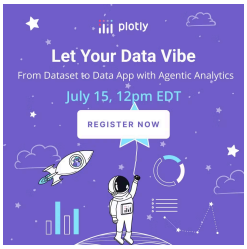
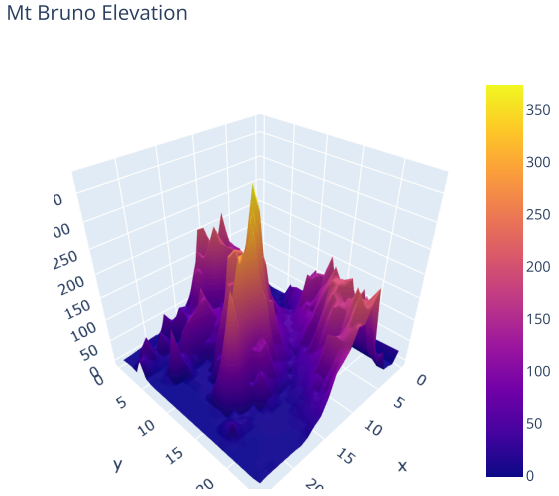
3D Surface Plots in Python

How to make 3D-surface plots in Python

Topographical 3D Surface Plot

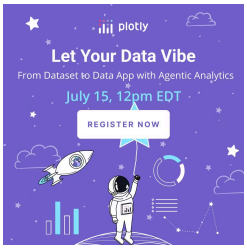


```
import plotly.graph_objects as go

import pandas as pd

# Read data from a csv
z_data = pd.read_csv('https://raw.githubusercontent.com/plotly/datasets/master/api_docs/mt_bruno_elevation.csv')

fig = go.Figure(data=[go.Surface(z=z_data.values)])

fig.update_layout(title=dict(text='Mt Bruno Elevation'), autosize=False,
                  width=500, height=500,
                  margin=dict(l=65, r=50, b=65, t=90))

fig.show()
```

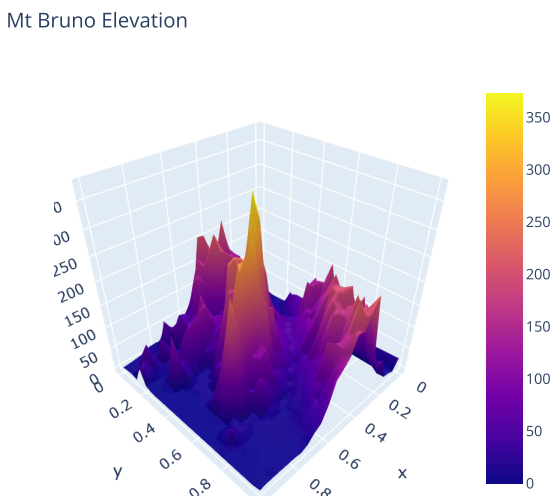


Passing x and y data to 3D Surface Plot

If you do not specify x and y coordinates, integer indices are used for the x and y axis. You can also pass x and y values to go.Surface.

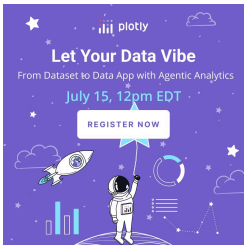


```
import plotly.graph_objects as go
import pandas as pd
import numpy as np
# Read data from a csv
z_data = pd.read_csv('https://raw.githubusercontent.com/plotly/datasets/master/api_docs/mt_bruno_elevation.csv')
z = z_data.values
sh_0, sh_1 = z.shape
x, y = np.linspace(0, 1, sh_0), np.linspace(0, 1, sh_1)
fig = go.Figure(data=[go.Surface(z=z, x=x, y=y)])
fig.update_layout(title=dict(text='Mt Bruno Elevation'), autosize=False,
                  width=500, height=500,
                  margin=dict(l=65, r=50, b=65, t=90))
fig.show()
```

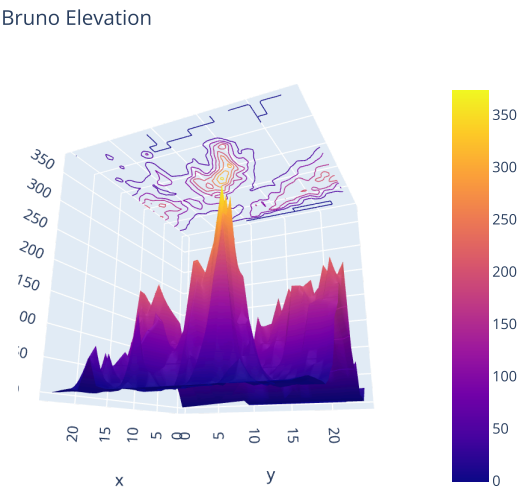


Surface Plot With Contours

Display and customize contour data for each axis using the contours attribute (reference (https://plotly.com/python/reference/surface/#surface-contours)).



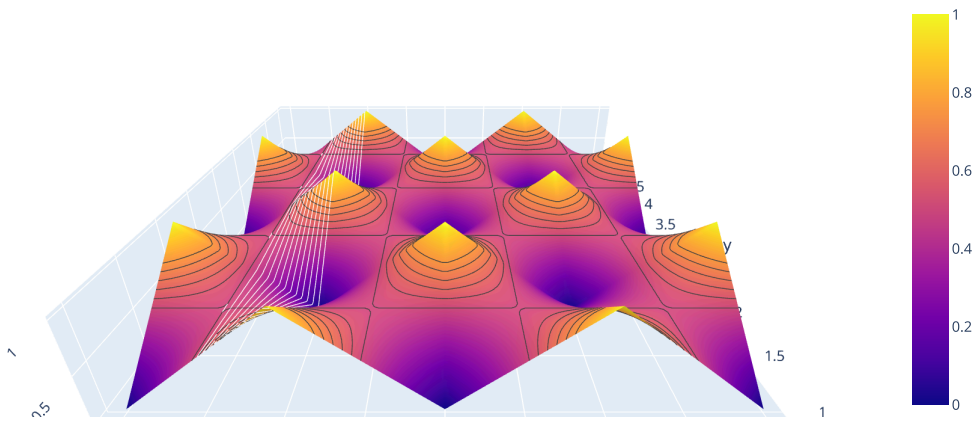
```
import plotly.graph_objects as go

import pandas as pd

# Read data from a csv
z_data = pd.read_csv('https://raw.githubusercontent.com/plotly/datasets/master/api_docs/mt_bruno_elevation.csv')

fig = go.Figure(data=[go.Surface(z=z_data.values)])
fig.update_traces(contours_z=dict(show=True, usecolormap=True,
                                  highlightcolor="limegreen", project_z=True))
fig.update_layout(title=dict(text='Mt Bruno Elevation'), autosize=False,
                  scene_camera_eye=dict(x=1.87, y=0.88, z=-0.64),
                  width=500, height=500,
                  margin=dict(l=65, r=50, b=65, t=90)
)

fig.show()
```



Configure Surface Contour Levels

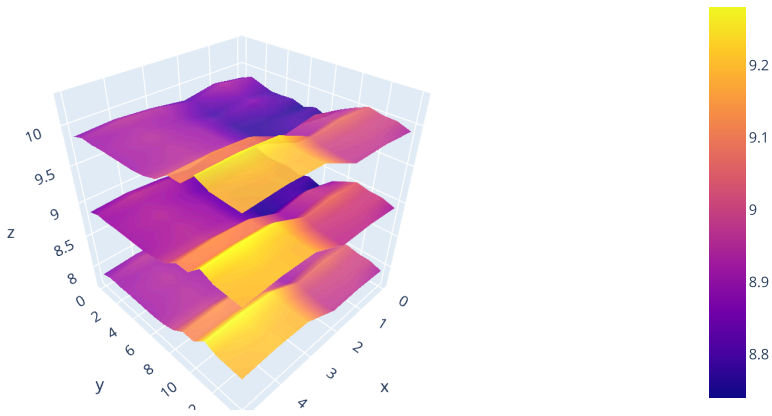
This example shows how to slice the surface graph on the desired position for each of x, y and z axis. contours.x.start (https://plotly.com/python/reference/surface/#surface-contours-x-start) sets the starting contour level value, `end` sets the end of it, and `size` sets the step between each contour level.

```
import plotly.graph_objects as go

fig = go.Figure(go.Surface(
    contours = {
        "x": {"show": True, "start": 1.5, "end": 2, "size": 0.04, "color":"white"},
        "z": {"show": True, "start": 0.5, "end": 0.8, "size": 0.05}
    },
    x = [1,2,3,4,5],
    y = [1,2,3,4,5],
    z = [
        [0, 1, 0, 1, 0],
        [1, 0, 1, 0, 1],
        [0, 1, 0, 1, 0],
        [1, 0, 1, 0, 1],
        [0, 1, 0, 1, 0]
    ]))
fig.update_layout(
        scene = {
            "xaxis": {"nticks": 20},
            "zaxis": {"nticks": 4},
            'camera_eye': {"x": 0, "y": -1, "z": 0.5},
            "aspectratio": {"x": 1, "y": 1, "z": 0.2}
        })
fig.show()
```



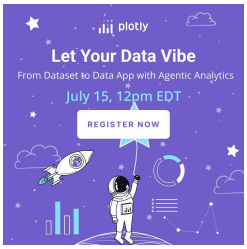
Multiple 3D Surface Plots

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

z1 = np.array([
    [8.83,8.89,8.81,8.87,8.9,8.87],
    [8.89,8.94,8.85,8.94,8.96,8.92],
    [8.84,8.9,8.82,8.92,8.93,8.91],
    [8.79,8.85,8.79,8.9,8.94,8.92],
    [8.79,8.88,8.81,8.9,8.95,8.92],
    [8.8,8.82,8.78,8.91,8.94,8.92],
    [8.75,8.78,8.77,8.91,8.95,8.92],
    [8.8,8.8,8.77,8.91,8.95,8.94],
    [8.74,8.81,8.76,8.93,8.98,8.99],
    [8.89,8.99,8.92,9.1,9.13,9.11],
    [8.97,8.97,8.91,9.09,9.11,9.11],
    [9.04,9.08,9.05,9.25,9.28,9.27],
    [9,9.01,9,9.2,9.23,9.2],
    [8.99,8.99,8.98,9.18,9.2,9.19],
    [8.93,8.97,8.97,9.18,9.2,9.18]
])

z2 = z1 + 1
z3 = z1 - 1

fig = go.Figure(data=[
    go.Surface(z=z1),
    go.Surface(z=z2, showscale=False, opacity=0.9),
    go.Surface(z=z3, showscale=False, opacity=0.9)

])

fig.show()
```

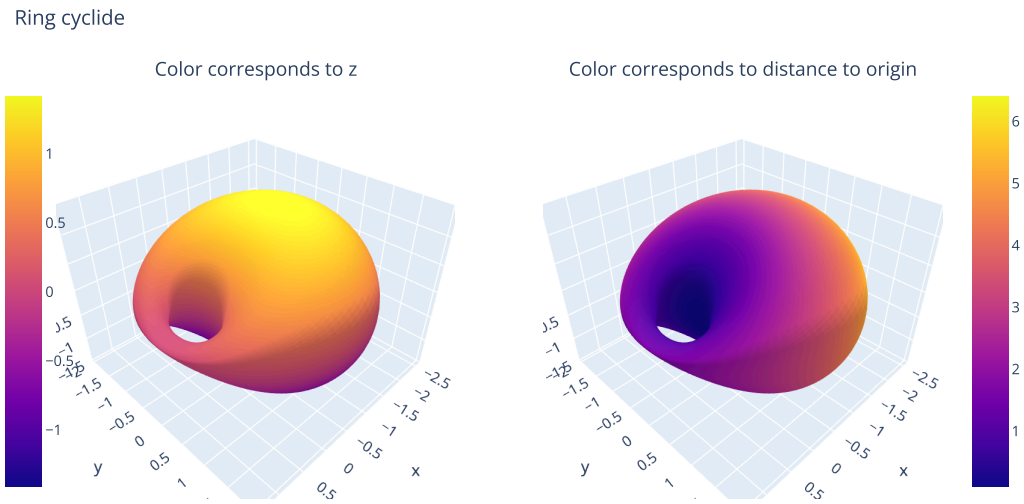


Setting the Surface Color

You can use the surfacecolor attribute to define the color of the surface of your figure. In this example, the surface color represents the distance from the origin, rather than the default, which is the z value.



```
import plotly.graph_objects as go
from plotly.subplots import make_subplots

# Equation of ring cyclide
# see https://en.wikipedia.org/wiki/Dupin_cyclide
import numpy as np
a, b, d = 1.32, 1., 0.8
c = a**2 - b**2
u, v = np.mgrid[0:2*np.pi:100j, 0:2*np.pi:100j]
x = (d * (c - a * np.cos(u) * np.cos(v)) + b**2 * np.cos(u)) / (a - c * np.cos(u) * np.cos(v))
y = b * np.sin(u) * (a - d*np.cos(v)) / (a - c * np.cos(u) * np.cos(v))
z = b * np.sin(v) * (c*np.cos(u) - d) / (a - c * np.cos(u) * np.cos(v))

fig = make_subplots(rows=1, cols=2,
                    specs=[[{'is_3d': True}, {'is_3d': True}]],
                    subplot_titles=['Color corresponds to z', 'Color corresponds to distance to origin'],
                    )

fig.add_trace(go.Surface(x=x, y=y, z=z, colorbar_x=-0.07), 1, 1)
fig.add_trace(go.Surface(x=x, y=y, z=z, surfacecolor=x**2 + y**2 + z**2), 1, 2)
fig.update_layout(title_text="Ring cyclide")
fig.show()
```



Reference

See https://plotly.com/python/reference/surface/ (https://plotly.com/python/reference/surface/) for more information!

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
```