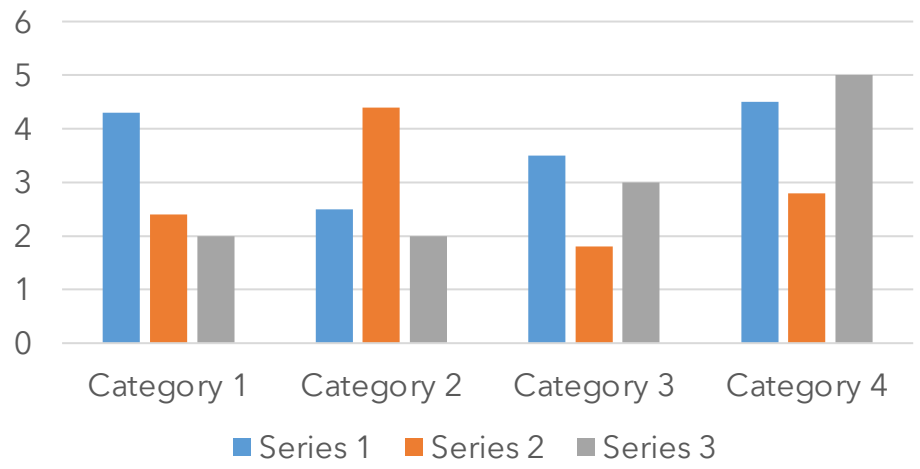
EUROVIS Leipzig 2023

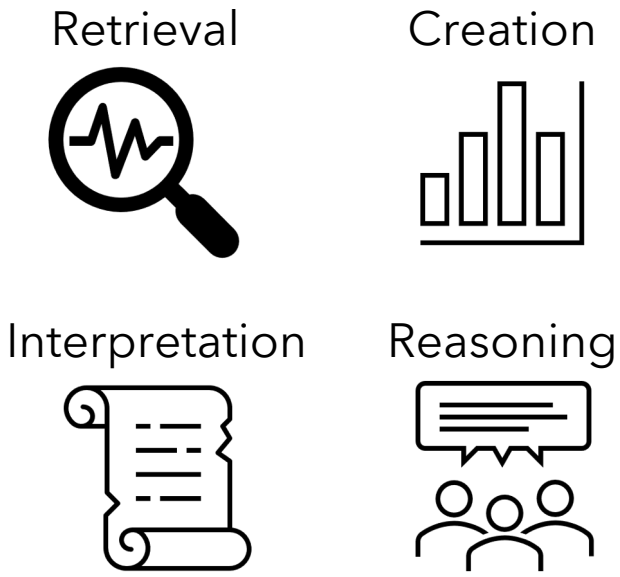
# The State of the Art in Creating Visualization Corpora for Automated Chart Analysis

Chen Chen, Zhicheng Liu

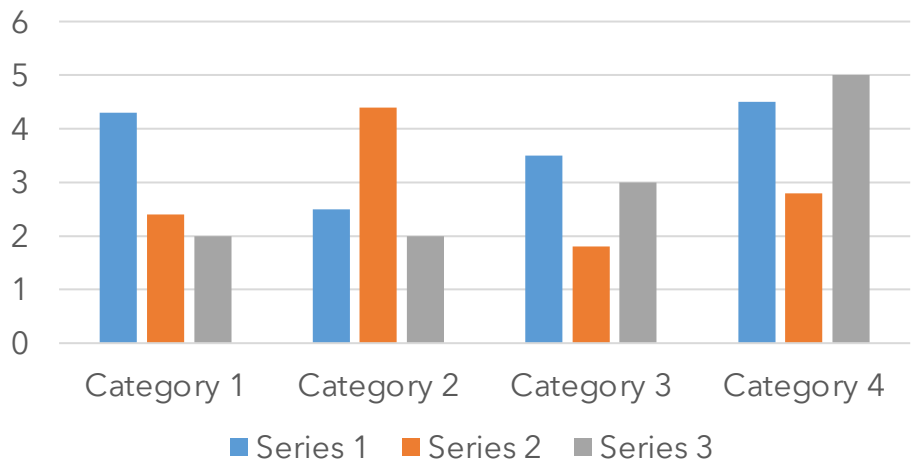
HCIL · University of Maryland · Department of Computer Science · HDI

# Background


6
5
4
3
2
1
0
Category 1
Category 2
Category 3
Category 4
Series 1
Series 2
Series 3


Retrieval
Creation
Interpretation
Reasoning

# Background

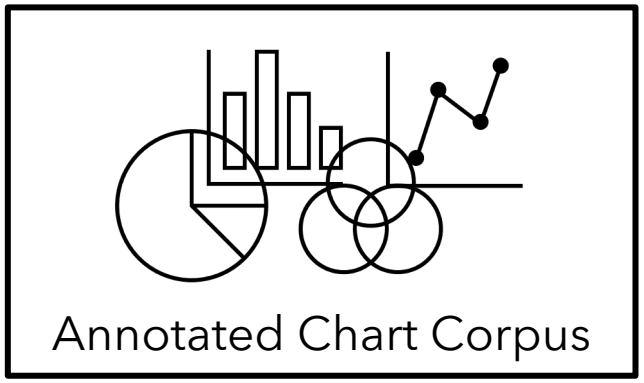



Retrieval

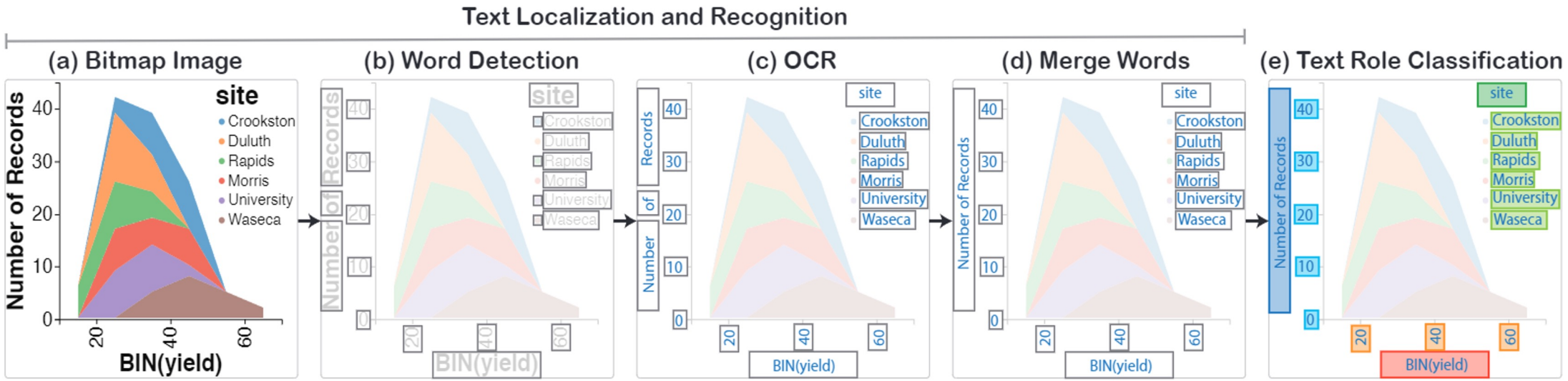
Creation

Interpretation

Reasoning



# An Example: REV




Poco and Heer. *Reverse-Engineering Visualizations: Recovering Visual Encodings from Chart Images*

collected 4,318 charts from Vega, Quartz, and academic papers;
annotated the bounding box, content, and role for each text element;
evaluated text recognition pipeline using the corpus.

# Motivation

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However, we have observed that many papers do **not**

- Use existing corpora but build own corpus instead
- Make the corpora with annotations publicly available
- Release their annotation tools
- Examine how different chart corpora influence model performance

# Motivation

Little research on:

- the common practices for creating the corpora
- what constitutes a good chart corpus
- the potential pitfalls and gaps in existing corpus-based research

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Little research on:

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- what constitutes a good chart corpus
- the potential pitfalls and gaps in existing corpus-based research

*It is difficult to*
*compare chart analysis techniques*
*measure scientific progress*
*identify unsolved research problems*

# Survey Goal

A comprehensive understanding of the state of the art in creating corpora for automated chart analysis research

- summarize current patterns and practices of corpora creation
- identify research gaps and opportunities
- recommend desired properties of benchmark corpora
- discuss research ideas on tools and methods

# Outline

- Survey
  - Method
  - Task Taxonomy
    (1) Why: the goal; (2) How: the method; (3) What: the output
  - Corpus Property
    (1) Format; (2) Scope; (3) Collection Method; (4) Annotations; (5) Diversity
- Challenges and Future Directions
  - Open opportunities
  - Desire properties of benchmark corpora
  - Desired tools

# Survey Method

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- Search 41
  - Start with AI4VIS [WWS*21] and ML4VIS [WCWQ21]
  - Three criteria: primary contribution, corpus description, and chart design

# Survey Method

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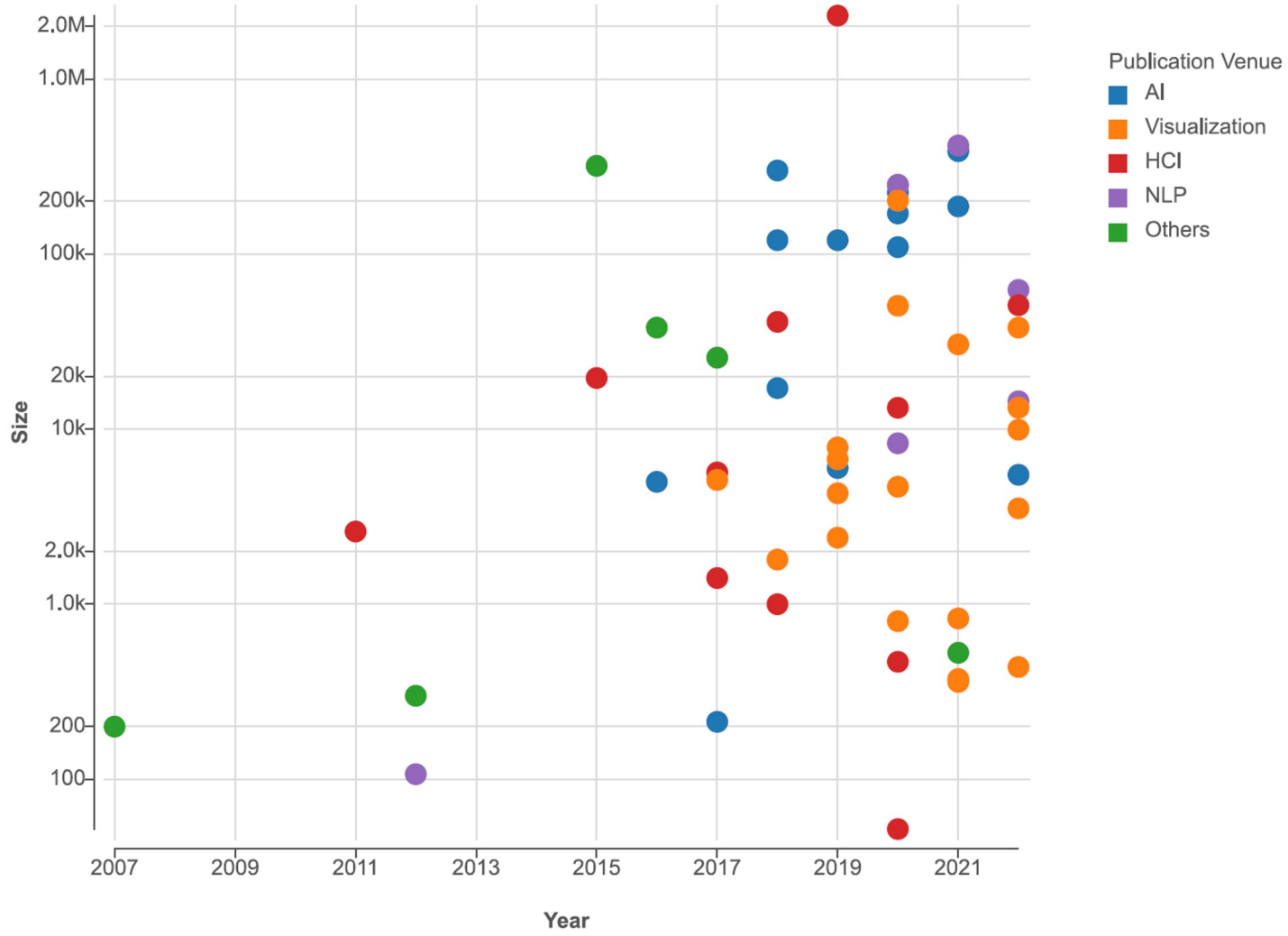
- Search 41
  - Start with AI4VIS [WWS*21] and ML4VIS [WCWQ21]
  - Three criteria: primary contribution, corpus description, and chart design
- Augment 56
  - Graph traversal over citation network
  - Excluded papers before 2007

# Overview of 56 Chart Corpora



# Bottom-up Coding
## task

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### Why: the goal

- Create a chart corpus
- Extract chart semantics
- Modify an existing chart
- Generate chart designs automatically
- Retrieve charts matching certain criteria
- Generate natural language descriptions


Battle et al. *Beagle: Automated Extraction and Interpretation of Visualizations from the Web*

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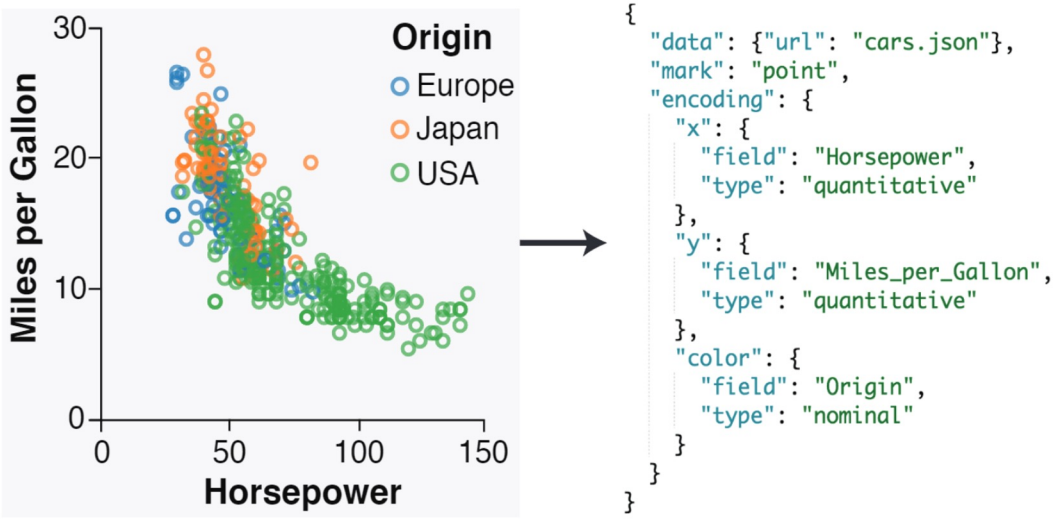


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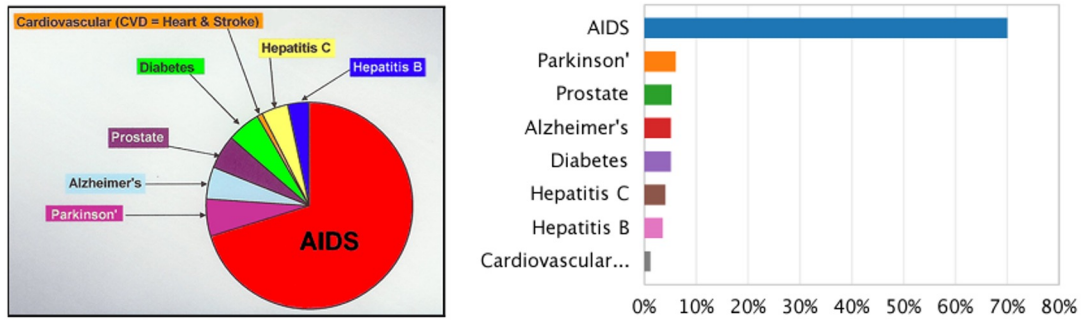


Figure 1: Chart Redesign. Left: A pie chart of NIH expenses per condition-related death. The chart suffers from random sorting, highly saturated colors, and erratic label placement. Right: Plotting the data as a sorted bar chart enables more accurate comparisons of data values [6, 20].

Savva et al. *ReVision: Automated Classification, Analysis and Redesign of Chart Images*

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task

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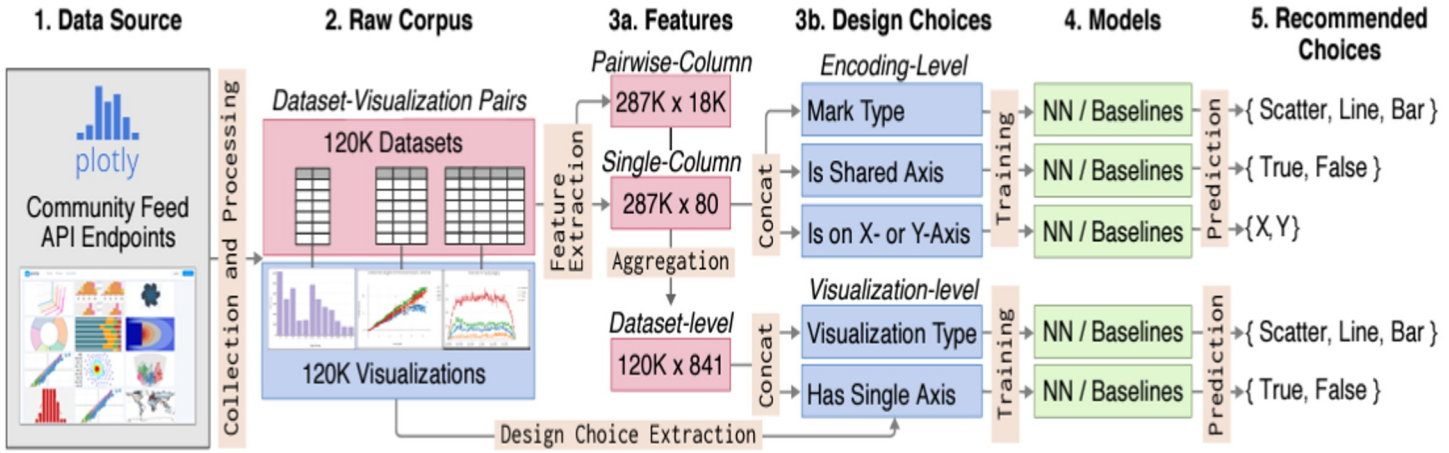


Hu et al. *VizML: A Machine Learning Approach to Visualization Recommendation*

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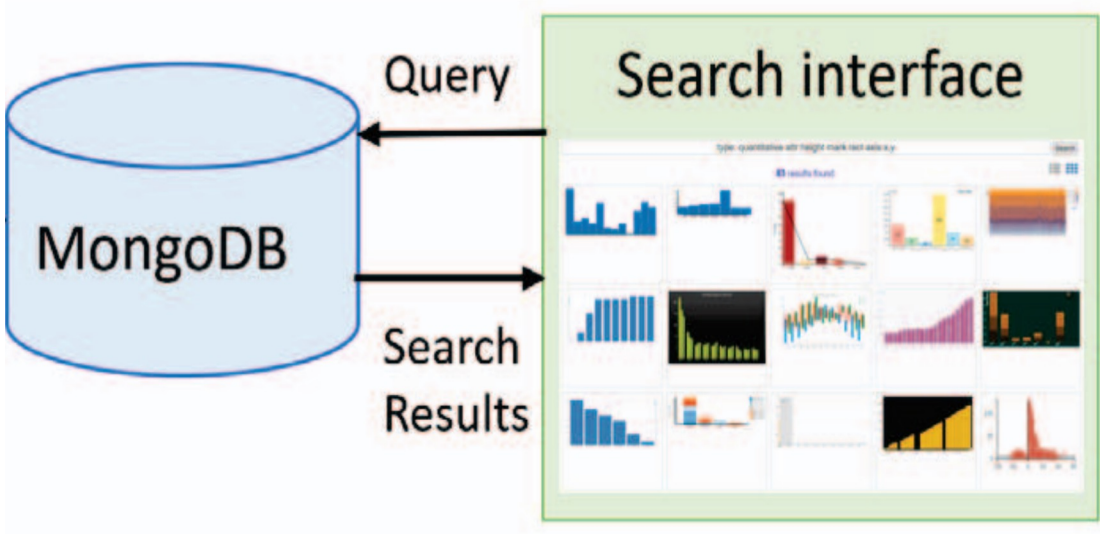


Hoque and Agrawala. *Searching the visual style and structure of d3 visualizations*

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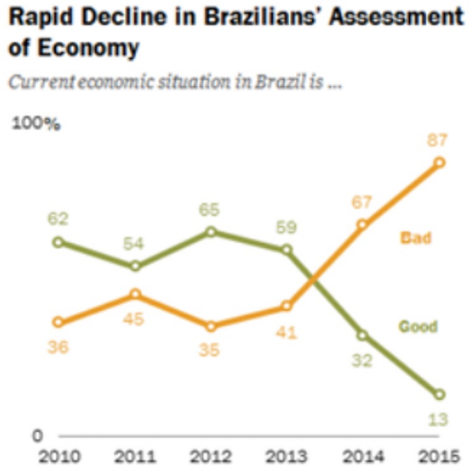


**Q1:** Which year has the most divergent opinions about Brazil's economy?

**Answer:** 2015

**Q2:** What is the peak value of the orange line?

**Answer:** 87

Masry et al. *ChartQA: A Benchmark for Question Answering about Charts with Visual and Logical Reasoning*

# Bottom-up Coding
## task

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Why: the goal

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How: the method

- modern neural networks
- classic machine learning
- heuristics-based algorithms

# Bottom-up Coding
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What: the output

- chart components
  - marks, encodings, layouts…
- synthesized descriptions
  - caption, summarization…
- derived properties
  - quality, similarity…

# Coding and Analysis
## corpus property

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**Format**

**Scope**

- chart type
- design variation

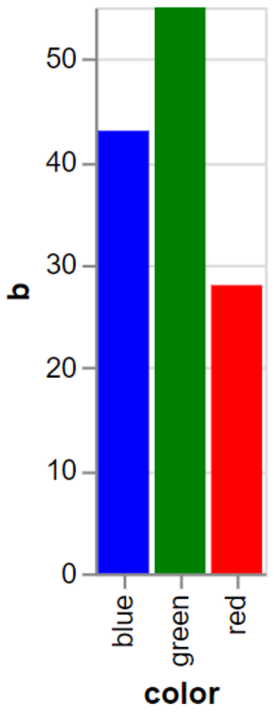
**Collection Method**

**Annotations**

- annotation type
- annotation method

**Diversity**

## Bitmap



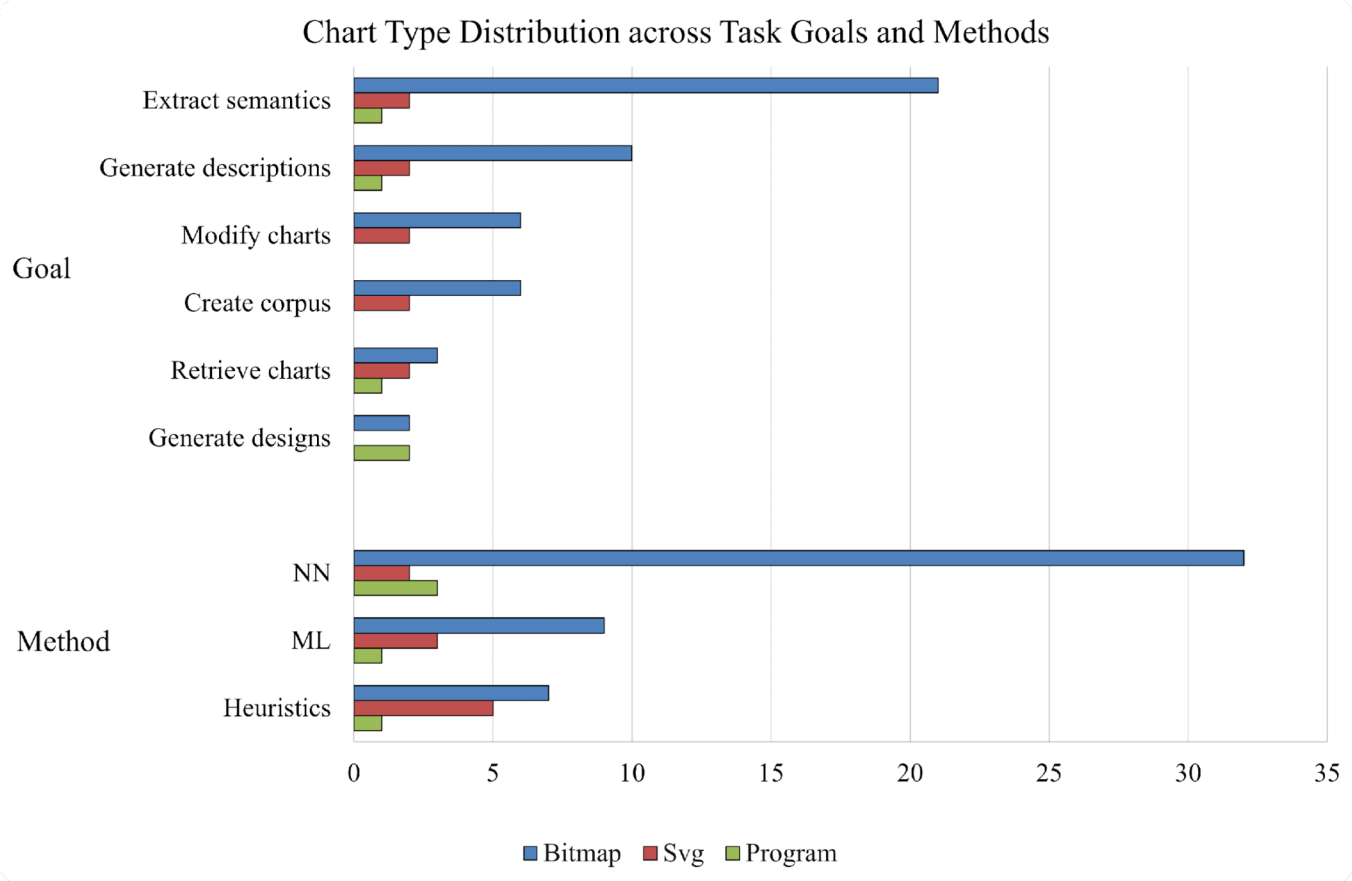

## SVG

```
<svg xmlns="http://www.w3.org/2000/svg" xmlns:xlink="http://www.w3.org/1999/xlink" version="1.1" class="marks"
 width="104" height="258" viewBox="0 0 104 258" style="background-color: white;">
 <g fill="none" stroke-miterlimit="10" transform="translate(39,5)">
  <g class="mark-group role-frame root" role="graphics-object" aria-roledescription="group mark container">
   <g transform="translate(0,0)">
    <path class="background" aria-hidden="true" d="M0.5,0.5h60v200h-60Z" fill="transparent" stroke="#ddd">
    </path>
    <g>
     <g class="mark-group role-axis" aria-hidden="true">…</g>
     <g class="mark-group role-axis" role="graphics-symbol" aria-roledescription="axis" aria-label="X-axis ti
     tled 'color' for a discrete scale with 3 values: blue, green, red">…</g>
     <g class="mark-group role-axis" role="graphics-symbol" aria-roledescription="axis" aria-label="Y-axis ti
     tled 'b' for a linear scale with values from 0 to 55">…</g>
     <g class="mark-rect role-mark marks" role="graphics-object" aria-roledescription="rect mark container">
      <path aria-label="color: red; b: 28" role="graphics-symbol" aria-roledescription="bar" d="M41,98.18181
      818181819h18v101.81818181818181h-18Z" fill="red"></path>
      <path aria-label="color: green; b: 55" role="graphics-symbol" aria-roledescription="bar" d="M21,0h18v2
      00h-18Z" fill="green"></path>
      <path aria-label="color: blue; b: 43" role="graphics-symbol" aria-roledescription="bar" d="M1,43.63636
      3636363626h18v156.36363636363637h-18Z" fill="blue"></path>
     </g>
    </g>
    <path class="foreground" aria-hidden="true" d display="none"></path>
   </g>
  </g>
 </g>
</svg>
```

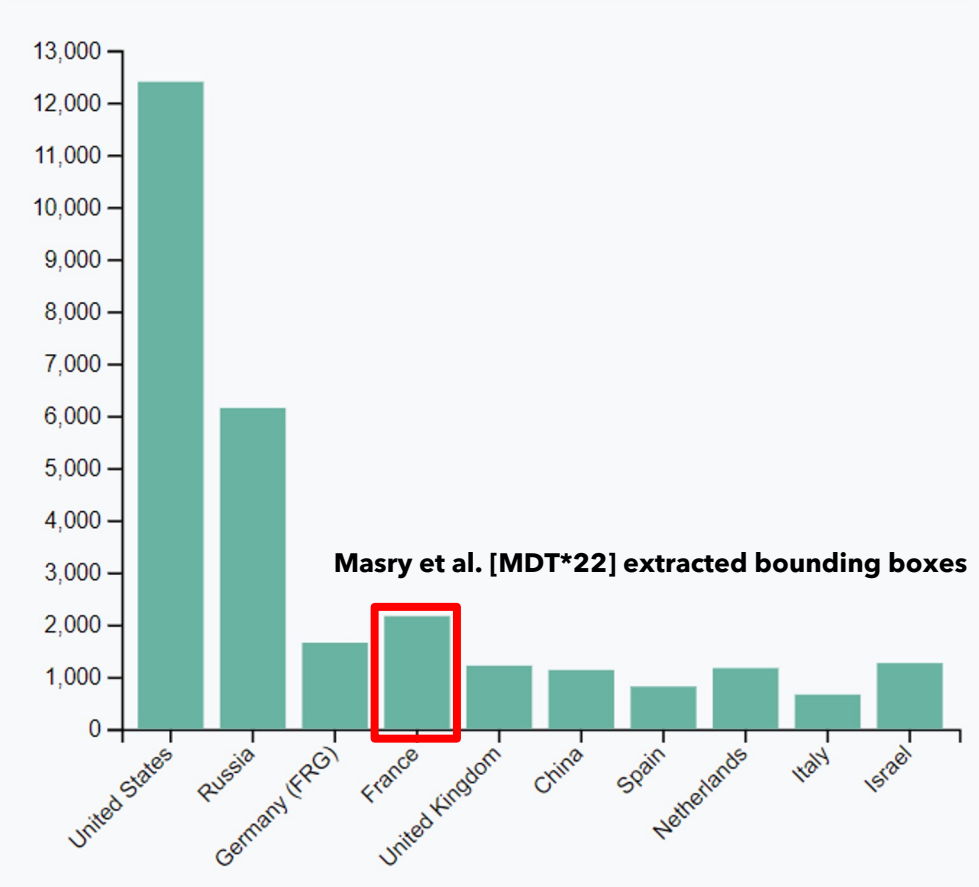
## Program

```
{
  "$schema": "https://vega.github.io/schema/vega-lite/v5.json",
  "description": "A bar chart that directly encodes color names in the data.",
  "data": {
    "values": [
      {
        "color": "red",
        "b": 28
      },
      {
        "color": "green",
        "b": 55
      },
      {
        "color": "blue",
        "b": 43
      }
    ]
  },
  "mark": "bar",
  "encoding": {
    "x": {
      "field": "color",
      "type": "nominal"
    },
    "y": {
      "field": "b",
      "type": "quantitative"
    },
    "color": {
      "field": "color",
      "type": "nominal",
      "scale": null
    }
  }
}
```

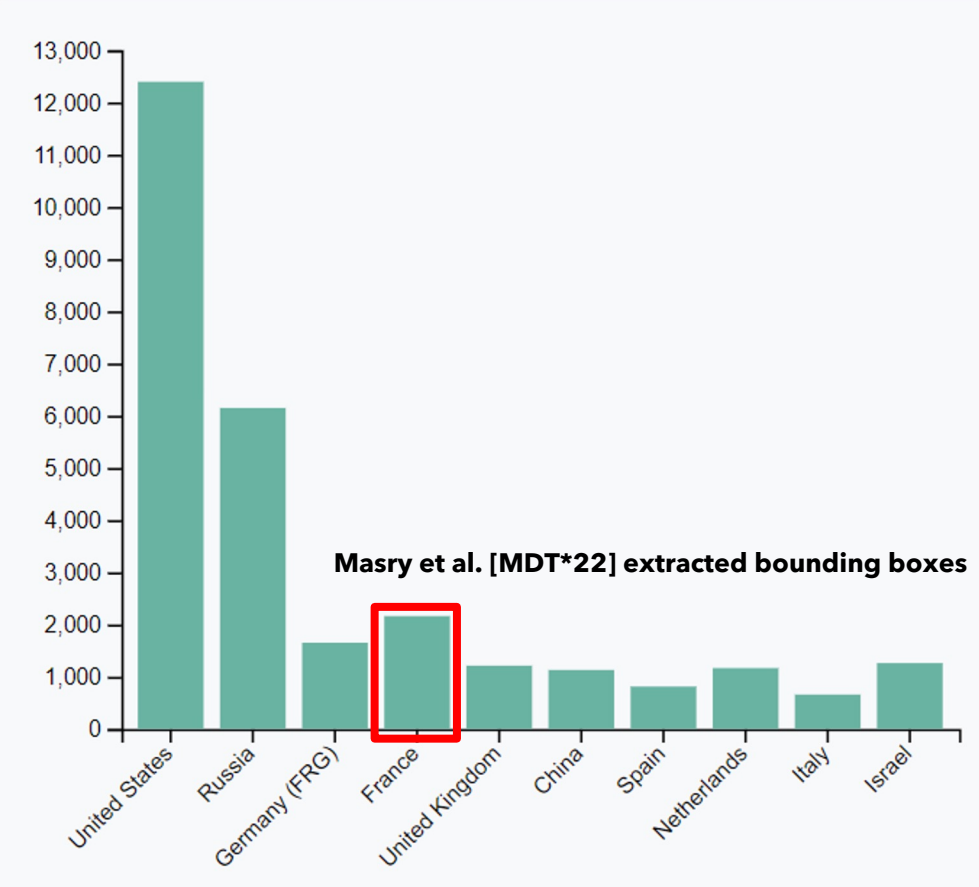
*https://vega.github.io/vega-lite/examples/bar_color_disabled_scale.html*




- 48 bitmap
- 10 SVG
- 5 program




```
▼<g class="tick" opacity="1" transform="translate(0,23.576923076923038)">
    <line stroke="#000" x2="-6"></line>
    <text fill="#000" x="-9" dy="0.32em">12,000</text>
  </g>
▼<g class="tick" opacity="1" transform="translate(0,0.5)">
    <line stroke="#000" x2="-6"></line>
    <text fill="#000" x="-9" dy="0.32em">13,000</text>
  </g>
</g>
<rect x="7.254901960784309" y="13.984615384615381" width="29.019607843137255" height="286.0153846153846" fill="#69b3a2"></rect>
<rect x="43.52941176470588" y="158.12307692307692" width="29.019607843137255" height="141.87692307692308" fill="#69b3a2"></rect>
<rect x="79.80392156862744" y="261.8538461538462" width="29.019607843137255" height="38.14615384615382" fill="#69b3a2"></rect>
<rect x="116.078431372549" y="250.1076923076923" width="29.019607843137255" height="49.892307692307696" fill="#69b3a2"></rect>
```




**Masry et al. [MDT*22] extracted bounding boxes**

**Poco and Heer [PH17] parsed text elements**

```
<g class="tick" opacity="1" transform="translate(0,23.576923076923038)">
  <line stroke="#000" x2="-6"></line>
  <text fill="#000" x="-9" dy="0.32em">12,000</text>
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```
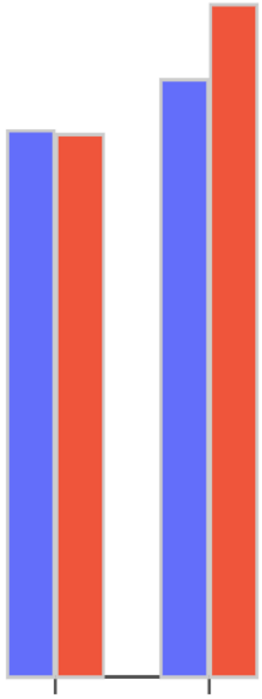



```
<g id="collection17" class="collection17">
  <g id="collection16" class="collection16">
    <rect id="rect24" class="rect24" x="100" y="137.50867194686887" width="16" height="162.49132805313113" style="fill: rgb(99, 110, 250); stroke: rgb(204, 204, 204); stroke-width: 1; stroke-dasharray: none;"/>
    <rect id="rect25" class="rect24" x="117" y="138.65125984428636" width="16" height="161.34874015571364" style="fill: rgb(239, 85, 59); stroke: rgb(204, 204, 204); stroke-width: 1; stroke-dasharray: none;"/>
  </g>
  <g id="collection18" class="collection16">
    <rect id="rect26" class="rect24" x="153" y="122.37662949583793" width="16" height="177.62337050416207" style="fill: rgb(99, 110, 250); stroke: rgb(204, 204, 204); stroke-width: 1; stroke-dasharray: none;"/>
    <rect id="rect27" class="rect24" x="170" y="100" width="16" height="200" style="fill: rgb(239, 85, 59); stroke: rgb(204, 204, 204); stroke-width: 1; stroke-dasharray: none;"/>
  </g>
</g>
```

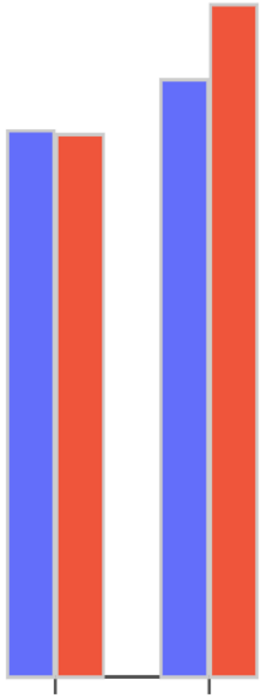
**(a) Mascot**

```
<g class="barlayer mlayer">
  <g class="trace bars" style="opacity: 1;">
    <path d="M36.55,260V59.32H182.75V260Z" style="vector-effect: non-scaling-stroke; opacity: 1; stroke-width: 0px; fill: rgb(99, 110, 250); fill-opacity: 1;"/>
    <path d="M402.05,260V40.64H548.25V260Z" style="vector-effect: non-scaling-stroke; opacity: 1; stroke-width: 0px; fill: rgb(99, 110, 250); fill-opacity: 1;"/>
  </g>
  <g class="trace bars" style="opacity: 1;">
    <path d="M182.75,260V60.73H328.95V260Z" style="vector-effect: non-scaling-stroke; opacity: 1; stroke-width: 0px; fill: rgb(239, 85, 59); fill-opacity: 1;"/>
    <path d="M548.25,260V13H694.45V260Z" style="vector-effect: non-scaling-stroke; opacity: 1; stroke-width: 0px; fill: rgb(239, 85, 59); fill-opacity: 1;"/>
  </g>
</g>
```

**(b) Plotly**

```
<g class="mark-rect role-mark marks" role="graphics-object" aria-roledescription="rect mark container">
  <path aria-label="sex: Female; value: 18.10519; smoker: no" role="graphics-symbol" aria-roledescription="bar" d="M10.000000000000007,49.123416666666664h20v150.87658333333334h-20Z" fill="#4c78a8"/>
  <path aria-label="sex: Female; value: 17.97788; smoker: yes" role="graphics-symbol" aria-roledescription="bar" d="M30.000000000000007,50.18433333333334h20v149.81566666666666h-20Z" fill="#f58518"/>
  <path aria-label="sex: Male; value: 19.79124; smoker: no" role="graphics-symbol" aria-roledescription="bar" d="M60.00000000000001,35.07300000000002h20v164.92699999999996h-20Z" fill="#4c78a8"/>
  <path aria-label="sex: Male; value: 22.2845; smoker: yes" role="graphics-symbol" aria-roledescription="bar" d="M80,14.29583333333333h20v185.70416666666668h-20Z" fill="#f58518"/>
</g>
```

**(c) Vega-Lite**



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<rect id="rect24" class="rect24" x="100" y="137.50867194686887" width="16" height="162.49132805313113" style="fill: rgb(99, 110, 250); stroke: rgb(204, 204, 204); stroke-width: 1; stroke-dasharray: none;"/>
```

(a) Mascot

```
<path d="M36.55,260V59.32H182.75V260Z" style="vector-effect: non-scaling-stroke; opacity: 1; stroke-width: 0px; fill: rgb(99, 110, 250); fill-opacity: 1;"/>
```

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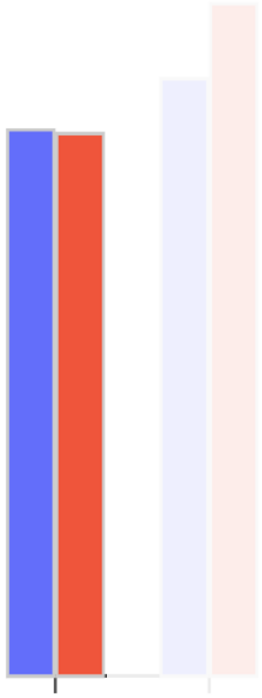

```
<g id="collection16" class="collection16">
  <rect id="rect24" class="rect24" x="100" y="137.50867194686887" width="16" height="162.49132805313113" style="fill: rgb(99, 110, 250); stroke: rgb(204, 204, 204); stroke-width: 1; stroke-dasharray: none;"/>
  <rect id="rect25" class="rect24" x="117" y="138.65125984428636" width="16" height="161.34874015571364" style="fill: rgb(239, 85, 59); stroke: rgb(204, 204, 204); stroke-width: 1; stroke-dasharray: none;"/>
</g>
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<g class="barlayer mlayer">
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    <path d="M402.05,260V40.64H548.25V260Z" style="vector-effect: non-scaling-stroke; opacity: 1; stroke-width: 0px; fill: rgb(99, 110, 250); fill-opacity: 1;"/>
  </g>
  <g class="trace bars" style="opacity: 1;">
    <path d="M182.75,260V60.73H328.95V260Z" style="vector-effect: non-scaling-stroke; opacity: 1; stroke-width: 0px; fill: rgb(239, 85, 59); fill-opacity: 1;"/>
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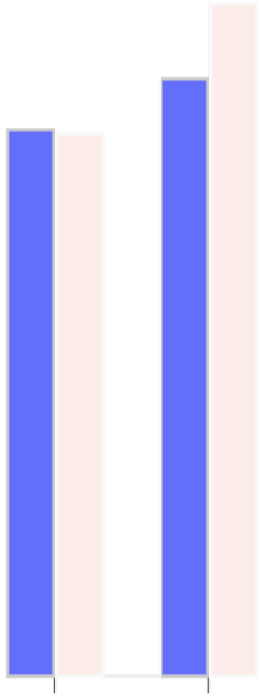
```

(c) Vega-Lite



```
▼<g id="collection17" class="collection17">
  ▼<g id="collection16" class="collection16">
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     <rect id="rect25" class="rect24" x="117" y="138.65125984428636" width="16" height="161.34874015571364" style="fill: rgb(239, 85, 59); stroke: rgb(204, 204, 204); stroke-width: 1; stroke-dasharray: none;"/>
   </g>
  ▼<g id="collection18" class="collection16">
     <rect id="rect26" class="rect24" x="153" y="122.37662949583793" width="16" height="177.62337050416207" style="fill: rgb(99, 110, 250); stroke: rgb(204, 204, 204); stroke-width: 1; stroke-dasharray: none;"/>
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   </g>
 </g>
```

(a) Mascot

```
▼<g class="barlayer mlayer">
 ▼<g class="trace bars" style="opacity: 1;">
    <path d="M36.55,260V59.32H182.75V260Z" style="vector-effect: non-scaling-stroke; opacity: 1; stroke-width: 0px; fill: rgb(99, 110, 250); fill-opacity: 1;"/>
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  </g>
 ▼<g class="trace bars" style="opacity: 1;">
    <path d="M182.75,260V60.73H328.95V260Z" style="vector-effect: non-scaling-stroke; opacity: 1; stroke-width: 0px; fill: rgb(239, 85, 59); fill-opacity: 1;"/>
    <path d="M548.25,260V13H694.45V260Z" style="vector-effect: non-scaling-stroke; opacity: 1; stroke-width: 0px; fill: rgb(239, 85, 59); fill-opacity: 1;"/>
   </g>
 </g>
```

(b) Plotly

```
▼<g class="mark-rect role-mark marks" role="graphics-object" aria-roledescription="rect mark container">
   <path aria-label="sex: Female; value: 18.10519; smoker: no" role="graphics-symbol" aria-roledescription="bar" d="M10.000000000000007,49.123416666666664h20v150.87658333333334h-20Z" fill="#4c78a8"/>
   <path aria-label="sex: Female; value: 17.97788; smoker: yes" role="graphics-symbol" aria-roledescription="bar" d="M30.000000000000007,50.18433333333334h20v149.81566666666666h-20Z" fill="#f58518"/>
   <path aria-label="sex: Male; value: 19.79124; smoker: no" role="graphics-symbol" aria-roledescription="bar" d="M60.00000000000001,35.07300000000002h20v164.92699999999996h-20Z" fill="#4c78a8"/>
   <path aria-label="sex: Male; value: 22.2845; smoker: yes" role="graphics-symbol" aria-roledescription="bar" d="M80,14.295833333333333h20v185.70416666666668h-20Z" fill="#f58518"/>
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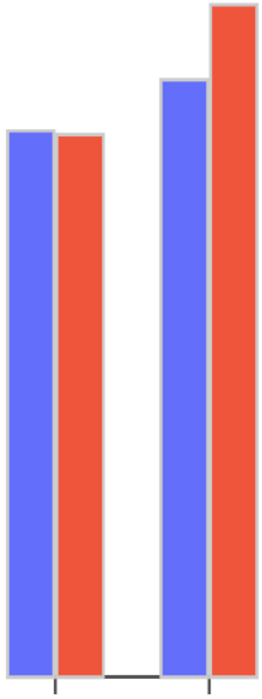

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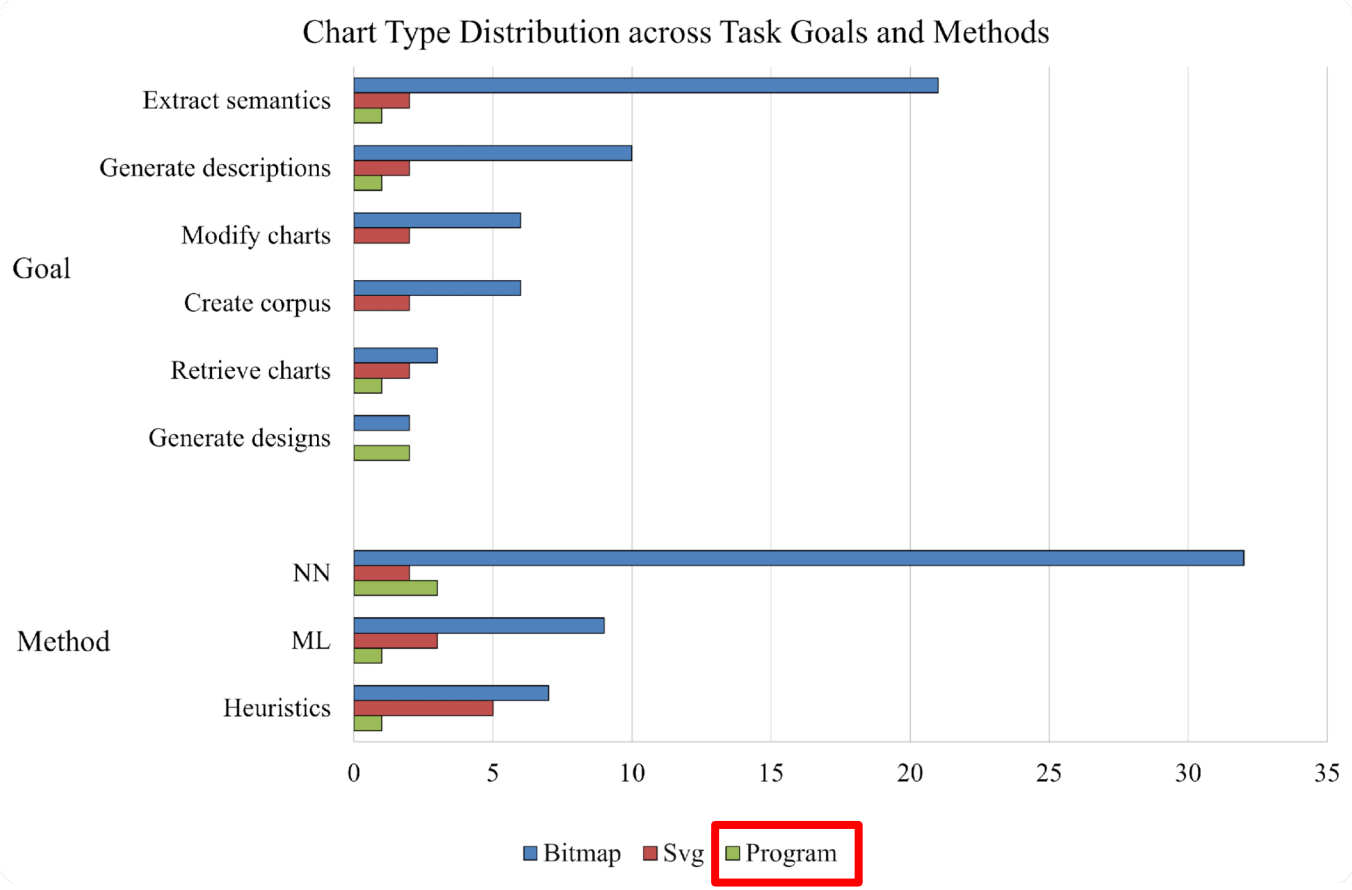
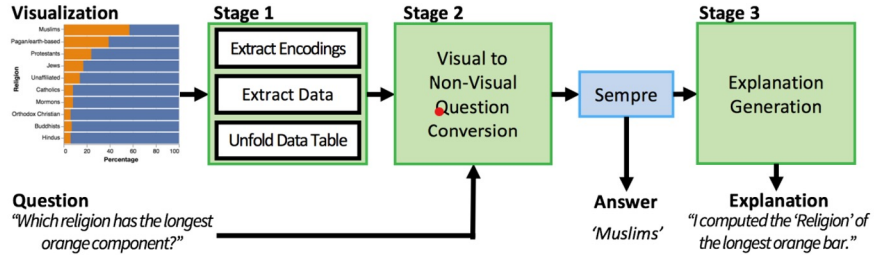
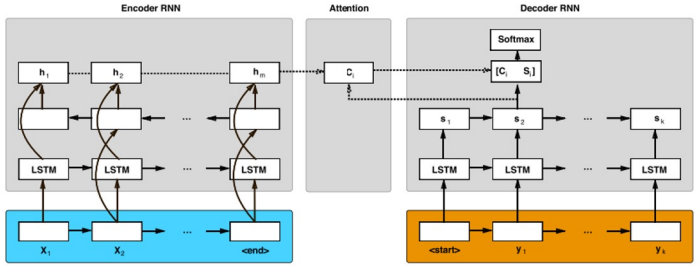
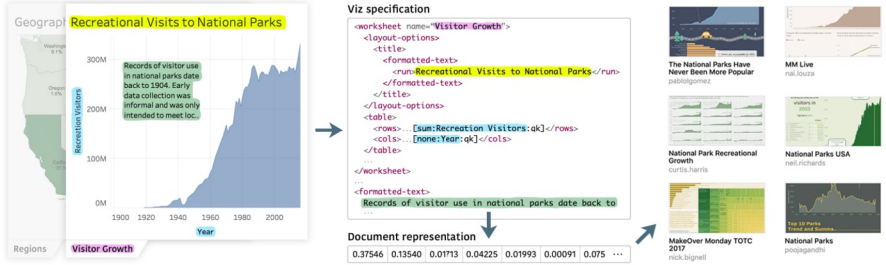



Kim et al. [KHA20]

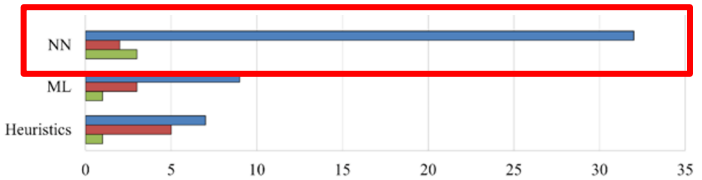



Dibia and Demiralp [DD19]

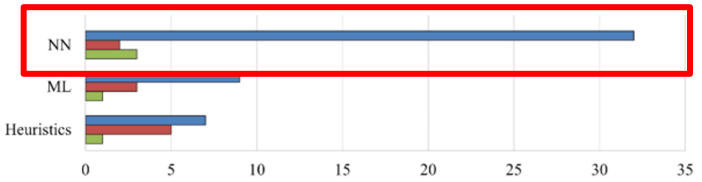


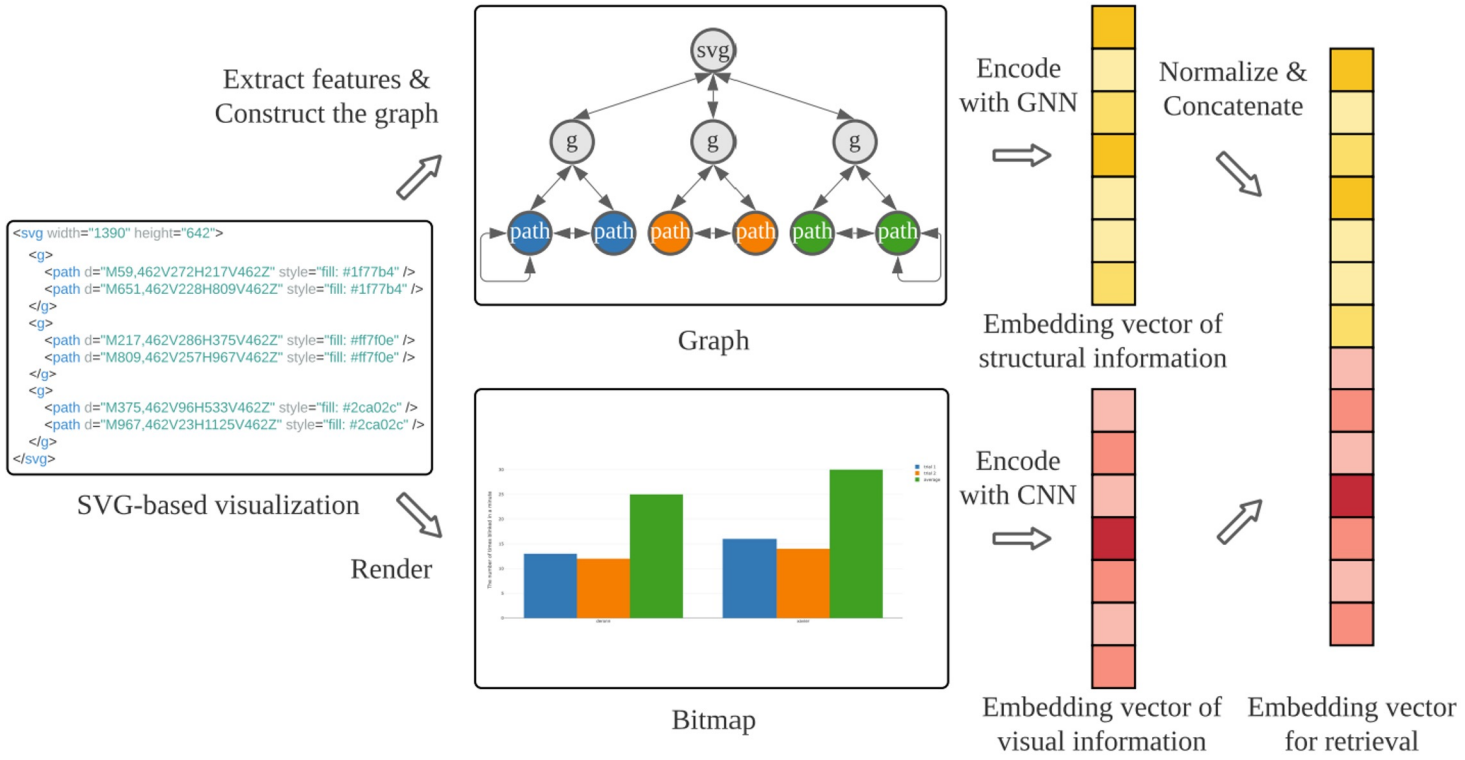

Oppermann et al. [OKM20]

Bitmap charts are naturally compatible with CNNs.



# Bitmap charts are naturally compatible with CNNs. SVGs could be better analyzed with GNNs.




Li et al. *Structure-aware Visualization Retrieval*

Assumptions or inclusion criteria during the chart selection process. They are usually specified to constrain the research problem space to achieve feasible solutions.

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We identified two kinds of scopes:

- Chart type
- Design variation

| Chart Type | Frequency | Percentage |
|---|---|---|
| Bar | 38 | 73.07% |
| Line | 31 | 59.62% |
| Pie | 18 | 34.62% |
| Scatterplot | 16 | 30.77% |
| Infographics | 9 | 17.31% |
| Area | 9 | 17.31% |
| Map | 8 | 15.38% |
| Treemap | 4 | 7.69% |
| Boxplot | 4 | 7.69% |
| Heatmap | 3 | 5.77% |
| Table | 3 | 5.77% |
| Venn | 3 | 5.77% |
| Parallel Coordinate | 3 | 5.77% |
| Sunburst | 3 | 5.77% |
| Donut | 3 | 5.77% |
| Node-link Diagram | 3 | 5.77% |
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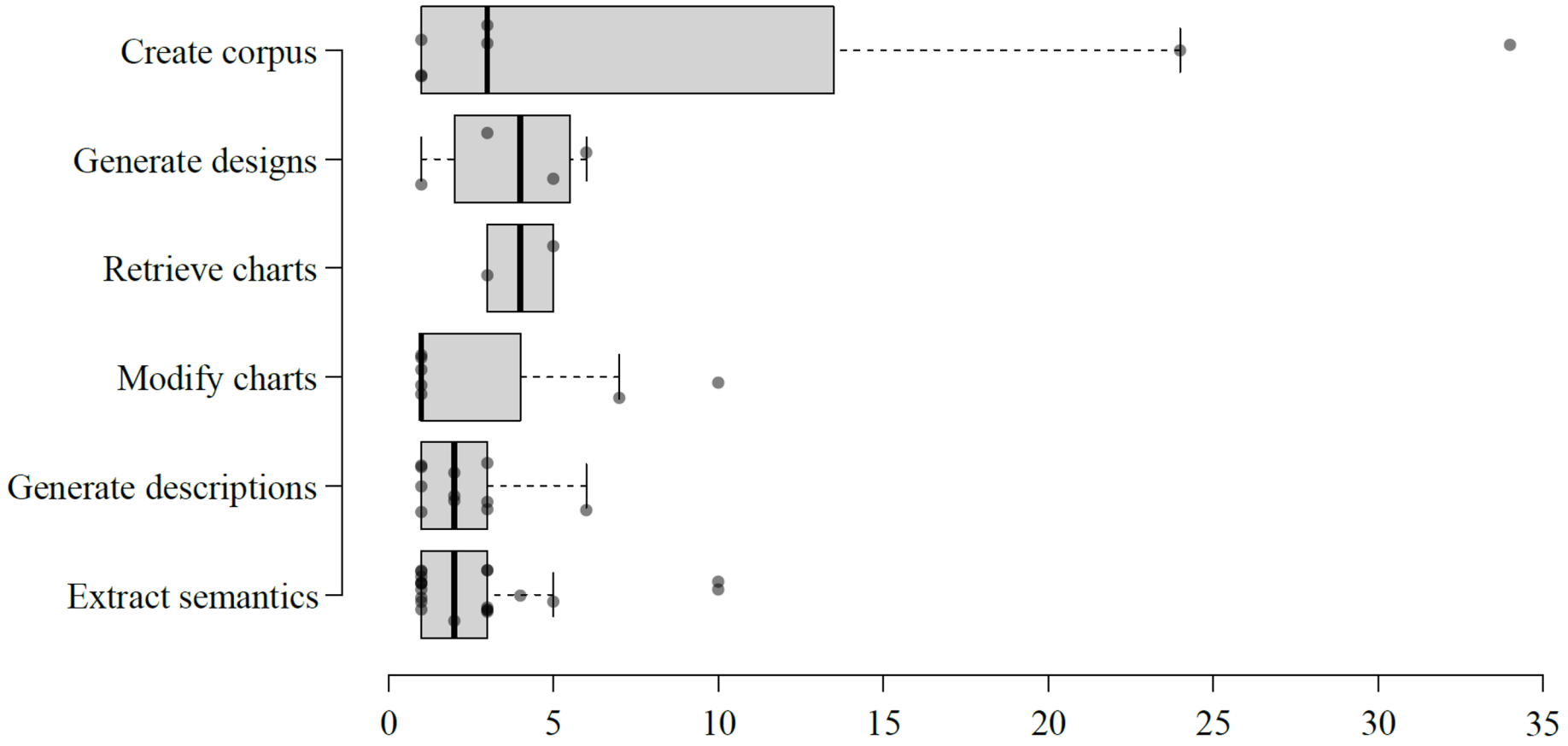
Create corpus
Generate designs
Retrieve charts
Modify charts
Generate descriptions
Extract semantics
0
5
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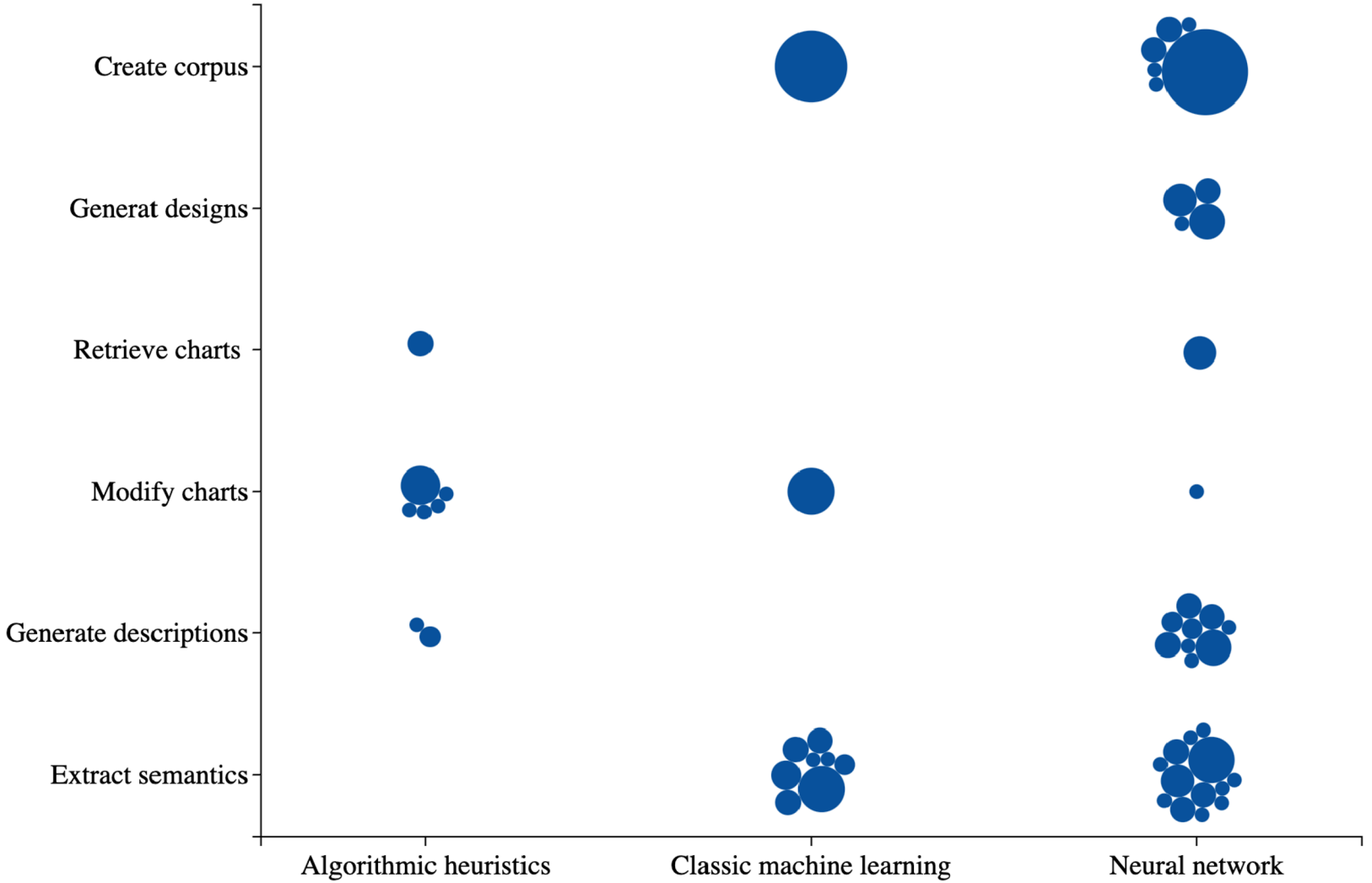
20
25
30
35


Create corpus
Generat designs
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Modify charts
Generate descriptions
Extract semantics
Algorithmic heuristics
Classic machine learning
Neural network

| Design Variation Type | Assumption | Relevant Corpora |
|---|---|---|
| composite arrangement | only multiple-view charts | [CZL*20] |
| | no multiple-view charts | [CAM*18, WTD*20, PH17, HGH21, LWL*20] |
| | no layered charts | [JKS*17, PH17, CJP*19] |
| mark and glyph | no abstract icons or symbols | [JKS*17] |
| | only proportion-related charts | [QSC*20, CZW*19] |
| | only timeline-related infographics | [CWW*19] |
| | no handmade sketches | [JKS*17, CAM*18, SDHL15] |
| | no 3D effects | [SKC*11, DWS*22, CJP*19] |
| chart component | chart must have a legend | [PMH17, MKT22] |
| | axes being at the left and bottom | [SKC*11] |
| coordinate space | in Cartesian coordinate space | [WTD*20, PH17] |

Collection method describes how charts in a corpus were collected. We have observed four kinds of collection methods.

- reusing and transforming existing corpus
- web crawling
- manual curation
- computer-aided generation

Out of the 56 corpora:

- 17 are publicly available
- 9 were generated by modifying existing corpora
- only 4 corpora (FigureQA [KAM*18], VIF [LWL*20], SciCap [HGH21], REV [PH17]) were reused in subsequent works

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Transformations in those 9 corpora:

- Adding new charts to increase size or diversity
- Adding new annotations to support new tasks

Gather charts matching certain criteria from targeted sources automatically.

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Web crawling sources:

- Search engines e.g., Google Image Search
- Galleries of online charting tools, e.g., Tableau, Vega-Lite
- Public documented materials, e.g., online Excel sheets
- Public scholarly repositories, e.g., DBLP, Semantic Scholar
- Public data sharing platforms, e.g., the Pew research, Our World In Data

When the quality and variation of chart design matters more than the size of a corpus, some works such as Cui et al. [CZW*19] decided to collect charts manually.

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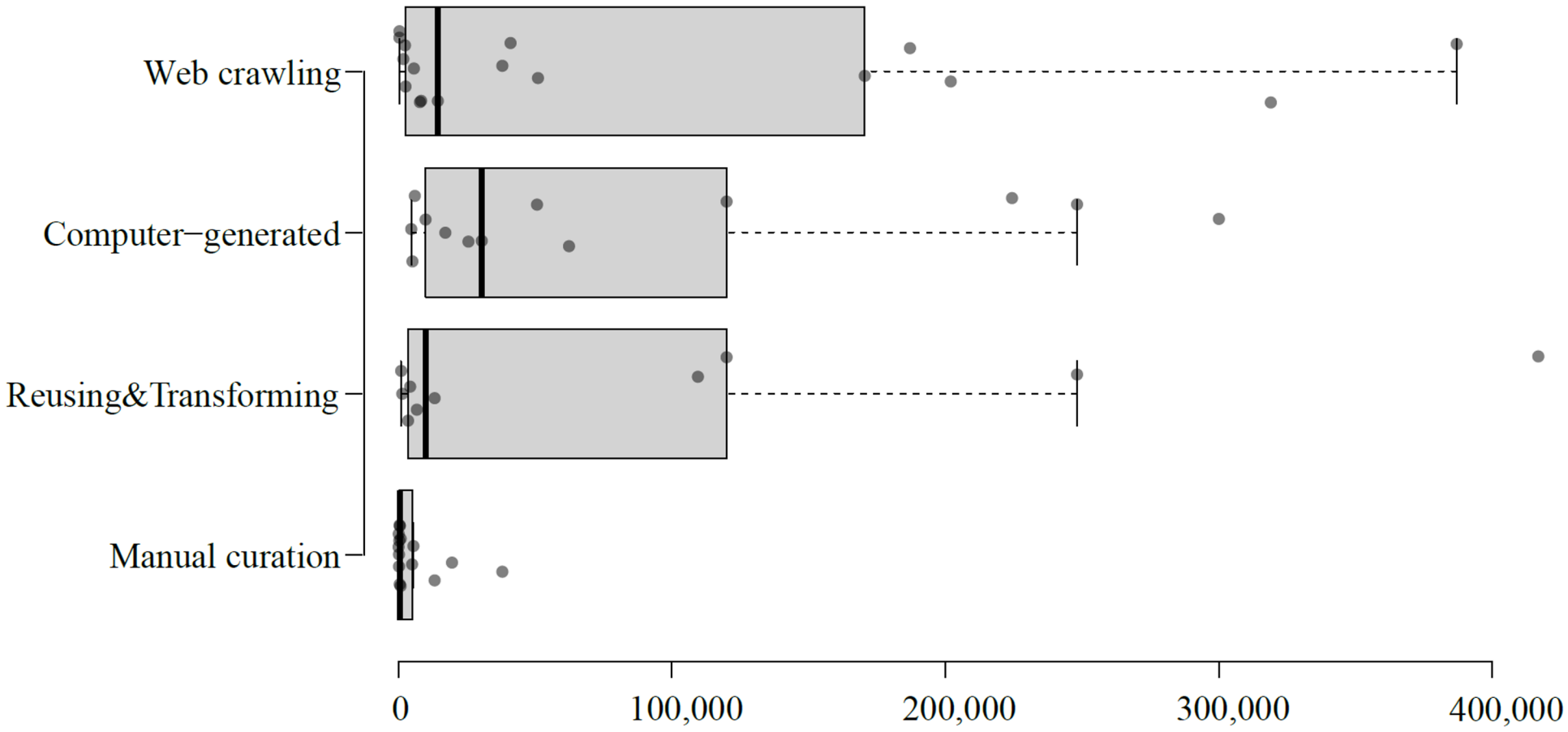
Advantages:

- they could inspect each chart candidate and decide if they would like to include it in the corpus
- The sources for web crawling are still useful

To use computer charting tools to generate a corpus.

- Underlying datasets
  - Synthetic ones by varying types and distributions
  - Real ones online, e.g., World Development Indicators
- Charting tools
  - Matplotlib
  - Vega-Lite
  - Bokeh
  - GeoPandas
  - Timeline Storyteller


Web crawling
Computer−generated
Reusing&Transforming
Manual curation
0
100,000
200,000
300,000
400,000

Annotations are labels associated with charts in a corpus

- serving as ground truth for chart analysis tasks
- the sources where the charts are collected usually do not provide needed labels
- as reported in Battle et al. [BDM*18], there is a lack of consistent metadata across different sources

| Annotation Type | Relevant Corpora |
|---|---|
| bounding box | for mark or glyph [LLJ*20, LLWL21, LWL21, CRMY17, CSG*20, QSC*20, HWWL21], for legend [LWL21, CSG*20, MGKK20, HWWL21], for axes [MGKK20, CRMY17, HWWL21], for text [LWL21, ZZC*21, PH17, CRMY17, SGCV19, CSG*20, MGKK20, SKC*11, HWWL21], for main chart area [LLWL21, DWS*22, HWWL21], for chart sub-views [CZL*20] |
| chart type | [BDM*18, JKS*17, TLL*16, CAM*18, KM18, SKC*11, CWG16, GZB12, DWS*22, CJP*19] |
| question-answer pair | [KHA20, MDT*22, KPCK18, KAM*18, MBT*22, CSG*20, CPL*22, MGKK20] |
| question-caption pair | [CZK*19, MKT22] |
| text role | [ZZC*21, CWG16, PH17] |
| infographics element type | [LWL*20, QSC*20] |
| pairwise style similarity | [SDHL15, MTW*18] |
| saliency map | [BKO*17] |
| aesthetics ranking | [FWD*19] |

In-house labeling: in-person process where a small group of people gathers to annotate charts manually; usually two considerations:

- user interface for annotation
- training procedure

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Crowdsourcing: online process where workers from platforms such as Amazon's MTurk are recruited to annotate charts

Template-based generation: question-answer and chart-caption annotations can be generated based on pre-defined templates

- Compared to crowdsourcing, avoids high expenses, but lacks rich linguistic variation

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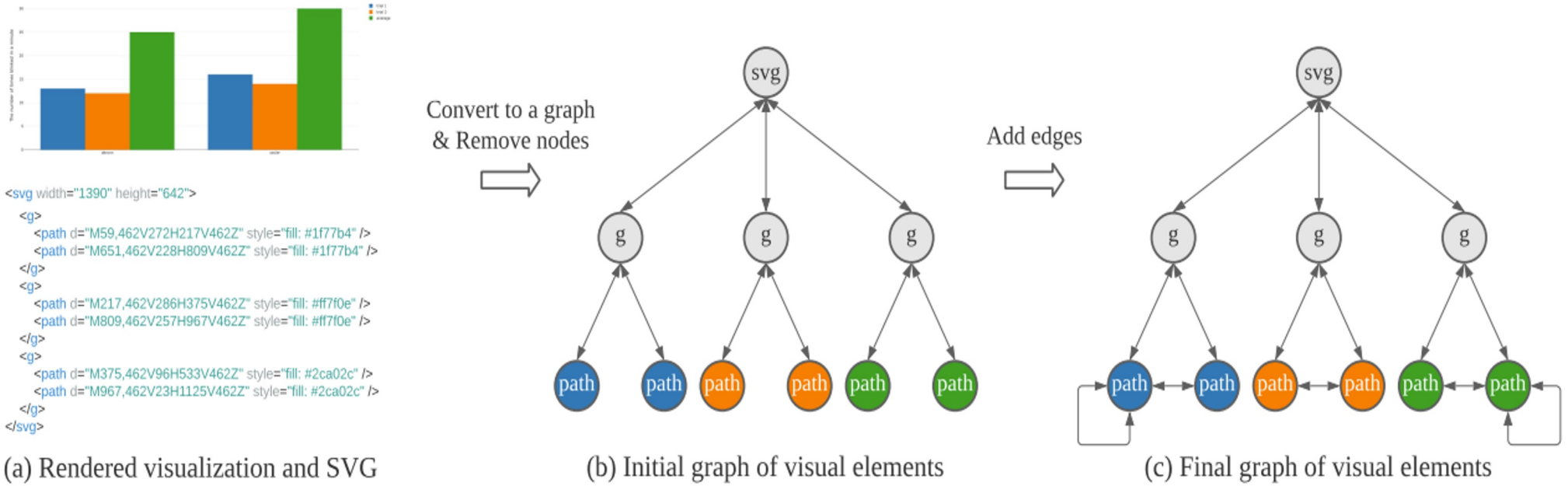
Automatic extraction: Application-specific API (e.g., bounding boxes in Matplotlib, data values in Excel)

Diversity measures how much the charts differ from one another.

Why it is important?

- diversity is an under-explored property that significantly influence the scalability, generalizability, and robustness of developed techniques




Li et al. *Structure-aware Visualization Retrieval*

- source websites: to collect charts from multiple sources
- chart topics: to collect charts on various topics
- chart creators: to sample from online providers whose charts are created by a larger community of content creators
- scholarly document repositories: to enrich publication venues and increasing the year range

- underlying datasets: to generate a variety of diverse synthetic datasets for plotting
- style parameters: to enumerate the style parameters in the code
- visual questions and captions: to alleviate poor linguistic variations from templates
  - Design more diverse templates [CZK*19, SS20]
  - Combine crowdsourcing, templates, and in-house labeling [MGKK20]
  - Adopt large language models [MDT*20]

## Feature tags can be a better way

**beyond chart types**

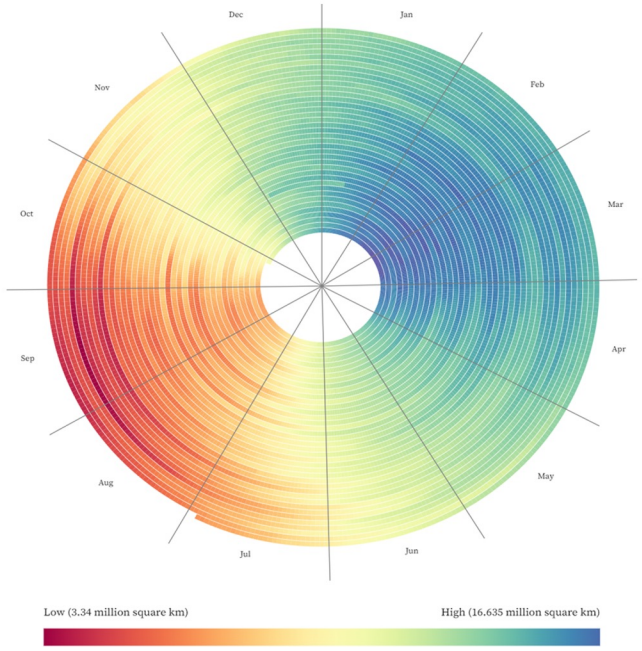
beyond chart similarity

tool/source-agnostic chart analysis

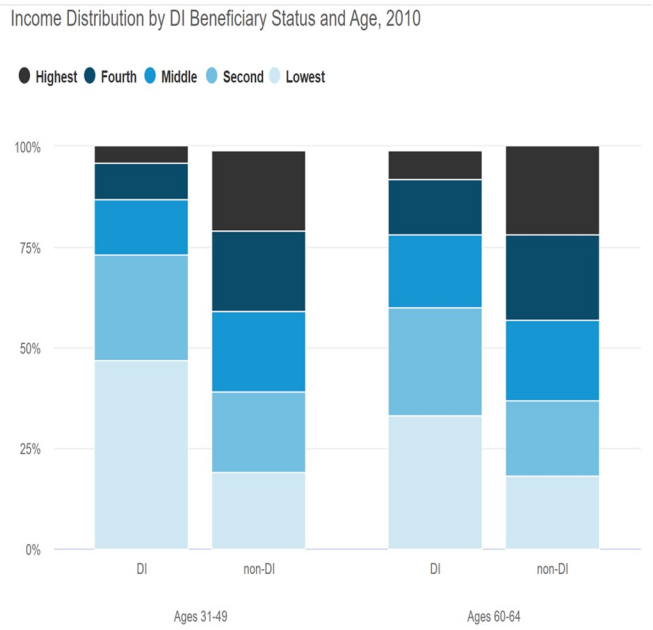
intelligent design generation

diversity quantification

understanding interaction&animation




(a) Spiral Heatmap




(b) Grouped Stacked Bar Chart

beyond chart types

**beyond chart similarity**

tool/source-agnostic chart analysis

intelligent design generation

diversity quantification

understanding interaction&animation

Chart quality (aesthetics, effectiveness, memorability, ...) is under-explored

*"when visualization creators are seeking design ideas, similarity may not be their primary desired criterion; instead, they prefer alternative or bespoke designs to broaden the scope of consideration"*

Bako et al. *Understanding how Designers Find and Use Data Visualization Examples*

beyond chart types

beyond chart similarity

**tool/source-agnostic chart analysis**

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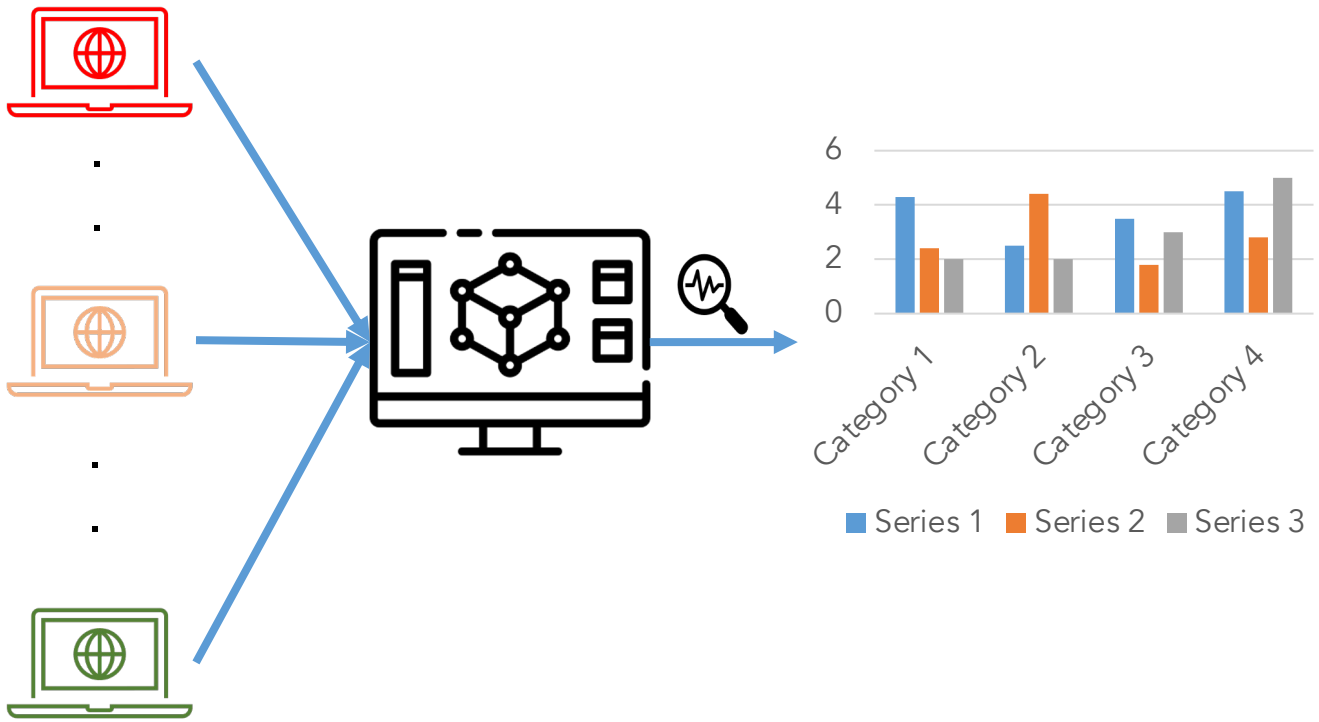
## Enhanced generalizability



beyond chart types

beyond chart similarity

tool/source-agnostic chart analysis

**intelligent design generation**

diversity quantification

understanding interaction&animation

Current research on automatic generation of chart design mostly relies on a **program** chart corpus from a **single charting tool**.

It is worth thinking that what techniques are required to automate design ideas from various sources if we would like to include bitmaps and SVGs.

beyond chart types

beyond chart similarity

tool/source-agnostic chart analysis

intelligent design generation

**diversity quantification**

understanding interaction&animation

No metric to measure diversity

- There is a clear need for systematic methods to evaluate chart diversity
- Such methods can guide chart selection processes

beyond chart types

beyond chart similarity

tool/source-agnostic chart analysis

intelligent design generation

diversity quantification

**understanding interaction&animation**

## Interaction & Animation

- the logic for interactions and animations is usually hidden
- How to automatically capture them remains open

## Enhanced Chart Diversity within a Corpus

- little effort in enhancing diversity in terms of chart format

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## Multi-level Fine-Grained Annotations

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- little effort in enhancing diversity in terms of chart format

## Multi-level Fine-Grained Annotations

- the lack of fine-grained annotations makes it difficult to reuse existing corpora for new tasks

## Interactivity and Animation Understanding

- semantic abstract for describing them & methods for capturing and understanding them

## Smart Web Crawler

- The implementation handles composition arrangements in HTMLs which can be random

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## Chart Pre-Processor

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## Mix-Initiative Annotating System

- Dedicated research in human-AI collaboration for the annotation process is necessary

# Thanks for listening!

EUROVIS Leipzig 2023

## Corpus Properties

format, scope, collection method, annotations, diversity

## Opportunities

- Beyond chart type
- Beyond chart similarity
- Tool/Source-agnostic analysis
- Design generation
- Diversity quantification
- Interaction & Animation

## Towards Benchmark Corpora

- Properties
  - Diversity
  - Multi-level Fine-Grained Annotations
  - Interactivity and Animation Understanding
- Needed tools
  - Smart web crawler
  - Smart image processor
  - Mix-initiative annotating system

**Contact: cchen24@umd.edu**