

```
1: import matplotlib.pyplot as plt
2: import numpy as np
3: import sys
4:
5:
6: def f(x, y):
7:     return 3 * (x - 5)**4 + 10 * (y - 9)**2
8:
9:
10: def g(x, y):
11:     return np.maximum(x - 5, 0) + 10 * np.abs(y - 9)
12:
13:
14: def main(outfile):
15:     x = np.linspace(0, 10, 400)
16:     y = np.linspace(0, 18, 400)
17:     X, Y = np.meshgrid(x, y)
18:     Z_f = f(X, Y)
19:     Z_g = g(X, Y)
20:
21:     fig = plt.figure(figsize=(12, 6))
22:
23:     ax = fig.add_subplot(1, 2, 1, projection='3d')
24:     ax.plot_surface(X, Y, Z_f, cmap='viridis')
25:     ax.set_title('$f(x, y)$')
26:     ax.set_xlabel('$x$')
27:     ax.set_ylabel('$y$')
28:     ax.set_zlabel('$f(x, y)$')
29:
30:     ax = fig.add_subplot(1, 2, 2, projection='3d')
31:     ax.plot_surface(X, Y, Z_g, cmap='magma')
32:     ax.set_title('$g(x, y)$')
33:     ax.set_xlabel('$x$')
34:     ax.set_ylabel('$y$')
35:     ax.set_zlabel('$g(x, y)$')
36:
37:     plt.savefig(outfile)
38:     plt.show()
39:
40: def main_contour(outfile):
41:     x = np.linspace(0, 10, 400)
42:     y = np.linspace(0, 18, 400)
43:     X, Y = np.meshgrid(x, y)
44:     Z_f = f(X, Y)
45:     Z_g = g(X, Y)
46:
47:     fig = plt.figure(figsize=(12, 6))
48:
49:     ax = fig.add_subplot(1, 2, 1)
50:     ax.contourf(X, Y, Z_f, levels=30, cmap='viridis')
51:     ax.set_title('$f(x, y)$')
52:     ax.set_xlabel('$x$')
53:     ax.set_ylabel('$y$')
54:     # ax.set_zlabel('$f(x, y)$')
55:
56:     ax = fig.add_subplot(1, 2, 2)
57:     ax.contourf(X, Y, Z_g, levels=30, cmap='viridis')
58:     ax.set_title('$g(x, y)$')
59:     ax.set_xlabel('$x$')
60:     ax.set_ylabel('$y$')
61:     # ax.set_zlabel('$g(x, y)$')
62:
63:     plt.savefig(outfile)
64:     plt.show()
65:
66:
67: if __name__ == "__main__":
68:     if len(sys.argv) != 2:
69:         print("Usage: python script.py <output_file>")
70:         sys.exit(1)
71:
72:     outfile = sys.argv[1]
73:     main_contour(outfile)
74:
```