

Speeding Up Collaboration Across Disciplines

by Taking Complexity Out of Sharing Computational Analysis Using Shiny Apps

Sema4 is a patient-centered health intelligence company that advances healthcare through data-driven insights. The idea underlying Sema4's work is that more information and deeper analysis of health data will improve the diagnosis, treatment, and prevention of disease. To achieve this goal, the company aggregates, curates, annotates, structures, and analyzes large data sets using their analytics platform Centrellis™. This platform is then used to build predictive models of human health using artificial intelligence (AI)-based algorithms.

Centrellis yields insights that can inform on individual patients' conditions, power informed decision-making across the drug development pipeline, and provide health systems with access to critical data. The company also uses these insights to develop information-rich genomic tests, such as Sema4 Signal™, that help detect disease, support healthcare providers in identifying the best therapies for each individual patient, and guide treatment decisions.

Sema4 addresses the challenge of effectively applying high-end data, such as genomic information, to support health systems and healthcare providers in better understanding each patient and their journey and matching each patient with the best personalized care.

The Challenge

Sema4 collects, aggregates, and analyses large amounts of complex biological and medical data. Conducting these complex analyses requires a multidisciplinary and geographically spread out team of computational biologists, bioinformaticians, and data scientists who analyze these data sets in collaboration with physicians, e.g. hospital oncologists.

One of the challenges the precision oncology team at Sema4 faced was to find an efficient and interactive way to share their data analytics with physicians at partner

Goal

Enable seamless cloud-based interactive collaboration between Sema4's precision oncology team and hospital oncologists using visualization packages that can be flexibly and interactively adjusted in real-time.

Key Benefits

- Facilitate efficient interactive collaboration between computational scientists and physicians by enabling computational analytics and visualization in real-time
- Avoid people and infrastructure delays due to the need for iterative analysis and visualization cycles
- Enable deeper insights through active, collaborative, and faster knowledge sharing
- Improve collaboration in a secure, controlled and consistent environment

“ The data analysis that we do is highly tactile. If you've done a good job, the oncologists will always have more questions. But we always had to say, 'I'll get those answers in time for our next meeting.' Surely there's a better way? Why can't we analyze data on the fly? ”

Scott Newman, PhD, Senior Director of Precision Oncology, Sema4

hospitals during meetings. Presentations containing static graphs, e.g., a gene expression plot of a specific gene, invariably prompted questions that the Sema4 presenter could not answer without rerunning the analysis and replotting the results.

The Solution

Code Ocean is a cloud-based platform for computational research that streamlines workflows and provides one platform for creating, organizing, and sharing complete analysis. By allowing users across the pipeline to develop and share standardized Compute Capsules™ consisting of data, code, the computing environment and results, Code Ocean ensures standardization and scalability across diverse teams and makes a broad range of advanced analytics and visualization tools easily accessible.

The solution to the problem of static analysis, which led to repeated and time-consuming rounds of questions and answers, was adding a Shiny app to the Compute Capsule. This app allows the presenter to flexibly answer questions that come up during meetings for applications such as:

- **Analyzing gene expression data** - adding a Shiny app to a Capsule containing gene expression data makes it easy to show an interactive visual representation of the data that can be adjusted in real-time to show the expression pattern of each gene in which the oncologists are interested. This addition allows deep collaborative exploration of the data set with a team of experts that is otherwise difficult and time-consuming to achieve.
- **Interactive Sankey diagrams** – these flow diagrams are used to visualize patient flow through different lines of therapy. While looking at aggregate data is of interest, breaking the patient population down by metadata, e.g. by gender, age, genetics or tumor subtype, generates better insights. A Shiny app integrated into the Compute

Capsule facilitates the real-time parsing and visualizing of aggregate data using intuitive sliders.

- Adding visualization packages and handling tools such as Shiny apps to Compute Capsules makes the dialogue with experts from different domains more productive and cuts down on time-consuming cycles of back-and-forth.

The Results

Instead of displaying static data in the form of screenshots in a Powerpoint presentation, Scott Newman can now use Shiny apps powered by Code Ocean Compute Capsules to help with presenting to oncologists. This approach allows for:

- **Faster collaboration:** the interaction with hospital oncologists is quicker, allowing Scott to answer questions on the spot, rather than replotting the data off-line and then waiting to share them at the next meeting or via email.
- **Interactive analysis:** oncologists can now interact with the analysis in real-time, making discovery more interactive and collaborative, which can lead to deeper discussion and insights.
- **Less IT development and support burden:** one platform hosts multiple configurations of computational tools and interactive web-based Shiny apps, reducing IT development and support requirements.

🗨️ Using the Compute Capsule as a platform for our Shiny app, I was able to make beautiful interactive visualizations without the need for a web developer. This ability was a big win. 🎉

Scott Newman, PhD, Senior Director of Precision Oncology, Sema4

Why Code Ocean

- Facilitates interactive collaboration and analysis sharing between individuals and teams in the cloud.
- Provides highly flexible and configurable Compute Capsules that can be custom-tailored for all needs, e.g. interactive data visualization.
- Offers integrative computational research experience, emphasizing researchers' productivity and reproducibility without any additional IT burden.
- Guarantees superb customer support that exceeds user expectations and operational support with transparent upgrade processes.