Recommendations and Previews for Browsing Visualization Collections

Michael Oppermann

In collaboration with Robert Kincaid Tamara Munzner
Tableau workbooks
The Americas
$230B international tourism income
Large-scale visualization collections
Users have difficulty discovering relevant content.

Users often start from scratch instead of reusing content.
Agenda

1. Content-based recommendations

2. Representative previews (result snippets)
Recommendation systems are increasingly used to assist users by surfacing relevant content.
Visual encoding recommendation

Tableau ShowMe, Voyager, Draco, Data2Vis, ...
Visual encoding recommendation

Tableau ShowMe, Voyager, Draco, Data2Vis, …
Visualization workbook recommendations based on content features
Recommendation systems

Content-based filtering

Collaborative filtering
Recommendation systems

Content-based filtering

- Focus of our work
- Finding relevant items based on their actual content
- Less diverse but more accurate recommendations
- Allows identification of *near-duplicate* items

Collaborative filtering
Recommendation systems

Content-based filtering

Collaborative filtering

- Recommendations based on user interactions
- Requires no domain knowledge, allows fast computation, serendipitous recommendations
- Cold start problem for new items or new users
Recommendation systems

Content-based filtering

Collaborative filtering

Hybrid system
Recommendation systems

Content-based filtering

Collaborative filtering

Hybrid system
Which content features are most informative for comparisons?

What techniques can we use for comparing and ranking viz specifications?
Text-based similarity measure

- Content-based recommendations
- Facilitate information seeking
Process

Close collaboration with the Recommender Systems Group at Tableau
Process

Close collaboration with the Recommender Systems Group at Tableau

VizCommender

- Extract content from viz specifications
- Analysis & feature engineering
- Proof-of-concept interface
Process

Close collaboration with the *Recommender Systems Group* at Tableau

**VizCommender**
- Extract content from viz specifications
- Analysis & feature engineering
- Proof-of-concept interface

**User study:** Crowdsourced human text similarity judgements

**Comparative model analysis**
VizCommender prototype
Tableau visualization workbook

Sales Commission

- New quota: $500K
- Base salary: 50,000

Estimated Quota Attainment
- Barbara Davis: 35%
- Betty Clark: 16%
- Carol Allen: 59%
- Charles Lee: OK
- Christopher...
- Daniel González: 50%
- David Thompson:

Commissions

Overview

26% Shipped Late

Count of Customers
- West
- East
- Central
- South

Number of Shipments

4 Jul 18 Jul 1

Sales and Profit by Customer

Sales

$0 $5,000 $10,000 $15,000 $20,000 $25,000

Profit

($5,000)

Customer Analysis
Workbook

Sales and Profit by Customer

Visualization specification

```xml
<worksheet name="Customer Analysis">
  <layout-options>
    <title>
      <formatted-text>
        <run>Sales and Profit by Customer</run>
      </formatted-text>
    </title>
  </layout-options>
  <table>
    <rows>[sum:Profit:qk]</rows>
    <cols>[sum:Sales:qk]</cols>
  </table>
</worksheet>
```
Workbook

Sales and Profit by Customer

Visualization specification

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      </formatted-text>
    </title>
  </layout-options>
  <table>
    <rows>...[sum:Profit:k]</rows>
    <cols>...[sum:Sales:k]</cols>
  </table>
...  
</worksheet>
```
### Workbook

#### Sales and Profit by Customer

![Sales and Profit by Customer](image)

#### Customer Analysis

<table>
<thead>
<tr>
<th>City</th>
<th>Customer Name</th>
<th>Sales</th>
<th>Discount</th>
<th>...</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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<tr>
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<td></td>
</tr>
</tbody>
</table>

### Visualization specification

```xml
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    <layout-options>
        <title>
            <formatted-text>
                <run>Sales and Profit by Customer</run>
            </formatted-text>
        </title>
    </layout-options>
    <table>
        <rows>...[sum:Profit:qk]</rows>
        <cols>...[sum:Sales:qk]</cols>
    </table>
    ...
</worksheet>
```
Workbook

Sales and Profit by Customer

Visualization specification

```xml
<worksheet name="Customer Analysis">
  <layout-options>
    <title>
      <formatted-text>
        <run>Sales and Profit by Customer</run>
      </formatted-text>
    </title>
  </layout-options>
  <table>
    <rows>...[sum:Profit:qk]</rows>
    <cols>...[sum:Sales:qk]</cols>
  </table>
  ...
</worksheet>

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    </metadata-record>
    ...
    <metadata-record class="column">
      <remote-name>Customer Name</remote-name>
    </metadata-record>
    ...
    <remote-name>Sales</remote-name>
  </metadata-records>
</datasource>
```
Initial experiments

Extracted text

Visual encodings
Different data, same encoding

Governor WA

Bryant

Inslee

Sales

Office Supplies

Furniture
Different data, same encoding

Same data, different visual encodings

Governor WA

Bryant

Inslee

Sales

Office Supplies

Furniture

Region

CO2 Emissions

Africa

Asia

Europe

Middle East

Oceania

The Americas

The Americas 84.5M

Africa 11.3M

Asia 116.6M

Europe 69.9M

Middle East 15.7M

The Americas 84.5M

Africa 11.3M

Asia 116.6M

Europe 69.9M

Middle East 15.7M
Leaving out visual encodings
Leaving out visual encodings

For design inspiration and learning
  ‣ Need visual style
Leaving out visual encodings

For design inspiration and learning
  ‣ Need visual style

Our primary task: Information seeking
  ‣ Core enterprise task
  ‣ Subject matter of a workbook
  ‣ **Do not need** visual style (marks, colors, layout properties, ...)

Data challenges
Data challenges

Very limited text
Data challenges

**Very limited text**

Additional challenges:

- Multi-sheet workbooks and nested visualizations
Data challenges

Very limited text

Additional challenges:

- Multi-sheet workbooks and nested visualizations
- Incomplete workbooks
Data challenges

**Very limited text**

Additional challenges:

- Multi-sheet workbooks and nested visualizations
- Incomplete workbooks
- Multiple versions
Data challenges

Very limited text

Additional challenges:

› Multi-sheet workbooks and nested visualizations
› Incomplete workbooks
› Multiple versions
› Out-of-vocabulary words
Extracted text

customer analysis sales profit discount commission segment ratio ranking count ship performance target furniture office home supplies city drilldown late early product category forecast order quantity target ...
Extracted text

customer analysis sales profit discount commission segment ratio ranking count ship performance target furniture office home supplies city drilldown late early product category forecast order quantity target ...

Transform?

Numeric document representation

| 0.37546 | 0.13540 | 0.01713 | 0.04225 | 0.01993 | ... |
Extracted text

customer analysis sales profit discount commission segment ratio ranking count ship performance target furniture office home supplies city drilldown late early product category forecast order quantity target ...

Transform?

Numeric document representation

| 0.37546 | 0.13540 | 0.01713 | 0.04225 | 0.01993 | ...

Comparisons?
Extracted text

customer analysis sales profit discount commission segment ratio ranking count ship performance target furniture office home supplies city drilldown late early product category forecast order quantity target ...

Transform?

Numeric document representation

0.37546  0.13540  0.01713  0.04225  0.01993 ...

Recommendations

Comparisons?
NLP models

- TF-IDF & cosine similarity
- Latent semantic indexing (LSI) & cosine similarity
- Latent dirichlet allocation (LDA) & Jensen-Shannon divergence
- Word embeddings (Doc2Vec, GloVe) & cosine similarity
Overview

VizCommender
- Extract content from viz specifications
- Analysis & feature engineering
- Proof-of-concept interface

User study: Crowdsourced human text similarity judgements

Comparative model analysis
Overview

VizCommender
- Extract content from viz specifications
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User study: Crowdsourced human text similarity judgements

Comparative model analysis
Crowdsourced human similarity judgements
2-alternative forced choice experiment

135 Triplets

- Reference
- Alternative 1
- Alternative 2
2-alternative forced choice experiment

135 Triplets

Reference

Alternative 1  Alternative 2

75 Participants
2-alternative forced choice experiment

135 Triplets

Reference

Alternative 1

Alternative 2

75 Participants

NLP models
Experimental stimulus

Is A or B more similar to the Reference?

<table>
<thead>
<tr>
<th>Sheet 1</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Reference</strong></td>
</tr>
<tr>
<td>airplane safety</td>
</tr>
<tr>
<td>AVG(Age)  Sex  Embarked</td>
</tr>
<tr>
<td>pclass  survived  name  sex  age  sibsp  parch  ticket  fare  cabin  embarked  boat  body  home.dest</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Flight incidents</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>A</strong></td>
</tr>
<tr>
<td>Q2</td>
</tr>
<tr>
<td>SUM(Survived)  Sex</td>
</tr>
<tr>
<td>pclass  survived  name  sex  age  sibsp  parch  ticket  fare  cabin  embarked  boat  body  home.dest</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>National Parks</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>B</strong></td>
</tr>
<tr>
<td>Sheet 7</td>
</tr>
<tr>
<td><strong>AVG(Recreation Visitors)</strong></td>
</tr>
<tr>
<td>Park Name  Recreation Visitors  Non-Recreation Visitors  Park Name  Park Type  State  Park Name (copy)</td>
</tr>
</tbody>
</table>
Experimental stimulus

Is A or B more similar to the Reference?

Baseball Story Final

Sheet 9
Height & Batting Average & Handedness

<table>
<thead>
<tr>
<th>height</th>
<th>AVG(avg)</th>
<th>handedness</th>
</tr>
</thead>
<tbody>
<tr>
<td>name, handedness, height, weight, avg, HR</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Final Visualization

Weight
Baseball Player Weight distribution

<table>
<thead>
<tr>
<th>Weight</th>
<th>Weight (lbs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>name, handedness, height, weight, avg, HR</td>
<td></td>
</tr>
</tbody>
</table>

Olympics 2016 - Which Athlete and Sport are you

Event

<table>
<thead>
<tr>
<th>SUM(Number of Athletes)</th>
<th>Sport</th>
</tr>
</thead>
<tbody>
<tr>
<td>id, name, nationality, sex, date_of_birth, height, weight, sport, gold, silver, bronze, year_of_birth, Bronze (copy), Gold (copy), Height (copy), id, nationality (copy), Silver (copy), Weight (copy), year_of_birth (copy), year_of_birth</td>
<td></td>
</tr>
</tbody>
</table>
## Agreement scores

<table>
<thead>
<tr>
<th></th>
<th>LDA</th>
<th>TF-IDF</th>
<th>GloVe</th>
<th>Doc2Vec</th>
<th>LSI</th>
</tr>
</thead>
<tbody>
<tr>
<td>TF-IDF</td>
<td>.978</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GloVe</td>
<td>.978</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Doc2Vec</td>
<td>.912</td>
<td>.889</td>
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<td></td>
<td></td>
</tr>
<tr>
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<tr>
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</table>

- Very good alignment between human similarity judgements and off-the-shelf model predictions
- LDA performed slightly better
Gov. Gavin Newsom declared a state of emergency Tuesday in response to wildfires in California, as the state gave evacuation orders and battled the effects of a sweltering heat wave, rolling blackouts and the coronavirus pandemic.

By early Wednesday morning, the state fire authorities had ordered residents to evacuate in parts of Santa Cruz, San Mateo, Napa and Sonoma Counties, in Northern California, where thunderstorms brought lightning strikes this week.

The largest fire in the region, called the SCU Lightning Complex, had spread to 35,000 acres in several counties east of San Jose and was 4 percent contained. Another fire, called the LNU Lightning Complex fire, was quickly growing north of the Bay Area, with 32,000 acres burned by about 9:30 Tuesday night.

That fire forced evacuations in parts of Napa and Sonoma, with the authorities warning of an “immediate threat to life” in some places. Local news outlets showed structures consumed by flames in Vacaville, about 35 miles southwest of Sacramento, and fire overtaking a camera meant to help spot wildfires on Mount Vaca. Photos and videos on social media showed flames lapping at the road and, in the hours before dawn, some images showed a glowing red sky, as the fire lit up dense smoke.

To the south, residents in Oakland and San Francisco could smell smoke as they woke up on Wednesday morning. The authorities around Northern California warned of poor air quality in addition to the rising heat …
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**Extracted text from viz workbook**

- customer
- analysis
- sales
- profit
- discount
- commission
- segment
- ratio
- ranking
- count
- ship
- performance
- target
- furniture
- office
- home
- supplies
- city
- drilldown
- late
- early
- product
- category
- forecast
- order
- quantity …
Proof-of-concept implementation
Interactive workbook
Recommendation panel
Similarity facets for different user tasks

- Related workbooks
- Similar data
- Similar versions
Similarity facets for different user tasks

- Related workbooks
- Similar data
- Similar versions
Similarity facets for different user tasks

- Related workbooks
- Similar data
- Similar versions
Similarity facets for different user tasks

- Related workbooks
- Similar data
- Similar versions
Summary (VizCommender)

- Challenges for content-based visualization recommendations
- Design and implementation of a proof-of-concept pipeline
- Analysis of applicable NLP techniques
Generalizable to other visualization platforms
Generalizable to other visualization platforms
Compressing visualization bundles into representative previews
Visualization bundles

workbooks, reports, looks, apps, ...

Covid-19 Viz Roundup

There are a lot of data visualizations related to covid-19 on news sites. The goal of this article is to be a repository for some of the data visualizations that I have found useful for understanding the pandemic, both to keep track of them myself and to share them with others.

Financial Times Interactive Chart

One of the most comparable metrics across countries is number of new deaths per day (7-day rolling average) since the pandemic started. For that country, shown on a log scale, linear growth rates well captured on log scale.
Strange Attractors

We can use a density plot to plot the orbit of a strange attractor.

The orbit is modeled as a JavaScript `Iterable` and 16,000,000 orbit samples are rendered in batches using a sequential log color scale.
How to compress visualization bundles into representative previews?
We present a computational pipeline for the generation of visualization snippets.
Understanding needs and current practices
Understanding needs and current practices

Review snippets
Understanding needs and current practices

Review snippets

Analyze bundles
Understanding needs and current practices

- Review snippets
- Analyze bundles
- Tableau product groups
Existing snippet designs

Single thumbnail

Only bundle title
Challenges

images & text
Challenges

images & text
Assemble and lay out snippets

Computational pipeline

Extract content from collections

Select and rank bundle image content

Select and compress bundle text content

Assemble and lay out snippets
Computational pipeline

- Extract content from collections
- Select and rank bundle image content
- Select and compress bundle text content
- Assemble and lay out snippets
Assemble and lay out snippets

Computational pipeline

Extract content from collections

Select and rank bundle image content

Select and compress bundle text content

Assemble and lay out snippets
Computational pipeline

- Extract content from collections
- Select and rank bundle image content
- Select and compress bundle text content
- Assemble and lay out snippets
Filter empty views
Filter views that are part of a dashboard
Filter similar views
Rank images

prioritize dashboards and unique chart types
Image selection and ranking

Filter empty images → Filter nested images → Rank images → Filter similar images → Re-rank images to increase diversity
Image selection and ranking

Filter empty images
- Dominant colour clustering (k-means)

Filter nested images
- Bundle specification

Rank images
- Prioritize dashboards, colour diversity, unique chart types

Filter similar images
- A) Histogram of colours
- B) Histogram of oriented gradients
- C) Structural similarity index
- D) Siamese CNN

Re-rank images to increase diversity
- Maximal marginal relevance (image similarity)
Image selection and ranking

1. Filter empty images
   - Dominant colour clustering (k-means)
2. Filter nested images
   - Bundle specification
3. Rank images
   - Prioritize dashboards, colour diversity, unique chart types
4. Filter similar images
   - A) Histogram of colours
   - B) Histogram of oriented gradients
   - C) Structural similarity index
   - D) Siamese CNN
5. Re-rank images to increase diversity
   - Maximal marginal relevance (image similarity)

Visual inspectors
Assemble and lay out snippets

Computational pipeline

Extract content from collections

Select and rank bundle image content

Select and compress bundle text content

Assemble and lay out snippets
Compress text content

1. Preprocess text
2. Generate ordered list of keywords
3. Filter keywords
4. Add back calendar years
5. Select meta-data

Visual inspectors
<table>
<thead>
<tr>
<th>Distance</th>
<th>Keyword 1</th>
<th>Keyword 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.15</td>
<td>competitiveness</td>
<td>competitive</td>
</tr>
<tr>
<td>0.14</td>
<td>cohort</td>
<td>cohortid</td>
</tr>
<tr>
<td>0.14</td>
<td>genderid</td>
<td>gender</td>
</tr>
<tr>
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<td>ethnicity</td>
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</tr>
<tr>
<td>0.14</td>
<td>lot</td>
<td>lots</td>
</tr>
<tr>
<td>0.14</td>
<td>customer</td>
<td>custom</td>
</tr>
<tr>
<td>0.12</td>
<td>productid</td>
<td>product</td>
</tr>
<tr>
<td>0.12</td>
<td>retweeted</td>
<td>retweet</td>
</tr>
<tr>
<td>0.12</td>
<td>quarter</td>
<td>quarterly</td>
</tr>
<tr>
<td>0.12</td>
<td>productid</td>
<td>product</td>
</tr>
<tr>
<td>0.12</td>
<td>productid</td>
<td>product</td>
</tr>
<tr>
<td>0.12</td>
<td>defaults</td>
<td>defaults</td>
</tr>
<tr>
<td>0.12</td>
<td>productid</td>
<td>product</td>
</tr>
<tr>
<td>0.11</td>
<td>indicator</td>
<td>indicador</td>
</tr>
<tr>
<td>0.11</td>
<td>businesses</td>
<td>business</td>
</tr>
<tr>
<td>0.11</td>
<td>acre</td>
<td>acres</td>
</tr>
</tbody>
</table>
Computational pipeline

- Extract content from collections
- Select and rank bundle image content
- Select and compress bundle text content
- Assemble and lay out snippets
Top-down design framework
<table>
<thead>
<tr>
<th>How many? How big?</th>
<th>How to display?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Result page</td>
<td></td>
</tr>
<tr>
<td>Snippet</td>
<td></td>
</tr>
<tr>
<td>Text</td>
<td></td>
</tr>
<tr>
<td>Images</td>
<td></td>
</tr>
</tbody>
</table>
How many? How big?

How to display?

A) Grid
B) Strip
C) List
D) Table
E) Preview

Result page

Snippet

Text

Images
<table>
<thead>
<tr>
<th>Result page</th>
<th>A) Grid</th>
<th>B) Strip</th>
<th>C) List</th>
<th>D) Table</th>
<th>E) Preview</th>
</tr>
</thead>
<tbody>
<tr>
<td>Snippet</td>
<td>A) Variable size</td>
<td>B) Fixed size/ratio</td>
<td>A) Vertical</td>
<td>B) Horizontal</td>
<td>C) Table</td>
</tr>
<tr>
<td>Text</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Images</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Result page</td>
<td>Font sizes, max. title length</td>
<td>Title, meta-data, and keywords</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-------------</td>
<td>------------------------------</td>
<td>--------------------------------</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>A) Variable size</td>
<td>A) Vertical</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>B) Fixed size/ratio</td>
<td>B) Horizontal</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Snippet</td>
<td></td>
<td>C) Table</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Text</td>
<td>A) Show n keywords</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>B) Fit as many keywords as possible</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Images</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
How many? How big?

How to display?

Result page

Snippet

A) Variable size B) Fixed size/ratio

A) Vertical  B) Horizontal  C) Table

Text

Font sizes, max. title length

A) Show $n$ keywords
B) Fit as many keywords as possible

Title, meta-data, and keywords

Images

Min. image size

A) Show $n$ images
B) Fit as many images as possible

Collage (+ carousel for overflow images)
<table>
<thead>
<tr>
<th>How many? How big?</th>
<th>How to display?</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Result page</strong></td>
<td><strong>A) Grid</strong></td>
</tr>
<tr>
<td><strong>Snippet</strong></td>
<td><strong>B) Fixed size/ratio</strong></td>
</tr>
<tr>
<td><strong>Text</strong></td>
<td><strong>A) Vertical</strong></td>
</tr>
<tr>
<td><strong>Images</strong></td>
<td><strong>B) Horizontal</strong></td>
</tr>
</tbody>
</table>

- Font sizes, max. title length
- B) Fit as many keywords as possible
- Min. image size
- B) Fit as many images as possible
- Title, meta-data, and keywords
- Collage (+ carousel for overflow images)
<table>
<thead>
<tr>
<th>Result page</th>
<th>Snippet</th>
<th>Text</th>
<th>Images</th>
</tr>
</thead>
<tbody>
<tr>
<td>How many? How big?</td>
<td>A) Variable size</td>
<td>Font sizes, max. title length</td>
<td>Min. image size</td>
</tr>
<tr>
<td>How to display?</td>
<td>B) Strip</td>
<td>Title, meta-data, and keywords</td>
<td>Collage (+ carousel for overflow images)</td>
</tr>
<tr>
<td></td>
<td>A) Vertical</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Other page and snippet layouts
<table>
<thead>
<tr>
<th>Content</th>
<th>Username</th>
<th>Date</th>
<th>Views</th>
</tr>
</thead>
<tbody>
<tr>
<td>gun_ownership_final</td>
<td>feng.wang2440</td>
<td>3 years ago</td>
<td>2 views</td>
</tr>
<tr>
<td>Affordability (CD) (DEV) (USERGUIDE)</td>
<td>justin4598</td>
<td>3 years ago</td>
<td>121 views</td>
</tr>
<tr>
<td>Dashboard</td>
<td>alisha.panda</td>
<td>3 years ago</td>
<td>6 views</td>
</tr>
<tr>
<td>18790878_XuHuawei_Viz3</td>
<td>xu.huawei2091</td>
<td>4 years ago</td>
<td>2 views</td>
</tr>
<tr>
<td>Book14</td>
<td>than2123</td>
<td>3 years ago</td>
<td>12 views</td>
</tr>
<tr>
<td>Train 7</td>
<td>winsrat2257</td>
<td>3 years ago</td>
<td>29 views</td>
</tr>
</tbody>
</table>
gun_ownership_final
death firearms mass 2014-2016 policy rate shoot enforcement residents shooting resource less people state gang united drug related crime national

Affordability (CD) (DEV) (USERGUIDE)
bedroom broken income mobile quanlity unitize language threshold convertedvalue quantitative geography previous octet geometry household value indicatorscore customlegend province

Dashboard
performance overall ship customer product profit sales market shipping priority cost postal discount segment city country state

18790878_XuHuawei_Viz3
overview household conclusion protection owning positive owners population cats dogs pet

Book14
phone kasaraagol product cliente segmento medio categoria customer prioritade contenido subcategoe envio [한글어] 해당성 priority commande subkategorie kundensegment expedition bestelpriorität embalaje envio sous 順番区分 昔日优先級

Train 7
stack hilightable ship sales customer product postal discount segment profit hvsales city country forecast state indicator
A/B comparisons
Superstore
.product productdetails sheet sale map
daystoship sales productview
Prosper - v1220201823h00
myriam3764  •  2 years ago  •  121 views

loan client originate 2013 origination score recovery chargedoff yearly terms

Prosper - v1220201823h00
myriam3764  •  121 views
Summary (VizSnippets)

- Key challenges and a top-down design framework pertaining to visualization snippets
- A computational pipeline for the lossy compression of visualization bundles into snippets
- A methodology for extensive visual inspection through random sampling
Recommendations and Previews for Browsing Visualization Collections

Michael Oppermann (michaeloppermann.com)


2) M. Oppermann and T. Munzner: “VizSnippets: Compressing Visualization Bundles Into Representative Previews for Browsing Visualization Collections” [under review]