DS-210: Programming for Data Science

Lecture 6:

- Ethics of data processing (continued)
- Final project expectations
- Intro to SciPy

Homework 1

- Due today
- Submissions via Gradescope (Entry code: 3Y85PZ)
- Submit a single IPython notebook (preferred). Or a `.zip` file. Or a few files.

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Homework 2

- Out today
- Due next Wednesday

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- **Lots of data sets have private information**

- **Last time:** infamous examples
  - Enron emails
  - AOL search
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  - DNA database
  - a relative submitted their DNA
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What do you think about this?

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What do you think about this?

- **Bottom line:**
    - Be careful publishing any data
    - You never know how something might be used
    - Respect privacy of subjects

Final project expectations

- You pick the topic
- Has to be related to graphs
  - either graph data (e.g., Stanford Large Network Dataset Collection)
  - or derived graph data
- You have to submit a proposal (due 3/18)
  - try to be creative
  - will give you feedback
  - you will have to use Rust

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Sample: Six Degrees of Separation

- Consider a graph in which people who know each other are connected
- **Conjecture:** any pair of people at most 6 steps away from each other
- **Sample problem:** find out for a random pairs of people how far they are from each other on a social network

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- What we plan to cover
    - Simple example today: interpolation
    - Clustering (k-means)
    - Linear algebra (linear regression)
    - Optimization

Interpolation / Extrapolation

Data: known data points

Goal: design a function that passes through the data points and also give possible values

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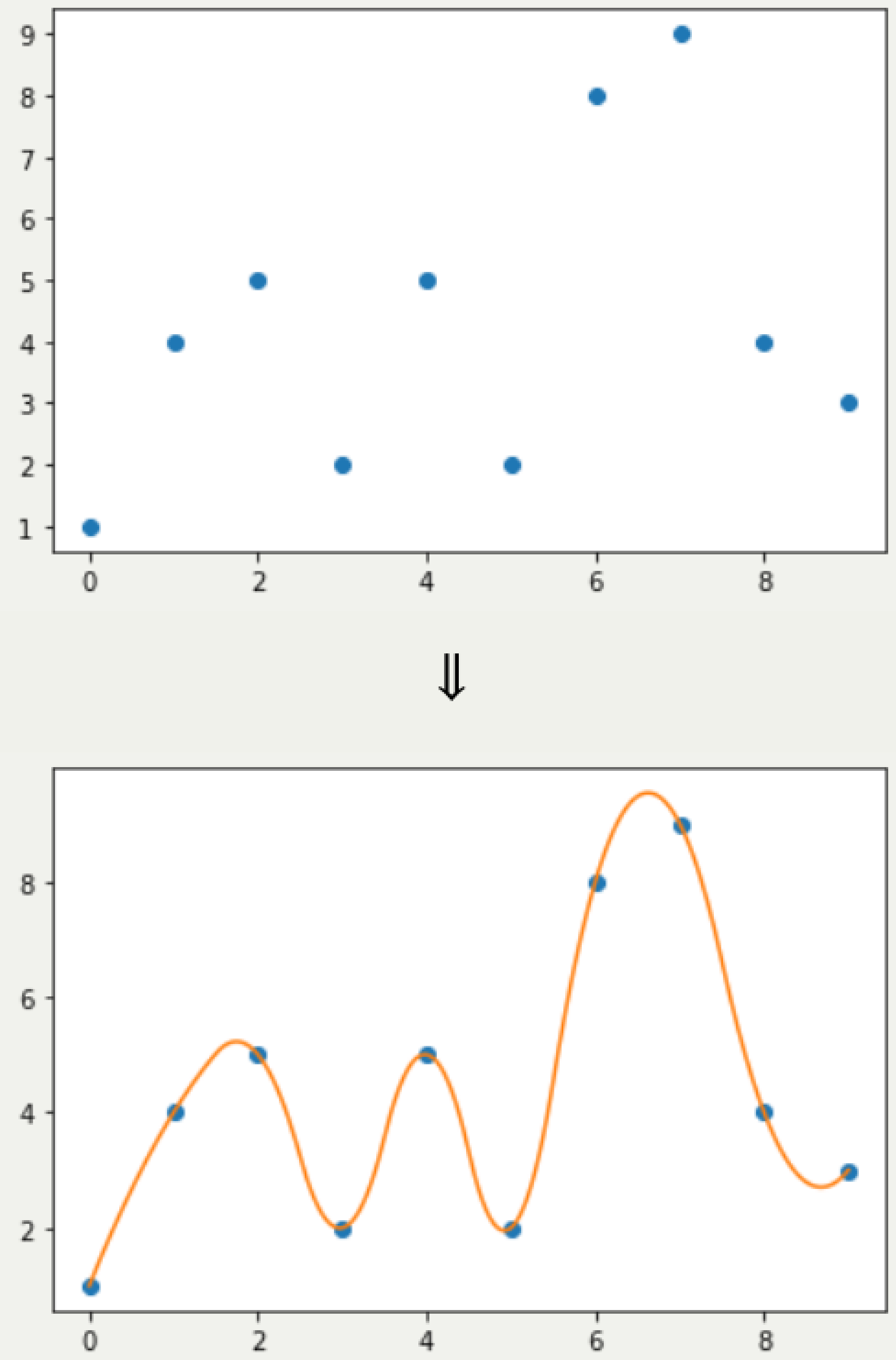
Example of interpolation



Example of 1D interpolation

In [1]:

```
import numpy as np
from scipy.interpolate import interp1d
x = np.arange(10)
y = np.array([1,4,5,2,5,2,8,9,4,3])

# We now compute two functions interpolating the
# data points. Options for kind: cubic, linear, nearest
# previous, next, ...
f = interp1d(x,y,kind='linear')
g = interp1d(x,y,kind='cubic')
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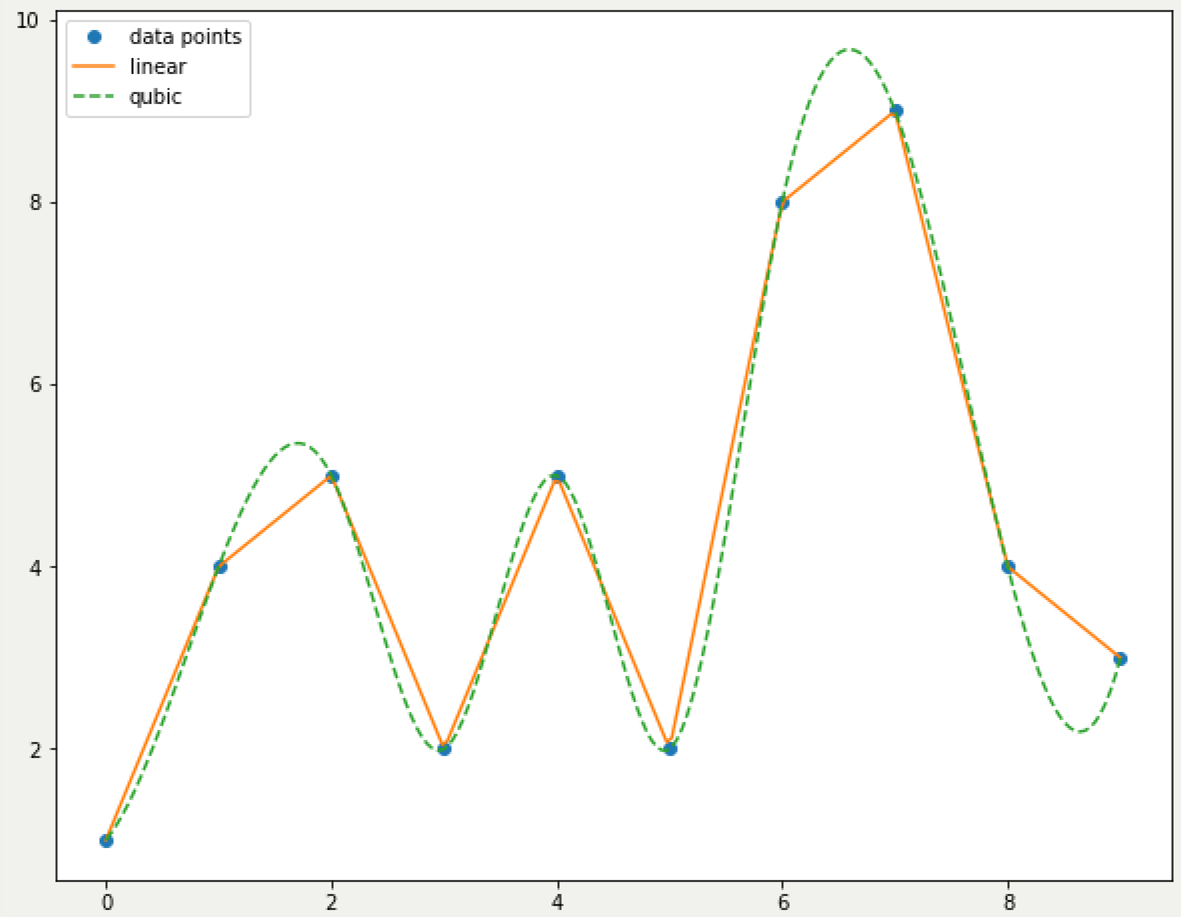
In [2]:

```
import matplotlib.pyplot as plt
plt.figure(figsize=(10,8))
xplot = np.linspace(0,9,num=200,endpoint=True)
plt.plot(x,y,'o',xplot,f(xplot),'-',\
        xplot,g(xplot),'--');
plt.legend(['data points','linear','qubic'],
          loc='upper left');
```



Example of 2D interpolation ($f(x, y) = \sin(x + y) * \cos(x - y)$)

In [3]:

```
from scipy.interpolate import Rbf
import math

samples = 200
side = 4*math.pi
plot_grid_size = 200

# Sample points and compute the value of f on them
rng = np.random.default_rng()
x = rng.random(samples)*side-side/2
y = rng.random(samples)*side-side/2
z = np.sin(x+y) * np.cos(x-y)

# compute the interpolating function
rbf = Rbf(x, y, z)

# Compute grid points and interpolation values
# for visualization
edges = np.linspace(-side/2, side/2, plot_grid_size+1)
centers = edges[:-1] + (edges[1] - edges[2])/2
XI, YI = np.meshgrid(centers, centers)
ZI = rbf(XI, YI)
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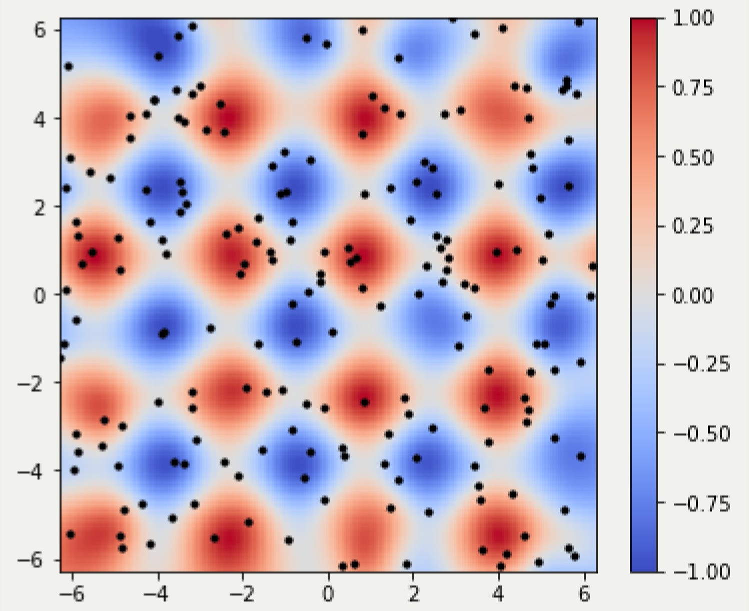
In [4]:

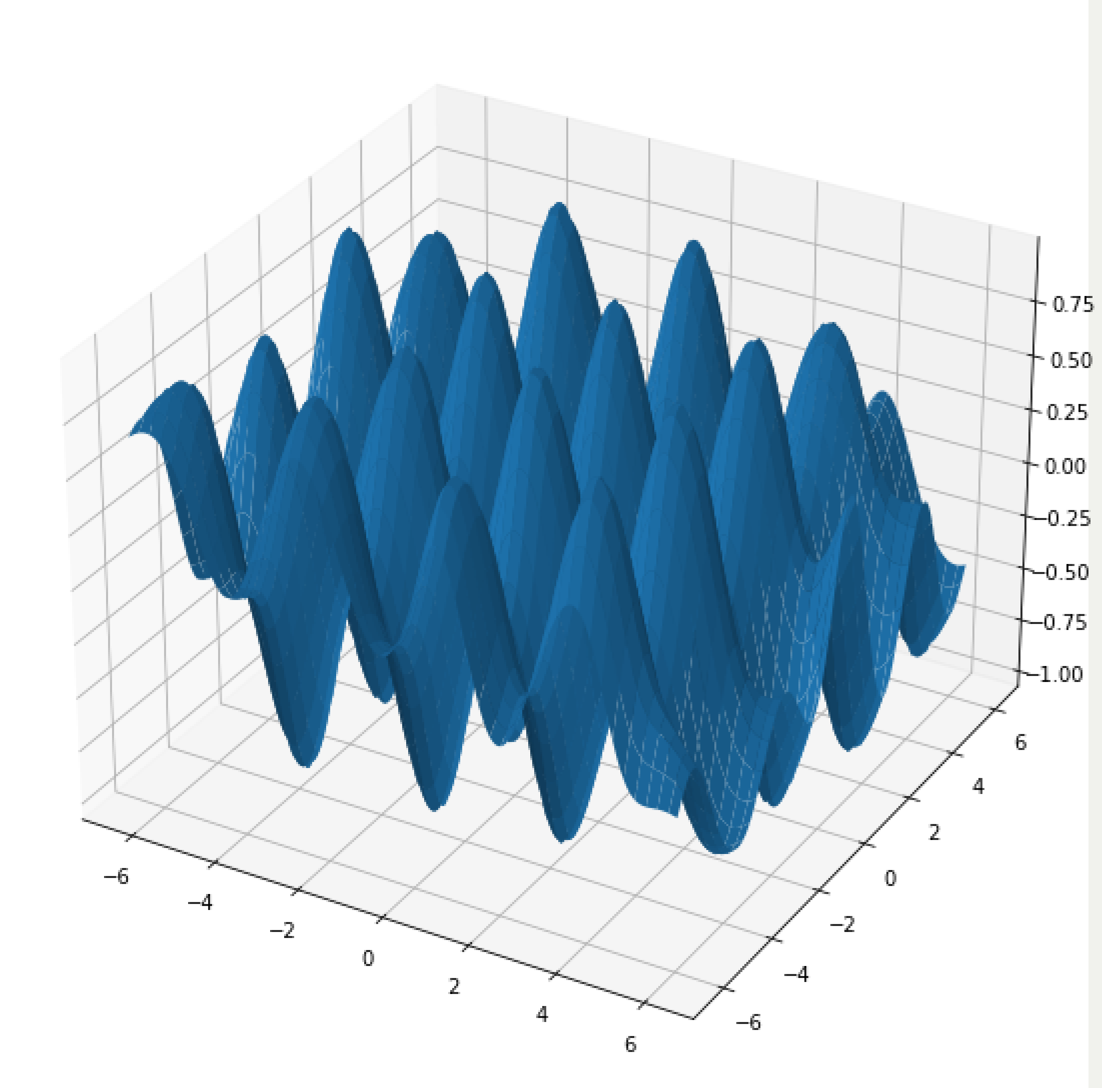
```python
X_edges, Y_edges = np.meshgrid(edges, edges)
lims = dict(cmap='coolwarm', vmin=-1, vmax=1)
plt.figure(figsize=(6,5.1))
plt.pcolormesh(X_edges, Y_edges, ZI, **lims)
plt.colorbar()
plt.scatter(x, y, 10, [[0,0,0]])
plt.xlim(-side/2, side/2)
plt.ylim(-side/2, side/2);
```



- black dots: the points we sampled
- blue to red: interpolation value

In [5]:

```
# 3d visualization
import mpl_toolkits
fig = plt.figure(figsize=(10,10))
ax = plt.axes(projection='3d')
ax.plot_surface(XI, YI, ZI)
plt.show();
```



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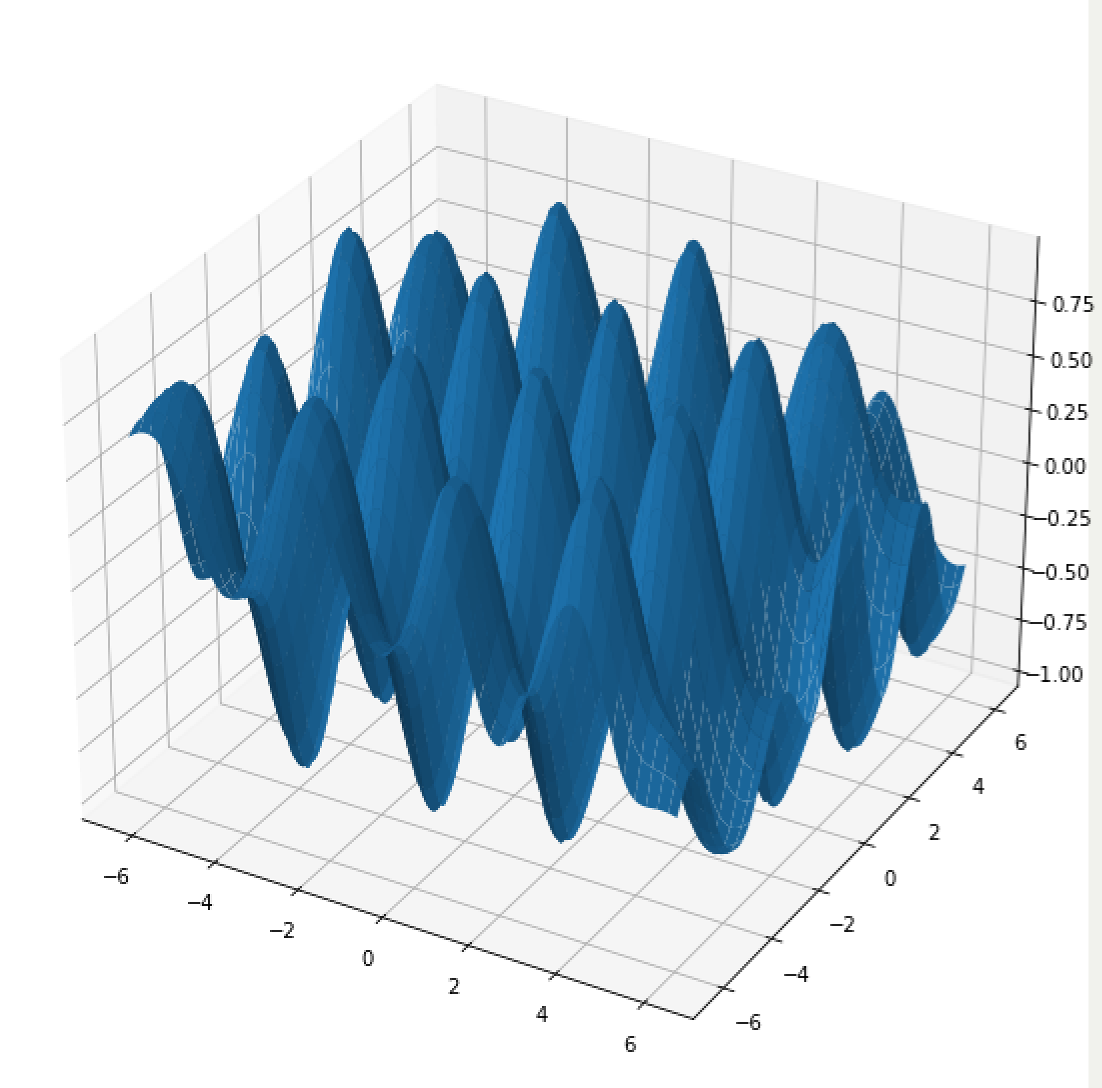

```
In [6]: # broader view
        side = 8*math.pi
        # Compute grid points and interpolation values
        edges = np.linspace(-side/2, side/2, plot_grid_size+1)
        centers = edges[:-1] + (edges[1] - edges[2])/2
        XI, YI = np.meshgrid(centers, centers)
        ZI = rbf(XI, YI)
        # visualization
        X_edges, Y_edges = np.meshgrid(edges, edges)
        plt.figure(figsize=(10,8))
        plt.pcolormesh(X_edges, Y_edges, ZI, **lims)
        plt.colorbar()
        plt.scatter(x, y, 10, [[0,0,0]])
        plt.xlim(-side/2, side/2)
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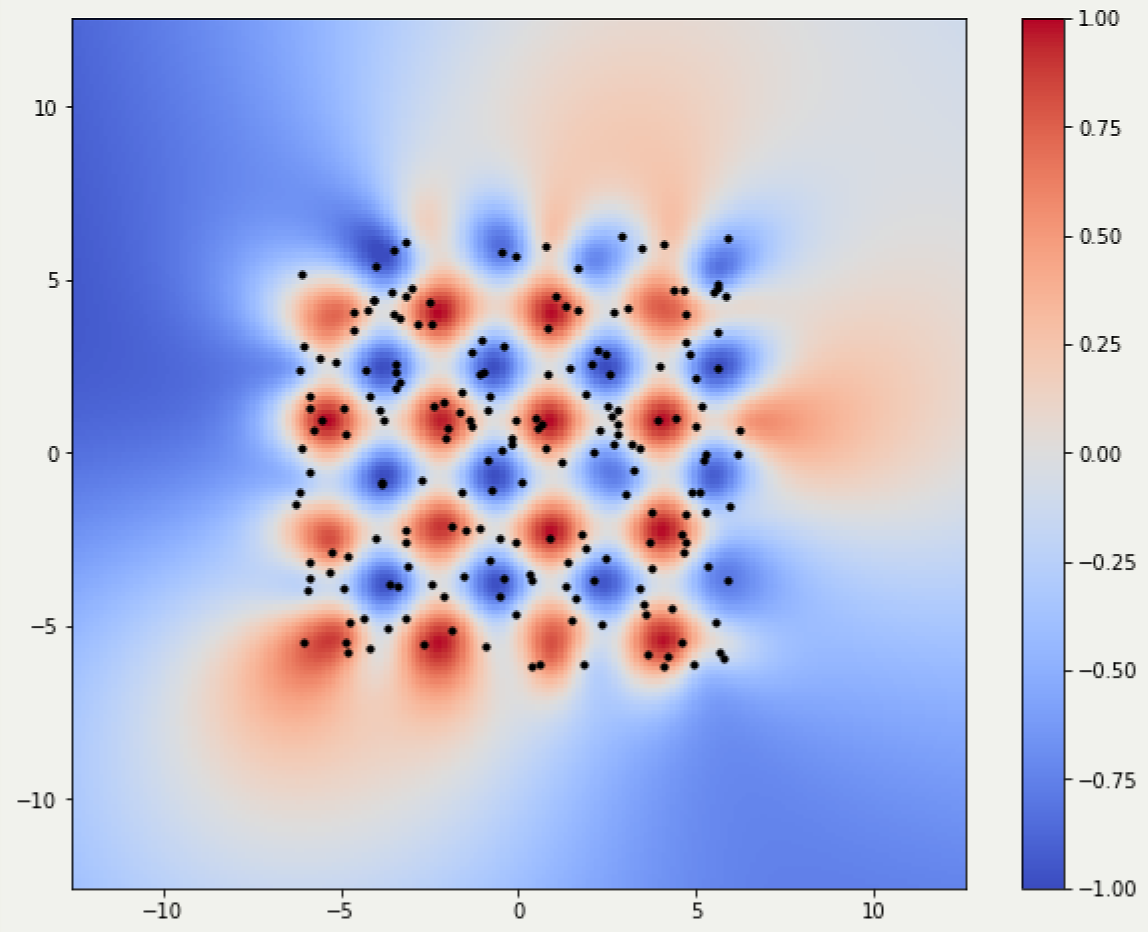
10
5
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−5
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