

Kvik: Interactive exploration of multi-omics data from the NOWAC postgenome biobank

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Norwegian Women and Cancer (NOWAC)

Identify the possible relationships between lifestyle and the risk of cancer.

Started data collection in **1991**, now the biobank holds more than **60 000** blood samples and **800** biopsies.

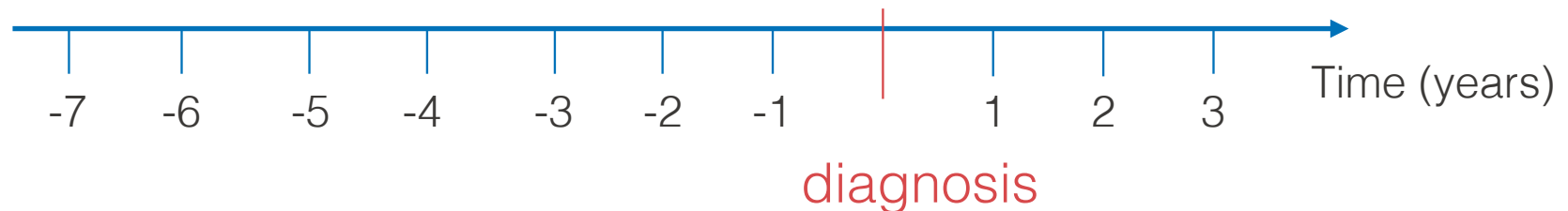
Information about **exposure** through questionnaires

Large research group with international collaborators

NOWAC Biobank

Data collection from several years prior to diagnosis, at time of diagnosis and post diagnosis

Multiple instruments and analysis methods



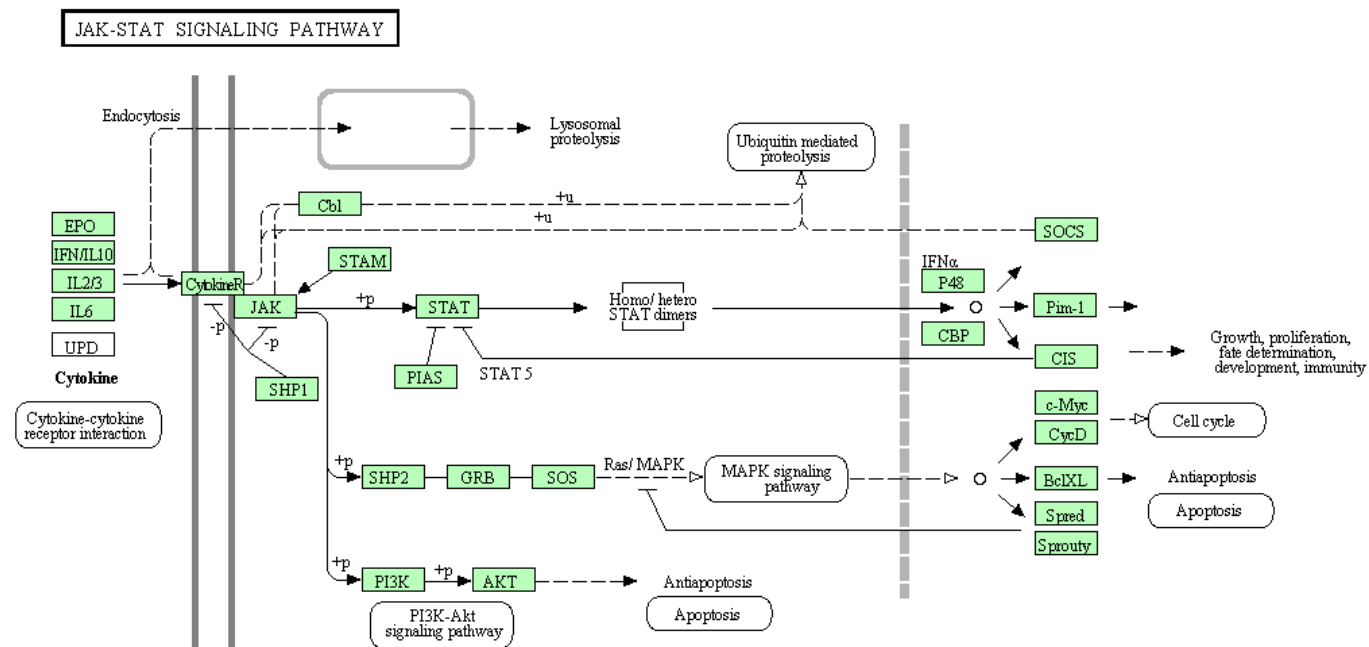
NOWAC Challenges

Integrating research data from **different sources** and between **multiple applications**

These explorations or analyses of the NOWAC biobank **without prior explicit hypothesis**

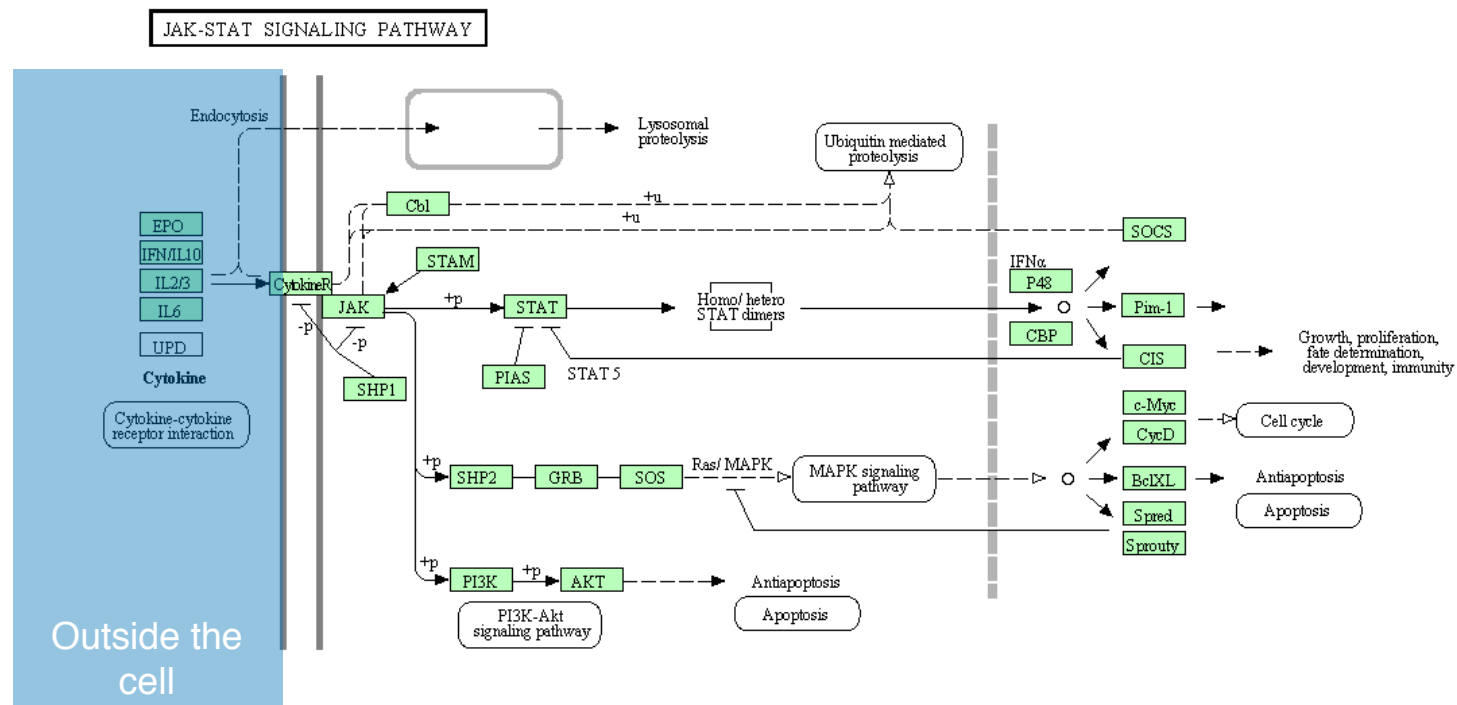
They **cannot share the NOWAC biobank** outside the research group, making current online tools unsuitable

Pathways



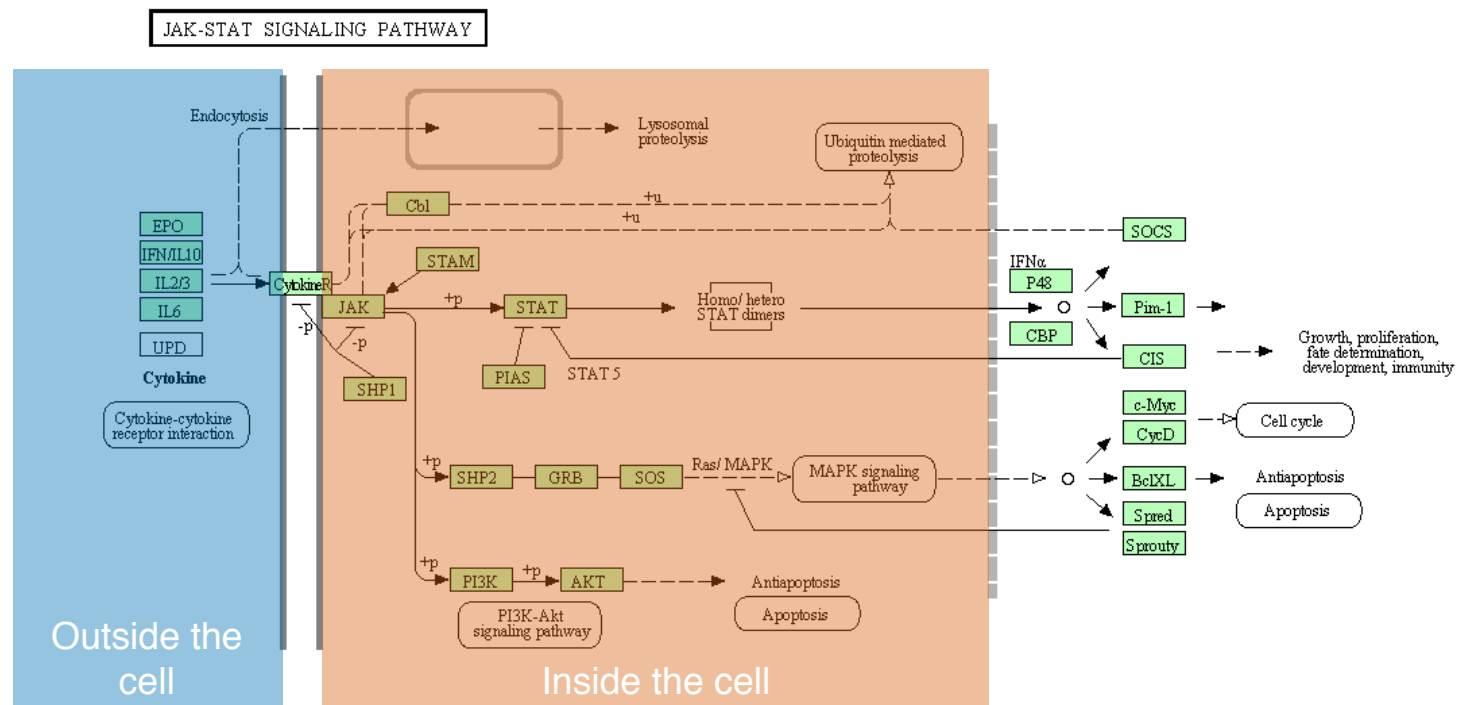
genome.jp/kegg-bin/show_pathway?hsa04630

Pathways



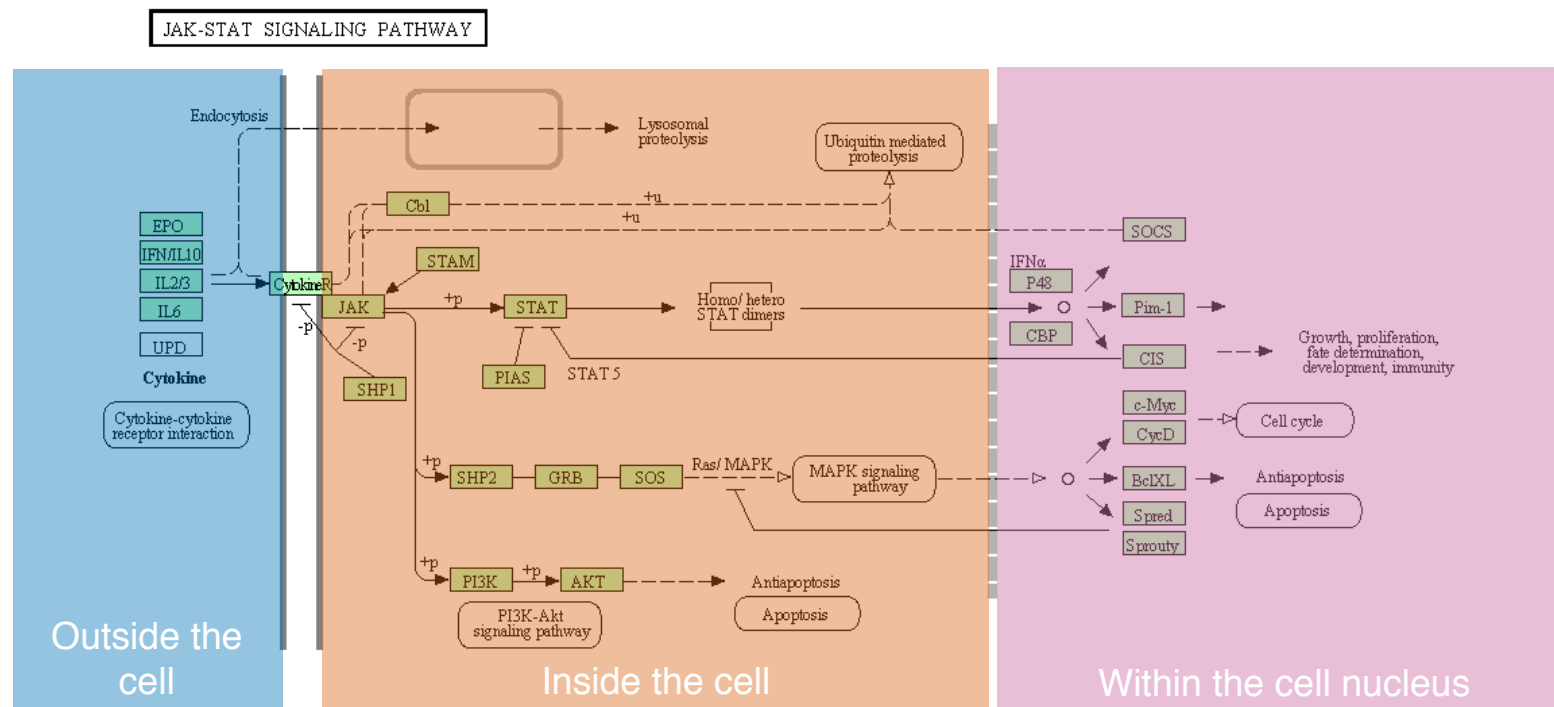
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Pathways



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Kvik

Integrates state of the art **pathway maps** from the KEGG database and **gene expression data** from the NOWAC postgenome biobank in a single system

Explore the dynamics of carcinogenesis through biological pathways and gene expression

Requirement Analysis

Identified seven requirements through collaboration with cancer researchers

Interactivity, Scalability, Simplicity, Familiarity,
Heterogeneity, Extendability, and Security

Requirement Analysis

Identified seven requirements through collaboration with cancer researchers

Interactivity, Scalability, **Simplicity**, **Familiarity**,
Heterogeneity, **Extendability** and Security,

Simplicity

Researchers shouldn't bother with installing **additional applications or browser plug-ins**

Kvik runs in a modern web browser using **HTML5** to provide a platform-independent exploration tool

Familiarity

Researchers work more efficiently using **familiar interfaces and representations**

Kvik uses expert-drawn **pathway maps** from **KEGG** to provide familiar views of biological pathway maps

Extendability

Researchers require data exploration systems to handle **new analysis methods** and **data processing systems**

Kvik has an extendable analysis backend allowing researchers to **incorporate their own statistical models** into the data exploration

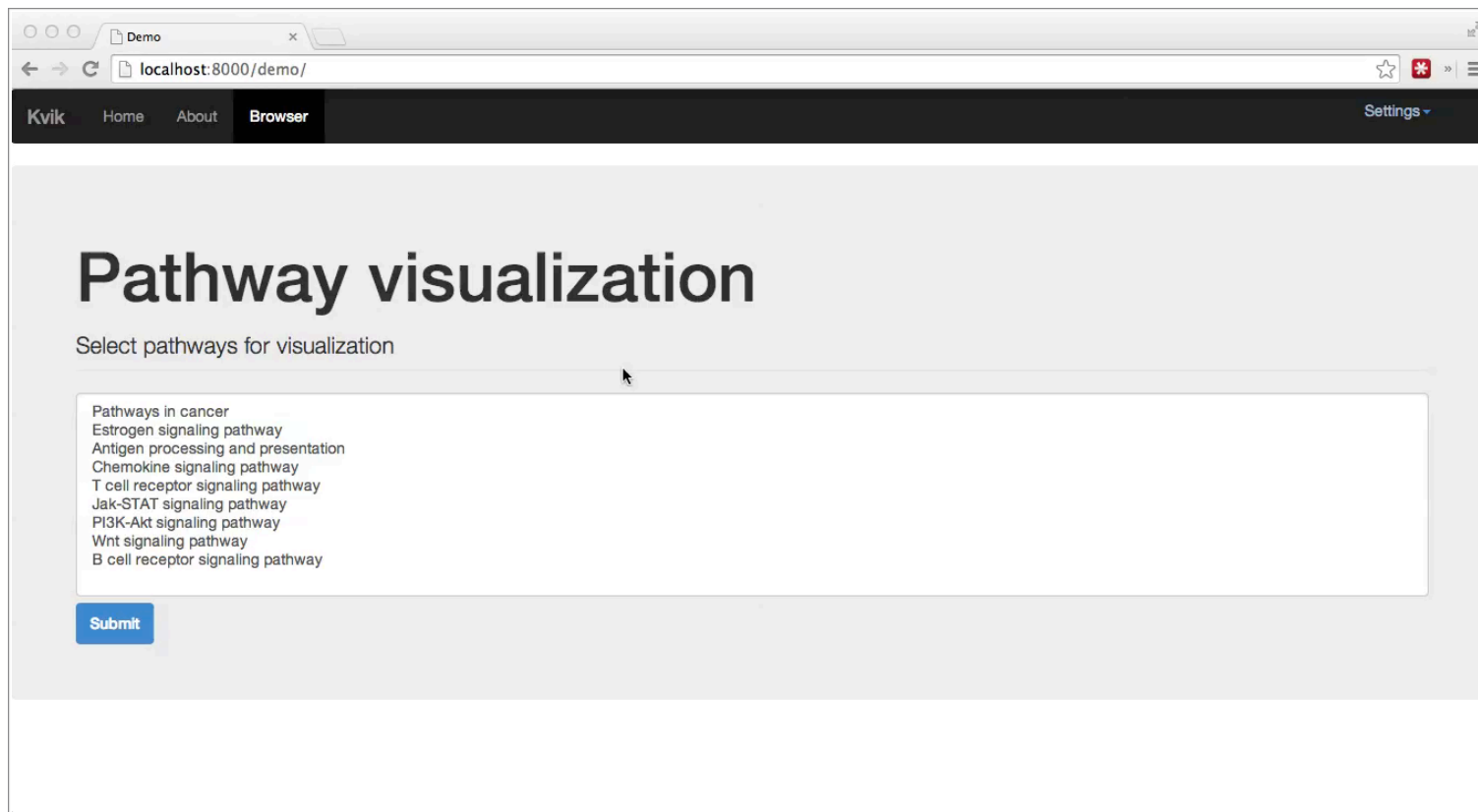
Kvik

Interactive exploration of the dynamics of carcinogenesis through studies of **biological pathways** and **genomic data**

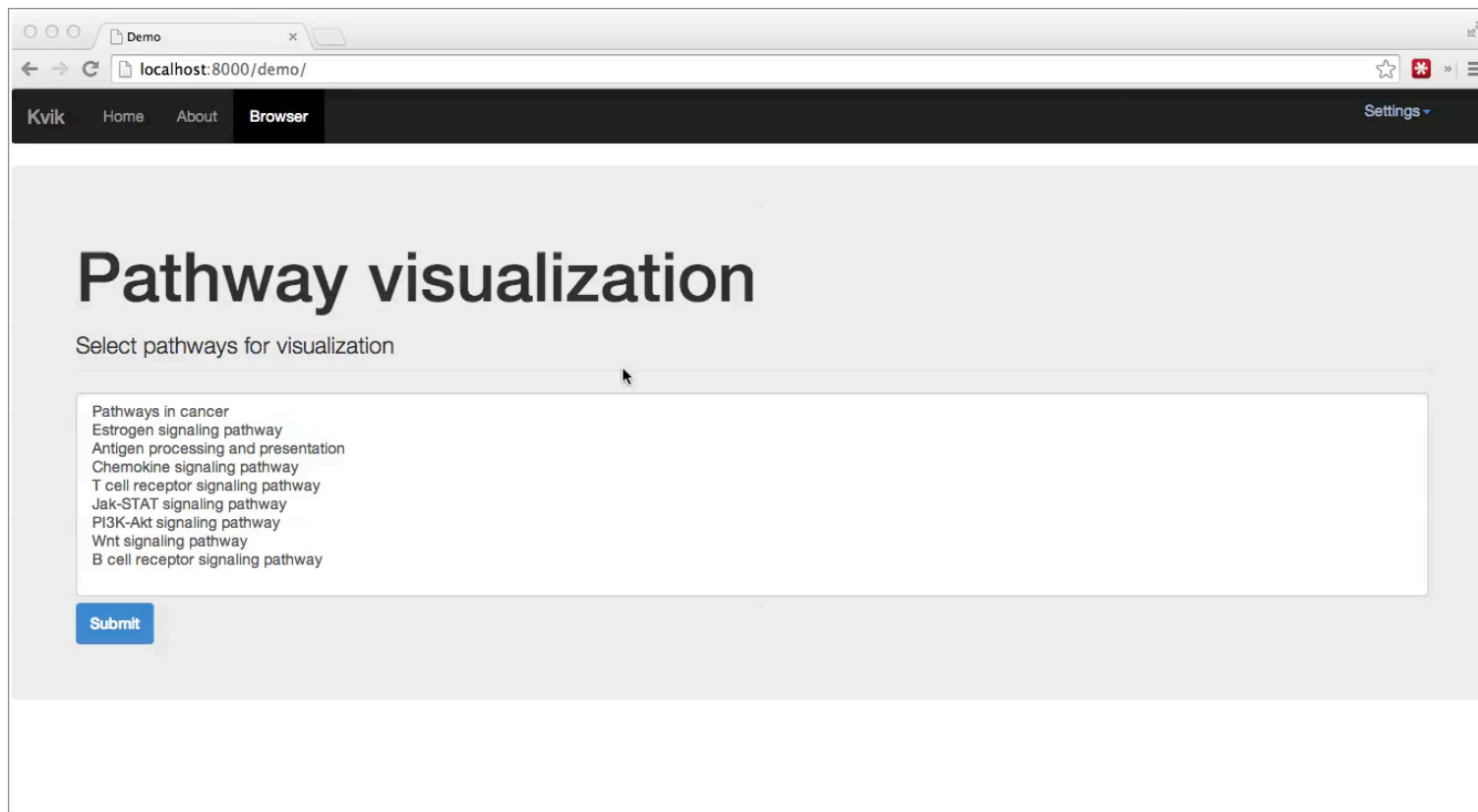
Kvik provides **state of the art pathway maps** from KEGG and uses modern JavaScript libraries to make it accessible through a web browser

Three-tiered architecture with a **lightweight web application** for data exploration and a **powerful backend** for statistical analysis

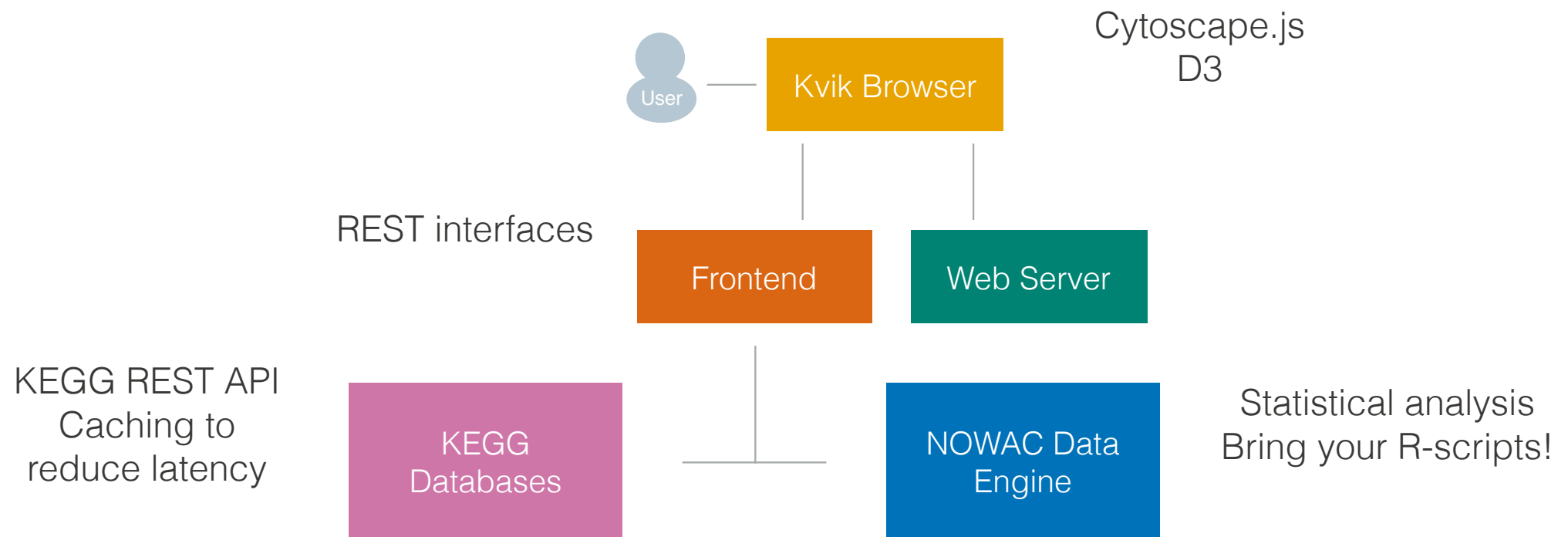
Demo



Demo



System Architecture



Evaluation

Experimental evaluation shows that Kvik provides **pathway visualizations** sub-second

Minimal resource usage on clients, making it suitable on lightweight platforms

Collaborators were satisfied with Kvik, requesting deployment of the system within the research group

Future Work

More advanced statistical analyses through **statistical packages** like Bioconductor

Collaboration and **sharing results** with other researchers using Kvik

Integrate **new data sources** and **more data** from the NOWAC biobank.

Future Work

High Performance Distributed Systems group (hpds.cs.uit.no)

Systems that leverage new **display hardware**, **computer interaction methods** and powerful **GPUs**

Concluding Remarks

The first version of Kvik provides **interactive exploration of biological pathways and gene expression data**

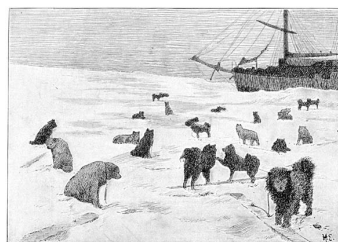
Kvik uses **familiar** representations and is **extendable** to new analysis methods and data

Without any installation or plug-ins, researchers can start exploring the data instantly

Open-sourced at github.com/fjukstad/kvik

Thank you!

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Kvik — Lead sled dog on Fridtjof Nansen's expedition to the North Pole

Visualizing Biological Pathways

