

# Accessible Charts

## Group G1:

Moritz Erlacher, Lisa Habich, Alexander Perko, Markus Stradner

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**Information Visualisation SS 2021**

# Overview

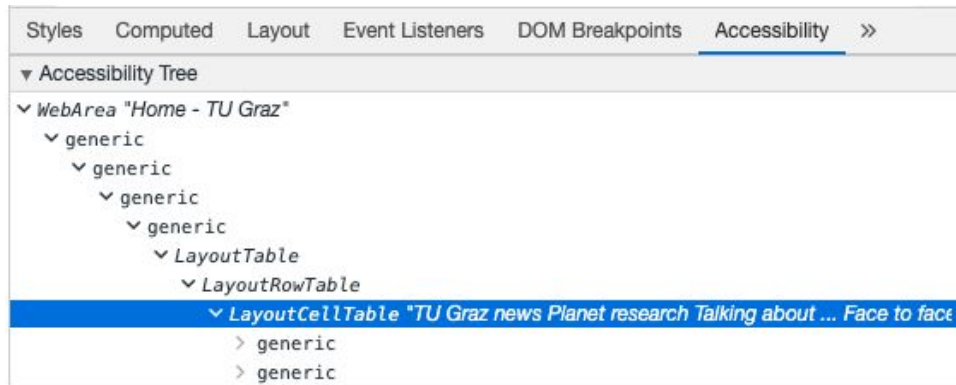
- Web A11y (Web Accessibility)
- ARIA
- Screen Readers
- Tools

# Web A11y (Web Accessibility)

- Makes web content accessible to blind or color blind people.
  - Web-UIs
  - Infographics
  - Text
- Different standards have emerged.
  - (See slides on the A11y Tree and ARIA).

# Web A11y A11y Tree and DOM Tree

- Parallel structures.
- A11y Tree is a subset of flattened DOM tree.
- Only accessible objects with impact on semantics created in A11y Tree for every DOM element.



Screenshot taken by Markus Stradner from <http://www.tugraz.at/> with Google Chrome on 3.5.2021.

# ARIA

- **ARIA: Accessible Rich Internet Applications**
  - Set of rules, roles and properties for the annotation of web content.
- **WAI: Web Accessibility Initiative**
  - Initiative for defining accessibility standards for web technologies.

# ARIA Rules when using ARIA

1. Always use native HTML, unless no other way to make element accessible.
2. Do not change native HTML semantics (e.g. using `<span role="button">` instead of `<button>`).
3. Make ARIA controls keyboard accessible (`tabindex="0"`).
4. For focusable elements never add `role="presentation"` or `aria-hidden="true"`.
5. Accessible names (e.g. `aria-label="Search"` or `<label>`).

# ARIA Properties

- `aria-label`: Label element with short name or value.
- `aria-labelledby`: Labeling by referring to element by id.
- `aria-describedby`: More detailed description of element.
- `aria-valuemin`/`aria-valuemax`: Min. and max. values of range elements.
- `aria-roledescription`: Natural-language equivalent to ARIA role.
- `aria-hidden`: Remove elements from A11y Tree. For purely decorative elements.

# ARIA ARIA Graphics Module - Roles

Additional roles for SVG elements:

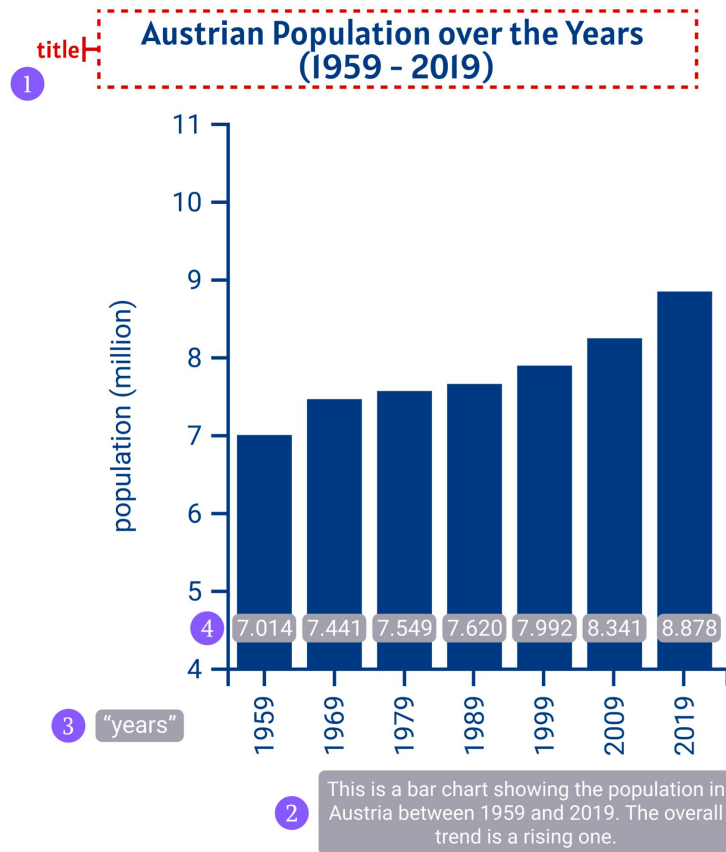
- `graphics-document`: Document conveys meaning through visual appearance.
- `graphics-object`: Section of graphics-document. Represents distinct object or sub-component with semantic meaning.
- `graphics-symbol`: Graphical object treated as single image component.



# ARIA Simply Annotated SVGs

Contains standard ARIA roles and properties.

- Visible graphic elements
- Tabindices (determine tab order)
- **Focusable elements**
- Non-visible labels (for focusable elements)

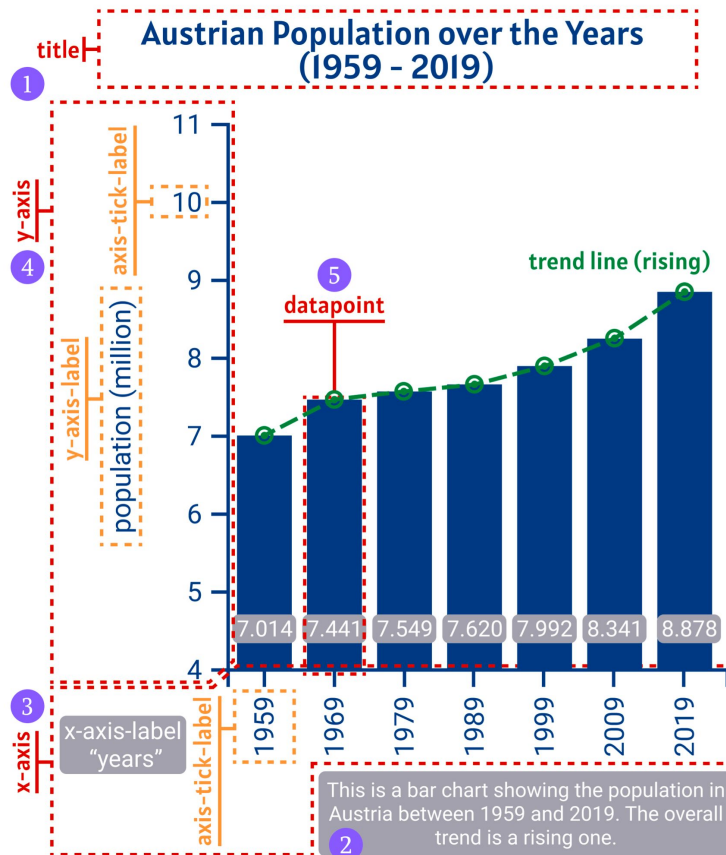


Drawn by Markus Stradner, inspired by the illustrations of a [barchart](#) from [Fizz Studio](#).

# ARIA Richly Annotated SVGs

Contains additional roles and properties.

- Visible graphic elements
- Tabindices (determine tab order)
- Focusable elements
- Non-visible labels (for focusable elements)
- Focusable, visible labels
- Supplementary information



Drawn by Markus Stradner, inspired by the illustrations of a [barchart](#) from [Fizz Studio](#).

# ARIA Creating Annotated SVGs

- Manual annotation:
  - From scratch.
  - Annotation of existing SVGs.
- Semi-automatic annotation:
  - Using “recipes” to generate initial SVGs (see slides on AChart).
- Automatic annotation:
  - Using vector graphic editors (see slide on Glimpse).

# ARIA Proposals for Rich Annotation

- **Describler/AChart:**
  - Custom taxonomy.
  - Non-standardised ARIA roles and properties.
- **W3C (Amelia Bellamy-Royds):**
  - ARIA roles and properties.
- **Highcharts:**
  - ARIA roles and properties.
  - Custom taxonomy.
- **Semiotic:**
  - ARIA roles and properties.
  - Custom taxonomy.
- **amChart:**
  - ARIA roles and properties.
  - Menu elements for data points.
- **FusionChart:**
  - ARIA roles and properties.
  - Custom taxonomy.

# ARIA Proposals for Rich Annotation

Meaning	Describer/ AChart	W3C (Amelia Bellamy-Royds)	Highcharts	Semiotic	amChart	FusionChart
Data Point Declaration	<code>datapoint</code>	<code>graphics-dataunit/ aria-datavalues</code>	<code>highcharts-point</code>	-	<code>menuitem</code>	-
Collection of Data Items	<code>dataset</code>	<code>graphics-dataline/ aria-datavaluearray</code>	<code>highcharts-line-series</code>	<code>lines/ pieces</code>	<code>menu</code>	<code>raphael-group- N-plot-group</code>
Legend Item	<code>legenditem</code>	-	<code>highcharts-legend- -item</code>	-	-	<code>raphael-group- N-legend</code>
Legend	<code>legend</code>	<code>graphics-legend</code>	<code>highcharts-legend</code>	-	-	<code>raphael-group- N-legend</code>
Axis Declaration	<code>xaxis/yaxis</code>	<code>graphics-axis</code>	<code>highcharts-axis highcharts-xaxis/ -yaxis</code>	<code>axis</code>	-	<code>raphael-group- N-dataset-axis</code>
Axis Label	<code>axislabel</code>	-	<code>highcharts-axis- labels</code>	<code>axis- label</code>	-	<code>raphael-group- N-dataset-axis</code>

# Screen Readers

- NVDA
- JAWS
- VoiceOver (macOS)
- Narrator (Windows)

# Screen Readers Usage Statistics

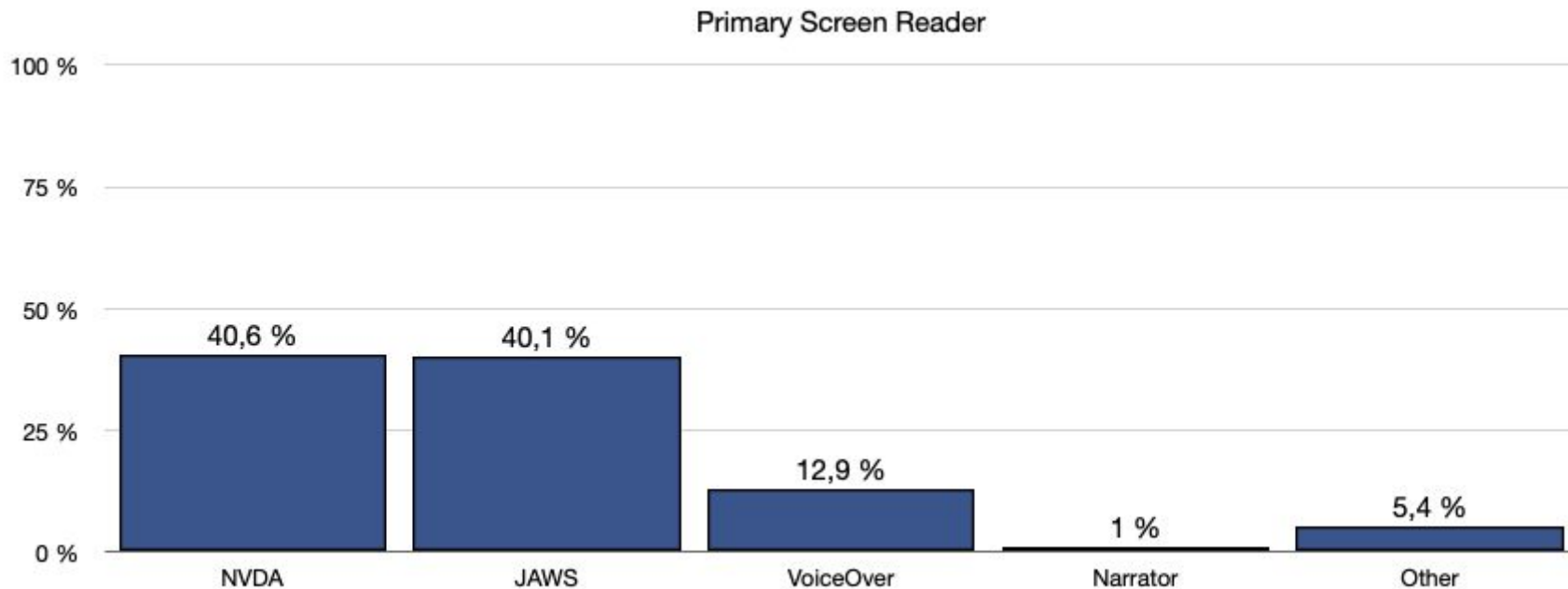
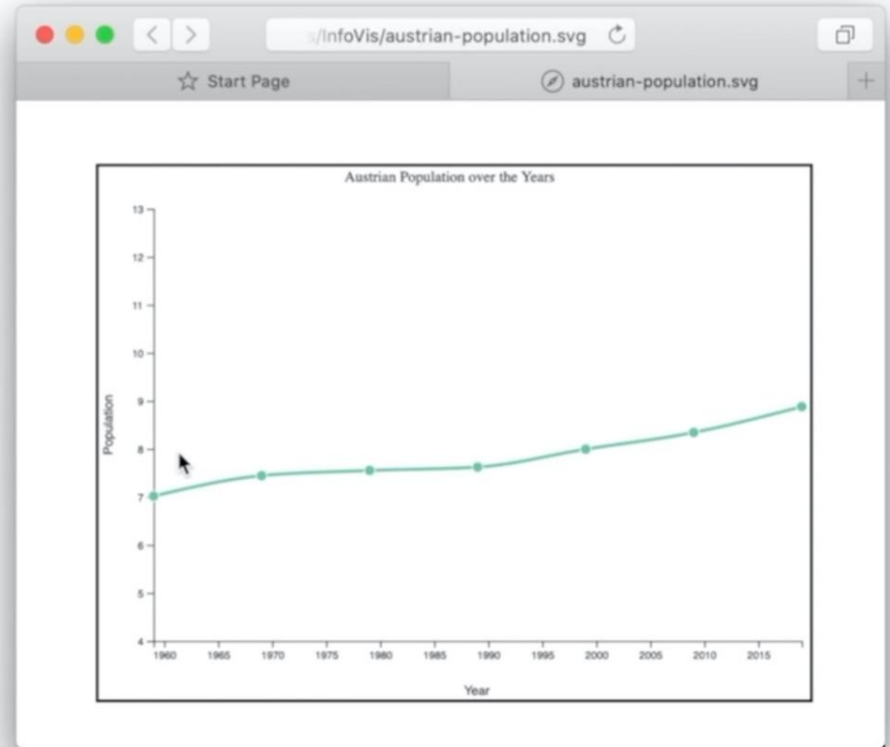


Diagram reproduced by Lisa Habich from <https://webaim.org/projects/screenreadersurvey8/> on 22.04.2021

# Screen Readers VoiceOver (macOS)

- Built in screen reader.
- Reads out UI elements and accessibility annotations.

× Austrian Population over the Years This chart shows the population of Austria from 1959 to 2019., Line Chart



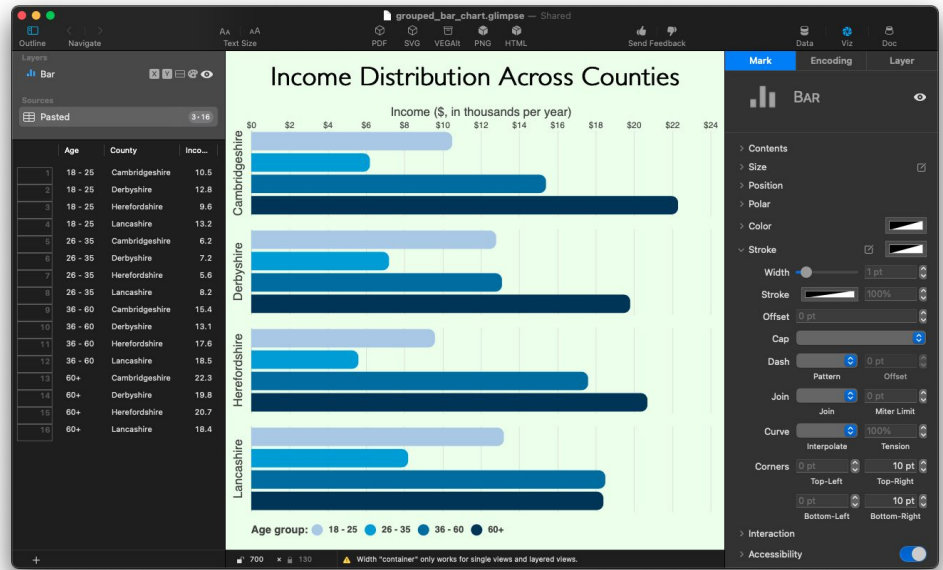


# Tools

- Generators (Editors):
  - Glimpse
  - AChart Creator
- Chart Readers:
  - AChart Interpreter
  - Describler
- Others

# Generators Glimpse

- Closed source
- Beta stage
- Native App (macOS)
- Set of visualization building blocks
- Automatic ARIA annotations



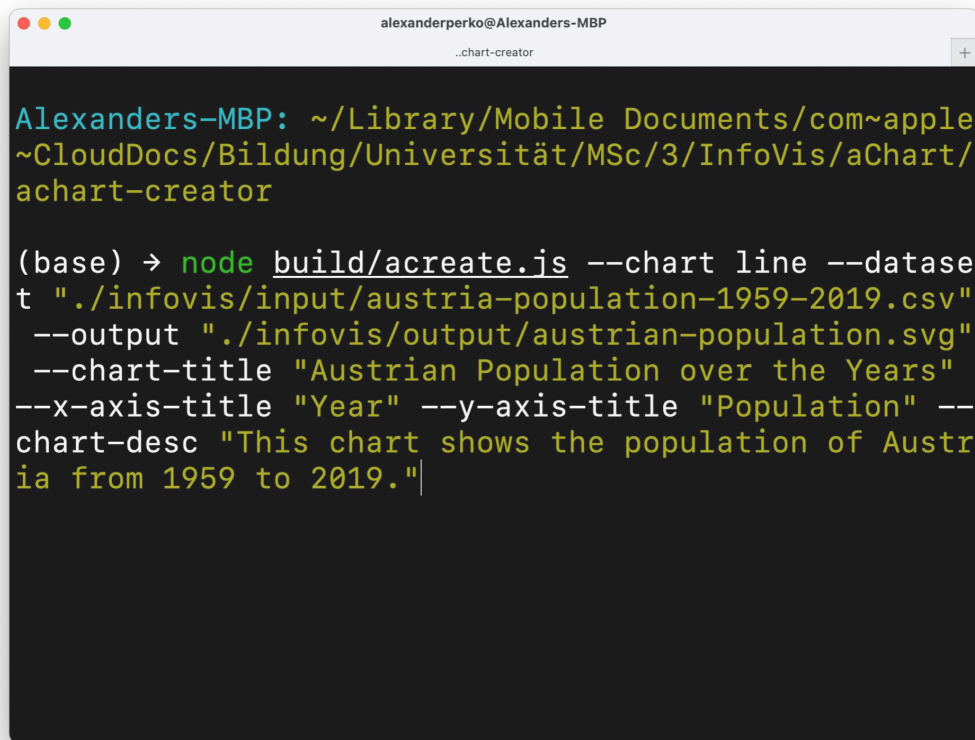
Screenshot taken from Glimpse.io on 20.04.2021.

```
1 ...
2 <g class="mark-group role-axis"
3   role="graphics-symbol" aria-roledescription="axis"
4   aria-label="Y-axis for a discrete scale with 4 values:
5   18 - 25, 26 - 35, 36 - 60, 60+>
```

File as produced by Glimpse taken from Glimpse.io on 20.04.2021.

# Generators AChart Creator

- Command line interface.
- SVG from CSV source.
- “Recipes” for:
  - Pie chart
  - Bar chart
  - Line chart
- Additional arguments for:
  - Title
  - Legend
  - Description
  - Axis-Labels
  - ...

A screenshot of a terminal window titled 'alexanderperko@Alexanders-MBP' with a sub-window title '...chart-creator'. The terminal shows the following command and its output:

```
Alexanders-MBP: ~/Library/Mobile Documents/com~apple~CloudDocs/Bildung/Universität/MSc/3/InfoVis/aChart/achart-creator  
  
(base) → node build/acrete.js --chart line --dataset './infovis/input/austria-population-1959-2019.csv' --output './infovis/output/austrian-population.svg' --chart-title "Austrian Population over the Years" --x-axis-title "Year" --y-axis-title "Population" --chart-desc "This chart shows the population of Austria from 1959 to 2019."
```

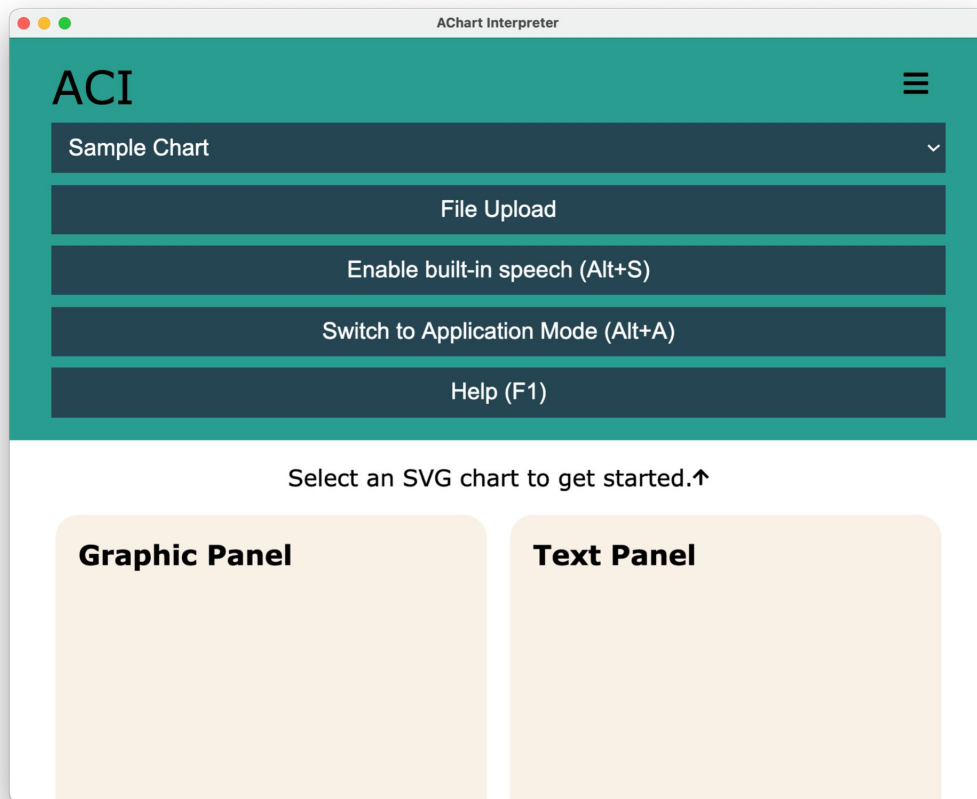
Screenshot taken by Alexander Perko from AChart Creator on 01.05.2021.

# Generators AChart Creator

- Pro:
  - **Semi-automated annotation.**
  - **Easy to use** (if used to CLIs).
  - Lightweight.
  - Cross-Platform (Windows, macOS, Linux).
- Contra:
  - Command line interface (entry barrier).
  - Limited in the number of output “recipes”.
  - No annotation of existing SVGs possible .  
(AChart has to be the starting point when creating an SVG).

# Readers AChart Interpreter

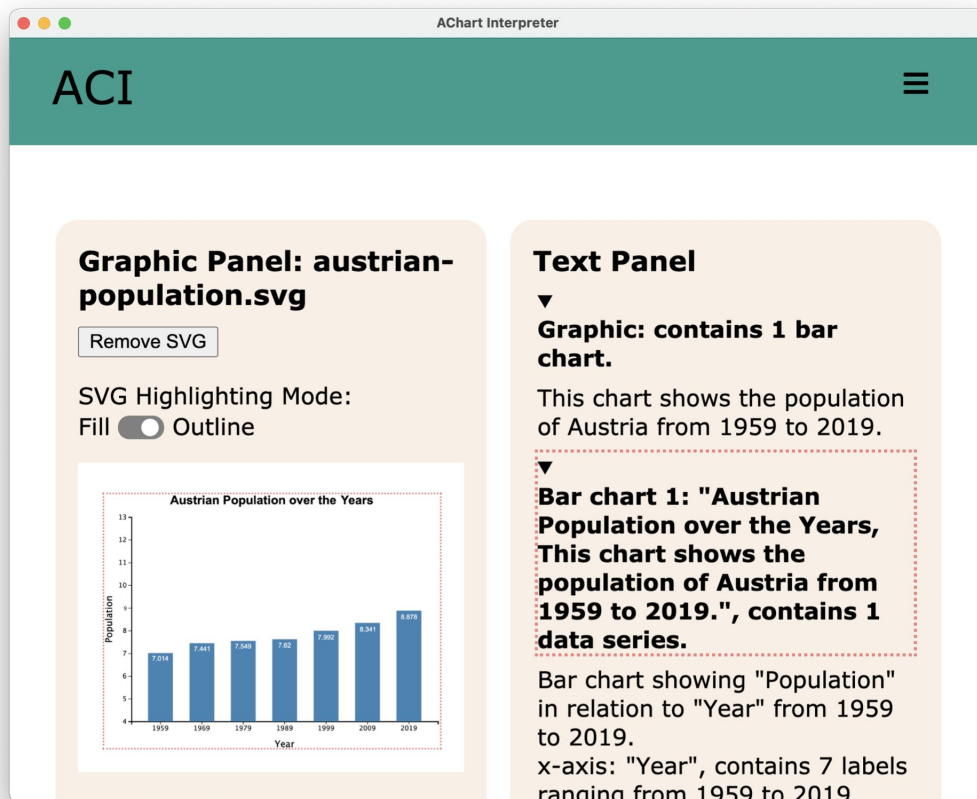
- Webapp
- Loads SVGs from file.
- Sample SVGs available.



Screenshot taken by Alexander Perko from AChart Interpreter under MIT Licence on 01.05.2021.

# Readers AChart Interpreter

- Webapp
- Loads SVGs from file.
- Sample SVGs available.
- Synchronized Split-Screen:
  - SVG chart on the left.
  - Textual description on the right.



The screenshot shows a web browser window titled "AChart Interpreter". The main heading is "ACI". Below the heading, there are two panels:

- Graphic Panel: austrian-population.svg**
  - A "Remove SVG" button.
  - SVG Highlighting Mode: Fill  Outline
  - A bar chart titled "Austrian Population over the Years" showing population from 1959 to 2019. The y-axis is labeled "Population" and ranges from 4 to 13. The x-axis is labeled "Year" and has labels for 1959, 1969, 1979, 1989, 1999, 2009, and 2019. The bars are blue with their values labeled on top: 7,014, 7,651, 7,549, 7,821, 7,992, 8,341, and 8,875.
- Text Panel**
  - ▼ **Graphic: contains 1 bar chart.**
  - This chart shows the population of Austria from 1959 to 2019.
  - ▼ **Bar chart 1: "Austrian Population over the Years, This chart shows the population of Austria from 1959 to 2019.", contains 1 data series.**
  - Bar chart showing "Population" in relation to "Year" from 1959 to 2019.
  - x-axis: "Year", contains 7 labels ranging from 1959 to 2019.

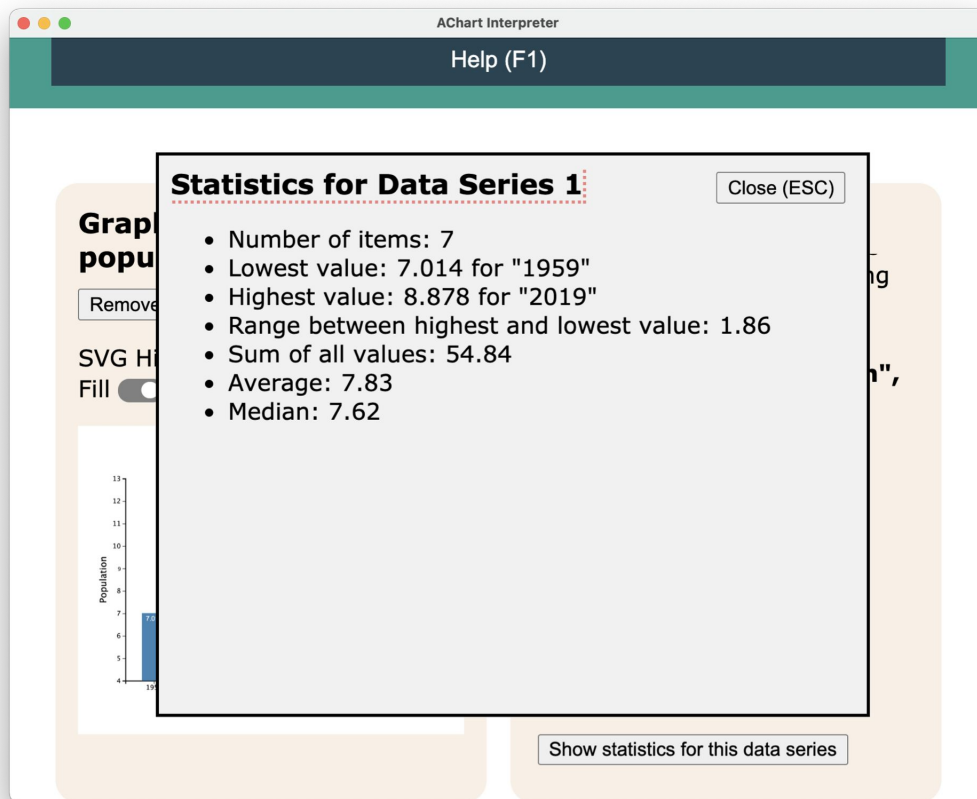
Screenshot taken by Alexander Perko from AChart Interpreter under MIT Licence on 01.05.2021.

Webapp: <https://tugraz-isds.github.io/achart-interpreter/> | Source: <https://github.com/tugraz-isds/achart-interpreter>

Showcase Video: <https://youtu.be/NLKqTTnKLIU>

# Readers AChart Interpreter

- Webapp
- Loads SVGs from file.
- Sample SVGs available.
- Synchronized Split-Screen:
  - SVG chart on the left.
  - Textual description on the right.
- **Statistics on the data:**
  - Median, average, ...
  - Enables a better understanding.



Screenshot taken by Alexander Perko from AChart Interpreter under MIT Licence on 01.05.2021.

# Readers AChart Interpreter

- **Pro:**
  - **Statistics** for getting an understanding of the underlying data (max, min, etc.).
  - **Easy to use** (GUI with tab-navigation).
  - Cross-Platform (Windows, macOS, Linux).
  - Connectors (tries to form whole sentences).
- **Contra:**
  - Works best with (~limited to) Chrome (file import).
  - Files have to be opened/imported with/from AChart - no browser integration.
  - Confusing to use “ranging from ... to ...” for string (non-number) categories.
  - Statistics hidden behind extra button (may be confusing/overlooked).
  - Broken electron building-pipeline (macOS; works in the browser though).

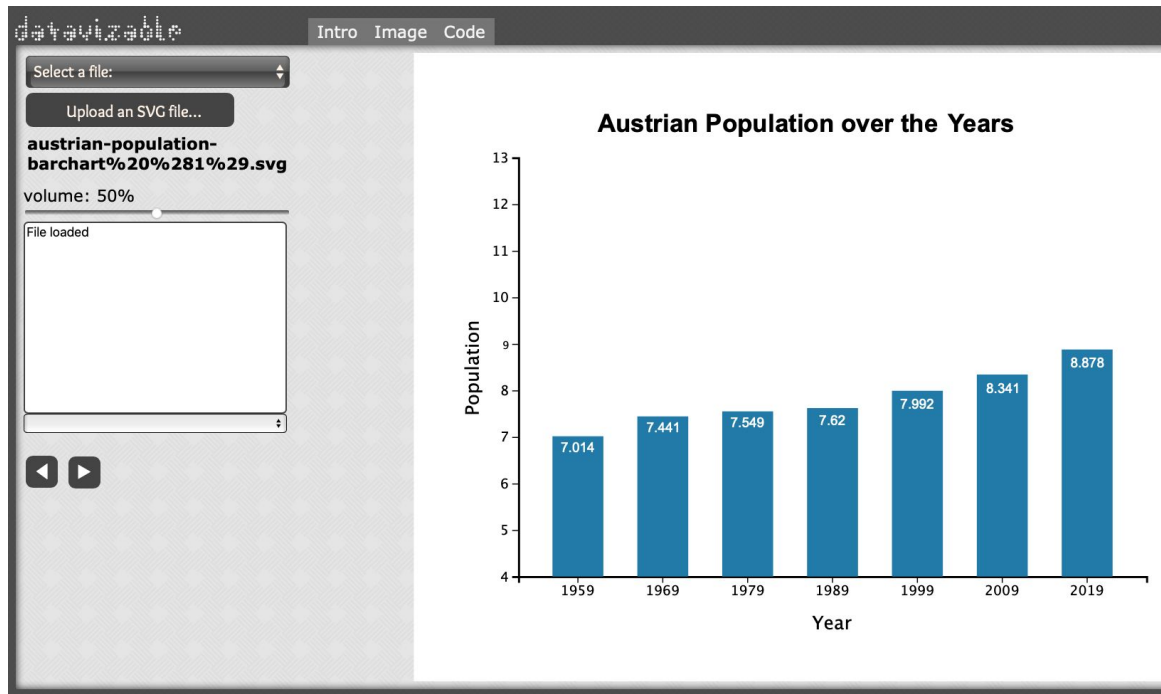


# AChart Creator & Interpreter

*DEMO*

# Readers Describler

- Webapp (written in plain JavaScript).
- Experimental state:
  - Very buggy.
  - Navigation issues.
  - Image loading issues.
  - Options to get more details often do not work.
- Uses language from operating system (wrong pronunciation).
- Works identically on localhost.



Screenshot taken by Markus Stradner from <http://describler.com/> under MIT Licence on 3.5.2021.

# Readers Describler

- Pro:
  - **Easy to use** (good introduction).
  - **Webapp**
  - Cross-Platform (Windows, macOS, Linux).
  - Local version works identically.
- Contra:
  - Very buggy (considering issues from previous slides).
  - Language from OS (bad pronunciation).

# Tools Others

- SVG-Generators currently in beta stage:
  - Fizz Studio
  - Glimpse
- Code editor plugins:
  - “Web Accessibility” for VS Code.
  - “Bri11iant” for VS Code.
- Accessibility audit in current browsers.