



SC22

Dallas, TX | hpc
accelerates.

SAGE3 - the Smart Amplified Group Environment

Laboratory for Advanced Visualization & Applications - University of Hawai'i at Mānoa
Electronic Visualization Laboratory - University of Illinois Chicago
Center for Human-Computer Interaction - Virginia Tech

NSF Award ACI- 2004014 (UHM), 2003800 (UIC), 2003387 (VT)



The Team

University of Hawai'i at Mānoa - Laboratory for Advanced Visualization & Applications

- Jason Leigh [Lead PI]
- Mahdi Belcaïd [PI - AI lead]
- Ryan Theriot [Software developer]
- Nurit Kirshenbaum [PostDoc]
- Roderick Tabalba [PhD Student]
- Michael Rogers [Masters Student]
- Andy Yu [Masters Student]



University of Illinois Chicago - Electronic Visualization Laboratory

- Andrew Johnson [Chicago PI]
- Maxine Brown [PI - outreach and reporting]
- Luc Renambot [PI - software development lead]
- Lance Long [Infrastructure]
- Veronica Grosso [Masters Student]
- Arthur Nishimoto [PhD Student]



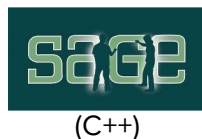
Virginia Tech

- Chris North [Virginia PI - user-interaction / user-experience]
- Jesse Harden [PhD Student]
- Elizabeth Christman [MS Student]



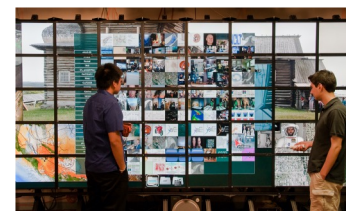
Evolution of the World from SAGE to SAGE3

2004



Compute Cluster
\$500K-\$1M systems

Grid Computing



2014

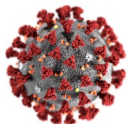


Single PC
\$100K-\$300K
systems

Science Portals &
Gateways
Cloud Computing

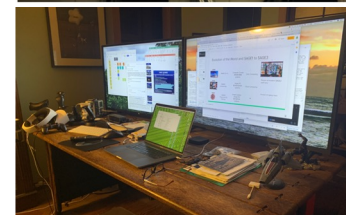


2020



Single Laptop -
Single PC
\$3K-\$100K systems

Data Science
Notebooks,
Cloud AI &
Containers
NSF Cyber
Ecosystem



Classic Single Projector Meeting Room vs SAGE2 vs Zoom

Using this technology:	Co-located With SAGE2							M	Co-located Without SAGE2 (using a projector)							M	Remote With Zoom							M
	Strongly Disagree	Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Agree	Strongly Agree		Strongly Disagree	Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Agree	Strongly Agree		Strongly Disagree	Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Agree	Strongly Agree	
I maintain focus on the meeting	0	0	0	0	1	9	2	6.1	1	0	4	0	5	2	0	4.2	1	3	2	1	2	2	0	3.5
I contribute content to the meeting	0	0	0	0	0	7	5	6.4	1	4	5	1	1	0	0	2.75	0	2	2	2	3	2	0	4.1
I find it easy to contribute content	0	0	0	0	0	3	9	6.75	6	3	3	0	0	0	0	1.75	0	1	3	3	4	0	0	3.9
I actively participated in the meeting	0	0	0	0	0	6	6	6.5	1	2	3	2	3	1	0	3.6	0	1	5	1	3	1	0	3.8
I get sufficient feedback	0	0	0	1	4	2	5	5.9	1	2	2	3	3	1	0	3.7	0	1	2	3	4	1	0	4.2
I find it easy to make suggestions	0	0	0	1	1	4	6	6.25	2	0	6	3	1	0	0	3.1	0	0	4	4	2	0	1	4.1
I enjoy using this technology in meetings	0	0	0	0	0	1	11	6.9	4	4	2	2	0	0	0	2.2	3	2	2	3	1	0	0	2.7
most participants contribute content to the meeting	0	0	0	0	2	8	2	6	2	6	3	1	0	0	0	2.25	0	5	2	0	2	0	1	3
most participants listened to each other	0	0	0	1	4	6	1	5.6	0	2	3	2	4	1	0	3.9	0	0	1	1	5	2	2	5.3
most participants contribute content at appropriate times	0	0	0	2	1	7	2	5.75	0	4	3	2	3	0	0	3.3	0	0	3	1	3	3	1	4.8
most participants avoided interruptions	0	0	1	4	4	2	1	4.8	0	1	1	3	4	3	0	4.6	0	1	2	2	2	2	2	4.7
most participants were attentive	0	0	0	1	2	8	1	5.75	0	1	5	3	2	1	0	3.75	0	2	2	3	2	2	0	4
most participants displayed attentive non-verbal body language	0	0	2	3	3	2	2	4.9	0	3	4	3	1	1	0	3.4	0	2	3	2	3	1	0	3.8
when applicable, a consensus is reached	0	0	0	3	6	2	1	5	0	0	4	6	2	0	0	3.8	0	0	2	3	4	2	0	4.6
	Co-located With SAGE2							n=12	Co-located Without SAGE2 (using a projector)							n=12	Remote With Zoom							n=11

Kirshenbaum et al 2021, [Traces of Time through Space: Advantages of Creating Complex Canvases in Collaborative Meetings](#). Proc. ACM Hum.-Comput. Interact., Vol. 5, No. ISS, Article 502. Publication date: November 2021.



Focus of SAGE3

- In a post-pandemic world, the future of work is converging toward *hybrid* model.
- AI has moved beyond hype.
- Transform the nature of work with cyber-infrastructure that takes advantage of human-AI partnership.
- Re-architect SAGE2 from the ground up using modern Web frameworks.
- Create a new model of collaboration in a post-pandemic reality.
- Incorporate emerging AI capabilities to:
 - Make it easier for non-AI experts to use AI for data processing, analysis, visualization and collaboration.
 - Improve user experience when working with information.



The Beta - Released Today!

- Streamlined user experience
- Full content mirroring between laptops and walls
- Architecture designed for AI integration
- Server installation now optional
- Source and server release soon

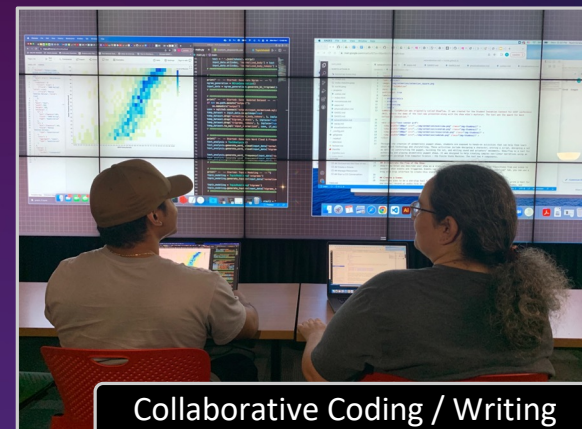
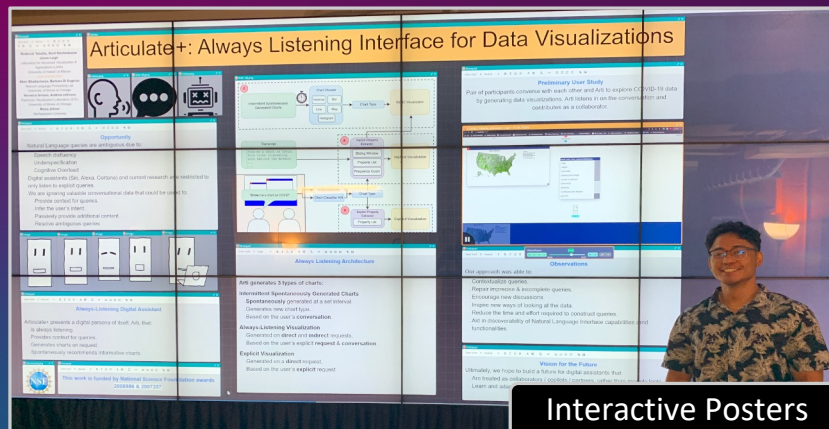
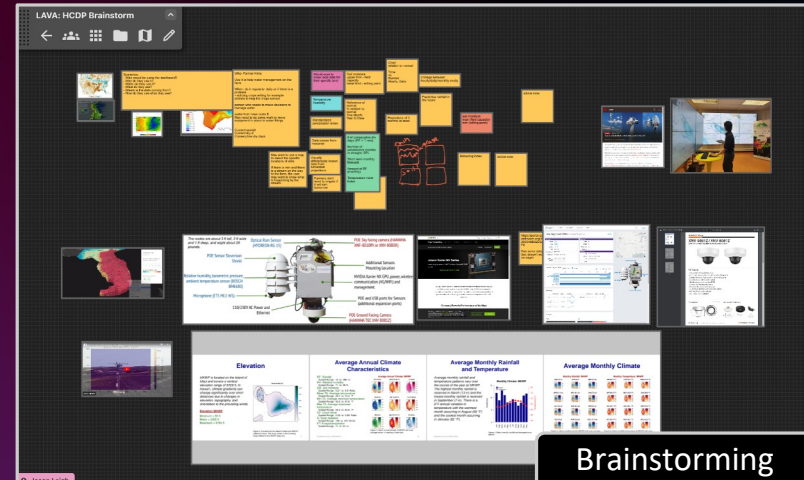


Streamlined User Experience

- SAGE3 mirrors content for every client
 - Large displays.
 - Personal computers.
- Organize content in Rooms and Boards with *infinite* work space.
- New toolbar system & customizable interface for the way you work.

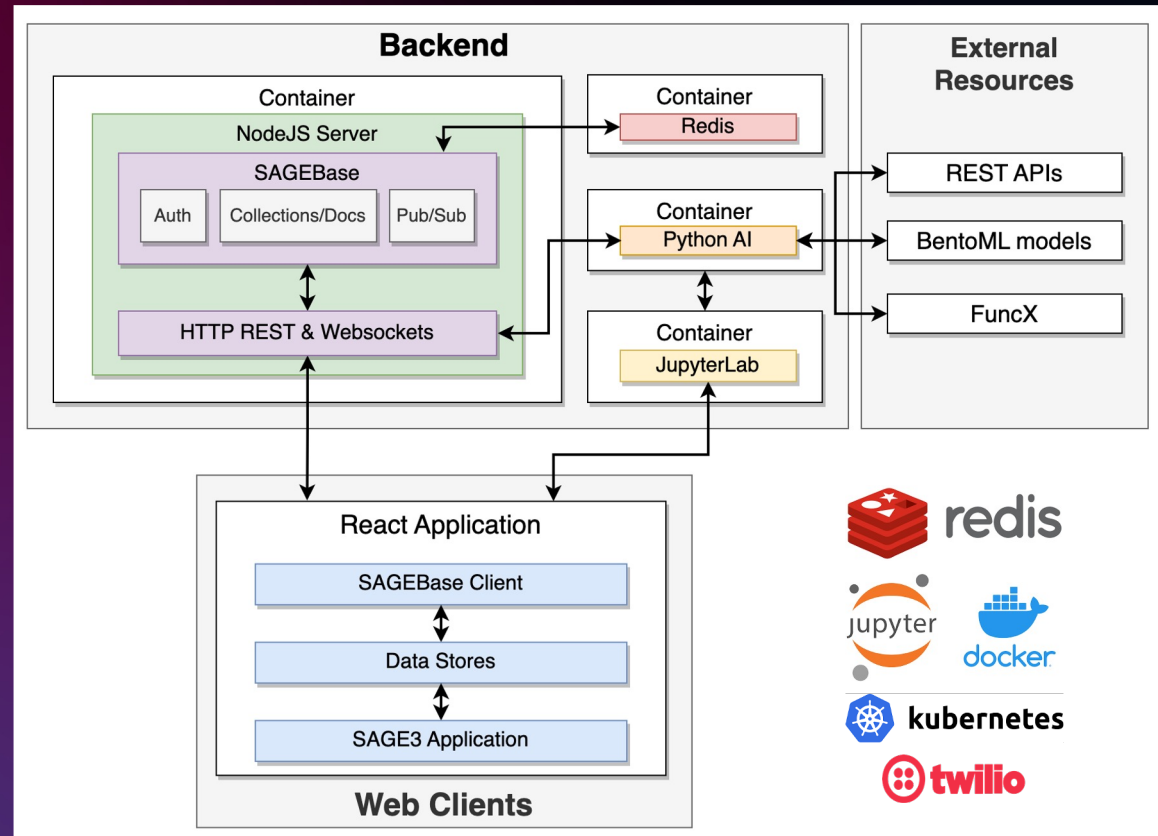


Scenarios



Architecture

- REDIS
 - Database Layer (In-memory)
 - Low latency message broker
- SAGEBase (Typescript, NPM Package)
 - Database service layer
 - Collections/Documents
 - Authentication
 - Building blocks for *collaborative* web apps
- Web Server (NodeJS / Typescript)
 - Communication Layer
 - HTTP/WS APIs
- Web Clients (React / Typescript)
 - Chrome
 - Electron Desktop Application
- Python AI
 - Uses Python to tap into the rich ecosystem of data science and AI
- JupyterLab
 - Language agnostic data science environment





Vision for Data Science & AI in SAGE3

- Informed by science
- Make it easier to use DS/AI to collaboratively answer more complex questions
- Making AI a first class collaborator in the scientific discovery process

With Coding

JupyterLab
SAGECells

Without Coding

SmartPanels
Articulate

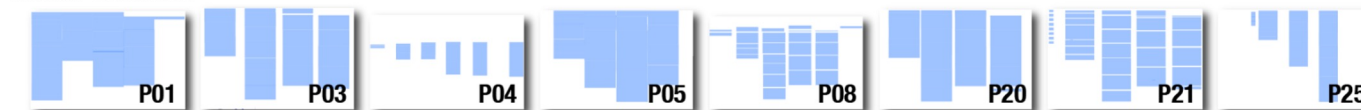


Spatialization of Data Science Notebooks

Linear



Multi-Column



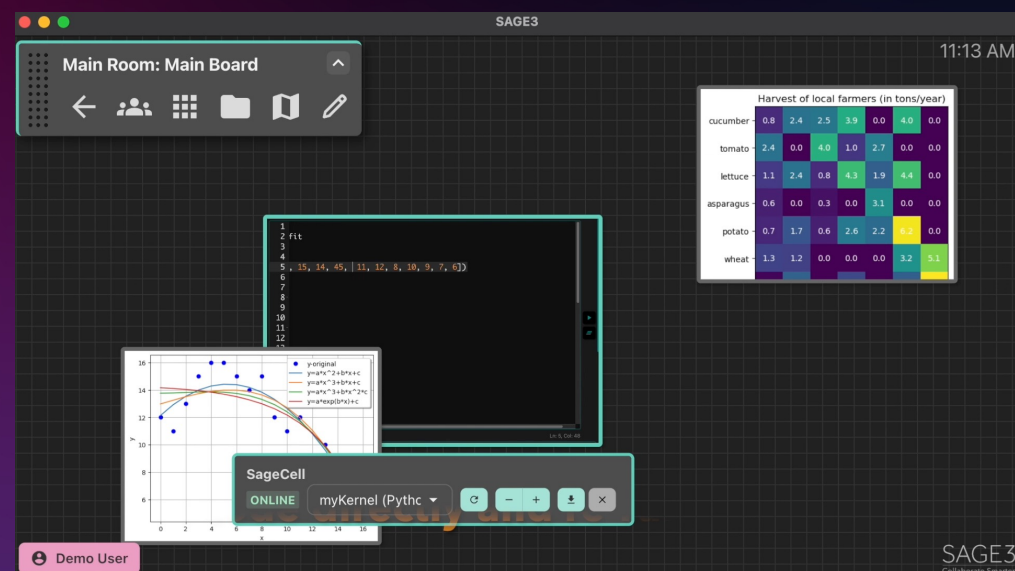
Workboard



Jesse Harden, E. Christman, N. Kirshenbaum, J. Wenskovitch, J. Leigh and C. North,
Exploring Organization of Computational Notebook Cells in 2D Space, 2022 IEEE Symposium on Visual
 Languages and Human-Centric Computing (VL/HCC), 2022, pp. 1-6, doi: 10.1109/VL/HCC53370.2022.9833128.

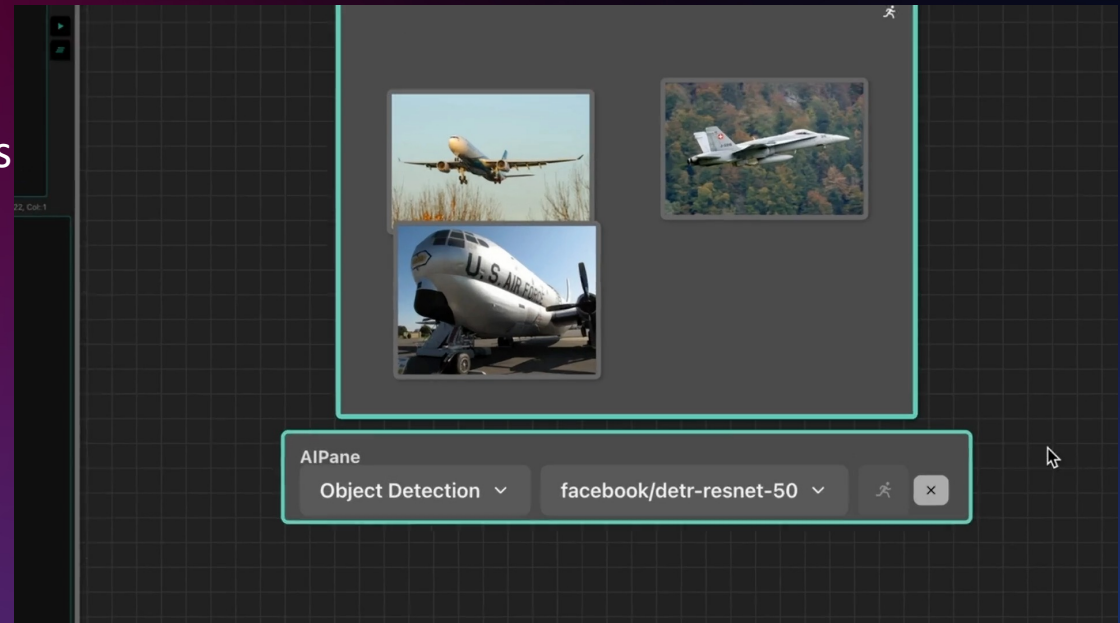
AI: SAGECells

- KernelDashboard: manages creation of public or private kernels in Python or R.
- SAGECell: write and execute code.
 - Access shared kernels.
 - Fully supports collaboration.
 - Edit code, view results, and export output.
 - Code can be dragged onto the board to open a SAGECell or downloaded locally.
- Explore data together, better.
- Leverages JupyterLab framework.
- Future work:
 - Provide ways to connect and organize cells.



AI: SmartPanels

- Democratizing AI.
- Provides code-free access to AI models for a variety of tasks.
- Automatically detects and provides models for the following media and tasks.
- Uses FuncX to execute containerized models (BentoML) on dedicated GPU resources, provisioned using Kubernetes.
- Future Work:
 - Use Auto-ML to produce new models.
 - SmartTables: A no-code way to interact with, wrangle, and generate models for tabular data.

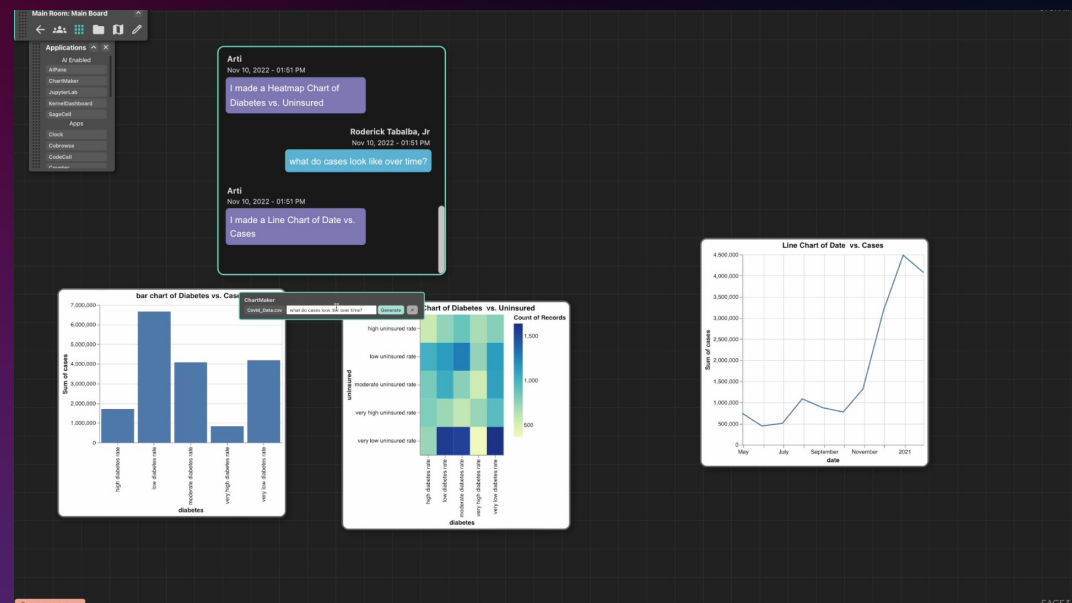


AI: *Articulate* Integration with SAGE3



- Automatically make charts using natural language.
- Move toward a Human-AI partnership
- User does not need to indicate what type of chart to make, AI determines the most appropriate chart.
- User can spend more time thinking about the problem they are solving rather than the knobs they have to turn to make a chart.

Roderick Tabalba, A. Bhattacharya V. Grosso, N. Kirshenbaum, A. Johnson, B. Di Eugenio, M. Zellner, J. Leigh,
Articulate+ : An Always-Listening Natural Language Interface for Creating Data Visualizations, Conversational User Interfaces, July 26, 2022, Glasgow, UK. <https://doi.org/10.1145/3543829.3544534>



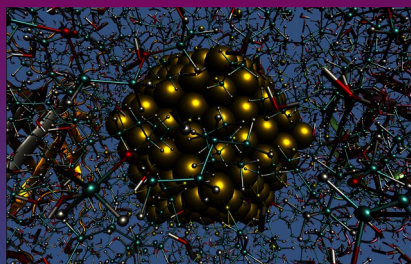
IIS 2007257 & 2008986



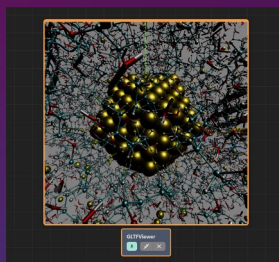
SAGE3 in Immersive Headsets

- Stand in the midst of SAGE boards in a 3D space.
- Future: Leverage VR to examine 3D spatial content.

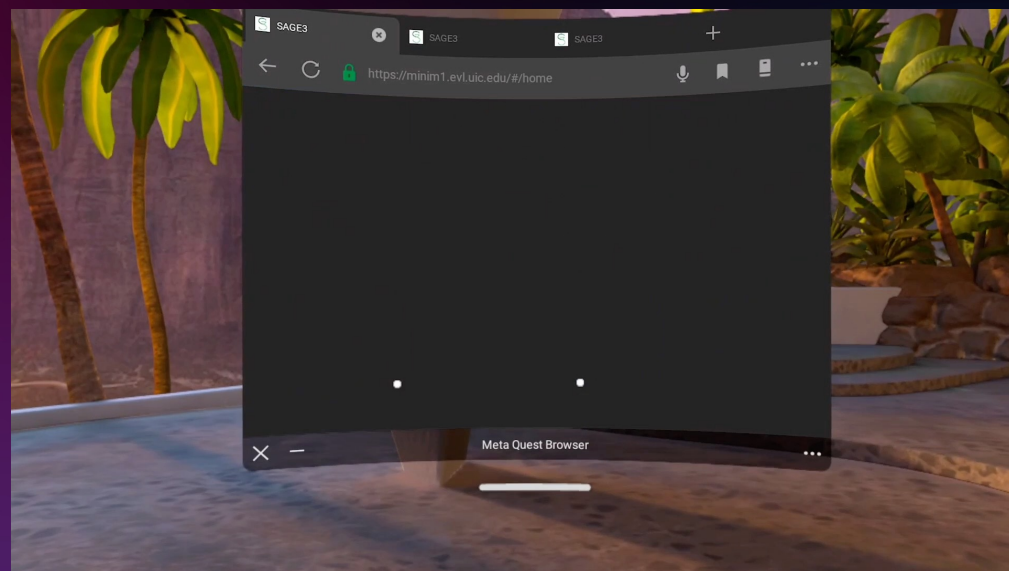
Unity 3D on Desktop/AR/VR



3D View on SAGE3 Board



SAGE3 API

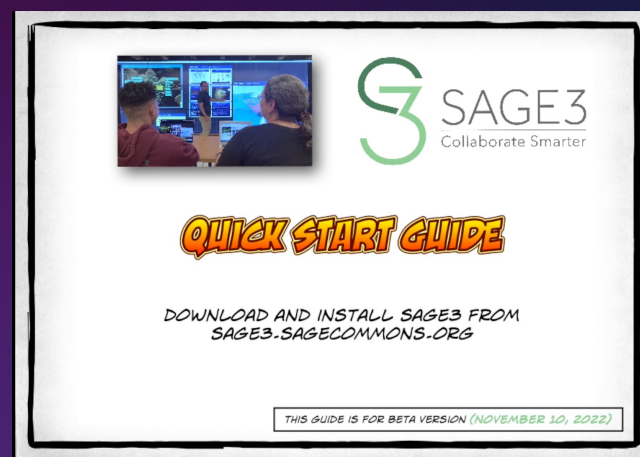


Roadmap

Nov 15, 2022	SAGE3 Beta Released (public servers, desktop app)
Feb 1, 2023	SAGE3 Server Released (Docker Images etc)
March 1, 2023	SAGE3 Source Released
March 1, 2023	App Development Manual Released
Summer 2023	Co-Browsing Released

Try AI in the Dev Server, Data Science Room.
Later 2023:

- AI: SAGECells
- AI: Jupyter Notebook Collaboration
- AI: SmartPanels



Questions?

- What current features are you most interested in?
- What are any new features you are interested in that we mentioned?
- Are you interested in hosting your own server?
- Do you want us to maintain servers? Run on commercial clouds?
- Are you interested in paying a consortium fee to manage SAGE3? Or would prefer NSF to pay for it?
- Are you interested in writing SAGE3 apps?
 - What APIs do you want to see integrated?
- How would you like to use SAGE3?
- Are you interested in contributing to the base source code?
- Do you want to see video conferencing inside of SAGE3?
- What other conferences you attend that you would you like us to show SAGE at?
- What data science problems do you work with?
- R vs Python?



Preview SAGE3 and AI Capabilities at the Starlight Booth (2847)

insert picture of booth here

sage3.sagecommons.org
Join us on Slack: tinyurl.com/sagecommunity

