Heatmaps in Python

How to make Heatmaps in Python with Plotly.

The term "heatmap" usually refers to a Cartesian plot with data visualized as colored rectangular tiles, which is the subject of this page. It is also sometimes used to refer to actual maps with density data displayed as color intensity (/python/tile-density-heatmaps/).

Plotly supports two different types of colored-tile heatmaps:

1. **Matrix Heatmaps** accept a 2-dimensional matrix or array of data and visualizes it directly. This type of heatmap is the subject of this page.
2. **Density Heatmaps** accept data as a list and visualizes aggregated quantities like counts or sums of this data. Please refer to the 2D Histogram documentation (/python/2D-Histogram/) for this kind of figure.

Heatmaps with Plotly Express

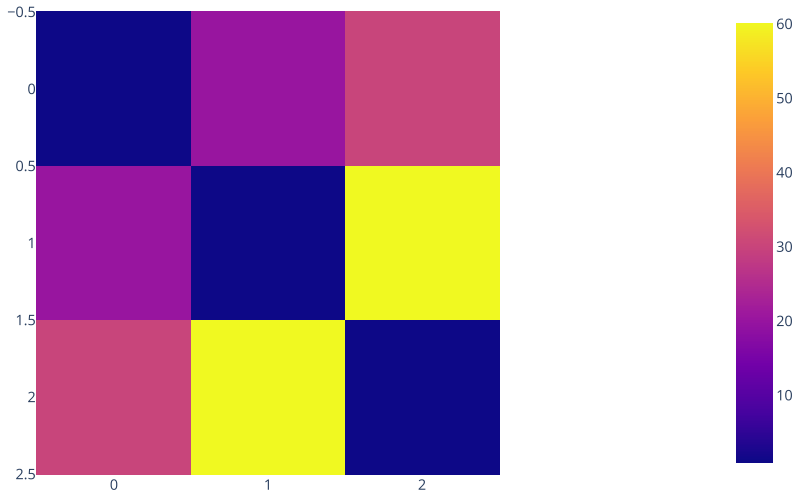
Plotly Express (/python/plotly-express/) is the easy-to-use, high-level interface to Plotly, which operates on a variety of types of data (/python/px-arguments/) and produces easy-to-style figures (/python/styling-plotly-express/). With `px.imshow`, each value of the input array or data frame is represented as a heatmap pixel.

The `px.imshow()` function can be used to display heatmaps (as well as full-color images, as its name suggests). It accepts both array-like objects like lists of lists and numpy or xarray arrays, as well as supported DataFrame objects (/python/px-arguments#supported-dataframes).

For more examples using `px.imshow`, including examples of faceting and animations, as well as full-color image display, see the the imshow documentation page (/python/imshow).

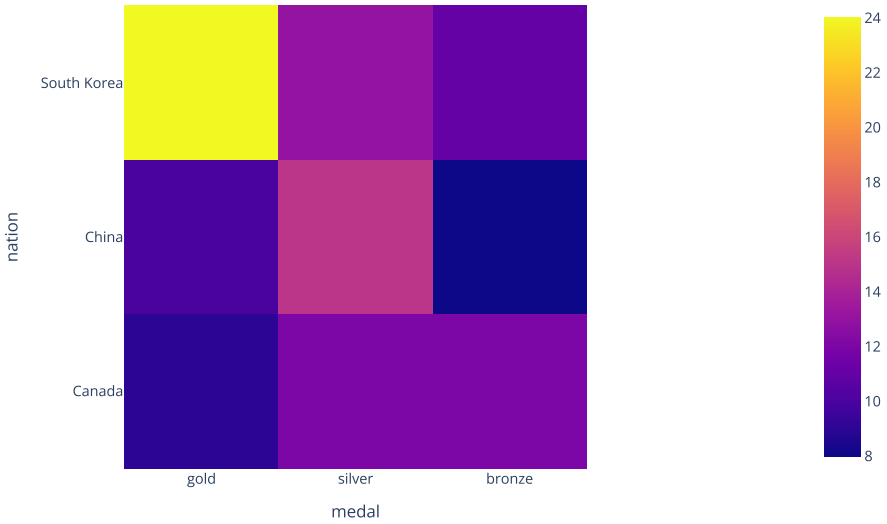
```
import plotly.express as px

fig = px.imshow([[1, 20, 30],
                 [20, 1, 60],
                 [30, 60, 1]])
fig.show()
```




```
import plotly.express as px

df = px.data.medals_wide(indexed=True)
fig = px.imshow(df)
fig.show()
```



Displaying Text on Heatmaps

You can add the values to the figure as text using the `text_auto` argument. Setting it to `True` will display the values on the bars, and setting it to a d3-format formatting string will format the output format.

```
import plotly.express as px

z = [[.1, .3, .5, .7, .9],
     [1, .8, .6, .4, .2],
     [.2, 0, .5, .7, .9],
     [.9, .8, .4, .2, 0],
     [.3, .4, .5, .7, 1]]

fig = px.imshow(z, text_auto=True)
fig.show()
```

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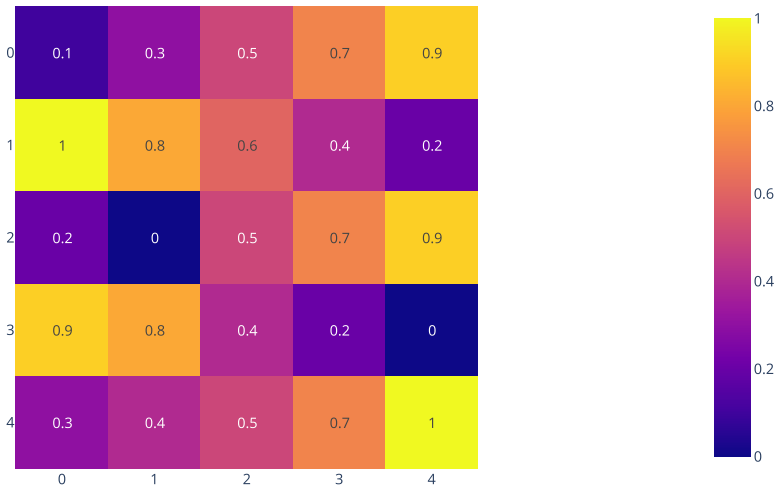


Heatmaps in Dash

Dash (https://plotly.com/dash/) is the best way to build analytical apps in Python using Plotly figures. To run the app below, run `pip install dash`, click "Download" to get the code and run `python app.py`.

Get started with the official Dash docs (https://dash.plotly.com/installation) and **learn how to effortlessly** style (https://plotly.com/dash/design-kit/) **&** deploy (https://plotly.com/dash/app-manager/) **apps like this with** Dash Enterprise (https://plotly.com/dash/).

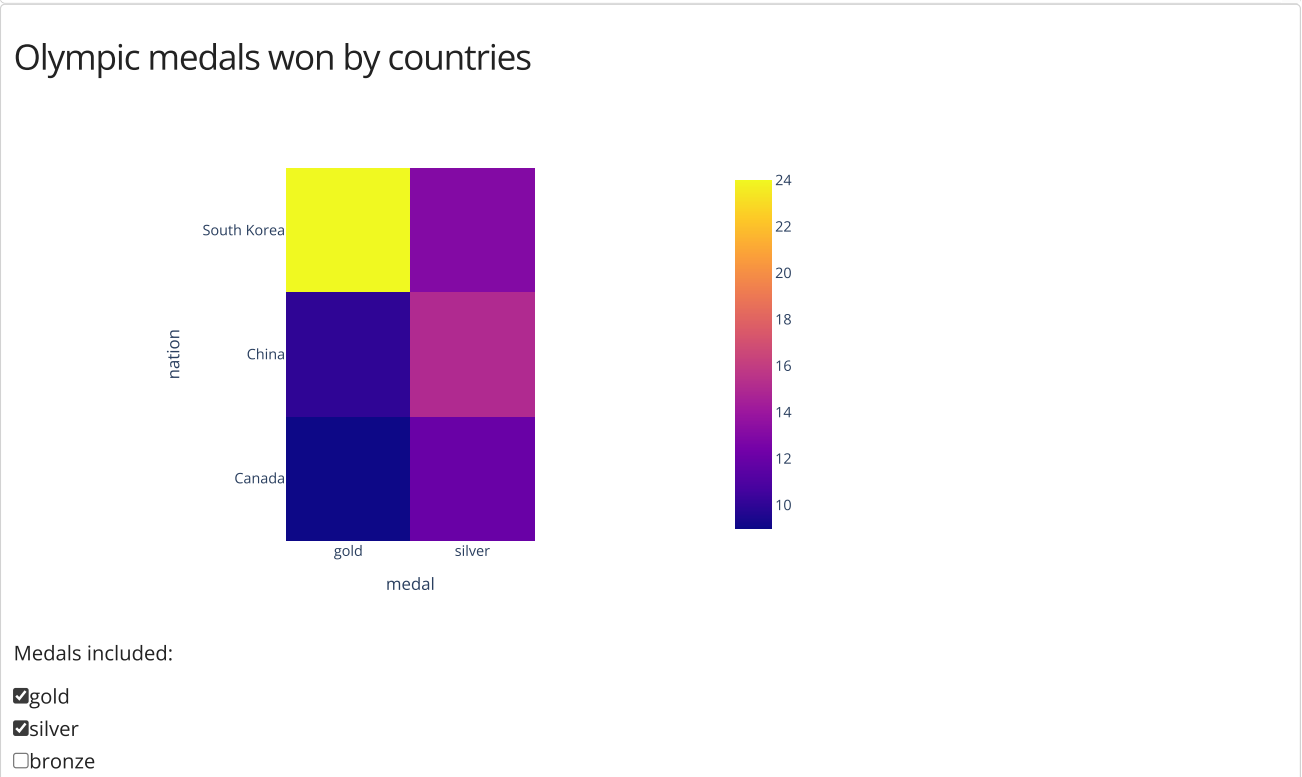
```
from dash import Dash, dcc, html, Input, Output
import plotly.express as px

app = Dash(__name__)


app.layout = html.Div([
    html.H4('Olympic medals won by countries'),
    dcc.Graph(id="graph"),
    html.P("Medals included:"),
    dcc.Checklist(
        id='medals',
        options=["gold", "silver", "bronze"],
        value=["gold", "silver"],
    ),
])


@app.callback(
    Output("graph", "figure"),
    Input("medals", "value"))
def filter_heatmap(cols):
    df = px.data.medals_wide(indexed=True) # replace with your own data source
    fig = px.imshow(df[cols])
    return fig
```

DOWNLOAD



Controlling Aspect Ratio

By default, px.imshow() produces heatmaps with square tiles, but setting the aspect argument to "auto" will instead fill the plotting area with the heatmap, using non-square tiles.

```
import plotly.express as px

z = [[.1, .3, .5, .7, .9],
     [1, .8, .6, .4, .2],
     [.2, 0, .5, .7, .9],
     [.9, .8, .4, .2, 0],
     [.3, .4, .5, .7, 1]]

fig = px.imshow(z, text_auto=True, aspect="auto")
fig.show()
```

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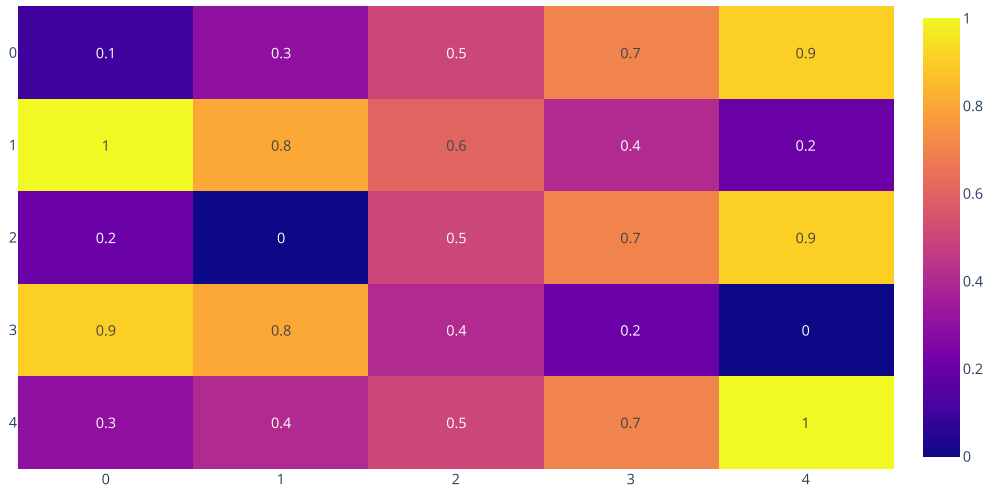
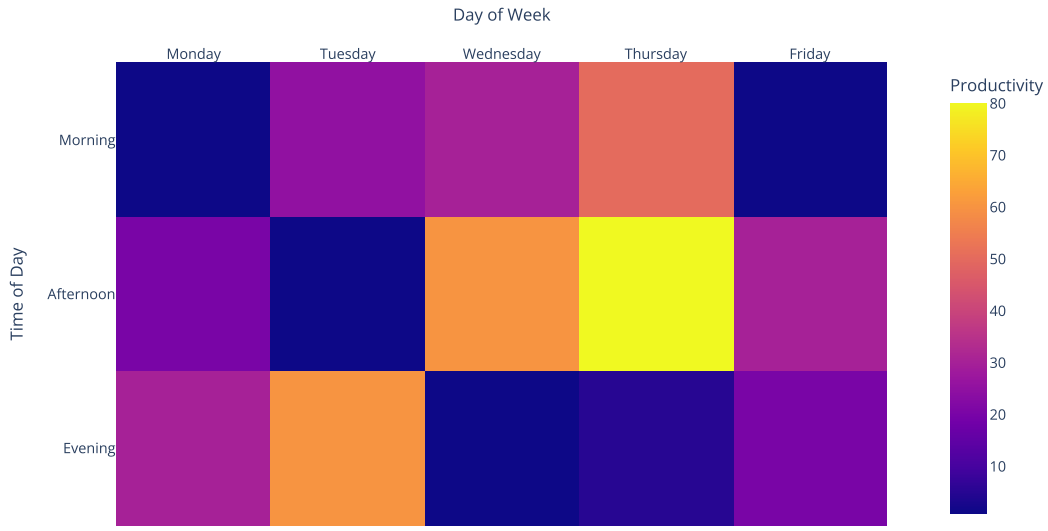


Customizing the axes and labels on a heatmap

You can use the x, y and labels arguments to customize the display of a heatmap, and use .update_xaxes() to move the x axis tick labels to the top:

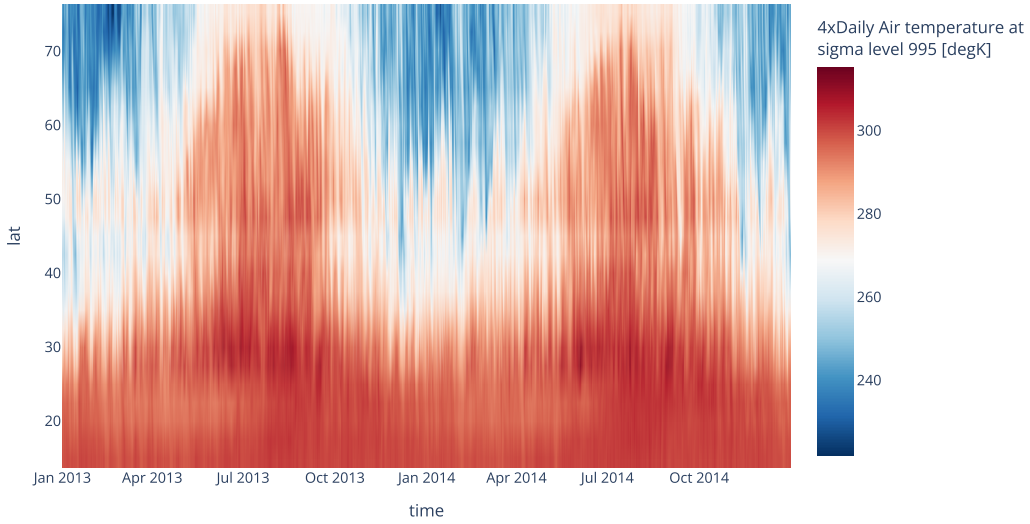
```
import plotly.express as px
data=[[1, 25, 30, 50, 1], [20, 1, 60, 80, 30], [30, 60, 1, 5, 20]]
fig = px.imshow(data,
                labels=dict(x="Day of Week", y="Time of Day", color="Productivity"),
                x=['Monday', 'Tuesday', 'Wednesday', 'Thursday', 'Friday'],
                y=['Morning', 'Afternoon', 'Evening']
               )
fig.update_xaxes(side="top")
fig.show()
```



Display an xarray image with px.imshow

xarrays (http://xarray.pydata.org/en/stable/) are labeled arrays (with labeled axes and coordinates). If you pass an xarray image to px.imshow, its axes labels and coordinates will be used for axis titles. If you don't want this behavior, you can pass img.values which is a NumPy array if img is an xarray. Alternatively, you can override axis titles hover labels and colorbar title using the `labels` attribute, as above.

```
import plotly.express as px
import xarray as xr
# Load xarray from dataset included in the xarray tutorial
airtemps = xr.tutorial.open_dataset('air_temperature').air.sel(lon=250.0)
fig = px.imshow(airtemps.T, color_continuous_scale='RdBu_r', origin='lower')
fig.show()
```

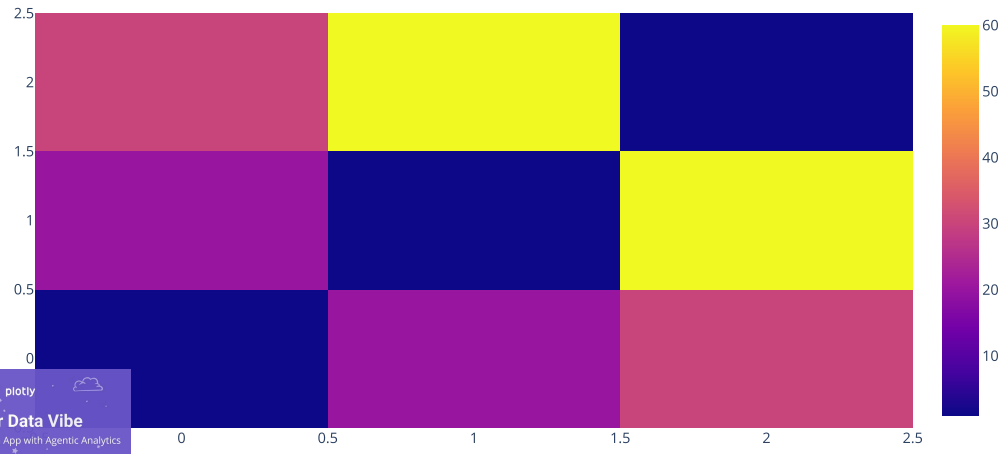


Basic Heatmap with plotly.graph_objects

If Plotly Express does not provide a good starting point, it is also possible to use the more generic go.Heatmap class from plotly.graph_objects (/python/graph-objects/).

```
import plotly.graph_objects as go

fig = go.Figure(data=go.Heatmap(
                    z=[[1, 20, 30],
                      [20, 1, 60],
                      [30, 60, 1]]))
fig.show()
```

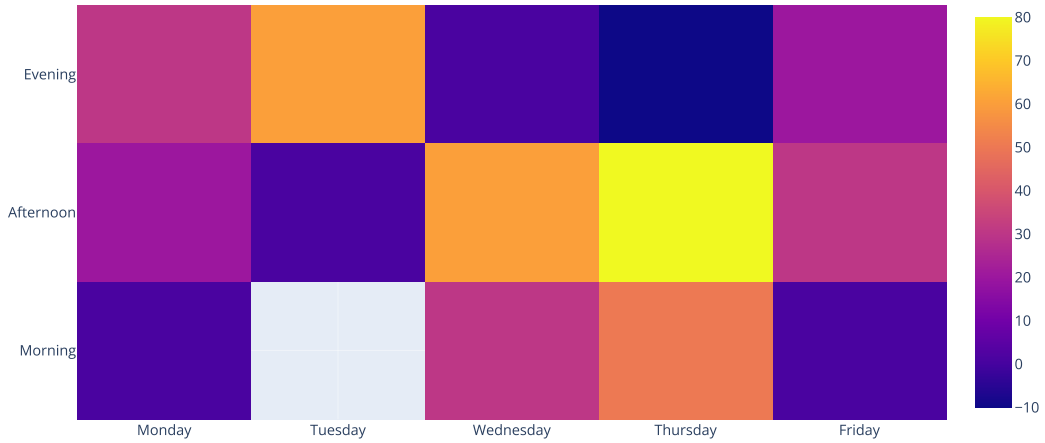


Heatmap with Categorical Axis Labels

In this example we also show how to ignore hovertext (https://plotly.com/python/hover-text-and-formatting/) when we have missing values in the data by setting the hoverongaps (https://plotly.com/python/reference/heatmap/#heatmap-hoverongaps) to False.

```
import plotly.graph_objects as go

fig = go.Figure(data=go.Heatmap(
                   z=[[1, None, 30, 50, 1], [20, 1, 60, 80, 30], [30, 60, 1, -10, 20]],
                   x=['Monday', 'Tuesday', 'Wednesday', 'Thursday', 'Friday'],
                   y=['Morning', 'Afternoon', 'Evening'],
                   hoverongaps = False))
fig.show()
```



Heatmap with Unequal Block Sizes

```
import plotly.graph_objects as go
import numpy as np

# Build the rectangles as a heatmap
# specify the edges of the heatmap squares
phi = (1 + np.sqrt(5) )/2. # golden ratio
xe = [0, 1, 1+(1/(phi**4)), 1+(1/(phi**3)), phi]
ye = [0, 1/(phi**3), 1/phi**3+1/phi**4, 1/(phi**2), 1]

z = [ [13,3,3,5],
      [13,2,1,5],
      [13,10,11,12],
      [13,8,8,8]
    ]

fig = go.Figure(data=go.Heatmap(
          x = np.sort(xe),
          y = np.sort(ye),
          z = z,
          type = 'heatmap',
          colorscale = 'Viridis'))

# Add spiral line plot

def spiral(th):
    a = 1.120529
    b = 0.306349
    r = a*np.exp(-b*th)
    return (r*np.cos(th), r*np.sin(th))

theta = np.linspace(-np.pi/13,4*np.pi,1000); # angle
(x,y) = spiral(theta)

fig.add_trace(go.Scatter(x= -x+x[0], y= y-y[0],
     line =dict(color='white',width=3)))

axis_template = dict(range = [0,1.6], autorange = False,
             showgrid = False, zeroline = False,
             linecolor = 'black', showticklabels = False,
             ticks = '' )

fig.update_layout(margin = dict(t=200,r=200,b=200,l=200),
    xaxis = axis_template,
    yaxis = axis_template,
    showlegend = False,
    width = 700, height = 700,
    autosize = False )

fig.show()
```

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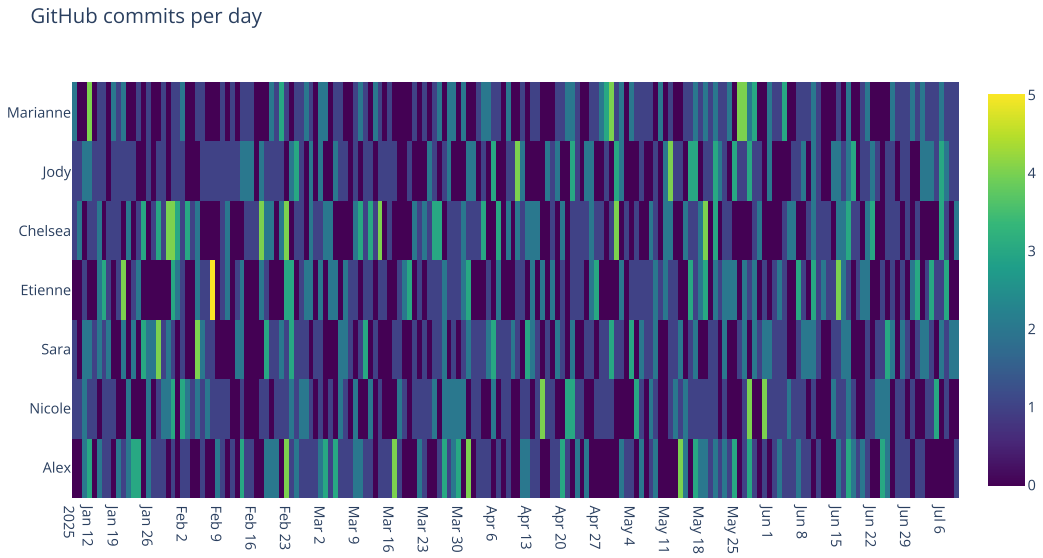
Heatmap with Datetime Axis

```
import plotly.graph_objects as go
import datetime
import numpy as np
np.random.seed(1)

programmers = ['Alex','Nicole','Sara','Etienne','Chelsea','Jody','Marianne']

base = datetime.datetime.today()
dates = base - np.arange(180) * datetime.timedelta(days=1)
z = np.random.poisson(size=(len(programmers), len(dates)))

fig = go.Figure(data=go.Heatmap(
        z=z,
        x=dates,
        y=programmers,
        colorscale='Viridis'))

fig.update_layout(
    title=dict(text='GitHub commits per day'),
    xaxis_nticks=36)

fig.show()
```



Text on Heatmap Points

In this example we add text to heatmap points using `texttemplate`. We use the values from the `text` attribute for the text. We also adjust the font size using `textfont`.

```
import plotly.graph_objects as go

fig = go.Figure(data=go.Heatmap(
                    z=[[1, 20, 30],
                      [20, 1, 60],
                      [30, 60, 1]],
                    text=[['one', 'twenty', 'thirty'],
                          ['twenty', 'one', 'sixty'],
                          ['thirty', 'sixty', 'one']],
                    texttemplate="%{text}",
                    textfont={"size":20}))

fig.show()
```

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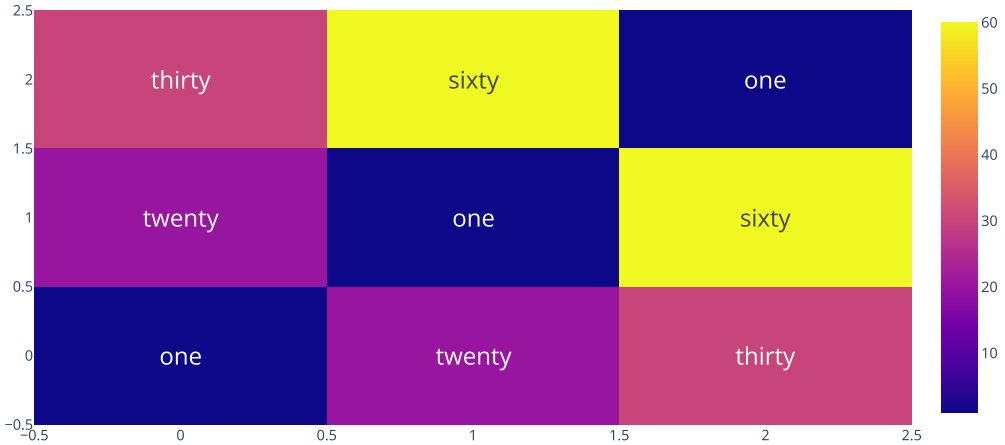

Heatmap and datashader

Arrays of rasterized values build by datashader can be visualized using plotly's heatmaps, as shown in the plotly and datashader tutorial (/python/datashader/).

Reference

See function reference for px.(imshow) (https://plotly.com/python-api-reference/generated/plotly.express.imshow) or https://plotly.com/python/reference/heatmap/ (https://plotly.com/python/reference/heatmap/) for more information and chart attribute options!

What About Dash?

Dash (https://dash.plot.ly/) is an open-source framework for building analytical applications, with no Javascript required, and it is tightly integrated with the Plotly graphing library.

Learn about how to install Dash at https://dash.plot.ly/installation (https://dash.plot.ly/installation).

Everywhere in this page that you see fig.show(), you can display the same figure in a Dash application by passing it to the figure argument of the Graph component (https://dash.plot.ly/dash-core-components/graph) from the built-in dash_core_components package like this:

```
import plotly.graph_objects as go # or plotly.express as px
fig = go.Figure() # or any Plotly Express function e.g. px.bar(...)
# fig.add_trace( ... )
# fig.update_layout( ... )

from dash import Dash, dcc, html

app = Dash()
app.layout = html.Div([
    dcc.Graph(figure=fig)
])

app.run(debug=True, use_reloader=False)  # Turn off reloader if inside Jupyter
```