# Piled Bars: Dense Visualization of Numeric Data

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## Abstract

Given a limited chart area, increasing the amount of data presented while maintaining clarity remains one of the challenges in data visualization. In this paper, we present *piled bars*, a new technique for dense visualization of numeric data. It is a layered bar chart design where all the bars are sorted and aligned on a single, shared axis. It improves the resolution of the data encoding compared to "wrapped bars" (which doesn't layer the bars and uses multiple axes), by overlapping each bar within a row. In this paper, we describe the design of piled bars (including an open source library), and compare it to wrapped bars.

**Keywords**: Visualization

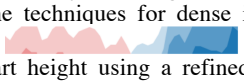
**Index Terms**: H.5.2. Information Interfaces: User Interfaces.

## 1 Introduction

Visualizing data enables rapid sense making through visual perception. However, the amount of data that can be effectively visualized is limited by the chart space. Designing perceptually accurate, dense data visualizations remains a challenge for many data types – even simple numeric data. With a standard, single-column horizontal bar chart, the chart height limits the number of perceptually distinguishable records. The wrapped bars design [2] extends bar charts to a multi-column design, and adapts them to show more data in comparable space.

We present a new visualization technique that we call *piled bars* (Figure 1), which aligns bars across multiple layers along a shared axis. It utilizes the full chart width to encode data, thus increasing available resolution. It also facilitates bar comparison since all bars are displayed on a shared baseline. We describe its design, contrast it to wrapped bars, and discuss its application with negative values using its bi-directional axis. We also developed a JavaScript library to generate Piled Bars, chubuk.js, and made it available at adilyalcin.me/chubuk.js.

## 2 Related Work

Increasing data density is among Tufte's visualization guidelines [5]. Among the techniques for dense information visualization, *horizon charts*  [1] display time-series in a compact chart height using a refined line chart design. They divide the numeric data axis into equal sized bands, and collapse the bands while adjusting the color darkness per band. Javed et al. [4] discussed alternatives to visualize multiple time series in a limited area, including braided charts  , and assessed perceptual performance with lab experiments. Fuchs et al. [3] evaluated alternative glyph designs for time series data in small multiple settings, where each glyph represents dense temporal data.

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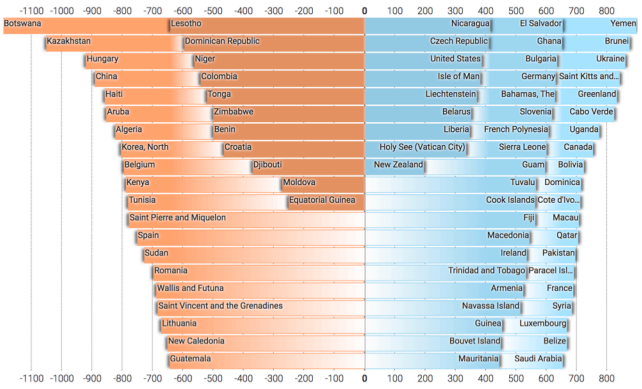



Figure 1. A piled bars chart visualizing a random measurement of 80 countries. The country names are shown at the end at the bars. All bars are sorted and divided into 3 positive and 2 negative layers.

## 3 Piled Bars Design

The piled bars design is a multi-layered data visualization technique that uses a single, shared baseline for all bars. A piled bars chart can be generated by splitting a standard sorted bar chart into multiple layers, and piling the layers with the shortest ones on top (Figure 2). In contrast, wrapped bars generate multiple columns with separated axes and baselines. Piled bars align all bars along the same axis, easing the visual comparison across bars on different layers compared to wrapped bars. Piled bars also utilize the chart width fully to create the single horizontal data scale, and thus represent the bars with higher resolution. We compare the piled bars and wrapped bars techniques side-by-side in Table 1.

The piled bars introduce overlaps among bars within each row. To visually separate overlapping bars, we designed a monochrome gradient coloring approach with shadowing (Figure 3). By positioning smaller bars on top, each bar remains visible. The sorting of bars ensures that layers are separate and distinct.

The readability of overlapping bars, and thus the piled bars, is hindered as the bars (values) get closer within a row, either because of more columns, or because of the data distribution. Inserting records, or increasing bar height, may increase the number of columns, and thus increase overlaps. In addition, unlike wrapped bars, columns cannot be separated with a horizontal gap to improve readability, due to the shared axis among all columns.

### 3.1 Visualizing Negative Values and Groups

Piled bars can be used to visualize datasets including both negative and positive values (Figure 1), by extending the bars in both directions from the baseline (←0→). Piled bars also reveal the difference in the number of records across the opposing directions, using the number of columns and the number of rows on the smallest columns on both sides as visual cues. Aggregated sums of the records on the two sides can be visualized using a supplementary chart with only two bars, one for each side. The top-most row of a piled bars chart also allows directly comparing the maximum absolute values on both sides (←0→).

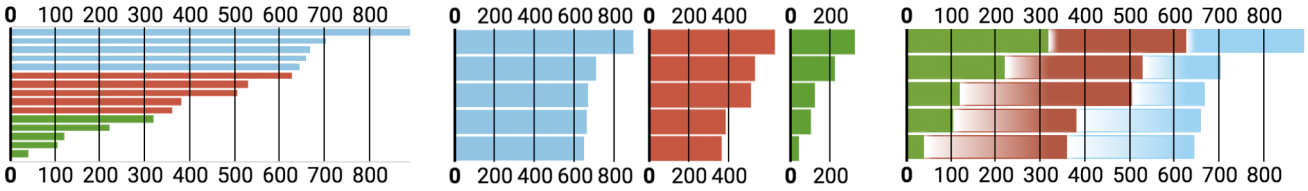



Figure 2. Transformation from a bar chart (left) to wrapped bars (middle) and piled bars (right). Colors and gridlines are for demonstration.

| | Wrapped Bars | Piled Bars |
|---|---|---|
| Baseline and axis | Each column has **separate** baseline and axis. | All columns share the **same** baseline and axis. |
| Adding columns | Shrinks bar width ↔ and reduces visual data resolution. | Increases overlaps, by adding more bars per row. |
| Grouping Records | Bars can be color-coded to visualize record categories. | Color use is limited. Can use bi-directional axis for two groups. |
| Label Display | Labels can be shown within or next to blocks. | Within blocks only. Bar position is based on data values. |
| Other properties | Columns can be separated by gaps. | Layout is fixed per data values. |

Table 1. Summary of wrapped bars and piled bars visualization techniques.

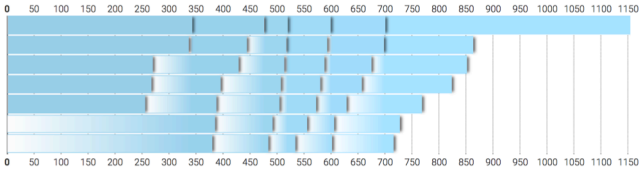
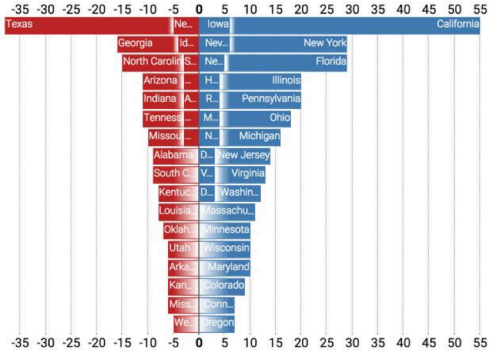


Figure 3. Piled bars rendering approach. Shorter columns (left) are darker than longer columns (right). Each layer has a gradient that starts from the smallest extent of that layer, and ends at the smallest extent of the next smaller layer. Piling also uses dark bar shadows, which also helps to distinguish top rows that do not have gradients.




(Top) Piled bars, records grouped by party. Democrats won in three more states than Republicans did (by comparing middle layers).

(Botttom) Wrapped bars, states ordered by electoral vote. Among the states with higher votes (left), Democrats are more frequent.

Figure 2. Electoral vote results for the 2012 U.S. presidential elections. Each of the 50 states has a number of electoral votes (block size) and a winning party (**Democrat** or **Republican**).

In piled bars, the sides of the baseline can also be used to separate, visualize, and compare two groups of records (Figure 4). However, this approach is limited to two groups. Specifically, the overlaps in piled bars limit the use of color (i.e. Del.. Utah Washing...). In contrast, wrapped bars can display multiple groups with multiple colors. As another example, if measurements reflect either male, female, or unknown gender (three categories), piled bars may not be able to effectively visualize genders of each bar (record/person) using three different colors.

## 4 Discussion

While the multi-layered approach of piled bars is similar to horizon charts, piled bars do not visualize time-series data, but numeric data. The bands in horizon charts show different layers of a split-axis, and are collapsed on top of each other. In piled bars, the axis is not sub-divided; all layers share the same axis and scale. Also, we rendered bars using gradients and shadows to visually separate the overlaps. Alternative designs may adjust the color hue and luminance, and/or overlay bars with alternative shadows and position adjustments among layers.

## 5 Conclusion

Piled Bars are a new visualization technique which aim to increase the number and resolution of numeric data visualized in a single chart. It uses a single shared chart axis to align data with high resolution to enable comparison across bars. While the overlapping limits its flexibility in design, and potentially ease of learning, its strength in resolution and shared baseline among different layers make it a viable alternative for visualizing many numbers.

## References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