09 - Springs

April 5, 2023

0.0.1 An engineering problem from "Engineering Optimization" by Xin-She Yang

Goal: Design an optimal spring (cheapest / least material needed) that does the job. Parameters we can change: d, the diameter of the coil; L, the length of the spring; w, the thickness of the wire.

Task: Minimize

$$(2+L)dw^2$$

subject to the constraints

$$g_1(L,d,w) = 1 - \frac{d^3 L}{7178 w^4} \leq 0$$

$$g_2(L,d,w) = \frac{4d^2 - wd}{12566 dw^3 - w^4} + \frac{1}{5108 w^2} - 1 \leq 0$$

$$g_3(L,d,w) = 1 - \frac{140.45 w}{d^2 L} \leq 0$$

$$g_4(L,d,w) = \frac{w+d}{1.5} - 1 \leq 0$$

with boundary conditions

$$0.05 \leq w \leq 2.0 \qquad 0.25 \leq d \leq 1.3 \qquad 2.0 \leq L \leq 15.0$$

```
[123]: import math
       import random
```

```
[124]: def random_in_range(lower, upper):
           return random.random() * (upper - lower) + lower
       random_in_range(2, 15)
```

```
[124]: 2.0106875203456873
```

```
[125]: def g1(L,d,w):
           return 1 - d**3 * L / (7178 * w**4)

       def g2(L,d,w):
           return (4*d**2 - w*d)/(12566 * d * w**3 - w**4) + 1/(5108*w**2) - 1

       def g3(L,d,w):
           return 1 - 140.45 * w / (d**2*L)
```

```
def g4(L,d,w):
    return (w+d)/1.5 - 1

def satisfies_constraints(L,d,w):
    return g1(L,d,w) <= 0 and g2(L,d,w) <= 0 and g3(L,d,w) <= 0 and g4(L,d,w)␣
    ↪<= 0
```

[126]:
```python
def score(L,d,w):  # w-squared is "w**2" not "w^2"
    return (2+L)*d*w**2
```

[127]:
```python
def tweak(L,d,w):
    delta_w = 0.01
    delta_d = 0.01
    delta_L = 0.1

    new_w = w + random_in_range(-1, 1) * delta_w
    while new_w < 0.05 or new_w > 2:
        new_w = w + random_in_range(-1, 1) * delta_w

    new_d = d + random_in_range(-1, 1) * delta_d
    while new_d < 0.25 or new_d > 1.3:
        new_d = d + random_in_range(-1, 1) * delta_d

    new_L = L + random_in_range(-1, 1) * delta_L
    while new_L < 2 or new_L > 15:
        new_L = L + random_in_range(-1, 1) * delta_L

    return (new_L, new_d, new_w)

tweak(15, 1.3, 2.0)
```

[127]: (14.97787828092911, 1.2920563042094673, 1.9965802873790817)

[165]:
```python
def random_solution():
    return (
        random_in_range(2, 15),
        random_in_range(0.25, 1.3),
        random_in_range(0.05, 2),
    )
print(random_solution())
```

(14.01370625216404, 0.7403139249850232, 0.6796030430896093)

[144]:
```python
# what does the * do
def test(num1, num2):
    return num1 + num2
L = [1,3]
```

```
test(*L)
```

[144]: 4

[ ]:

[178]:
```
# from mpl_toolkits.mplot3d import Axes3D
# import numpy as np
# import matplotlib.pyplot as plt
# from IPython.display import clear_output
# from math import sqrt, pi

# def show_spring(L,d,w):
#     N = L/sqrt(1+(pi*d)**2)


#     fig = plt.figure()
#     ax = fig.add_subplot(projection='3d')
#     theta = np.linspace(0, N * 2 * np.pi, 1000)
#     z = theta/2/np.pi
#     x = d * np.sin(theta)
#     y = d* np.cos(theta)
#     ax.plot(x, y, z, label='parametric curve', lw=w*10) # the full spiral

#     plt.xlim([-2,2])
#     plt.ylim([-2,2])
#     plt.show()
```

[ ]:

[161]:
```
def hill_climbing():

    start = random_solution()
    while not satisfies_constraints(*start):
        start = random_solution()
    sol = start
    value = score(*sol)

    bad = 0
    while True:
        new_sol = tweak(*sol)
        while not satisfies_constraints(*new_sol):
            new_sol = tweak(*sol)
        new_value = score(*new_sol)
        if new_value < value:
            bad = 0
            sol = new_sol
```

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```
                value = new_value
                # uncomment the two lines below to show the picture
                # you may need to install the matplotlib library with "pip"
                #clear_output(wait=True)
                #show_spring(*sol)

        else:
            bad += 1
            if bad > 1000:
                print(value)
                return sol
```

[166]:
```
sol = hill_climbing()
#sol = [2.02310938, 0.25113418, 0.05218225]
# L, d, w
print(sol)
print(g1(*sol), g2(*sol), g3(*sol), g4(*sol))
print(score(*sol))
```

0.007822910240361827
(10.38317014267178, 0.2517895255010054, 0.05008981455795739)
-2.66810534191345 -0.3159275933374608 -9.687247768290987 -0.7987471066273581
0.007822910240361827

[167]:
```
old_sol = [2.02310938, 0.25113418, 0.05218225]
score(*old_sol)
```

[167]: 0.0027511436522230925

[ ]:

[170]:
```
# smarter: sample 1000 tweaks to find a good initial_temp that gives a desired␣
 ↪p_0
# or: heat the system slowly until the % of worsening solutions is what you want
initial_temp = 0.005
alpha = 0.99
final_temp = initial_temp / 1000
trials_per_temp = 10000

start = random_solution()
while not satisfies_constraints(*start):
    start = random_solution()
sol = start
value = score(*sol)
```

```python
[171]: temp = initial_temp
       generation = 0
       best_sol = None
       best_score = None

       while temp >= final_temp:
           generation += 1
           accepted_worse = 0
           total_worse = 0
           for i in range(trials_per_temp):
               new_sol = tweak(*sol)
               while not satisfies_constraints(*new_sol):
                   new_sol = tweak(*sol)

               new_value = score(*new_sol)

               delta = new_value - value
               delta *= -1
               if delta >= 0:
                   sol = new_sol
                   value = new_value
                   if best_score is None or value < best_score:
                       best_sol = sol
                       best_score = value
               else:
                   total_worse += 1
                   p = math.exp(delta/temp)
                   r = random.random()
                   if r <= p:
                       accepted_worse += 1
                       sol = new_sol
                       value = new_value

           from time import sleep
           #sleep(0.5)
           #clear_output(wait=True)

           print(
               f"Gen #{generation}: temp = {temp:.6f}, "
               f"best score = {best_score:.8f}, "
               f"cur score = {value:.8f}, "
               f"worse accepted = {round(accepted_worse/total_worse*100,2):.2f}%"
           )
           #show_spring(*sol)
           temp = temp * alpha
```

Gen #1: temp = 0.005000, best score = 0.00421056, cur score = 0.00710505, worse

```
accepted = 64.03%
Gen #2: temp = 0.004950, best score = 0.00421056, cur score = 0.00878450, worse
accepted = 67.84%
Gen #3: temp = 0.004901, best score = 0.00421056, cur score = 0.01409158, worse
accepted = 66.47%
Gen #4: temp = 0.004851, best score = 0.00421056, cur score = 0.01485309, worse
accepted = 63.07%
Gen #5: temp = 0.004803, best score = 0.00421056, cur score = 0.01772720, worse
accepted = 59.69%
Gen #6: temp = 0.004755, best score = 0.00421056, cur score = 0.01289778, worse
accepted = 59.07%
Gen #7: temp = 0.004707, best score = 0.00421056, cur score = 0.02624243, worse
accepted = 56.63%
Gen #8: temp = 0.004660, best score = 0.00421056, cur score = 0.02293023, worse
accepted = 59.15%
Gen #9: temp = 0.004614, best score = 0.00421056, cur score = 0.01084928, worse
accepted = 56.49%
Gen #10: temp = 0.004568, best score = 0.00395709, cur score = 0.00497024, worse
accepted = 66.00%
Gen #11: temp = 0.004522, best score = 0.00321054, cur score = 0.00531015, worse
accepted = 76.67%
Gen #12: temp = 0.004477, best score = 0.00321054, cur score = 0.00795670, worse
accepted = 75.42%
Gen #13: temp = 0.004432, best score = 0.00299095, cur score = 0.00963613, worse
accepted = 72.00%
Gen #14: temp = 0.004388, best score = 0.00297195, cur score = 0.00528520, worse
accepted = 76.06%
Gen #15: temp = 0.004344, best score = 0.00297195, cur score = 0.00584078, worse
accepted = 69.47%
Gen #16: temp = 0.004300, best score = 0.00297195, cur score = 0.00623903, worse
accepted = 71.69%
Gen #17: temp = 0.004257, best score = 0.00297195, cur score = 0.00521329, worse
accepted = 67.81%
Gen #18: temp = 0.004215, best score = 0.00297195, cur score = 0.00698546, worse
accepted = 68.45%
Gen #19: temp = 0.004173, best score = 0.00297195, cur score = 0.00723088, worse
accepted = 76.10%
Gen #20: temp = 0.004131, best score = 0.00297195, cur score = 0.00490021, worse
accepted = 72.35%
Gen #21: temp = 0.004090, best score = 0.00297195, cur score = 0.00541367, worse
accepted = 73.09%
Gen #22: temp = 0.004049, best score = 0.00297195, cur score = 0.01835899, worse
accepted = 67.75%
Gen #23: temp = 0.004008, best score = 0.00297195, cur score = 0.00783818, worse
accepted = 60.04%
Gen #24: temp = 0.003968, best score = 0.00297195, cur score = 0.00885235, worse
accepted = 70.78%
Gen #25: temp = 0.003928, best score = 0.00297195, cur score = 0.00712444, worse
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accepted = 68.50%
Gen #26: temp = 0.003889, best score = 0.00297195, cur score = 0.00725832, worse
accepted = 70.16%
Gen #27: temp = 0.003850, best score = 0.00297195, cur score = 0.00896632, worse
accepted = 71.98%
Gen #28: temp = 0.003812, best score = 0.00297195, cur score = 0.01606299, worse
accepted = 57.97%
Gen #29: temp = 0.003774, best score = 0.00297195, cur score = 0.00810905, worse
accepted = 59.13%
Gen #30: temp = 0.003736, best score = 0.00297195, cur score = 0.01066864, worse
accepted = 68.37%
Gen #31: temp = 0.003699, best score = 0.00297195, cur score = 0.01477920, worse
accepted = 70.36%
Gen #32: temp = 0.003662, best score = 0.00297195, cur score = 0.00675476, worse
accepted = 65.42%
Gen #33: temp = 0.003625, best score = 0.00293493, cur score = 0.00601877, worse
accepted = 72.80%
Gen #34: temp = 0.003589, best score = 0.00293493, cur score = 0.01392322, worse
accepted = 73.46%
Gen #35: temp = 0.003553, best score = 0.00293493, cur score = 0.01305641, worse
accepted = 53.07%
Gen #36: temp = 0.003517, best score = 0.00293493, cur score = 0.01269399, worse
accepted = 62.14%
Gen #37: temp = 0.003482, best score = 0.00293493, cur score = 0.00999861, worse
accepted = 68.18%
Gen #38: temp = 0.003447, best score = 0.00293493, cur score = 0.01093240, worse
accepted = 65.51%
Gen #39: temp = 0.003413, best score = 0.00293493, cur score = 0.00534572, worse
accepted = 64.97%
Gen #40: temp = 0.003379, best score = 0.00293493, cur score = 0.00472213, worse
accepted = 69.65%
Gen #41: temp = 0.003345, best score = 0.00293493, cur score = 0.00855857, worse
accepted = 70.97%
Gen #42: temp = 0.003311, best score = 0.00293493, cur score = 0.01744091, worse
accepted = 66.74%
Gen #43: temp = 0.003278, best score = 0.00293493, cur score = 0.00716274, worse
accepted = 71.20%
Gen #44: temp = 0.003246, best score = 0.00293493, cur score = 0.00558241, worse
accepted = 69.88%
Gen #45: temp = 0.003213, best score = 0.00293493, cur score = 0.01395588, worse
accepted = 62.64%
Gen #46: temp = 0.003181, best score = 0.00293493, cur score = 0.01026171, worse
accepted = 56.15%
Gen #47: temp = 0.003149, best score = 0.00293493, cur score = 0.01187097, worse
accepted = 49.31%
Gen #48: temp = 0.003118, best score = 0.00293493, cur score = 0.01033109, worse
accepted = 55.96%
Gen #49: temp = 0.003086, best score = 0.00293493, cur score = 0.00782246, worse
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accepted = 69.56%
Gen #50: temp = 0.003056, best score = 0.00293493, cur score = 0.00493807, worse
accepted = 66.60%
Gen #51: temp = 0.003025, best score = 0.00293493, cur score = 0.00666093, worse
accepted = 71.24%
Gen #52: temp = 0.002995, best score = 0.00293493, cur score = 0.00494891, worse
accepted = 68.81%
Gen #53: temp = 0.002965, best score = 0.00293493, cur score = 0.00557617, worse
accepted = 59.87%
Gen #54: temp = 0.002935, best score = 0.00293493, cur score = 0.01160005, worse
accepted = 72.85%
Gen #55: temp = 0.002906, best score = 0.00293493, cur score = 0.00596164, worse
accepted = 66.82%
Gen #56: temp = 0.002877, best score = 0.00293493, cur score = 0.00363228, worse
accepted = 68.38%
Gen #57: temp = 0.002848, best score = 0.00293493, cur score = 0.00513568, worse
accepted = 67.14%
Gen #58: temp = 0.002820, best score = 0.00287946, cur score = 0.00577265, worse
accepted = 70.63%
Gen #59: temp = 0.002791, best score = 0.00287946, cur score = 0.00759013, worse
accepted = 67.92%
Gen #60: temp = 0.002763, best score = 0.00287946, cur score = 0.00559028, worse
accepted = 74.38%
Gen #61: temp = 0.002736, best score = 0.00287946, cur score = 0.01013472, worse
accepted = 56.96%
Gen #62: temp = 0.002708, best score = 0.00287946, cur score = 0.01295504, worse
accepted = 55.67%
Gen #63: temp = 0.002681, best score = 0.00287946, cur score = 0.00662852, worse
accepted = 65.98%
Gen #64: temp = 0.002655, best score = 0.00287946, cur score = 0.01223683, worse
accepted = 57.51%
Gen #65: temp = 0.002628, best score = 0.00287946, cur score = 0.01259734, worse
accepted = 55.15%
Gen #66: temp = 0.002602, best score = 0.00287946, cur score = 0.00956170, worse
accepted = 47.08%
Gen #67: temp = 0.002576, best score = 0.00287946, cur score = 0.00672987, worse
accepted = 61.86%
Gen #68: temp = 0.002550, best score = 0.00287946, cur score = 0.00737434, worse
accepted = 58.33%
Gen #69: temp = 0.002524, best score = 0.00287946, cur score = 0.00927032, worse
accepted = 65.93%
Gen #70: temp = 0.002499, best score = 0.00287946, cur score = 0.00540184, worse
accepted = 61.26%
Gen #71: temp = 0.002474, best score = 0.00287946, cur score = 0.01647990, worse
accepted = 61.19%
Gen #72: temp = 0.002449, best score = 0.00287946, cur score = 0.00961566, worse
accepted = 54.69%
Gen #73: temp = 0.002425, best score = 0.00287946, cur score = 0.00622561, worse
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accepted = 58.54%
Gen #74: temp = 0.002401, best score = 0.00287946, cur score = 0.00416707, worse
accepted = 67.01%
Gen #75: temp = 0.002377, best score = 0.00287946, cur score = 0.00705093, worse
accepted = 61.42%
Gen #76: temp = 0.002353, best score = 0.00287946, cur score = 0.00479649, worse
accepted = 58.64%
Gen #77: temp = 0.002329, best score = 0.00287946, cur score = 0.00631337, worse
accepted = 65.68%
Gen #78: temp = 0.002306, best score = 0.00287946, cur score = 0.00539148, worse
accepted = 69.18%
Gen #79: temp = 0.002283, best score = 0.00287946, cur score = 0.00468533, worse
accepted = 64.62%
Gen #80: temp = 0.002260, best score = 0.00287946, cur score = 0.01502199, worse
accepted = 64.30%
Gen #81: temp = 0.002238, best score = 0.00287946, cur score = 0.00668747, worse
accepted = 52.52%
Gen #82: temp = 0.002215, best score = 0.00287946, cur score = 0.00697002, worse
accepted = 58.65%
Gen #83: temp = 0.002193, best score = 0.00287946, cur score = 0.00829976, worse
accepted = 49.62%
Gen #84: temp = 0.002171, best score = 0.00287946, cur score = 0.00607188, worse
accepted = 54.41%
Gen #85: temp = 0.002149, best score = 0.00287946, cur score = 0.01372014, worse
accepted = 58.31%
Gen #86: temp = 0.002128, best score = 0.00287946, cur score = 0.00578419, worse
accepted = 55.20%
Gen #87: temp = 0.002107, best score = 0.00287946, cur score = 0.00466005, worse
accepted = 60.58%
Gen #88: temp = 0.002086, best score = 0.00287946, cur score = 0.00676553, worse
accepted = 59.94%
Gen #89: temp = 0.002065, best score = 0.00287946, cur score = 0.01390481, worse
accepted = 59.83%
Gen #90: temp = 0.002044, best score = 0.00287946, cur score = 0.00608846, worse
accepted = 52.59%
Gen #91: temp = 0.002024, best score = 0.00287946, cur score = 0.00935634, worse
accepted = 62.65%
Gen #92: temp = 0.002003, best score = 0.00287946, cur score = 0.01459849, worse
accepted = 47.19%
Gen #93: temp = 0.001983, best score = 0.00287946, cur score = 0.00421938, worse
accepted = 59.05%
Gen #94: temp = 0.001964, best score = 0.00287946, cur score = 0.00516977, worse
accepted = 59.15%
Gen #95: temp = 0.001944, best score = 0.00287946, cur score = 0.00870168, worse
accepted = 57.21%
Gen #96: temp = 0.001924, best score = 0.00287946, cur score = 0.00847303, worse
accepted = 58.66%
Gen #97: temp = 0.001905, best score = 0.00287946, cur score = 0.00499342, worse
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accepted = 60.88%
Gen #98: temp = 0.001886, best score = 0.00287946, cur score = 0.00689060, worse
accepted = 58.21%
Gen #99: temp = 0.001867, best score = 0.00287946, cur score = 0.00890406, worse
accepted = 62.05%
Gen #100: temp = 0.001849, best score = 0.00287946, cur score = 0.00414666,
worse accepted = 62.07%
Gen #101: temp = 0.001830, best score = 0.00287946, cur score = 0.00525576,
worse accepted = 56.51%
Gen #102: temp = 0.001812, best score = 0.00287946, cur score = 0.00589571,
worse accepted = 64.26%
Gen #103: temp = 0.001794, best score = 0.00287946, cur score = 0.00717275,
worse accepted = 58.86%
Gen #104: temp = 0.001776, best score = 0.00287946, cur score = 0.00513918,
worse accepted = 58.89%
Gen #105: temp = 0.001758, best score = 0.00287946, cur score = 0.00650915,
worse accepted = 57.53%
Gen #106: temp = 0.001740, best score = 0.00287946, cur score = 0.00412560,
worse accepted = 61.13%
Gen #107: temp = 0.001723, best score = 0.00287946, cur score = 0.00554456,
worse accepted = 60.49%
Gen #108: temp = 0.001706, best score = 0.00287946, cur score = 0.00683152,
worse accepted = 62.57%
Gen #109: temp = 0.001689, best score = 0.00287946, cur score = 0.00433841,
worse accepted = 61.37%
Gen #110: temp = 0.001672, best score = 0.00287946, cur score = 0.00606767,
worse accepted = 65.39%
Gen #111: temp = 0.001655, best score = 0.00287946, cur score = 0.00500436,
worse accepted = 58.00%
Gen #112: temp = 0.001639, best score = 0.00287946, cur score = 0.00478540,
worse accepted = 47.34%
Gen #113: temp = 0.001622, best score = 0.00287946, cur score = 0.00636166,
worse accepted = 59.46%
Gen #114: temp = 0.001606, best score = 0.00287946, cur score = 0.00594469,
worse accepted = 53.99%
Gen #115: temp = 0.001590, best score = 0.00287946, cur score = 0.01034374,
worse accepted = 60.85%
Gen #116: temp = 0.001574, best score = 0.00287946, cur score = 0.01075635,
worse accepted = 56.20%
Gen #117: temp = 0.001558, best score = 0.00287946, cur score = 0.00584888,
worse accepted = 60.70%
Gen #118: temp = 0.001543, best score = 0.00287946, cur score = 0.00858750,
worse accepted = 54.91%
Gen #119: temp = 0.001527, best score = 0.00287946, cur score = 0.00923253,
worse accepted = 50.72%
Gen #120: temp = 0.001512, best score = 0.00287946, cur score = 0.01030485,
worse accepted = 50.63%
Gen #121: temp = 0.001497, best score = 0.00287946, cur score = 0.00524454,

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worse accepted = 54.79%
Gen #122: temp = 0.001482, best score = 0.00287946, cur score = 0.00492179,
worse accepted = 59.45%
Gen #123: temp = 0.001467, best score = 0.00287946, cur score = 0.00446049,
worse accepted = 57.80%
Gen #124: temp = 0.001452, best score = 0.00287946, cur score = 0.00560359,
worse accepted = 59.22%
Gen #125: temp = 0.001438, best score = 0.00287946, cur score = 0.00583716,
worse accepted = 48.36%
Gen #126: temp = 0.001424, best score = 0.00287946, cur score = 0.00320223,
worse accepted = 44.58%
Gen #127: temp = 0.001409, best score = 0.00287946, cur score = 0.01018388,
worse accepted = 47.06%
Gen #128: temp = 0.001395, best score = 0.00287946, cur score = 0.00558617,
worse accepted = 39.99%
Gen #129: temp = 0.001381, best score = 0.00287946, cur score = 0.00664850,
worse accepted = 54.13%
Gen #130: temp = 0.001367, best score = 0.00287946, cur score = 0.00604749,
worse accepted = 54.16%
Gen #131: temp = 0.001354, best score = 0.00287946, cur score = 0.00627913,
worse accepted = 53.97%
Gen #132: temp = 0.001340, best score = 0.00287946, cur score = 0.00521210,
worse accepted = 52.95%
Gen #133: temp = 0.001327, best score = 0.00287946, cur score = 0.00782671,
worse accepted = 43.97%
Gen #134: temp = 0.001314, best score = 0.00287946, cur score = 0.00875072,
worse accepted = 38.33%
Gen #135: temp = 0.001300, best score = 0.00287946, cur score = 0.00857434,
worse accepted = 50.40%
Gen #136: temp = 0.001287, best score = 0.00287946, cur score = 0.00824771,
worse accepted = 51.79%
Gen #137: temp = 0.001275, best score = 0.00287946, cur score = 0.00603240,
worse accepted = 51.68%
Gen #138: temp = 0.001262, best score = 0.00287946, cur score = 0.00855489,
worse accepted = 46.49%
Gen #139: temp = 0.001249, best score = 0.00287946, cur score = 0.00968976,
worse accepted = 31.48%
Gen #140: temp = 0.001237, best score = 0.00287946, cur score = 0.00578552,
worse accepted = 41.42%
Gen #141: temp = 0.001224, best score = 0.00287946, cur score = 0.00798135,
worse accepted = 54.07%
Gen #142: temp = 0.001212, best score = 0.00287946, cur score = 0.00539267,
worse accepted = 53.85%
Gen #143: temp = 0.001200, best score = 0.00286175, cur score = 0.00567485,
worse accepted = 52.79%
Gen #144: temp = 0.001188, best score = 0.00286175, cur score = 0.00585484,
worse accepted = 48.20%
Gen #145: temp = 0.001176, best score = 0.00286175, cur score = 0.00370800,
```

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worse accepted = 52.31%
Gen #146: temp = 0.001164, best score = 0.00286175, cur score = 0.00440766,
worse accepted = 56.21%
Gen #147: temp = 0.001153, best score = 0.00286175, cur score = 0.00572344,
worse accepted = 52.95%
Gen #148: temp = 0.001141, best score = 0.00286175, cur score = 0.00511749,
worse accepted = 54.62%
Gen #149: temp = 0.001130, best score = 0.00286175, cur score = 0.00488421,
worse accepted = 54.99%
Gen #150: temp = 0.001118, best score = 0.00286175, cur score = 0.00672787,
worse accepted = 50.37%
Gen #151: temp = 0.001107, best score = 0.00286175, cur score = 0.00648186,
worse accepted = 49.50%
Gen #152: temp = 0.001096, best score = 0.00286175, cur score = 0.00412155,
worse accepted = 46.08%
Gen #153: temp = 0.001085, best score = 0.00286175, cur score = 0.00567046,
worse accepted = 52.20%
Gen #154: temp = 0.001074, best score = 0.00286175, cur score = 0.00448794,
worse accepted = 46.44%
Gen #155: temp = 0.001064, best score = 0.00286175, cur score = 0.00498008,
worse accepted = 47.11%
Gen #156: temp = 0.001053, best score = 0.00286175, cur score = 0.00427379,
worse accepted = 51.11%
Gen #157: temp = 0.001042, best score = 0.00286175, cur score = 0.00680471,
worse accepted = 50.02%
Gen #158: temp = 0.001032, best score = 0.00286175, cur score = 0.00361172,
worse accepted = 51.20%
Gen #159: temp = 0.001022, best score = 0.00286175, cur score = 0.00522094,
worse accepted = 53.73%
Gen #160: temp = 0.001012, best score = 0.00286175, cur score = 0.00465619,
worse accepted = 51.74%
Gen #161: temp = 0.001001, best score = 0.00286175, cur score = 0.00361963,
worse accepted = 47.64%
Gen #162: temp = 0.000991, best score = 0.00286175, cur score = 0.00451247,
worse accepted = 45.49%
Gen #163: temp = 0.000981, best score = 0.00286175, cur score = 0.00770764,
worse accepted = 48.70%
Gen #164: temp = 0.000972, best score = 0.00286175, cur score = 0.00547708,
worse accepted = 50.44%
Gen #165: temp = 0.000962, best score = 0.00286175, cur score = 0.00499907,
worse accepted = 47.83%
Gen #166: temp = 0.000952, best score = 0.00286175, cur score = 0.00573129,
worse accepted = 49.88%
Gen #167: temp = 0.000943, best score = 0.00286175, cur score = 0.00707525,
worse accepted = 54.32%
Gen #168: temp = 0.000933, best score = 0.00286175, cur score = 0.00616356,
worse accepted = 50.21%
Gen #169: temp = 0.000924, best score = 0.00286175, cur score = 0.00521928,
```

worse accepted = 49.19%
Gen #170: temp = 0.000915, best score = 0.00286175, cur score = 0.00468676,
worse accepted = 48.79%
Gen #171: temp = 0.000906, best score = 0.00286175, cur score = 0.00558719,
worse accepted = 46.25%
Gen #172: temp = 0.000897, best score = 0.00286175, cur score = 0.00781400,
worse accepted = 45.49%
Gen #173: temp = 0.000888, best score = 0.00286175, cur score = 0.00599309,
worse accepted = 48.66%
Gen #174: temp = 0.000879, best score = 0.00286175, cur score = 0.00456377,
worse accepted = 48.20%
Gen #175: temp = 0.000870, best score = 0.00286175, cur score = 0.00584968,
worse accepted = 47.41%
Gen #176: temp = 0.000861, best score = 0.00286175, cur score = 0.00483702,
worse accepted = 49.81%
Gen #177: temp = 0.000853, best score = 0.00286175, cur score = 0.00355422,
worse accepted = 48.22%
Gen #178: temp = 0.000844, best score = 0.00286175, cur score = 0.00529684,
worse accepted = 50.35%
Gen #179: temp = 0.000836, best score = 0.00286175, cur score = 0.00411769,
worse accepted = 43.85%
Gen #180: temp = 0.000827, best score = 0.00286175, cur score = 0.00692114,
worse accepted = 33.84%
Gen #181: temp = 0.000819, best score = 0.00286175, cur score = 0.00438348,
worse accepted = 45.84%
Gen #182: temp = 0.000811, best score = 0.00286175, cur score = 0.00462403,
worse accepted = 51.28%
Gen #183: temp = 0.000803, best score = 0.00286175, cur score = 0.00483576,
worse accepted = 44.70%
Gen #184: temp = 0.000795, best score = 0.00286175, cur score = 0.00402692,
worse accepted = 47.10%
Gen #185: temp = 0.000787, best score = 0.00286175, cur score = 0.00417769,
worse accepted = 46.75%
Gen #186: temp = 0.000779, best score = 0.00286175, cur score = 0.00448043,
worse accepted = 46.20%
Gen #187: temp = 0.000771, best score = 0.00286175, cur score = 0.00494327,
worse accepted = 47.68%
Gen #188: temp = 0.000763, best score = 0.00286175, cur score = 0.00427745,
worse accepted = 45.45%
Gen #189: temp = 0.000756, best score = 0.00286175, cur score = 0.00428307,
worse accepted = 47.27%
Gen #190: temp = 0.000748, best score = 0.00286175, cur score = 0.00637407,
worse accepted = 42.31%
Gen #191: temp = 0.000741, best score = 0.00286175, cur score = 0.00353199,
worse accepted = 45.49%
Gen #192: temp = 0.000733, best score = 0.00286175, cur score = 0.00563265,
worse accepted = 40.70%
Gen #193: temp = 0.000726, best score = 0.00286175, cur score = 0.00420624,

worse accepted = 39.28%
Gen #194: temp = 0.000719, best score = 0.00286175, cur score = 0.00416886,
worse accepted = 44.33%
Gen #195: temp = 0.000712, best score = 0.00286175, cur score = 0.00520168,
worse accepted = 42.56%
Gen #196: temp = 0.000704, best score = 0.00286175, cur score = 0.00414149,
worse accepted = 46.23%
Gen #197: temp = 0.000697, best score = 0.00286175, cur score = 0.00348849,
worse accepted = 47.86%
Gen #198: temp = 0.000690, best score = 0.00286175, cur score = 0.00406003,
worse accepted = 40.84%
Gen #199: temp = 0.000684, best score = 0.00286175, cur score = 0.00401412,
worse accepted = 43.04%
Gen #200: temp = 0.000677, best score = 0.00286175, cur score = 0.00372316,
worse accepted = 43.45%
Gen #201: temp = 0.000670, best score = 0.00284769, cur score = 0.00425497,
worse accepted = 46.46%
Gen #202: temp = 0.000663, best score = 0.00284769, cur score = 0.00460428,
worse accepted = 38.54%
Gen #203: temp = 0.000657, best score = 0.00284769, cur score = 0.00354365,
worse accepted = 42.90%
Gen #204: temp = 0.000650, best score = 0.00284769, cur score = 0.00531196,
worse accepted = 42.26%
Gen #205: temp = 0.000644, best score = 0.00284769, cur score = 0.00407907,
worse accepted = 44.73%
Gen #206: temp = 0.000637, best score = 0.00284769, cur score = 0.00400544,
worse accepted = 39.10%
Gen #207: temp = 0.000631, best score = 0.00284769, cur score = 0.00459052,
worse accepted = 39.72%
Gen #208: temp = 0.000624, best score = 0.00284769, cur score = 0.00708697,
worse accepted = 26.22%
Gen #209: temp = 0.000618, best score = 0.00284769, cur score = 0.00587590,
worse accepted = 32.68%
Gen #210: temp = 0.000612, best score = 0.00284769, cur score = 0.00758968,
worse accepted = 41.67%
Gen #211: temp = 0.000606, best score = 0.00284769, cur score = 0.00400884,
worse accepted = 39.38%
Gen #212: temp = 0.000600, best score = 0.00284769, cur score = 0.00342922,
worse accepted = 44.02%
Gen #213: temp = 0.000594, best score = 0.00284769, cur score = 0.00474911,
worse accepted = 48.41%
Gen #214: temp = 0.000588, best score = 0.00284769, cur score = 0.00643216,
worse accepted = 39.10%
Gen #215: temp = 0.000582, best score = 0.00284769, cur score = 0.00348259,
worse accepted = 40.19%
Gen #216: temp = 0.000576, best score = 0.00284769, cur score = 0.00374614,
worse accepted = 43.64%
Gen #217: temp = 0.000570, best score = 0.00284769, cur score = 0.00434640,

worse accepted = 40.08%
Gen #218: temp = 0.000565, best score = 0.00284769, cur score = 0.00364491,
worse accepted = 46.06%
Gen #219: temp = 0.000559, best score = 0.00284769, cur score = 0.00544953,
worse accepted = 40.83%
Gen #220: temp = 0.000553, best score = 0.00284769, cur score = 0.00532885,
worse accepted = 34.72%
Gen #221: temp = 0.000548, best score = 0.00284769, cur score = 0.00536170,
worse accepted = 39.87%
Gen #222: temp = 0.000542, best score = 0.00284769, cur score = 0.00392803,
worse accepted = 37.75%
Gen #223: temp = 0.000537, best score = 0.00284769, cur score = 0.00443143,
worse accepted = 40.11%
Gen #224: temp = 0.000532, best score = 0.00284769, cur score = 0.00481987,
worse accepted = 41.48%
Gen #225: temp = 0.000526, best score = 0.00284769, cur score = 0.00413690,
worse accepted = 44.55%
Gen #226: temp = 0.000521, best score = 0.00284769, cur score = 0.00388925,
worse accepted = 35.49%
Gen #227: temp = 0.000516, best score = 0.00284769, cur score = 0.00387387,
worse accepted = 41.56%
Gen #228: temp = 0.000511, best score = 0.00284769, cur score = 0.00347617,
worse accepted = 40.11%
Gen #229: temp = 0.000506, best score = 0.00284769, cur score = 0.00324119,
worse accepted = 45.13%
Gen #230: temp = 0.000501, best score = 0.00284769, cur score = 0.00399430,
worse accepted = 45.22%
Gen #231: temp = 0.000496, best score = 0.00284769, cur score = 0.00435339,
worse accepted = 40.74%
Gen #232: temp = 0.000491, best score = 0.00284769, cur score = 0.00495855,
worse accepted = 38.88%
Gen #233: temp = 0.000486, best score = 0.00284769, cur score = 0.00393434,
worse accepted = 36.96%
Gen #234: temp = 0.000481, best score = 0.00284769, cur score = 0.00380314,
worse accepted = 45.32%
Gen #235: temp = 0.000476, best score = 0.00284769, cur score = 0.00542517,
worse accepted = 37.11%
Gen #236: temp = 0.000471, best score = 0.00284769, cur score = 0.00370575,
worse accepted = 34.89%
Gen #237: temp = 0.000467, best score = 0.00284769, cur score = 0.00327960,
worse accepted = 38.73%
Gen #238: temp = 0.000462, best score = 0.00284769, cur score = 0.00403495,
worse accepted = 40.66%
Gen #239: temp = 0.000457, best score = 0.00284769, cur score = 0.00475080,
worse accepted = 37.15%
Gen #240: temp = 0.000453, best score = 0.00284769, cur score = 0.00408733,
worse accepted = 38.28%
Gen #241: temp = 0.000448, best score = 0.00284769, cur score = 0.00369312,

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worse accepted = 39.73%
Gen #242: temp = 0.000444, best score = 0.00284769, cur score = 0.00325878,
worse accepted = 40.96%
Gen #243: temp = 0.000439, best score = 0.00284769, cur score = 0.00340720,
worse accepted = 40.65%
Gen #244: temp = 0.000435, best score = 0.00284769, cur score = 0.00332516,
worse accepted = 37.28%
Gen #245: temp = 0.000430, best score = 0.00284769, cur score = 0.00450282,
worse accepted = 40.03%
Gen #246: temp = 0.000426, best score = 0.00284769, cur score = 0.00353347,
worse accepted = 35.41%
Gen #247: temp = 0.000422, best score = 0.00283858, cur score = 0.00502267,
worse accepted = 37.63%
Gen #248: temp = 0.000418, best score = 0.00283858, cur score = 0.00439819,
worse accepted = 37.58%
Gen #249: temp = 0.000414, best score = 0.00283858, cur score = 0.00601839,
worse accepted = 34.44%
Gen #250: temp = 0.000409, best score = 0.00283858, cur score = 0.00433475,
worse accepted = 35.67%
Gen #251: temp = 0.000405, best score = 0.00283858, cur score = 0.00601550,
worse accepted = 33.83%
Gen #252: temp = 0.000401, best score = 0.00283858, cur score = 0.00333251,
worse accepted = 38.52%
Gen #253: temp = 0.000397, best score = 0.00283858, cur score = 0.00396391,
worse accepted = 35.92%
Gen #254: temp = 0.000393, best score = 0.00283858, cur score = 0.00429419,
worse accepted = 41.17%
Gen #255: temp = 0.000389, best score = 0.00283858, cur score = 0.00351672,
worse accepted = 41.23%
Gen #256: temp = 0.000385, best score = 0.00283858, cur score = 0.00403814,
worse accepted = 39.68%
Gen #257: temp = 0.000382, best score = 0.00283858, cur score = 0.00427166,
worse accepted = 36.27%
Gen #258: temp = 0.000378, best score = 0.00283858, cur score = 0.00392413,
worse accepted = 37.11%
Gen #259: temp = 0.000374, best score = 0.00283858, cur score = 0.00342199,
worse accepted = 34.01%
Gen #260: temp = 0.000370, best score = 0.00283858, cur score = 0.00375665,
worse accepted = 40.56%
Gen #261: temp = 0.000367, best score = 0.00283858, cur score = 0.00327172,
worse accepted = 35.35%
Gen #262: temp = 0.000363, best score = 0.00283858, cur score = 0.00383144,
worse accepted = 33.38%
Gen #263: temp = 0.000359, best score = 0.00283858, cur score = 0.00362554,
worse accepted = 41.44%
Gen #264: temp = 0.000356, best score = 0.00283858, cur score = 0.00439319,
worse accepted = 35.87%
Gen #265: temp = 0.000352, best score = 0.00283858, cur score = 0.00321933,
```

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worse accepted = 38.63%
Gen #266: temp = 0.000349, best score = 0.00283858, cur score = 0.00412546,
worse accepted = 34.77%
Gen #267: temp = 0.000345, best score = 0.00283858, cur score = 0.00425785,
worse accepted = 40.41%
Gen #268: temp = 0.000342, best score = 0.00283858, cur score = 0.00357217,
worse accepted = 31.87%
Gen #269: temp = 0.000338, best score = 0.00283858, cur score = 0.00358315,
worse accepted = 34.37%
Gen #270: temp = 0.000335, best score = 0.00283858, cur score = 0.00401719,
worse accepted = 38.94%
Gen #271: temp = 0.000331, best score = 0.00283858, cur score = 0.00363941,
worse accepted = 39.45%
Gen #272: temp = 0.000328, best score = 0.00283858, cur score = 0.00338977,
worse accepted = 35.24%
Gen #273: temp = 0.000325, best score = 0.00283858, cur score = 0.00356643,
worse accepted = 33.85%
Gen #274: temp = 0.000322, best score = 0.00283858, cur score = 0.00393548,
worse accepted = 36.64%
Gen #275: temp = 0.000318, best score = 0.00283858, cur score = 0.00361154,
worse accepted = 35.48%
Gen #276: temp = 0.000315, best score = 0.00283858, cur score = 0.00350177,
worse accepted = 37.20%
Gen #277: temp = 0.000312, best score = 0.00283858, cur score = 0.00405480,
worse accepted = 35.53%
Gen #278: temp = 0.000309, best score = 0.00283858, cur score = 0.00364756,
worse accepted = 35.34%
Gen #279: temp = 0.000306, best score = 0.00283858, cur score = 0.00392668,
worse accepted = 37.27%
Gen #280: temp = 0.000303, best score = 0.00283858, cur score = 0.00326951,
worse accepted = 33.76%
Gen #281: temp = 0.000300, best score = 0.00283858, cur score = 0.00383588,
worse accepted = 33.72%
Gen #282: temp = 0.000297, best score = 0.00283858, cur score = 0.00383288,
worse accepted = 35.79%
Gen #283: temp = 0.000294, best score = 0.00283858, cur score = 0.00409405,
worse accepted = 33.72%
Gen #284: temp = 0.000291, best score = 0.00283858, cur score = 0.00376116,
worse accepted = 33.21%
Gen #285: temp = 0.000288, best score = 0.00283858, cur score = 0.00412064,
worse accepted = 37.95%
Gen #286: temp = 0.000285, best score = 0.00283858, cur score = 0.00366254,
worse accepted = 37.57%
Gen #287: temp = 0.000282, best score = 0.00283858, cur score = 0.00334905,
worse accepted = 35.22%
Gen #288: temp = 0.000279, best score = 0.00283346, cur score = 0.00432704,
worse accepted = 34.94%
Gen #289: temp = 0.000277, best score = 0.00283346, cur score = 0.00303447,
```

worse accepted = 34.01%
Gen #290: temp = 0.000274, best score = 0.00283346, cur score = 0.00371945,
worse accepted = 34.36%
Gen #291: temp = 0.000271, best score = 0.00283346, cur score = 0.00305278,
worse accepted = 37.20%
Gen #292: temp = 0.000268, best score = 0.00283346, cur score = 0.00387241,
worse accepted = 34.67%
Gen #293: temp = 0.000266, best score = 0.00283346, cur score = 0.00405319,
worse accepted = 33.44%
Gen #294: temp = 0.000263, best score = 0.00283346, cur score = 0.00361710,
worse accepted = 36.64%
Gen #295: temp = 0.000260, best score = 0.00283346, cur score = 0.00366893,
worse accepted = 31.35%
Gen #296: temp = 0.000258, best score = 0.00283346, cur score = 0.00387967,
worse accepted = 37.36%
Gen #297: temp = 0.000255, best score = 0.00283346, cur score = 0.00469415,
worse accepted = 34.59%
Gen #298: temp = 0.000253, best score = 0.00283346, cur score = 0.00326819,
worse accepted = 34.59%
Gen #299: temp = 0.000250, best score = 0.00283346, cur score = 0.00339785,
worse accepted = 33.64%
Gen #300: temp = 0.000248, best score = 0.00283346, cur score = 0.00346493,
worse accepted = 33.01%
Gen #301: temp = 0.000245, best score = 0.00283346, cur score = 0.00394576,
worse accepted = 31.23%
Gen #302: temp = 0.000243, best score = 0.00283346, cur score = 0.00413621,
worse accepted = 32.75%
Gen #303: temp = 0.000240, best score = 0.00283346, cur score = 0.00381947,
worse accepted = 34.82%
Gen #304: temp = 0.000238, best score = 0.00283346, cur score = 0.00375674,
worse accepted = 35.66%
Gen #305: temp = 0.000236, best score = 0.00283346, cur score = 0.00337396,
worse accepted = 33.16%
Gen #306: temp = 0.000233, best score = 0.00283346, cur score = 0.00352497,
worse accepted = 35.81%
Gen #307: temp = 0.000231, best score = 0.00283346, cur score = 0.00343903,
worse accepted = 32.74%
Gen #308: temp = 0.000229, best score = 0.00283346, cur score = 0.00364593,
worse accepted = 36.12%
Gen #309: temp = 0.000226, best score = 0.00283346, cur score = 0.00367564,
worse accepted = 34.42%
Gen #310: temp = 0.000224, best score = 0.00283346, cur score = 0.00383557,
worse accepted = 35.97%
Gen #311: temp = 0.000222, best score = 0.00283346, cur score = 0.00327276,
worse accepted = 34.00%
Gen #312: temp = 0.000220, best score = 0.00283346, cur score = 0.00336214,
worse accepted = 31.43%
Gen #313: temp = 0.000217, best score = 0.00283346, cur score = 0.00325907,

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worse accepted = 33.64%
Gen #314: temp = 0.000215, best score = 0.00283346, cur score = 0.00350538,
worse accepted = 31.84%
Gen #315: temp = 0.000213, best score = 0.00283346, cur score = 0.00401977,
worse accepted = 33.80%
Gen #316: temp = 0.000211, best score = 0.00283346, cur score = 0.00381578,
worse accepted = 32.68%
Gen #317: temp = 0.000209, best score = 0.00283346, cur score = 0.00413603,
worse accepted = 33.23%
Gen #318: temp = 0.000207, best score = 0.00283346, cur score = 0.00341393,
worse accepted = 34.35%
Gen #319: temp = 0.000205, best score = 0.00283346, cur score = 0.00330159,
worse accepted = 33.41%
Gen #320: temp = 0.000203, best score = 0.00283346, cur score = 0.00350142,
worse accepted = 35.81%
Gen #321: temp = 0.000201, best score = 0.00283346, cur score = 0.00336162,
worse accepted = 33.67%
Gen #322: temp = 0.000199, best score = 0.00283346, cur score = 0.00319137,
worse accepted = 31.36%
Gen #323: temp = 0.000197, best score = 0.00283346, cur score = 0.00354270,
worse accepted = 32.23%
Gen #324: temp = 0.000195, best score = 0.00283346, cur score = 0.00293282,
worse accepted = 32.72%
Gen #325: temp = 0.000193, best score = 0.00283346, cur score = 0.00350827,
worse accepted = 33.47%
Gen #326: temp = 0.000191, best score = 0.00283346, cur score = 0.00321704,
worse accepted = 36.21%
Gen #327: temp = 0.000189, best score = 0.00283346, cur score = 0.00354204,
worse accepted = 30.80%
Gen #328: temp = 0.000187, best score = 0.00283346, cur score = 0.00367597,
worse accepted = 31.91%
Gen #329: temp = 0.000185, best score = 0.00283346, cur score = 0.00342863,
worse accepted = 31.05%
Gen #330: temp = 0.000183, best score = 0.00283346, cur score = 0.00373266,
worse accepted = 32.15%
Gen #331: temp = 0.000181, best score = 0.00283346, cur score = 0.00334955,
worse accepted = 33.32%
Gen #332: temp = 0.000180, best score = 0.00283346, cur score = 0.00325833,
worse accepted = 33.50%
Gen #333: temp = 0.000178, best score = 0.00283346, cur score = 0.00345343,
worse accepted = 31.80%
Gen #334: temp = 0.000176, best score = 0.00283346, cur score = 0.00317624,
worse accepted = 31.74%
Gen #335: temp = 0.000174, best score = 0.00283346, cur score = 0.00332207,
worse accepted = 32.16%
Gen #336: temp = 0.000172, best score = 0.00283346, cur score = 0.00335720,
worse accepted = 30.93%
Gen #337: temp = 0.000171, best score = 0.00283346, cur score = 0.00340713,
```

worse accepted = 32.06%
Gen #338: temp = 0.000169, best score = 0.00283346, cur score = 0.00316022,
worse accepted = 30.33%
Gen #339: temp = 0.000167, best score = 0.00283346, cur score = 0.00331467,
worse accepted = 32.16%
Gen #340: temp = 0.000166, best score = 0.00283346, cur score = 0.00328111,
worse accepted = 30.74%
Gen #341: temp = 0.000164, best score = 0.00283346, cur score = 0.00330673,
worse accepted = 31.07%
Gen #342: temp = 0.000162, best score = 0.00283346, cur score = 0.00343381,
worse accepted = 32.10%
Gen #343: temp = 0.000161, best score = 0.00283346, cur score = 0.00422966,
worse accepted = 30.92%
Gen #344: temp = 0.000159, best score = 0.00283346, cur score = 0.00346662,
worse accepted = 30.94%
Gen #345: temp = 0.000158, best score = 0.00283346, cur score = 0.00307936,
worse accepted = 32.84%
Gen #346: temp = 0.000156, best score = 0.00283346, cur score = 0.00363938,
worse accepted = 31.86%
Gen #347: temp = 0.000154, best score = 0.00283346, cur score = 0.00352118,
worse accepted = 31.64%
Gen #348: temp = 0.000153, best score = 0.00283346, cur score = 0.00315949,
worse accepted = 31.27%
Gen #349: temp = 0.000151, best score = 0.00283196, cur score = 0.00378359,
worse accepted = 30.13%
Gen #350: temp = 0.000150, best score = 0.00283196, cur score = 0.00303060,
worse accepted = 31.33%
Gen #351: temp = 0.000148, best score = 0.00283196, cur score = 0.00311583,
worse accepted = 32.03%
Gen #352: temp = 0.000147, best score = 0.00283196, cur score = 0.00342673,
worse accepted = 31.44%
Gen #353: temp = 0.000145, best score = 0.00283196, cur score = 0.00329439,
worse accepted = 27.58%
Gen #354: temp = 0.000144, best score = 0.00283196, cur score = 0.00329877,
worse accepted = 29.78%
Gen #355: temp = 0.000143, best score = 0.00283196, cur score = 0.00319289,
worse accepted = 29.53%
Gen #356: temp = 0.000141, best score = 0.00283196, cur score = 0.00319428,
worse accepted = 30.65%
Gen #357: temp = 0.000140, best score = 0.00283196, cur score = 0.00293741,
worse accepted = 27.77%
Gen #358: temp = 0.000138, best score = 0.00283196, cur score = 0.00338254,
worse accepted = 28.40%
Gen #359: temp = 0.000137, best score = 0.00283196, cur score = 0.00311604,
worse accepted = 30.29%
Gen #360: temp = 0.000136, best score = 0.00283196, cur score = 0.00308451,
worse accepted = 28.35%
Gen #361: temp = 0.000134, best score = 0.00283196, cur score = 0.00401681,

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worse accepted = 31.15%
Gen #362: temp = 0.000133, best score = 0.00283196, cur score = 0.00359335,
worse accepted = 28.57%
Gen #363: temp = 0.000131, best score = 0.00283196, cur score = 0.00313533,
worse accepted = 27.97%
Gen #364: temp = 0.000130, best score = 0.00283196, cur score = 0.00323016,
worse accepted = 27.69%
Gen #365: temp = 0.000129, best score = 0.00283196, cur score = 0.00321666,
worse accepted = 29.19%
Gen #366: temp = 0.000128, best score = 0.00283196, cur score = 0.00311159,
worse accepted = 31.06%
Gen #367: temp = 0.000126, best score = 0.00283156, cur score = 0.00367714,
worse accepted = 28.64%
Gen #368: temp = 0.000125, best score = 0.00283156, cur score = 0.00328634,
worse accepted = 28.85%
Gen #369: temp = 0.000124, best score = 0.00283156, cur score = 0.00306739,
worse accepted = 28.45%
Gen #370: temp = 0.000123, best score = 0.00283156, cur score = 0.00333467,
worse accepted = 29.33%
Gen #371: temp = 0.000121, best score = 0.00283156, cur score = 0.00307132,
worse accepted = 28.22%
Gen #372: temp = 0.000120, best score = 0.00283156, cur score = 0.00312397,
worse accepted = 27.57%
Gen #373: temp = 0.000119, best score = 0.00283156, cur score = 0.00325459,
worse accepted = 27.96%
Gen #374: temp = 0.000118, best score = 0.00283156, cur score = 0.00320241,
worse accepted = 28.95%
Gen #375: temp = 0.000117, best score = 0.00283156, cur score = 0.00361556,
worse accepted = 27.15%
Gen #376: temp = 0.000115, best score = 0.00283156, cur score = 0.00328264,
worse accepted = 27.27%
Gen #377: temp = 0.000114, best score = 0.00283156, cur score = 0.00332525,
worse accepted = 27.53%
Gen #378: temp = 0.000113, best score = 0.00283156, cur score = 0.00316158,
worse accepted = 28.19%
Gen #379: temp = 0.000112, best score = 0.00283156, cur score = 0.00346503,
worse accepted = 27.17%
Gen #380: temp = 0.000111, best score = 0.00283106, cur score = 0.00317393,
worse accepted = 26.21%
Gen #381: temp = 0.000110, best score = 0.00283106, cur score = 0.00308470,
worse accepted = 27.00%
Gen #382: temp = 0.000109, best score = 0.00283025, cur score = 0.00341707,
worse accepted = 27.88%
Gen #383: temp = 0.000108, best score = 0.00283025, cur score = 0.00310908,
worse accepted = 27.34%
Gen #384: temp = 0.000106, best score = 0.00283025, cur score = 0.00327609,
worse accepted = 26.23%
Gen #385: temp = 0.000105, best score = 0.00283025, cur score = 0.00330903,
```

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worse accepted = 25.98%
Gen #386: temp = 0.000104, best score = 0.00283025, cur score = 0.00318075,
worse accepted = 27.37%
Gen #387: temp = 0.000103, best score = 0.00283025, cur score = 0.00341394,
worse accepted = 26.19%
Gen #388: temp = 0.000102, best score = 0.00283025, cur score = 0.00315199,
worse accepted = 26.25%
Gen #389: temp = 0.000101, best score = 0.00283025, cur score = 0.00311542,
worse accepted = 24.73%
Gen #390: temp = 0.000100, best score = 0.00283025, cur score = 0.00334141,
worse accepted = 26.11%
Gen #391: temp = 0.000099, best score = 0.00282929, cur score = 0.00332603,
worse accepted = 25.58%
Gen #392: temp = 0.000098, best score = 0.00282929, cur score = 0.00337138,
worse accepted = 26.55%
Gen #393: temp = 0.000097, best score = 0.00282416, cur score = 0.00317540,
worse accepted = 24.68%
Gen #394: temp = 0.000096, best score = 0.00282416, cur score = 0.00318262,
worse accepted = 24.80%
Gen #395: temp = 0.000095, best score = 0.00282416, cur score = 0.00317133,
worse accepted = 25.64%
Gen #396: temp = 0.000094, best score = 0.00282416, cur score = 0.00313790,
worse accepted = 24.95%
Gen #397: temp = 0.000093, best score = 0.00282416, cur score = 0.00293301,
worse accepted = 25.59%
Gen #398: temp = 0.000093, best score = 0.00282416, cur score = 0.00329960,
worse accepted = 24.68%
Gen #399: temp = 0.000092, best score = 0.00282416, cur score = 0.00306885,
worse accepted = 24.42%
Gen #400: temp = 0.000091, best score = 0.00282416, cur score = 0.00309206,
worse accepted = 25.41%
Gen #401: temp = 0.000090, best score = 0.00282416, cur score = 0.00325206,
worse accepted = 24.93%
Gen #402: temp = 0.000089, best score = 0.00282416, cur score = 0.00299695,
worse accepted = 24.05%
Gen #403: temp = 0.000088, best score = 0.00282416, cur score = 0.00300985,
worse accepted = 24.80%
Gen #404: temp = 0.000087, best score = 0.00282416, cur score = 0.00326606,
worse accepted = 24.61%
Gen #405: temp = 0.000086, best score = 0.00282416, cur score = 0.00297155,
worse accepted = 24.53%
Gen #406: temp = 0.000085, best score = 0.00282416, cur score = 0.00319977,
worse accepted = 22.92%
Gen #407: temp = 0.000085, best score = 0.00282416, cur score = 0.00304300,
worse accepted = 23.37%
Gen #408: temp = 0.000084, best score = 0.00282416, cur score = 0.00292776,
worse accepted = 24.26%
Gen #409: temp = 0.000083, best score = 0.00282416, cur score = 0.00306791,
```

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worse accepted = 23.61%
Gen #410: temp = 0.000082, best score = 0.00282416, cur score = 0.00307513,
worse accepted = 21.92%
Gen #411: temp = 0.000081, best score = 0.00282416, cur score = 0.00290300,
worse accepted = 24.09%
Gen #412: temp = 0.000080, best score = 0.00282416, cur score = 0.00303366,
worse accepted = 24.41%
Gen #413: temp = 0.000080, best score = 0.00282416, cur score = 0.00316418,
worse accepted = 22.18%
Gen #414: temp = 0.000079, best score = 0.00282416, cur score = 0.00317120,
worse accepted = 22.67%
Gen #415: temp = 0.000078, best score = 0.00282416, cur score = 0.00337665,
worse accepted = 22.62%
Gen #416: temp = 0.000077, best score = 0.00282416, cur score = 0.00316829,
worse accepted = 21.62%
Gen #417: temp = 0.000076, best score = 0.00282416, cur score = 0.00312139,
worse accepted = 23.46%
Gen #418: temp = 0.000076, best score = 0.00282416, cur score = 0.00329086,
worse accepted = 22.37%
Gen #419: temp = 0.000075, best score = 0.00282416, cur score = 0.00319318,
worse accepted = 21.15%
Gen #420: temp = 0.000074, best score = 0.00282416, cur score = 0.00297867,
worse accepted = 21.98%
Gen #421: temp = 0.000073, best score = 0.00282416, cur score = 0.00307976,
worse accepted = 22.06%
Gen #422: temp = 0.000073, best score = 0.00282416, cur score = 0.00290097,
worse accepted = 21.94%
Gen #423: temp = 0.000072, best score = 0.00282416, cur score = 0.00306365,
worse accepted = 22.23%
Gen #424: temp = 0.000071, best score = 0.00282416, cur score = 0.00327460,
worse accepted = 20.66%
Gen #425: temp = 0.000071, best score = 0.00282416, cur score = 0.00305063,
worse accepted = 21.23%
Gen #426: temp = 0.000070, best score = 0.00282416, cur score = 0.00317834,
worse accepted = 20.96%
Gen #427: temp = 0.000069, best score = 0.00282416, cur score = 0.00307637,
worse accepted = 20.64%
Gen #428: temp = 0.000068, best score = 0.00282416, cur score = 0.00298102,
worse accepted = 20.46%
Gen #429: temp = 0.000068, best score = 0.00282416, cur score = 0.00298027,
worse accepted = 20.55%
Gen #430: temp = 0.000067, best score = 0.00282416, cur score = 0.00328853,
worse accepted = 20.07%
Gen #431: temp = 0.000066, best score = 0.00282416, cur score = 0.00302328,
worse accepted = 19.74%
Gen #432: temp = 0.000066, best score = 0.00282416, cur score = 0.00291540,
worse accepted = 20.18%
Gen #433: temp = 0.000065, best score = 0.00282416, cur score = 0.00338063,
```

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worse accepted = 20.04%
Gen #434: temp = 0.000064, best score = 0.00282416, cur score = 0.00293208,
worse accepted = 19.35%
Gen #435: temp = 0.000064, best score = 0.00282416, cur score = 0.00297290,
worse accepted = 19.48%
Gen #436: temp = 0.000063, best score = 0.00282248, cur score = 0.00302655,
worse accepted = 18.87%
Gen #437: temp = 0.000063, best score = 0.00282248, cur score = 0.00287512,
worse accepted = 19.62%
Gen #438: temp = 0.000062, best score = 0.00282248, cur score = 0.00300607,
worse accepted = 19.38%
Gen #439: temp = 0.000061, best score = 0.00282248, cur score = 0.00294849,
worse accepted = 19.64%
Gen #440: temp = 0.000061, best score = 0.00282248, cur score = 0.00311865,
worse accepted = 18.36%
Gen #441: temp = 0.000060, best score = 0.00282248, cur score = 0.00297553,
worse accepted = 18.48%
Gen #442: temp = 0.000059, best score = 0.00282248, cur score = 0.00297300,
worse accepted = 17.96%
Gen #443: temp = 0.000059, best score = 0.00282248, cur score = 0.00324756,
worse accepted = 17.80%
Gen #444: temp = 0.000058, best score = 0.00282219, cur score = 0.00299208,
worse accepted = 17.90%
Gen #445: temp = 0.000058, best score = 0.00282219, cur score = 0.00300225,
worse accepted = 17.52%
Gen #446: temp = 0.000057, best score = 0.00282219, cur score = 0.00291859,
worse accepted = 18.38%
Gen #447: temp = 0.000057, best score = 0.00282219, cur score = 0.00295711,
worse accepted = 18.10%
Gen #448: temp = 0.000056, best score = 0.00282219, cur score = 0.00316881,
worse accepted = 17.49%
Gen #449: temp = 0.000055, best score = 0.00282219, cur score = 0.00314429,
worse accepted = 18.02%
Gen #450: temp = 0.000055, best score = 0.00282219, cur score = 0.00304792,
worse accepted = 17.42%
Gen #451: temp = 0.000054, best score = 0.00282219, cur score = 0.00298298,
worse accepted = 16.92%
Gen #452: temp = 0.000054, best score = 0.00282219, cur score = 0.00298003,
worse accepted = 16.84%
Gen #453: temp = 0.000053, best score = 0.00282219, cur score = 0.00289152,
worse accepted = 16.85%
Gen #454: temp = 0.000053, best score = 0.00282219, cur score = 0.00301534,
worse accepted = 15.95%
Gen #455: temp = 0.000052, best score = 0.00282219, cur score = 0.00287780,
worse accepted = 16.13%
Gen #456: temp = 0.000052, best score = 0.00282219, cur score = 0.00293497,
worse accepted = 16.62%
Gen #457: temp = 0.000051, best score = 0.00282219, cur score = 0.00313175,
```

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worse accepted = 16.56%
Gen #458: temp = 0.000051, best score = 0.00282219, cur score = 0.00296076,
worse accepted = 15.44%
Gen #459: temp = 0.000050, best score = 0.00282219, cur score = 0.00316384,
worse accepted = 15.25%
Gen #460: temp = 0.000050, best score = 0.00282219, cur score = 0.00332034,
worse accepted = 15.80%
Gen #461: temp = 0.000049, best score = 0.00282219, cur score = 0.00295157,
worse accepted = 16.03%
Gen #462: temp = 0.000049, best score = 0.00282219, cur score = 0.00326543,
worse accepted = 14.44%
Gen #463: temp = 0.000048, best score = 0.00282219, cur score = 0.00307215,
worse accepted = 15.81%
Gen #464: temp = 0.000048, best score = 0.00282219, cur score = 0.00297171,
worse accepted = 15.53%
Gen #465: temp = 0.000047, best score = 0.00282219, cur score = 0.00301132,
worse accepted = 15.57%
Gen #466: temp = 0.000047, best score = 0.00282219, cur score = 0.00301011,
worse accepted = 14.86%
Gen #467: temp = 0.000046, best score = 0.00282219, cur score = 0.00296821,
worse accepted = 14.95%
Gen #468: temp = 0.000046, best score = 0.00282219, cur score = 0.00290026,
worse accepted = 14.33%
Gen #469: temp = 0.000045, best score = 0.00282219, cur score = 0.00301054,
worse accepted = 14.12%
Gen #470: temp = 0.000045, best score = 0.00282219, cur score = 0.00312726,
worse accepted = 14.28%
Gen #471: temp = 0.000044, best score = 0.00282219, cur score = 0.00291117,
worse accepted = 13.71%
Gen #472: temp = 0.000044, best score = 0.00282219, cur score = 0.00297550,
worse accepted = 13.63%
Gen #473: temp = 0.000044, best score = 0.00282219, cur score = 0.00288680,
worse accepted = 12.88%
Gen #474: temp = 0.000043, best score = 0.00282219, cur score = 0.00291398,
worse accepted = 13.38%
Gen #475: temp = 0.000043, best score = 0.00282219, cur score = 0.00284984,
worse accepted = 12.51%
Gen #476: temp = 0.000042, best score = 0.00282219, cur score = 0.00299897,
worse accepted = 13.34%
Gen #477: temp = 0.000042, best score = 0.00282219, cur score = 0.00294121,
worse accepted = 13.06%
Gen #478: temp = 0.000041, best score = 0.00282219, cur score = 0.00291496,
worse accepted = 13.23%
Gen #479: temp = 0.000041, best score = 0.00282219, cur score = 0.00298813,
worse accepted = 12.70%
Gen #480: temp = 0.000041, best score = 0.00282219, cur score = 0.00295943,
worse accepted = 12.33%
Gen #481: temp = 0.000040, best score = 0.00282219, cur score = 0.00286982,
```

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worse accepted = 12.38%
Gen #482: temp = 0.000040, best score = 0.00282219, cur score = 0.00300660,
worse accepted = 11.43%
Gen #483: temp = 0.000039, best score = 0.00282219, cur score = 0.00289306,
worse accepted = 11.57%
Gen #484: temp = 0.000039, best score = 0.00282219, cur score = 0.00306311,
worse accepted = 12.13%
Gen #485: temp = 0.000039, best score = 0.00282219, cur score = 0.00285517,
worse accepted = 11.85%
Gen #486: temp = 0.000038, best score = 0.00282219, cur score = 0.00290394,
worse accepted = 11.88%
Gen #487: temp = 0.000038, best score = 0.00282219, cur score = 0.00286158,
worse accepted = 11.52%
Gen #488: temp = 0.000037, best score = 0.00282219, cur score = 0.00293109,
worse accepted = 11.99%
Gen #489: temp = 0.000037, best score = 0.00282219, cur score = 0.00294789,
worse accepted = 11.56%
Gen #490: temp = 0.000037, best score = 0.00282219, cur score = 0.00292417,
worse accepted = 11.08%
Gen #491: temp = 0.000036, best score = 0.00282219, cur score = 0.00289892,
worse accepted = 10.97%
Gen #492: temp = 0.000036, best score = 0.00282219, cur score = 0.00299058,
worse accepted = 11.42%
Gen #493: temp = 0.000036, best score = 0.00282219, cur score = 0.00295790,
worse accepted = 10.70%
Gen #494: temp = 0.000035, best score = 0.00282219, cur score = 0.00286657,
worse accepted = 10.36%
Gen #495: temp = 0.000035, best score = 0.00282219, cur score = 0.00291087,
worse accepted = 10.12%
Gen #496: temp = 0.000035, best score = 0.00282219, cur score = 0.00293411,
worse accepted = 11.10%
Gen #497: temp = 0.000034, best score = 0.00282219, cur score = 0.00293074,
worse accepted = 10.73%
Gen #498: temp = 0.000034, best score = 0.00282219, cur score = 0.00300786,
worse accepted = 10.38%
Gen #499: temp = 0.000034, best score = 0.00282213, cur score = 0.00291279,
worse accepted = 9.02%
Gen #500: temp = 0.000033, best score = 0.00282213, cur score = 0.00304889,
worse accepted = 10.02%
Gen #501: temp = 0.000033, best score = 0.00282213, cur score = 0.00291249,
worse accepted = 9.91%
Gen #502: temp = 0.000033, best score = 0.00282213, cur score = 0.00302089,
worse accepted = 8.88%
Gen #503: temp = 0.000032, best score = 0.00282213, cur score = 0.00287835,
worse accepted = 9.10%
Gen #504: temp = 0.000032, best score = 0.00282213, cur score = 0.00289055,
worse accepted = 9.35%
Gen #505: temp = 0.000032, best score = 0.00282213, cur score = 0.00290252,
```

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worse accepted = 9.59%
Gen #506: temp = 0.000031, best score = 0.00282213, cur score = 0.00287883,
worse accepted = 9.30%
Gen #507: temp = 0.000031, best score = 0.00282136, cur score = 0.00298077,
worse accepted = 8.84%
Gen #508: temp = 0.000031, best score = 0.00282136, cur score = 0.00295538,
worse accepted = 8.59%
Gen #509: temp = 0.000030, best score = 0.00282136, cur score = 0.00289345,
worse accepted = 8.23%
Gen #510: temp = 0.000030, best score = 0.00282136, cur score = 0.00284305,
worse accepted = 8.27%
Gen #511: temp = 0.000030, best score = 0.00282136, cur score = 0.00294507,
worse accepted = 8.69%
Gen #512: temp = 0.000029, best score = 0.00282136, cur score = 0.00286342,
worse accepted = 8.27%
Gen #513: temp = 0.000029, best score = 0.00282136, cur score = 0.00305153,
worse accepted = 8.74%
Gen #514: temp = 0.000029, best score = 0.00282136, cur score = 0.00288190,
worse accepted = 8.26%
Gen #515: temp = 0.000029, best score = 0.00282136, cur score = 0.00288607,
worse accepted = 7.91%
Gen #516: temp = 0.000028, best score = 0.00282136, cur score = 0.00291321,
worse accepted = 8.01%
Gen #517: temp = 0.000028, best score = 0.00282136, cur score = 0.00288123,
worse accepted = 7.25%
Gen #518: temp = 0.000028, best score = 0.00282136, cur score = 0.00290829,
worse accepted = 7.81%
Gen #519: temp = 0.000027, best score = 0.00282136, cur score = 0.00287886,
worse accepted = 7.86%
Gen #520: temp = 0.000027, best score = 0.00282136, cur score = 0.00287065,
worse accepted = 7.51%
Gen #521: temp = 0.000027, best score = 0.00282136, cur score = 0.00296617,
worse accepted = 7.09%
Gen #522: temp = 0.000027, best score = 0.00282136, cur score = 0.00286787,
worse accepted = 7.26%
Gen #523: temp = 0.000026, best score = 0.00282136, cur score = 0.00287433,
worse accepted = 6.99%
Gen #524: temp = 0.000026, best score = 0.00282136, cur score = 0.00290396,
worse accepted = 6.75%
Gen #525: temp = 0.000026, best score = 0.00282136, cur score = 0.00284775,
worse accepted = 6.17%
Gen #526: temp = 0.000026, best score = 0.00282136, cur score = 0.00288401,
worse accepted = 6.27%
Gen #527: temp = 0.000025, best score = 0.00282136, cur score = 0.00284651,
worse accepted = 6.64%
Gen #528: temp = 0.000025, best score = 0.00282136, cur score = 0.00295083,
worse accepted = 7.21%
Gen #529: temp = 0.000025, best score = 0.00282136, cur score = 0.00293081,
```

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worse accepted = 6.47%
Gen #530: temp = 0.000025, best score = 0.00282136, cur score = 0.00288071,
worse accepted = 6.41%
Gen #531: temp = 0.000024, best score = 0.00282136, cur score = 0.00291006,
worse accepted = 6.43%
Gen #532: temp = 0.000024, best score = 0.00282136, cur score = 0.00293089,
worse accepted = 6.06%
Gen #533: temp = 0.000024, best score = 0.00282136, cur score = 0.00287187,
worse accepted = 6.20%
Gen #534: temp = 0.000024, best score = 0.00282136, cur score = 0.00290818,
worse accepted = 6.23%
Gen #535: temp = 0.000023, best score = 0.00282136, cur score = 0.00288600,
worse accepted = 6.04%
Gen #536: temp = 0.000023, best score = 0.00282136, cur score = 0.00288886,
worse accepted = 5.86%
Gen #537: temp = 0.000023, best score = 0.00282136, cur score = 0.00284614,
worse accepted = 5.49%
Gen #538: temp = 0.000023, best score = 0.00282136, cur score = 0.00291827,
worse accepted = 5.60%
Gen #539: temp = 0.000022, best score = 0.00282136, cur score = 0.00288483,
worse accepted = 5.66%
Gen #540: temp = 0.000022, best score = 0.00282136, cur score = 0.00284859,
worse accepted = 5.71%
Gen #541: temp = 0.000022, best score = 0.00282136, cur score = 0.00289810,
worse accepted = 5.17%
Gen #542: temp = 0.000022, best score = 0.00282132, cur score = 0.00284695,
worse accepted = 5.26%
Gen #543: temp = 0.000022, best score = 0.00282132, cur score = 0.00292086,
worse accepted = 4.44%
Gen #544: temp = 0.000021, best score = 0.00282132, cur score = 0.00288782,
worse accepted = 4.81%
Gen #545: temp = 0.000021, best score = 0.00282132, cur score = 0.00286645,
worse accepted = 5.03%
Gen #546: temp = 0.000021, best score = 0.00282132, cur score = 0.00286365,
worse accepted = 4.89%
Gen #547: temp = 0.000021, best score = 0.00282132, cur score = 0.00284353,
worse accepted = 5.04%
Gen #548: temp = 0.000020, best score = 0.00282132, cur score = 0.00292203,
worse accepted = 4.45%
Gen #549: temp = 0.000020, best score = 0.00282132, cur score = 0.00285805,
worse accepted = 4.47%
Gen #550: temp = 0.000020, best score = 0.00282132, cur score = 0.00286653,
worse accepted = 4.76%
Gen #551: temp = 0.000020, best score = 0.00282132, cur score = 0.00303883,
worse accepted = 4.06%
Gen #552: temp = 0.000020, best score = 0.00282132, cur score = 0.00286539,
worse accepted = 4.55%
Gen #553: temp = 0.000019, best score = 0.00282132, cur score = 0.00285427,
```

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worse accepted = 4.21%
Gen #554: temp = 0.000019, best score = 0.00282132, cur score = 0.00288976,
worse accepted = 4.03%
Gen #555: temp = 0.000019, best score = 0.00282132, cur score = 0.00286773,
worse accepted = 4.27%
Gen #556: temp = 0.000019, best score = 0.00282132, cur score = 0.00292980,
worse accepted = 4.26%
Gen #557: temp = 0.000019, best score = 0.00282132, cur score = 0.00285311,
worse accepted = 4.07%
Gen #558: temp = 0.000019, best score = 0.00282132, cur score = 0.00285351,
worse accepted = 4.10%
Gen #559: temp = 0.000018, best score = 0.00282132, cur score = 0.00289700,
worse accepted = 3.64%
Gen #560: temp = 0.000018, best score = 0.00282132, cur score = 0.00286724,
worse accepted = 4.08%
Gen #561: temp = 0.000018, best score = 0.00282132, cur score = 0.00287050,
worse accepted = 3.98%
Gen #562: temp = 0.000018, best score = 0.00282132, cur score = 0.00289897,
worse accepted = 4.15%
Gen #563: temp = 0.000018, best score = 0.00282132, cur score = 0.00286589,
worse accepted = 3.47%
Gen #564: temp = 0.000017, best score = 0.00282132, cur score = 0.00282930,
worse accepted = 3.64%
Gen #565: temp = 0.000017, best score = 0.00282132, cur score = 0.00286064,
worse accepted = 3.65%
Gen #566: temp = 0.000017, best score = 0.00282132, cur score = 0.00293640,
worse accepted = 3.52%
Gen #567: temp = 0.000017, best score = 0.00282132, cur score = 0.00287652,
worse accepted = 3.23%
Gen #568: temp = 0.000017, best score = 0.00282132, cur score = 0.00291825,
worse accepted = 3.51%
Gen #569: temp = 0.000017, best score = 0.00282132, cur score = 0.00287924,
worse accepted = 3.09%
Gen #570: temp = 0.000016, best score = 0.00282132, cur score = 0.00284054,
worse accepted = 2.76%
Gen #571: temp = 0.000016, best score = 0.00282132, cur score = 0.00286019,
worse accepted = 2.86%
Gen #572: temp = 0.000016, best score = 0.00282132, cur score = 0.00283216,
worse accepted = 2.84%
Gen #573: temp = 0.000016, best score = 0.00282132, cur score = 0.00284651,
worse accepted = 2.77%
Gen #574: temp = 0.000016, best score = 0.00282132, cur score = 0.00283461,
worse accepted = 2.78%
Gen #575: temp = 0.000016, best score = 0.00282132, cur score = 0.00283920,
worse accepted = 2.70%
Gen #576: temp = 0.000015, best score = 0.00282132, cur score = 0.00285464,
worse accepted = 2.65%
Gen #577: temp = 0.000015, best score = 0.00282132, cur score = 0.00283937,
```

worse accepted = 2.57%
Gen #578: temp = 0.000015, best score = 0.00282132, cur score = 0.00287595,
worse accepted = 2.88%
Gen #579: temp = 0.000015, best score = 0.00282132, cur score = 0.00287899,
worse accepted = 2.81%
Gen #580: temp = 0.000015, best score = 0.00282132, cur score = 0.00284660,
worse accepted = 3.18%
Gen #581: temp = 0.000015, best score = 0.00282132, cur score = 0.00290848,
worse accepted = 2.68%
Gen #582: temp = 0.000015, best score = 0.00282132, cur score = 0.00286498,
worse accepted = 2.60%
Gen #583: temp = 0.000014, best score = 0.00282132, cur score = 0.00286015,
worse accepted = 2.80%
Gen #584: temp = 0.000014, best score = 0.00282132, cur score = 0.00293042,
worse accepted = 2.29%
Gen #585: temp = 0.000014, best score = 0.00282132, cur score = 0.00285819,
worse accepted = 2.09%
Gen #586: temp = 0.000014, best score = 0.00282132, cur score = 0.00285705,
worse accepted = 2.88%
Gen #587: temp = 0.000014, best score = 0.00282132, cur score = 0.00286861,
worse accepted = 2.22%
Gen #588: temp = 0.000014, best score = 0.00282132, cur score = 0.00286340,
worse accepted = 2.36%
Gen #589: temp = 0.000014, best score = 0.00282132, cur score = 0.00285679,
worse accepted = 1.88%
Gen #590: temp = 0.000013, best score = 0.00282132, cur score = 0.00284610,
worse accepted = 1.70%
Gen #591: temp = 0.000013, best score = 0.00282132, cur score = 0.00288084,
worse accepted = 2.25%
Gen #592: temp = 0.000013, best score = 0.00282132, cur score = 0.00283567,
worse accepted = 2.06%
Gen #593: temp = 0.000013, best score = 0.00282132, cur score = 0.00284570,
worse accepted = 2.13%
Gen #594: temp = 0.000013, best score = 0.00282132, cur score = 0.00284248,
worse accepted = 1.94%
Gen #595: temp = 0.000013, best score = 0.00282132, cur score = 0.00288254,
worse accepted = 2.01%
Gen #596: temp = 0.000013, best score = 0.00282132, cur score = 0.00292695,
worse accepted = 1.92%
Gen #597: temp = 0.000013, best score = 0.00282132, cur score = 0.00285985,
worse accepted = 1.73%
Gen #598: temp = 0.000012, best score = 0.00282132, cur score = 0.00283028,
worse accepted = 1.84%
Gen #599: temp = 0.000012, best score = 0.00282132, cur score = 0.00284204,
worse accepted = 1.27%
Gen #600: temp = 0.000012, best score = 0.00282132, cur score = 0.00288582,
worse accepted = 1.57%
Gen #601: temp = 0.000012, best score = 0.00282132, cur score = 0.00284430,

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worse accepted = 1.73%
Gen #602: temp = 0.000012, best score = 0.00282132, cur score = 0.00286552,
worse accepted = 1.41%
Gen #603: temp = 0.000012, best score = 0.00282132, cur score = 0.00286594,
worse accepted = 1.69%
Gen #604: temp = 0.000012, best score = 0.00282132, cur score = 0.00283771,
worse accepted = 1.68%
Gen #605: temp = 0.000012, best score = 0.00282132, cur score = 0.00285434,
worse accepted = 1.57%
Gen #606: temp = 0.000011, best score = 0.00282132, cur score = 0.00289186,
worse accepted = 1.67%
Gen #607: temp = 0.000011, best score = 0.00282132, cur score = 0.00287713,
worse accepted = 1.47%
Gen #608: temp = 0.000011, best score = 0.00282132, cur score = 0.00288649,
worse accepted = 1.23%
Gen #609: temp = 0.000011, best score = 0.00282132, cur score = 0.00290146,
worse accepted = 1.51%
Gen #610: temp = 0.000011, best score = 0.00282132, cur score = 0.00284911,
worse accepted = 1.80%
Gen #611: temp = 0.000011, best score = 0.00282132, cur score = 0.00282780,
worse accepted = 1.46%
Gen #612: temp = 0.000011, best score = 0.00282132, cur score = 0.00284970,
worse accepted = 1.36%
Gen #613: temp = 0.000011, best score = 0.00282132, cur score = 0.00285884,
worse accepted = 1.42%
Gen #614: temp = 0.000011, best score = 0.00282132, cur score = 0.00286223,
worse accepted = 1.23%
Gen #615: temp = 0.000010, best score = 0.00282132, cur score = 0.00286708,
worse accepted = 1.15%
Gen #616: temp = 0.000010, best score = 0.00282132, cur score = 0.00283153,
worse accepted = 1.28%
Gen #617: temp = 0.000010, best score = 0.00282132, cur score = 0.00283591,
worse accepted = 1.30%
Gen #618: temp = 0.000010, best score = 0.00282132, cur score = 0.00283431,
worse accepted = 1.17%
Gen #619: temp = 0.000010, best score = 0.00282132, cur score = 0.00284349,
worse accepted = 1.35%
Gen #620: temp = 0.000010, best score = 0.00282132, cur score = 0.00284006,
worse accepted = 1.13%
Gen #621: temp = 0.000010, best score = 0.00282132, cur score = 0.00283400,
worse accepted = 1.35%
Gen #622: temp = 0.000010, best score = 0.00282132, cur score = 0.00289257,
worse accepted = 0.86%
Gen #623: temp = 0.000010, best score = 0.00282132, cur score = 0.00283279,
worse accepted = 0.85%
Gen #624: temp = 0.000010, best score = 0.00282132, cur score = 0.00282299,
worse accepted = 0.76%
Gen #625: temp = 0.000009, best score = 0.00282132, cur score = 0.00285261,
```

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worse accepted = 1.09%
Gen #626: temp = 0.000009, best score = 0.00282105, cur score = 0.00282105,
worse accepted = 1.04%
Gen #627: temp = 0.000009, best score = 0.00282105, cur score = 0.00285694,
worse accepted = 0.92%
Gen #628: temp = 0.000009, best score = 0.00282105, cur score = 0.00284282,
worse accepted = 0.96%
Gen #629: temp = 0.000009, best score = 0.00282105, cur score = 0.00284850,
worse accepted = 0.73%
Gen #630: temp = 0.000009, best score = 0.00282105, cur score = 0.00282814,
worse accepted = 0.82%
Gen #631: temp = 0.000009, best score = 0.00282105, cur score = 0.00284910,
worse accepted = 0.93%
Gen #632: temp = 0.000009, best score = 0.00282105, cur score = 0.00283305,
worse accepted = 0.89%
Gen #633: temp = 0.000009, best score = 0.00282105, cur score = 0.00284157,
worse accepted = 0.71%
Gen #634: temp = 0.000009, best score = 0.00282105, cur score = 0.00285467,
worse accepted = 0.73%
Gen #635: temp = 0.000009, best score = 0.00282105, cur score = 0.00283200,
worse accepted = 0.88%
Gen #636: temp = 0.000008, best score = 0.00282105, cur score = 0.00284800,
worse accepted = 0.80%
Gen #637: temp = 0.000008, best score = 0.00282105, cur score = 0.00283455,
worse accepted = 0.71%
Gen #638: temp = 0.000008, best score = 0.00282105, cur score = 0.00284066,
worse accepted = 0.64%
Gen #639: temp = 0.000008, best score = 0.00282105, cur score = 0.00286012,
worse accepted = 0.64%
Gen #640: temp = 0.000008, best score = 0.00282105, cur score = 0.00287860,
worse accepted = 0.90%
Gen #641: temp = 0.000008, best score = 0.00282105, cur score = 0.00282484,
worse accepted = 0.83%
Gen #642: temp = 0.000008, best score = 0.00282105, cur score = 0.00284426,
worse accepted = 0.64%
Gen #643: temp = 0.000008, best score = 0.00282105, cur score = 0.00283898,
worse accepted = 0.47%
Gen #644: temp = 0.000008, best score = 0.00282105, cur score = 0.00284643,
worse accepted = 0.67%
Gen #645: temp = 0.000008, best score = 0.00282105, cur score = 0.00286386,
worse accepted = 0.79%
Gen #646: temp = 0.000008, best score = 0.00282105, cur score = 0.00284218,
worse accepted = 0.67%
Gen #647: temp = 0.000008, best score = 0.00282105, cur score = 0.00282681,
worse accepted = 0.51%
Gen #648: temp = 0.000007, best score = 0.00282105, cur score = 0.00282909,
worse accepted = 0.73%
Gen #649: temp = 0.000007, best score = 0.00282105, cur score = 0.00286585,
```
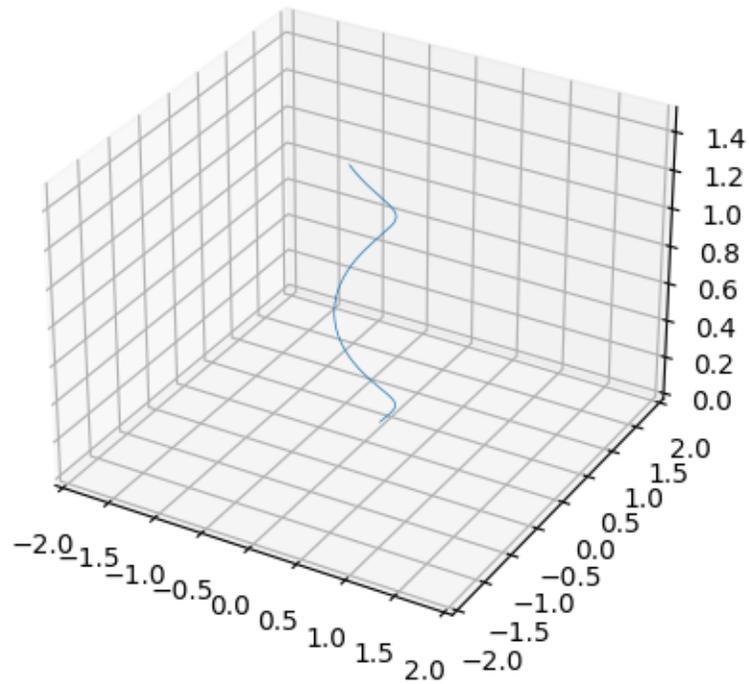
worse accepted = 0.61%
Gen #650: temp = 0.000007, best score = 0.00282105, cur score = 0.00283665,
worse accepted = 0.60%
Gen #651: temp = 0.000007, best score = 0.00282105, cur score = 0.00285322,
worse accepted = 0.52%
Gen #652: temp = 0.000007, best score = 0.00282105, cur score = 0.00285483,
worse accepted = 0.44%
Gen #653: temp = 0.000007, best score = 0.00282105, cur score = 0.00284551,
worse accepted = 0.58%
Gen #654: temp = 0.000007, best score = 0.00282105, cur score = 0.00282549,
worse accepted = 0.45%
Gen #655: temp = 0.000007, best score = 0.00282105, cur score = 0.00284578,
worse accepted = 0.42%
Gen #656: temp = 0.000007, best score = 0.00282105, cur score = 0.00282737,
worse accepted = 0.34%
Gen #657: temp = 0.000007, best score = 0.00282105, cur score = 0.00285043,
worse accepted = 0.40%
Gen #658: temp = 0.000007, best score = 0.00282105, cur score = 0.00283860,
worse accepted = 0.30%
Gen #659: temp = 0.000007, best score = 0.00282105, cur score = 0.00283036,
worse accepted = 0.21%
Gen #660: temp = 0.000007, best score = 0.00282105, cur score = 0.00283740,
worse accepted = 0.46%
Gen #661: temp = 0.000007, best score = 0.00282105, cur score = 0.00284003,
worse accepted = 0.53%
Gen #662: temp = 0.000007, best score = 0.00282105, cur score = 0.00284637,
worse accepted = 0.51%
Gen #663: temp = 0.000006, best score = 0.00282105, cur score = 0.00283404,
worse accepted = 0.39%
Gen #664: temp = 0.000006, best score = 0.00282105, cur score = 0.00285471,
worse accepted = 0.17%
Gen #665: temp = 0.000006, best score = 0.00282105, cur score = 0.00283656,
worse accepted = 0.34%
Gen #666: temp = 0.000006, best score = 0.00282105, cur score = 0.00282579,
worse accepted = 0.34%
Gen #667: temp = 0.000006, best score = 0.00282105, cur score = 0.00283747,
worse accepted = 0.21%
Gen #668: temp = 0.000006, best score = 0.00282105, cur score = 0.00282355,
worse accepted = 0.14%
Gen #669: temp = 0.000006, best score = 0.00282105, cur score = 0.00283737,
worse accepted = 0.37%
Gen #670: temp = 0.000006, best score = 0.00282105, cur score = 0.00282615,
worse accepted = 0.23%
Gen #671: temp = 0.000006, best score = 0.00282105, cur score = 0.00282540,
worse accepted = 0.29%
Gen #672: temp = 0.000006, best score = 0.00282105, cur score = 0.00283415,
worse accepted = 0.26%
Gen #673: temp = 0.000006, best score = 0.00282105, cur score = 0.00284762,

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worse accepted = 0.35%
Gen #674: temp = 0.000006, best score = 0.00282105, cur score = 0.00283126,
worse accepted = 0.41%
Gen #675: temp = 0.000006, best score = 0.00282105, cur score = 0.00283839,
worse accepted = 0.39%
Gen #676: temp = 0.000006, best score = 0.00282105, cur score = 0.00283502,
worse accepted = 0.40%
Gen #677: temp = 0.000006, best score = 0.00282105, cur score = 0.00283919,
worse accepted = 0.29%
Gen #678: temp = 0.000006, best score = 0.00282105, cur score = 0.00284260,
worse accepted = 0.15%
Gen #679: temp = 0.000005, best score = 0.00282105, cur score = 0.00284812,
worse accepted = 0.30%
Gen #680: temp = 0.000005, best score = 0.00282105, cur score = 0.00283939,
worse accepted = 0.34%
Gen #681: temp = 0.000005, best score = 0.00282105, cur score = 0.00283094,
worse accepted = 0.18%
Gen #682: temp = 0.000005, best score = 0.00282105, cur score = 0.00283838,
worse accepted = 0.29%
Gen #683: temp = 0.000005, best score = 0.00282105, cur score = 0.00283565,
worse accepted = 0.31%
Gen #684: temp = 0.000005, best score = 0.00282105, cur score = 0.00282926,
worse accepted = 0.26%
Gen #685: temp = 0.000005, best score = 0.00282105, cur score = 0.00282465,
worse accepted = 0.07%
Gen #686: temp = 0.000005, best score = 0.00282105, cur score = 0.00284387,
worse accepted = 0.03%
Gen #687: temp = 0.000005, best score = 0.00282105, cur score = 0.00284009,
worse accepted = 0.25%
Gen #688: temp = 0.000005, best score = 0.00282105, cur score = 0.00283351,
worse accepted = 0.30%
```

[172]: `best_sol`

[172]: (2.00047299141416, 0.2820535920314379, 0.050001582733134944)

[173]: `show_spring(*best_sol)`

```
[ ]:

[ ]:

[174]: sol = best_sol
       print(g1(*sol), g2(*sol), g3(*sol), g4(*sol))
```

-0.00043559870799891875 -0.23532009817822297 -43.1275212628269
-0.7786298834902847

```
[175]: score(*sol)
```

[175]: 0.0028210480328007986

```
[96]:

[ ]:

[ ]:

[ ]:

[ ]:
```

[ ]:

[ ]: