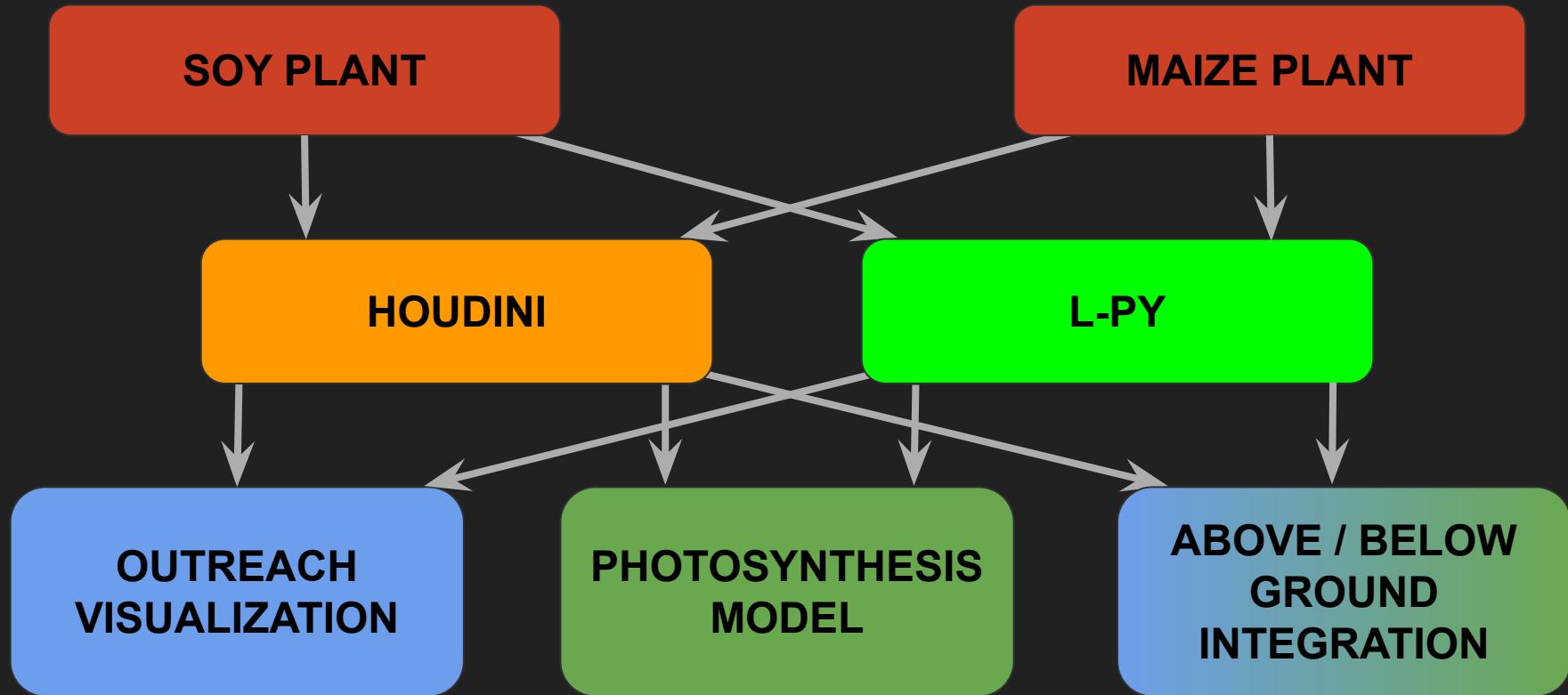
FUTURE STEPS: FEEDBACK

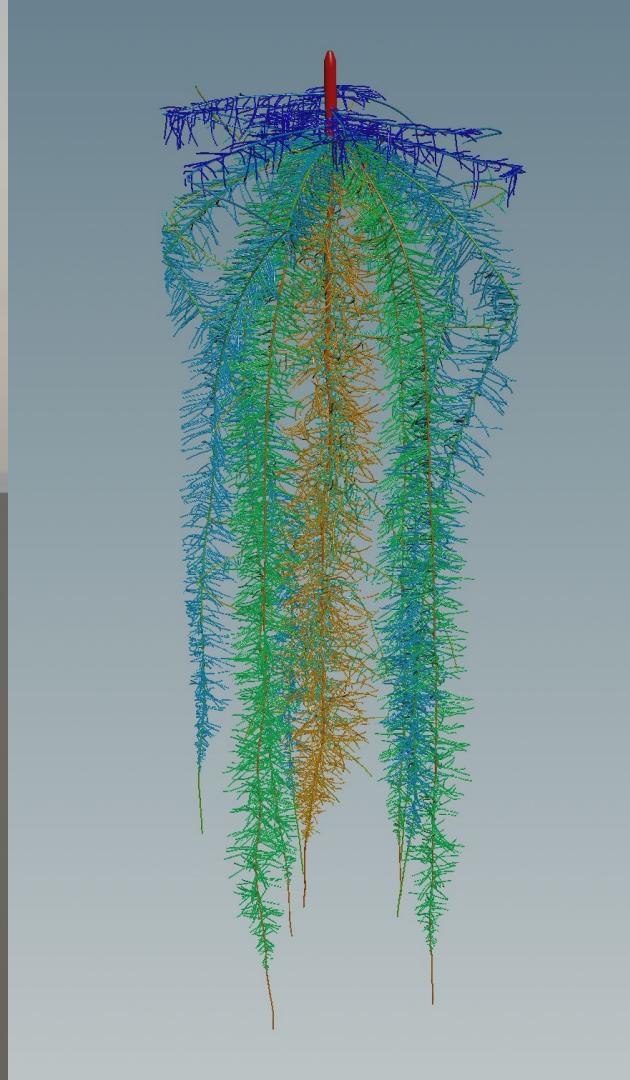
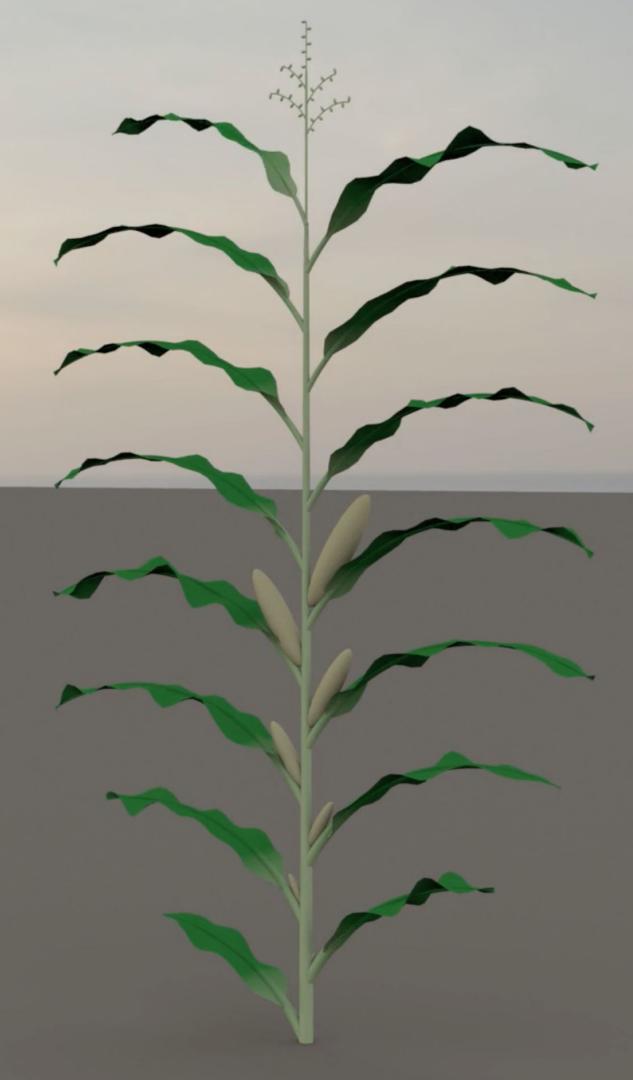


FUTURE STEPS: MAIZE



FUTURE STEPS: MAIZE





RESULTS

1.2.4.1 Soy L-System geometry AND visualization in Houdini

Initiate collaborative partnership with L-Py authors

L-Py soy implementation with L-System and external geometry

L-Py geometry integrated into photosynthesis model

1.3.5.1 Started maize above-ground L-System geometry

1.3.5.2 Started maize below-ground root model visualization

RESULTS

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FUTURE STEPS: TIMELINE

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- JUNE Data-driven maize plant L-System in Houdini
 - JULY Time-evolving maize root visualization
 - AUG Integrated above and below ground maize plant
 - SEPT Integrated Houdini-to-LPy pipeline, maize L-System in L-Py
 - OCT Integrate first model nutrition data into L-Py
 - NOV Outreach visualizations of nutrition-driven soy and maize
 - ● ● 2019 Develop self-collision in L-Py, integrate more model nutrition data, visualization of genetic / molecular models