ProtVista

Open-Source Protein Feature Visualisation with reusable Web Components

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UniProt

www.uniprot.org

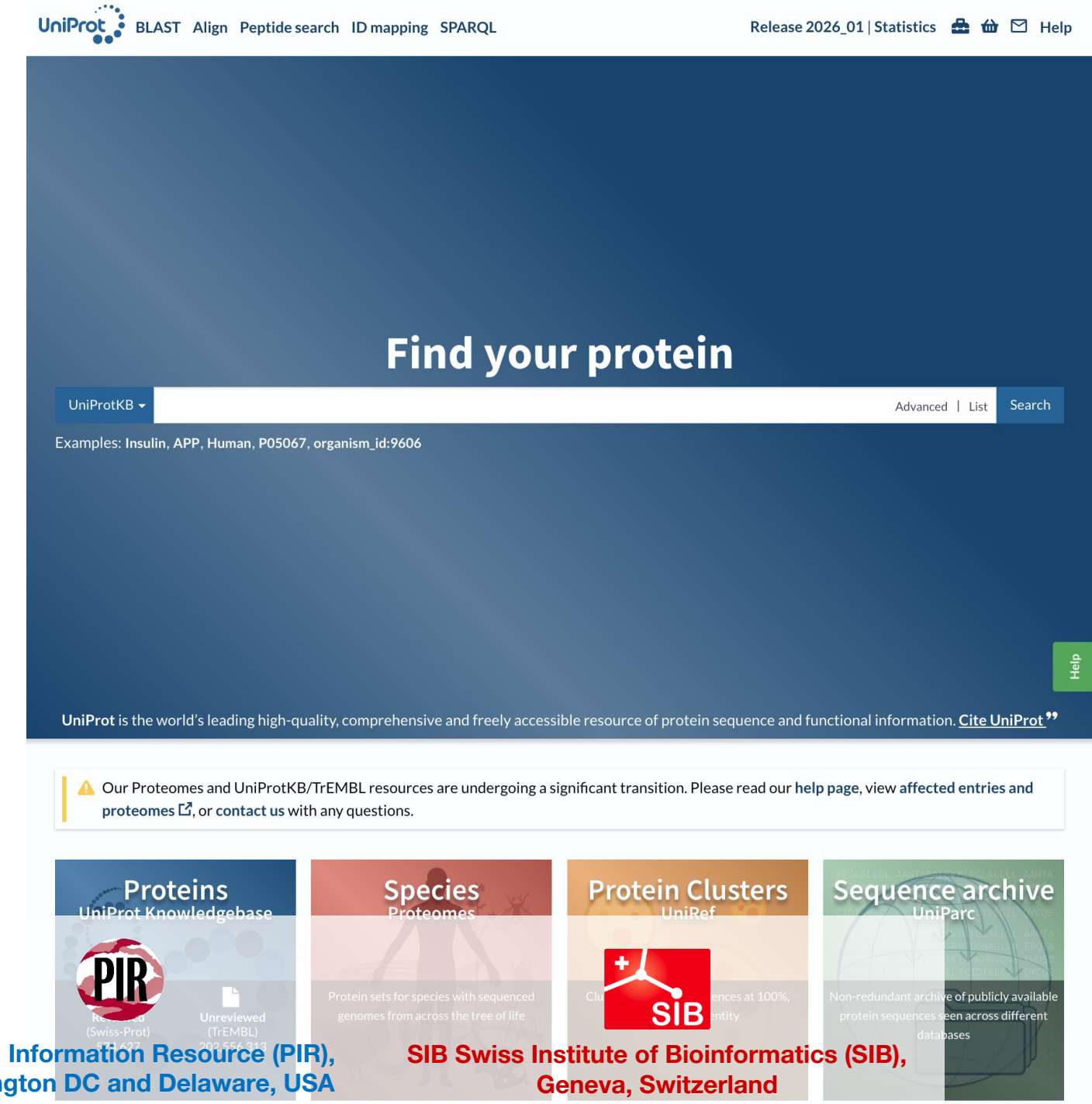
EMBL-EBI

UniProt

A comprehensive, high-quality and publicly accessible resource of protein sequence and functional information

It includes, among other things:

- Physiological protein function including subcellular location, pathways, reactions, interactions and involvement in disease
- Sequence annotation of domains, PTMs, mutations, disease variants and much more



EMBL-EBI

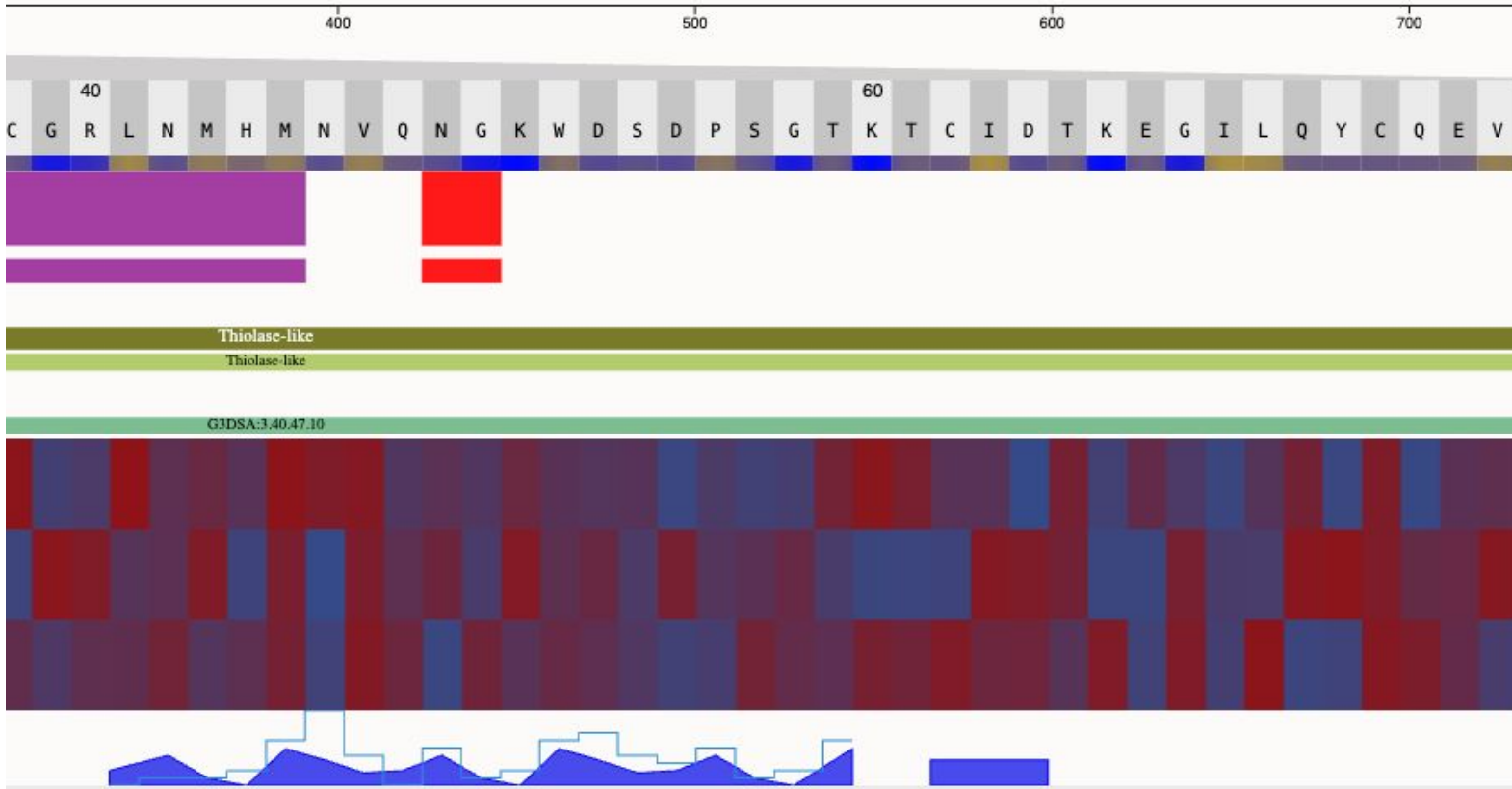
European Bioinformatics Institute (EMBL-EBI), Hinxton, Cambridge, UK

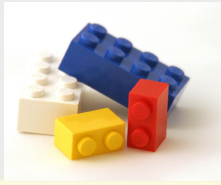
Protein Information Resource (PIR), Washington DC and Delaware, USA

SIB Swiss Institute of Bioinformatics (SIB), Geneva, Switzerland

Nightingale

- An **open-source** visualization library of **standard web components**
- Designed for representing protein-related data
- **Composable** architecture facilitates vertical stacking of tracks, aiding visual comparison across datasets
- **Interoperable** with other standard components, regardless of the underlying framework
- **Compatible** with any component following the **Nightingale APIs**





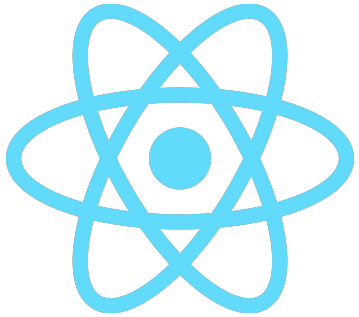
UniProt

InterPro

PDBe
Protein Data Bank in Europe

Building using the standards: Web Components

- Combination of standard APIs: **Custom elements** + **Shadow DOM** + **HTML templates**
- **Not dependent** on any framework



React
and related

Angular

Vue.js

...

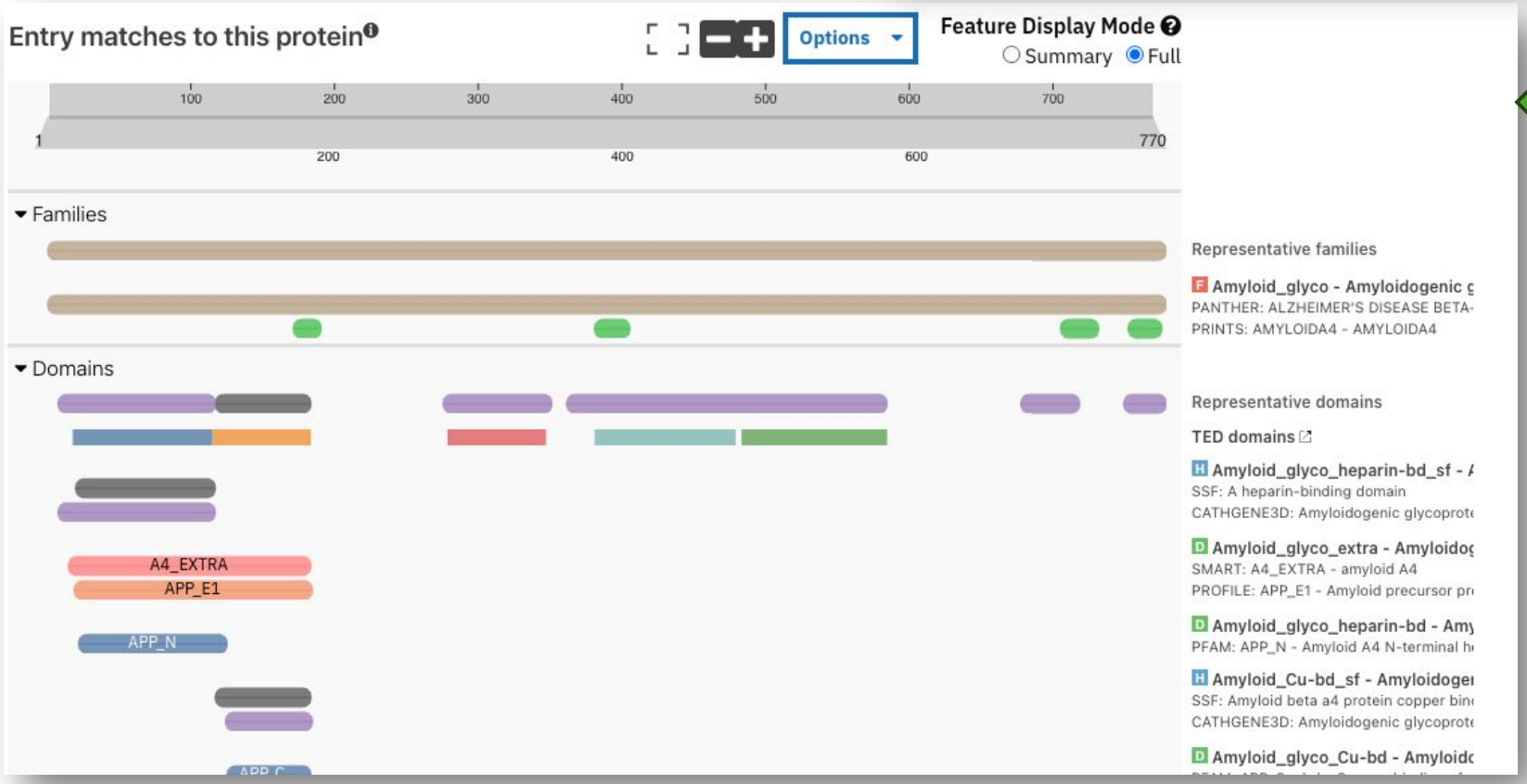
Vanilla JS

- **Limited** library dependencies
- Set of components, as **independent packages** under the @nightingale-elements scope on NPM

UniProt

Same blocks, diffe

Visualization showing family and domains in UniProt's entry page of P05067 using minimal number of tracks as needed

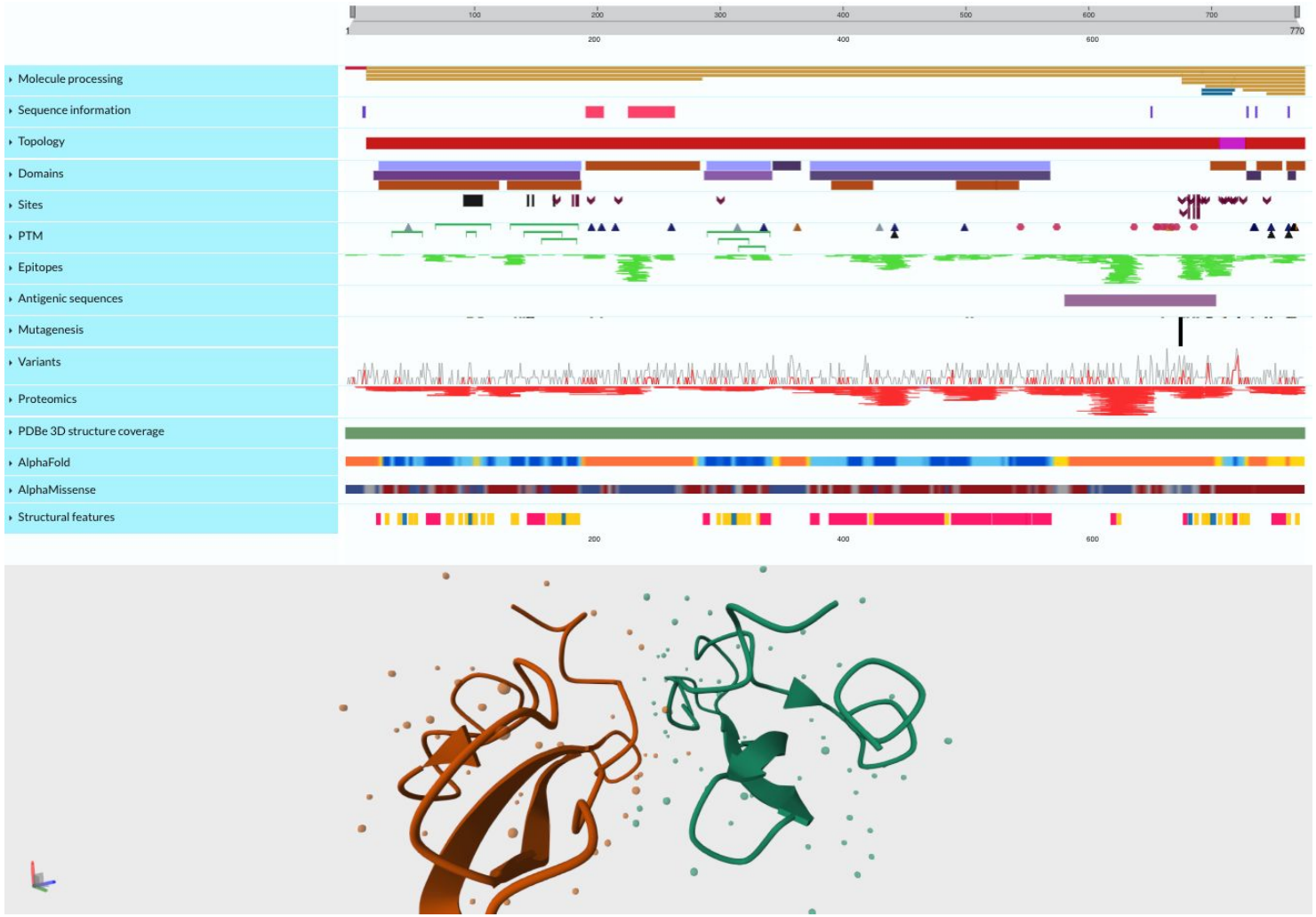


InterPro's protein viewer using Nightingale components for P05067

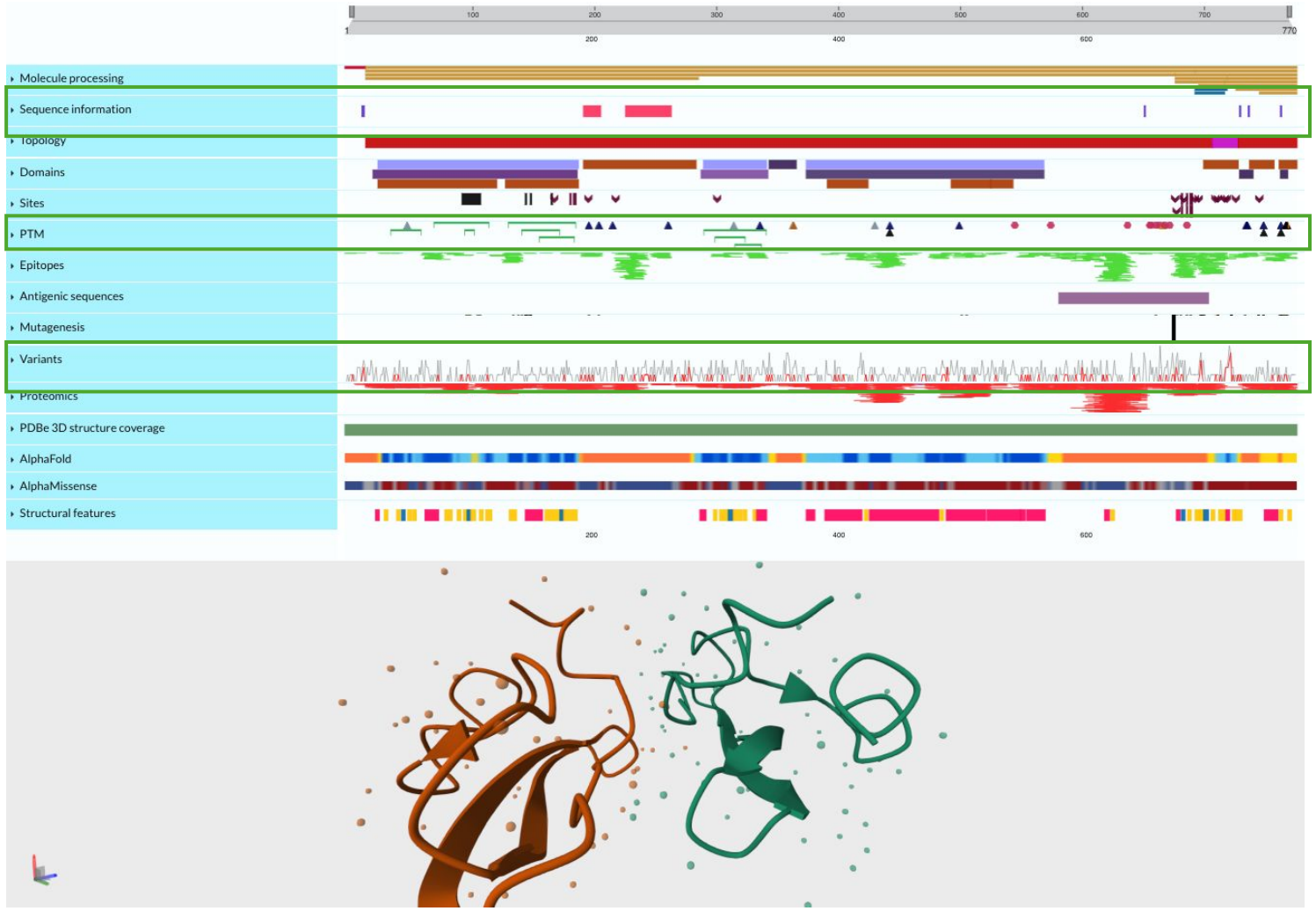
PDBe is an other user of Nightingale components

UniProt's ProtVista visualization

- **Turnkey** combination of tracks
- **Chooses** and aligns various tracks to best fit our needs
- Uses **different components** of Nightingale
- Uses UniProt's **data source**
- **Customizes tooltips** as needed
- Is itself a **Web Component**

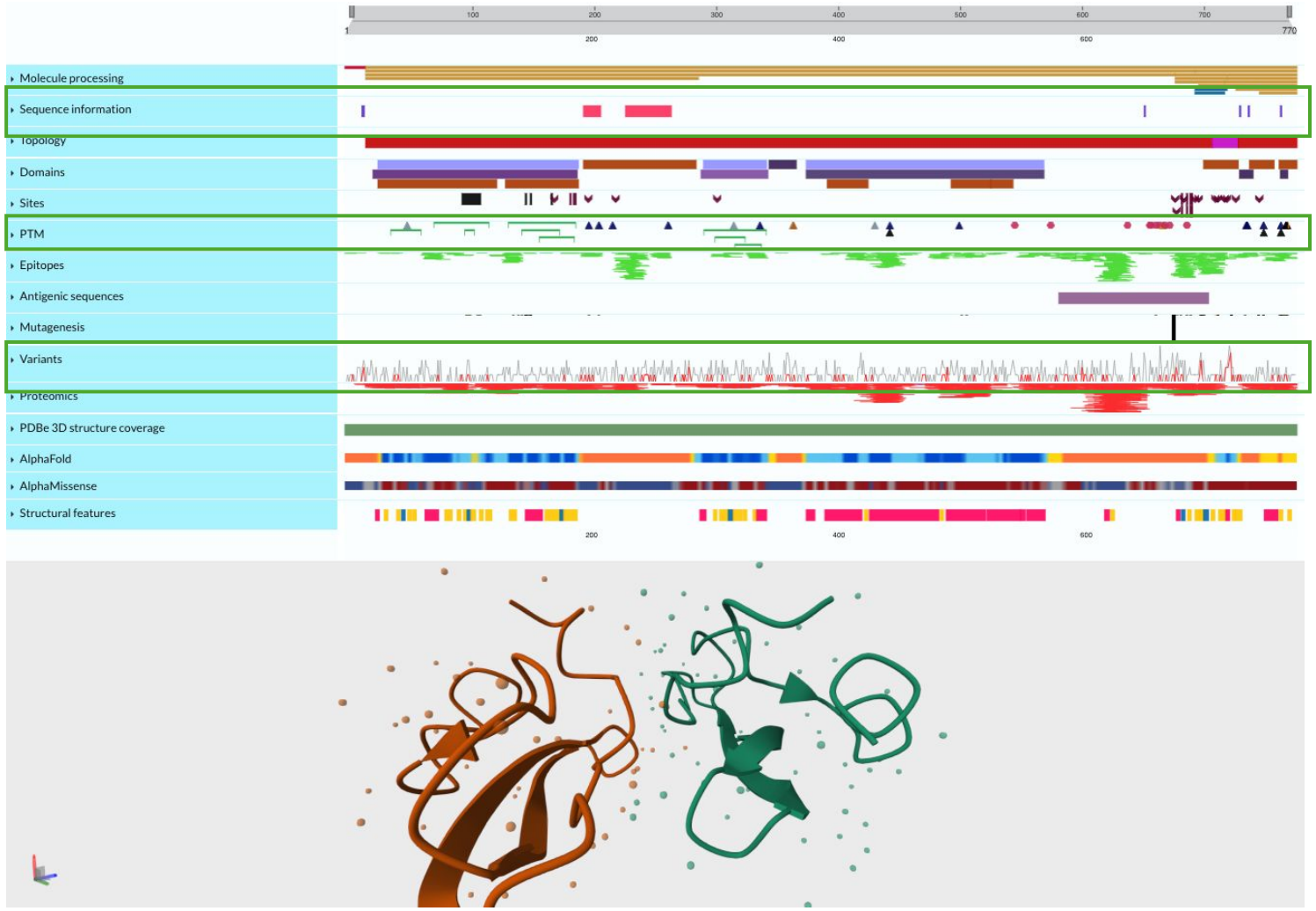


Human Amyloid-beta precursor protein in UniProt's ProtVista visualization



Human Amyloid-beta precursor protein in UniProt's ProtVista visualization

The viewer is composed of tracks – the fundamental building blocks.



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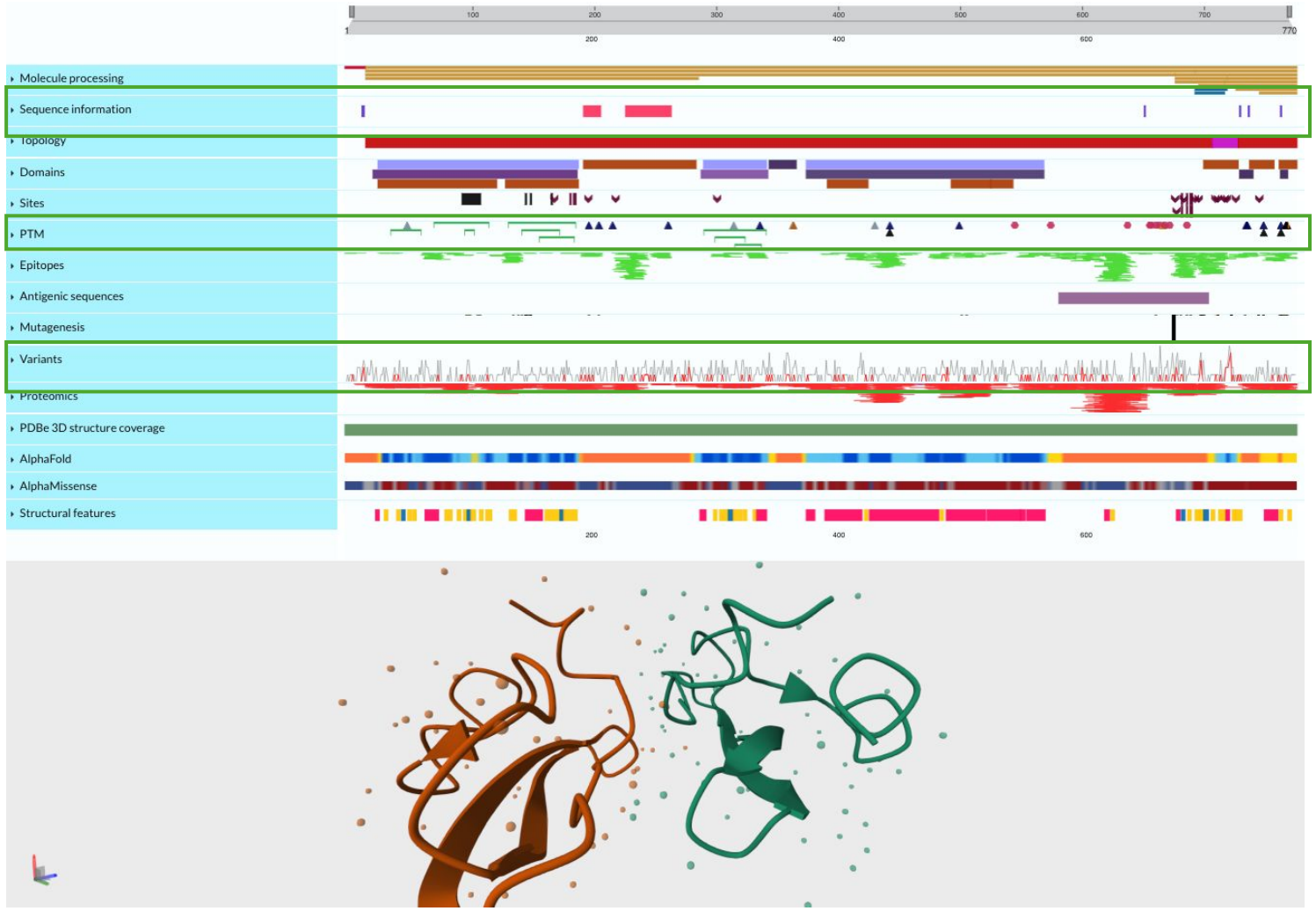

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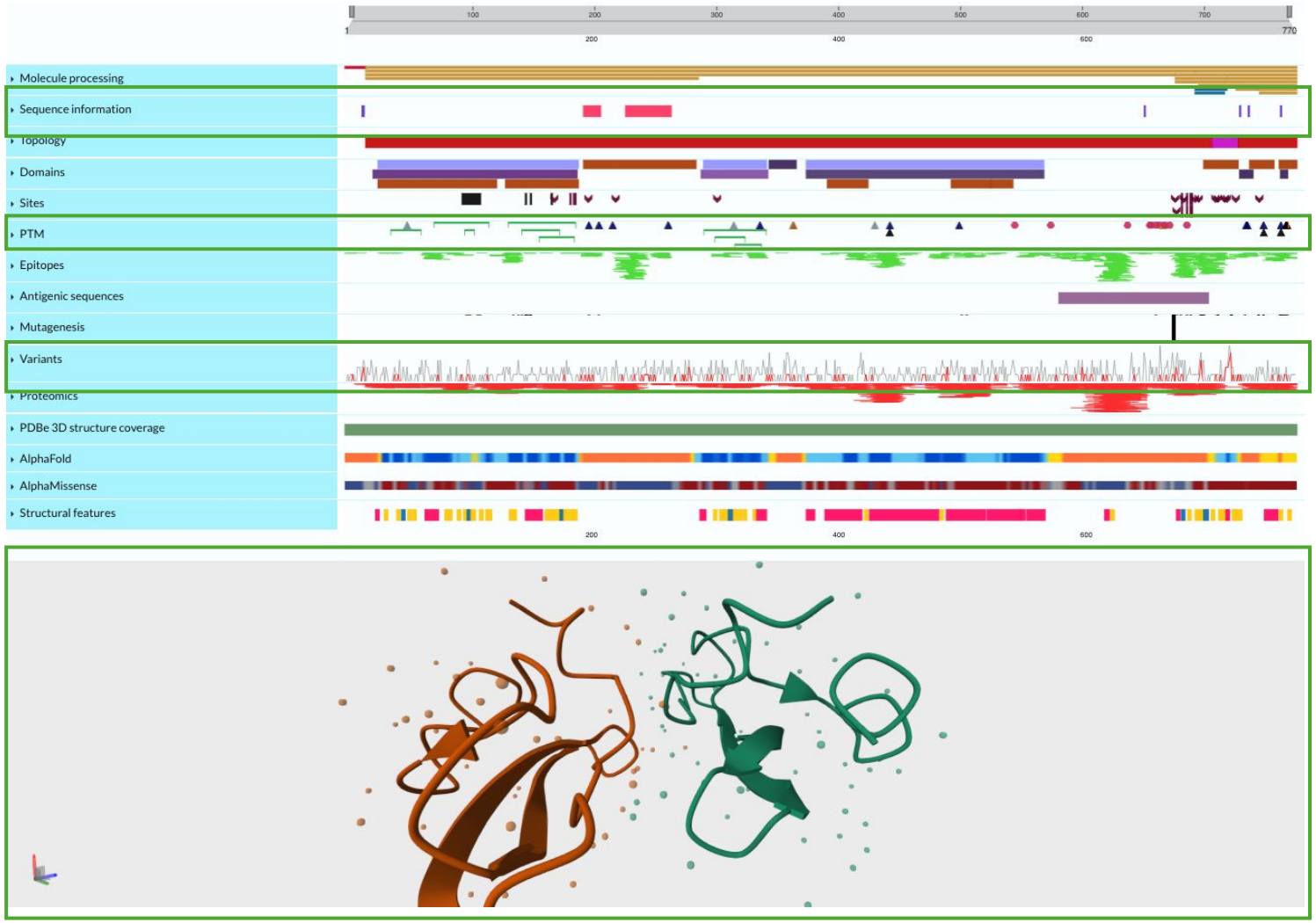
ProtVista fetches all the data and each track is responsible for representing its own data.



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The structure viewer is also treated as a track that render data in 3D context

Architecture

The manager serves as a container for all the tracks, handling events from its descendants and ensuring **synchronized** behavior across tracks.

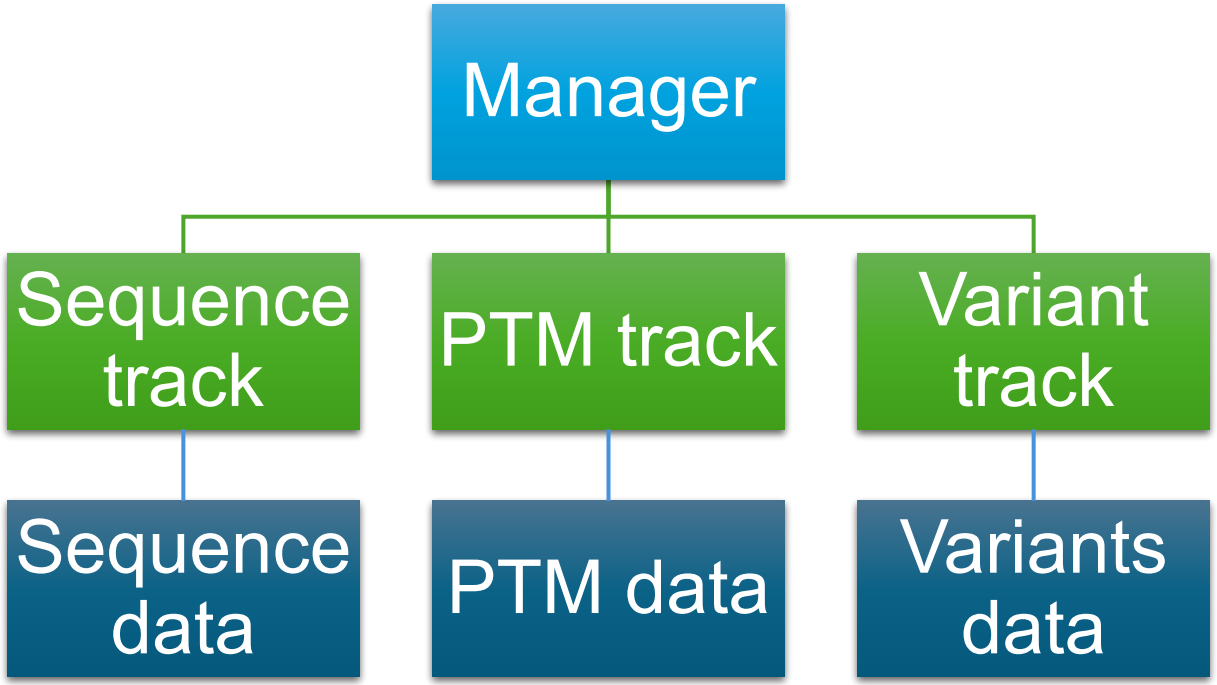


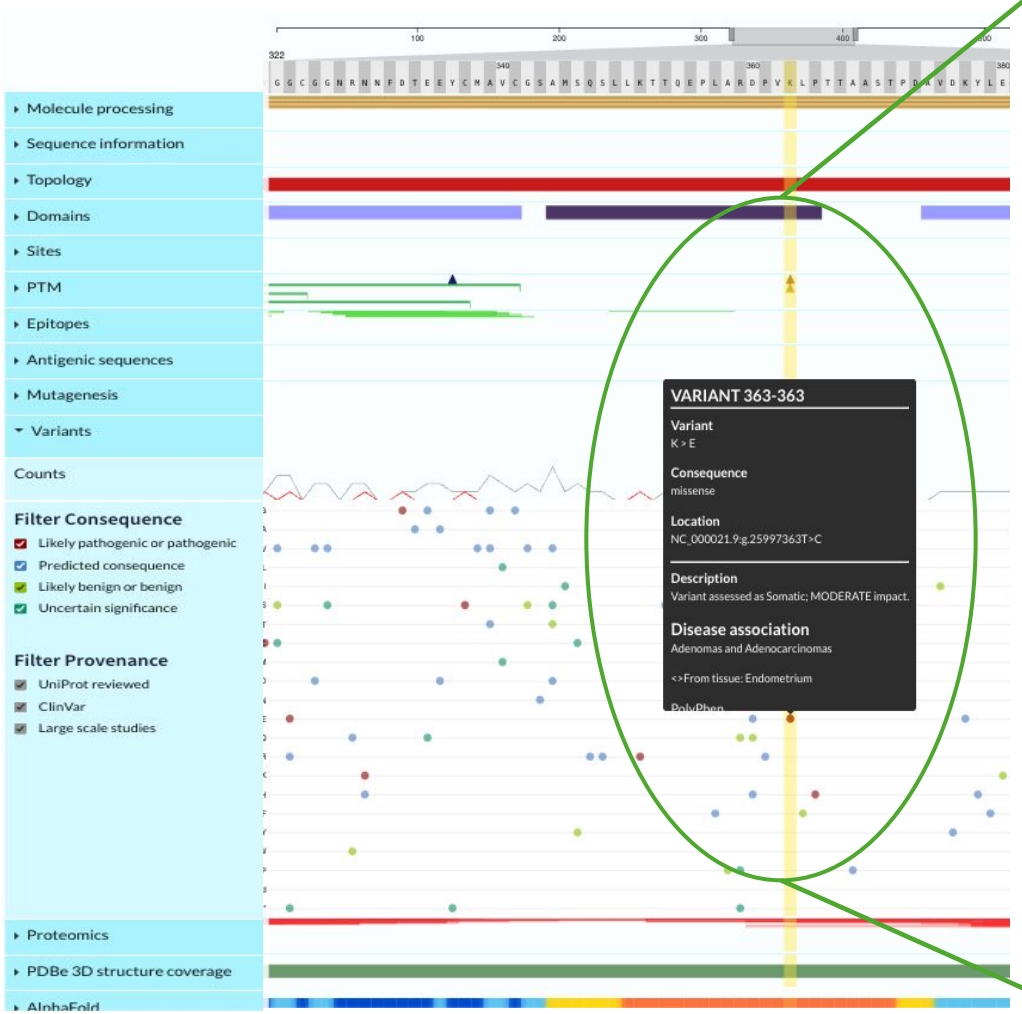
Image source: lego.com

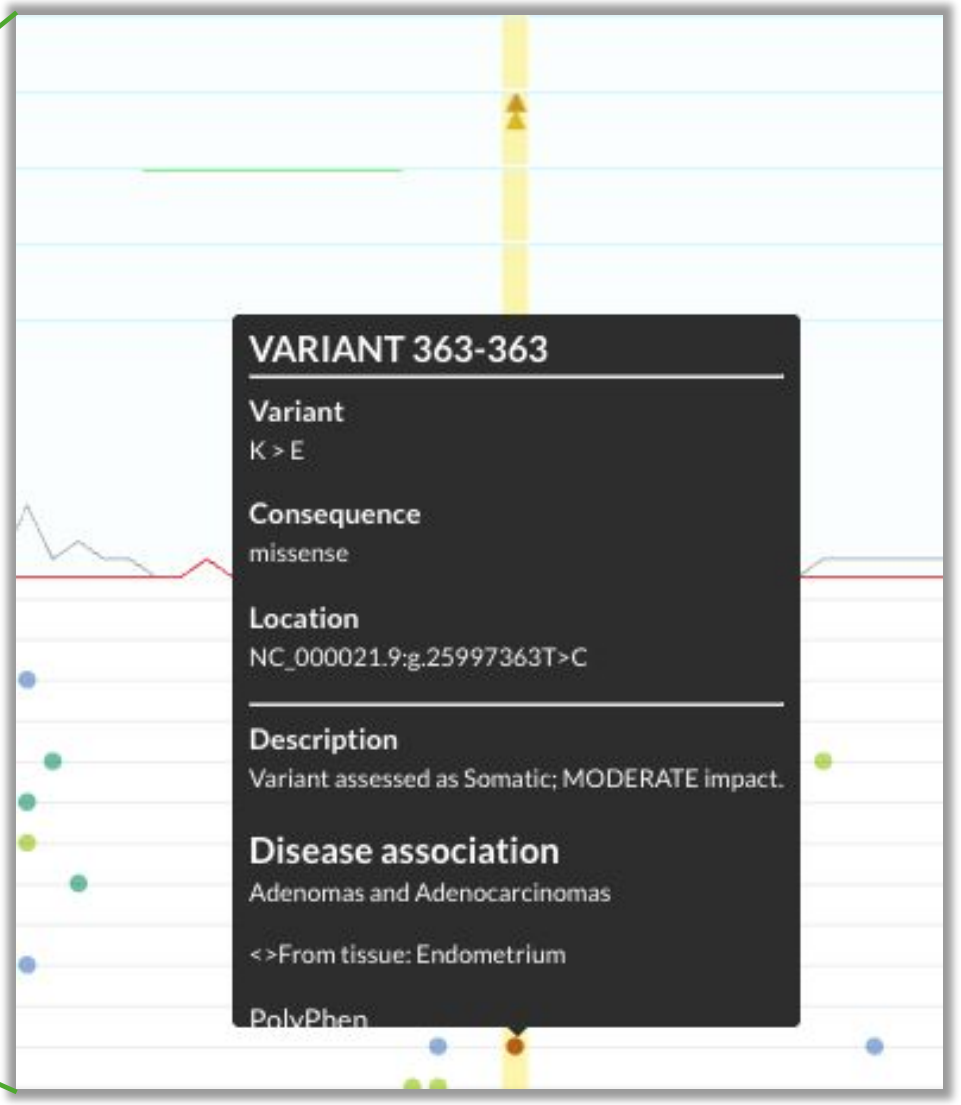
User clicks on a variant in the Variant track

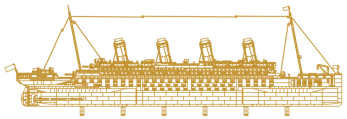
Track emits a ‘highlight’ event with the selected coordinates

The manager detects the event

The manager sets the value to all the other tracks’ highlight attribute







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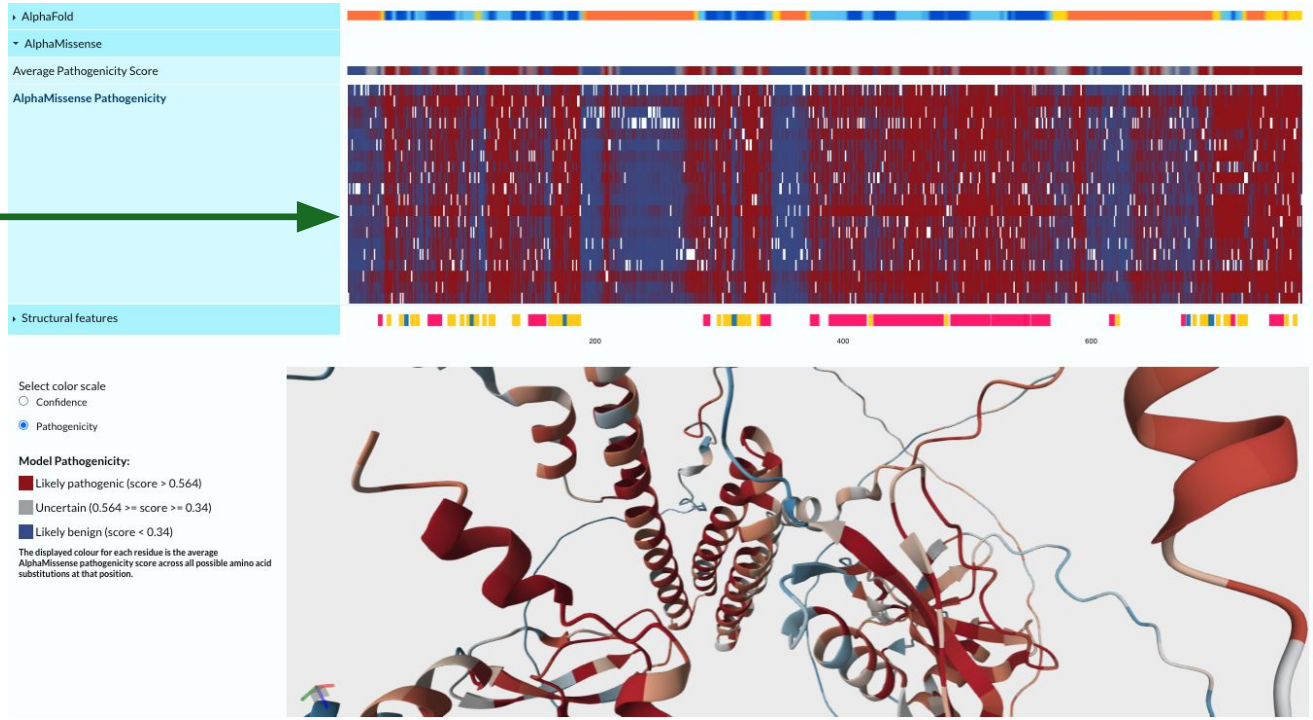
Under the hood

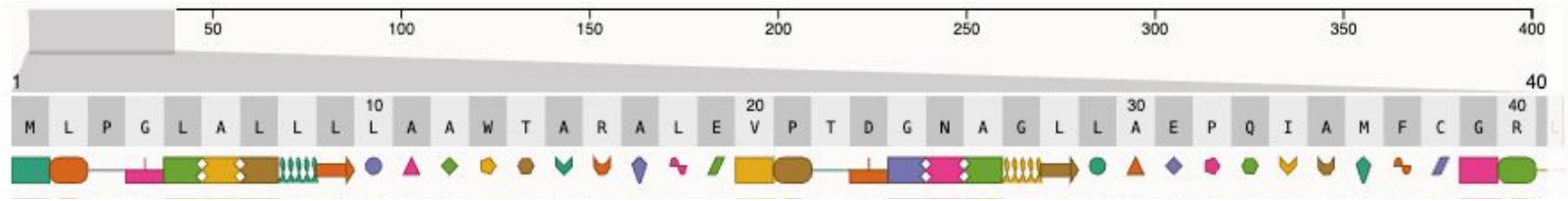
- **Lit** - for building reusable Web Components
- **D3.js** - for data-driven rendering via SVG and Canvas
- **HTML5 Canvas** – leveraged for high performance rendering in heavily used tracks
- **SVG overlay** – enables interactivity on top of Canvas for minimal performance impact

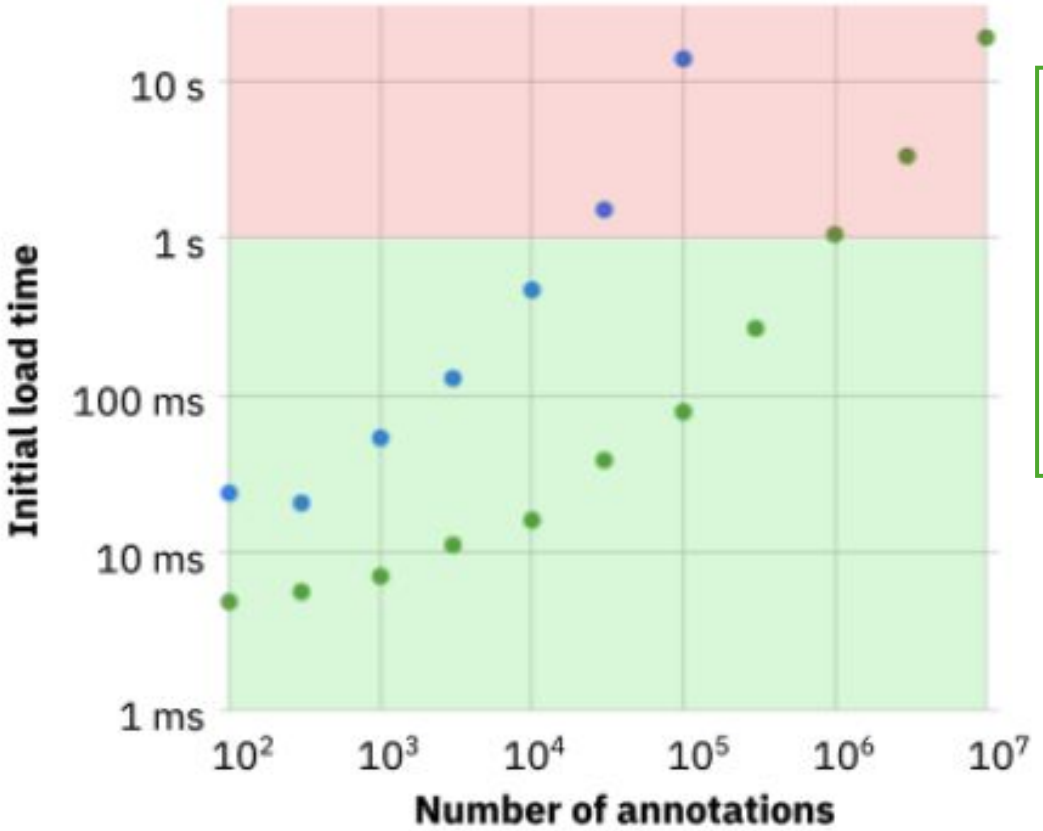
- Rendered using Canvas
- Pixels drawn directly onto the screen
- Doesn't retain all the elements in the DOM like SVG
- Reduces memory overhead



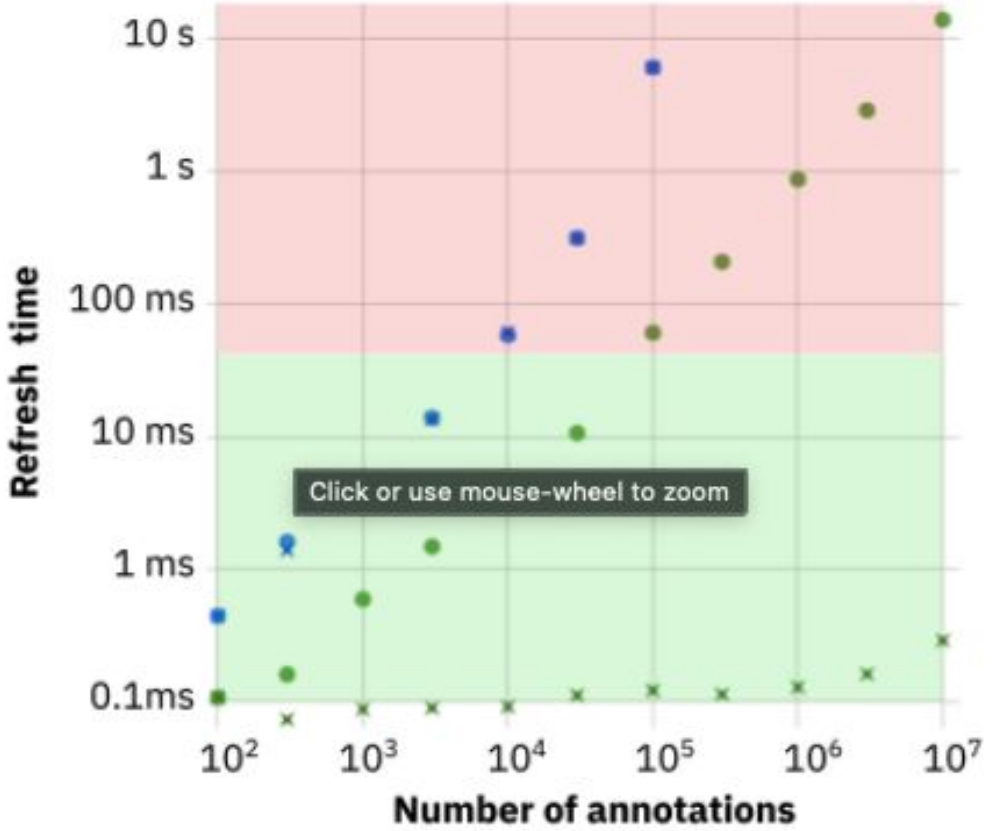
Performance optimization

Performance comparison between SVG and Canvas when visualizing the same dataset





- SVG
- X SVG when zoomed on 100 residues
- Canvas
- X Canvas when zoomed on 100 residues



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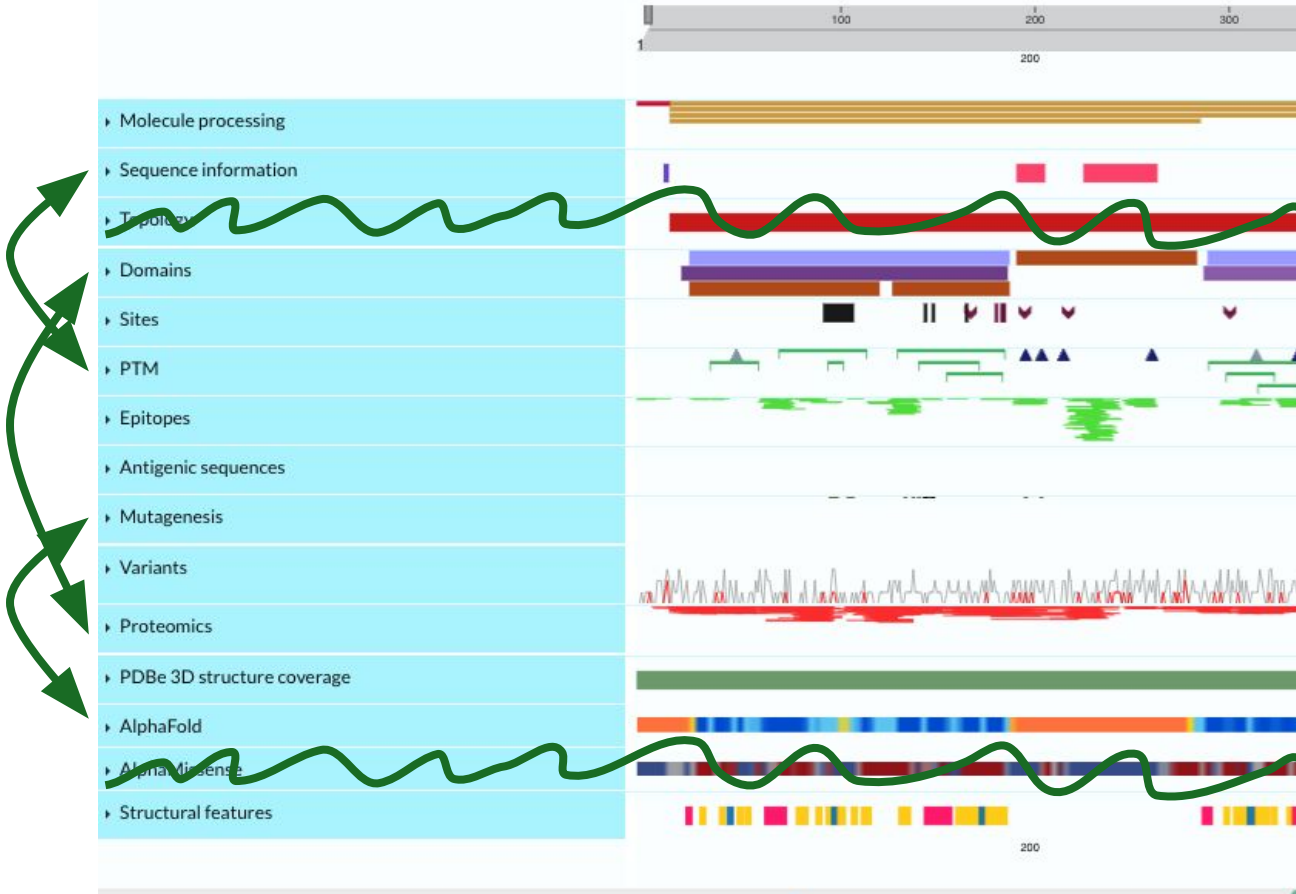
Challenges and future

- **From no dependency, to minimum dependencies**
  - Avoiding footguns
  - Embracing TypeScript
- **Package publication best practices**
  - Managing monorepos & bundles
- **Performance improvements**
  - Full transition to Canvas
  - Explore WebGL
- **Improve developer and user experiences**
- **Engaging a wider community**



Funding

It is a collaboration with InterPro and PDBe and licensed under the MIT License.

UniProt is is funded by joint awards by the National Institute of Health (NIH) [U24HG007822]; European Molecular Biology Laboratory (EMBL) core funds; Wellcome Trust [221320/Z/20/Z]; the UK Biotechnology and Biological Science Research Council [BB/W017970/1] and the United States National Science Foundation (NSF) [DBI-2129634]

Further ProtVista development will be supported by the Research Software Maintenance Fund, managed by the Software Sustainability Institute and funded by UKRI grant reference AH/Z000114/1

GitHub

Nightingale monorepo
https://github.com/ebi-webcomponents/nightingale
Nightingale Example pages
https://ebi-webcomponents.github.io/nightingale

ProtVista repo
https://github.com/ebi-webcomponents/protvista-uniprot

Any questions? 💬

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