

Lecture 13 - Knapsack Example

March 31, 2021

```
[115]: import math
import numpy
import random

def random_item():
    weight = round(random.random() * 50,2)
    value = round(numpy.random.normal(weight, 10, 1)[0],2)
    while value < 0:
        value = round(numpy.random.normal(weight, 10, 1)[0],2)
    return (weight, value)

def random_data(N):
    items = [random_item() for i in range(N)]
    capacity = max(1, round(random.random() * sum(item[0] for item in items)))
    return (items, capacity)

N = 4
print(random_data(N))
```

```
(([(18.72, 6.92), (49.05, 29.64), (46.82, 50.39), (5.04, 0.86)], 52)
```

0.0.1 We will represent each solution in the search space as a set of the indices of the items it contains.

For example, {0, 2} means the items (17.95, 36.31) and (35.63, 16.47).

```
[116]: def random_solution(N):
sol = set()
for i in range(N):
    if random.randint(0,1) == 0:
        sol.add(i)
return sol
```

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[117]: random_solution(N)
```

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[117]: {0, 1, 3}
```

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[118]: def greedy_solution(items, capacity):

    by_density = sorted(enumerate(items), key=lambda e: e[1][1]/e[1][0],
↳reverse=True)
    remaining_capacity = capacity
    sol = set()

    for (index, item) in by_density:
        if item[0] <= remaining_capacity:
            sol.add(index)
            remaining_capacity -= item[1]
    return sol
```

[]:

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[119]: def tweak(sol, N):

    index = random.randint(1, N-1)
    new_sol = set(sol)

    if index in new_sol:
        new_sol.remove(index)
    else:
        new_sol.add(index)

    return new_sol
```

```
[124]: # def score(sol, item):
    # if we have exceeded capacity:
    #     return 0
    #     return sum(items[ind][1] for ind in sol)
```

```
[129]: def score(sol, items, capacity):
    mu = 5
    value = sum(items[ind][1] for ind in sol)
    excess_weight = max(sum(items[ind][0] for ind in sol) - capacity, 0)
    return value * (1 - mu*excess_weight/capacity)
```

[]:

```
[130]: # 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 = 100
    alpha = 0.99
    final_temp = initial_temp / 2000
    trials_per_temp = 1000
```

```

N = 100
items, capacity = random_data(N)
sol = random_solution(N)
value = score(sol, items, capacity)
print("Greedy sol:", score(greedy_solution(items, capacity), items, capacity))

```

Greedy sol: 1707.7900000000002

```

[131]: temp = initial_temp
generation = 0
best_sol = None
best_score = None

print("capacity:", capacity)
while temp >= final_temp:
    generation += 1
    accepted_worse = 0
    total_worse = 0
    for i in range(trials_per_temp):
        new_sol = tweak(sol, N)
        new_value = score(new_sol, items, capacity)

        delta = new_value - value
        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

    print(
        f"Gen #{generation}: temp = {round(temp,2):.2f}, "
        f"best = {round(best_score,2):.2f}, best weight = {sum(items[ind][0]
→for ind in best_sol):.2f}, "
        f"cur score = {round(value,2):.2f}, "
        f"worse accepted = {round(accepted_worse/total_worse*100,2):.2f}%"
    )
    temp *= alpha

```

capacity: 1711

Gen #1: temp = 100.00, best = 1638.02, best weight = 1688.94, cur score = 1413.40, worse accepted = 80.84%
Gen #2: temp = 99.00, best = 1675.15, best weight = 1708.44, cur score = 1476.25, worse accepted = 79.39%
Gen #3: temp = 98.01, best = 1675.15, best weight = 1708.44, cur score = 1387.61, worse accepted = 77.17%
Gen #4: temp = 97.03, best = 1675.15, best weight = 1708.44, cur score = 1383.26, worse accepted = 76.99%
Gen #5: temp = 96.06, best = 1732.98, best weight = 1694.77, cur score = 1393.15, worse accepted = 76.90%
Gen #6: temp = 95.10, best = 1733.76, best weight = 1704.50, cur score = 1387.54, worse accepted = 76.60%
Gen #7: temp = 94.15, best = 1746.92, best weight = 1709.88, cur score = 1567.06, worse accepted = 77.12%
Gen #8: temp = 93.21, best = 1746.92, best weight = 1709.88, cur score = 1396.05, worse accepted = 79.43%
Gen #9: temp = 92.27, best = 1746.92, best weight = 1709.88, cur score = 1455.01, worse accepted = 75.92%
Gen #10: temp = 91.35, best = 1746.92, best weight = 1709.88, cur score = 1451.47, worse accepted = 78.25%
Gen #11: temp = 90.44, best = 1746.92, best weight = 1709.88, cur score = 1103.52, worse accepted = 76.98%
Gen #12: temp = 89.53, best = 1746.92, best weight = 1709.88, cur score = 1343.38, worse accepted = 76.20%
Gen #13: temp = 88.64, best = 1746.92, best weight = 1709.88, cur score = 1590.11, worse accepted = 75.31%
Gen #14: temp = 87.75, best = 1746.92, best weight = 1709.88, cur score = 1592.02, worse accepted = 75.44%
Gen #15: temp = 86.87, best = 1746.92, best weight = 1709.88, cur score = 1500.19, worse accepted = 74.78%
Gen #16: temp = 86.01, best = 1746.92, best weight = 1709.88, cur score = 1338.32, worse accepted = 74.65%
Gen #17: temp = 85.15, best = 1746.92, best weight = 1709.88, cur score = 1567.71, worse accepted = 75.89%
Gen #18: temp = 84.29, best = 1752.68, best weight = 1706.23, cur score = 1399.20, worse accepted = 74.01%
Gen #19: temp = 83.45, best = 1752.68, best weight = 1706.23, cur score = 1177.75, worse accepted = 73.75%
Gen #20: temp = 82.62, best = 1752.68, best weight = 1706.23, cur score = 1317.44, worse accepted = 77.76%
Gen #21: temp = 81.79, best = 1752.68, best weight = 1706.23, cur score = 1526.86, worse accepted = 75.49%
Gen #22: temp = 80.97, best = 1752.68, best weight = 1706.23, cur score = 1430.36, worse accepted = 74.44%
Gen #23: temp = 80.16, best = 1752.68, best weight = 1706.23, cur score = 1317.84, worse accepted = 75.26%
Gen #24: temp = 79.36, best = 1752.68, best weight = 1706.23, cur score =

1579.72, worse accepted = 75.22%
Gen #25: temp = 78.57, best = 1752.68, best weight = 1706.23, cur score =
1402.09, worse accepted = 76.14%
Gen #26: temp = 77.78, best = 1752.68, best weight = 1706.23, cur score =
1288.66, worse accepted = 72.26%
Gen #27: temp = 77.00, best = 1752.68, best weight = 1706.23, cur score =
1466.11, worse accepted = 76.02%
Gen #28: temp = 76.23, best = 1752.68, best weight = 1706.23, cur score =
1492.58, worse accepted = 76.77%
Gen #29: temp = 75.47, best = 1752.68, best weight = 1706.23, cur score =
1349.37, worse accepted = 69.19%
Gen #30: temp = 74.72, best = 1752.68, best weight = 1706.23, cur score =
1467.80, worse accepted = 69.68%
Gen #31: temp = 73.97, best = 1752.68, best weight = 1706.23, cur score =
1541.97, worse accepted = 73.52%
Gen #32: temp = 73.23, best = 1752.68, best weight = 1706.23, cur score =
1606.02, worse accepted = 69.24%
Gen #33: temp = 72.50, best = 1752.68, best weight = 1706.23, cur score =
1471.79, worse accepted = 75.57%
Gen #34: temp = 71.77, best = 1752.68, best weight = 1706.23, cur score =
1643.57, worse accepted = 70.57%
Gen #35: temp = 71.06, best = 1756.52, best weight = 1697.83, cur score =
1569.96, worse accepted = 68.50%
Gen #36: temp = 70.34, best = 1756.52, best weight = 1697.83, cur score =
1591.70, worse accepted = 69.57%
Gen #37: temp = 69.64, best = 1756.52, best weight = 1697.83, cur score =
1388.19, worse accepted = 68.87%
Gen #38: temp = 68.94, best = 1756.52, best weight = 1697.83, cur score =
1358.32, worse accepted = 71.65%
Gen #39: temp = 68.26, best = 1756.52, best weight = 1697.83, cur score =
1558.28, worse accepted = 67.97%
Gen #40: temp = 67.57, best = 1756.52, best weight = 1697.83, cur score =
1126.12, worse accepted = 73.46%
Gen #41: temp = 66.90, best = 1756.52, best weight = 1697.83, cur score =
1606.14, worse accepted = 65.04%
Gen #42: temp = 66.23, best = 1756.52, best weight = 1697.83, cur score =
1490.55, worse accepted = 68.57%
Gen #43: temp = 65.57, best = 1756.52, best weight = 1697.83, cur score =
1374.91, worse accepted = 66.28%
Gen #44: temp = 64.91, best = 1756.52, best weight = 1697.83, cur score =
1638.78, worse accepted = 67.29%
Gen #45: temp = 64.26, best = 1756.52, best weight = 1697.83, cur score =
1228.37, worse accepted = 68.22%
Gen #46: temp = 63.62, best = 1756.52, best weight = 1697.83, cur score =
1459.07, worse accepted = 71.99%
Gen #47: temp = 62.98, best = 1756.52, best weight = 1697.83, cur score =
1402.33, worse accepted = 68.75%
Gen #48: temp = 62.35, best = 1756.52, best weight = 1697.83, cur score =

1426.04, worse accepted = 65.12%
Gen #49: temp = 61.73, best = 1756.52, best weight = 1697.83, cur score = 1513.13, worse accepted = 68.60%
Gen #50: temp = 61.11, best = 1756.52, best weight = 1697.83, cur score = 1510.78, worse accepted = 66.01%
Gen #51: temp = 60.50, best = 1756.52, best weight = 1697.83, cur score = 1546.93, worse accepted = 65.62%
Gen #52: temp = 59.90, best = 1756.52, best weight = 1697.83, cur score = 1578.98, worse accepted = 66.28%
Gen #53: temp = 59.30, best = 1756.52, best weight = 1697.83, cur score = 1377.67, worse accepted = 66.83%
Gen #54: temp = 58.70, best = 1756.52, best weight = 1697.83, cur score = 1347.51, worse accepted = 63.34%
Gen #55: temp = 58.12, best = 1756.52, best weight = 1697.83, cur score = 1679.09, worse accepted = 64.95%
Gen #56: temp = 57.54, best = 1756.52, best weight = 1697.83, cur score = 1424.16, worse accepted = 63.93%
Gen #57: temp = 56.96, best = 1756.52, best weight = 1697.83, cur score = 1550.38, worse accepted = 66.11%
Gen #58: temp = 56.39, best = 1756.52, best weight = 1697.83, cur score = 1468.09, worse accepted = 63.41%
Gen #59: temp = 55.83, best = 1756.52, best weight = 1697.83, cur score = 1350.56, worse accepted = 64.70%
Gen #60: temp = 55.27, best = 1756.52, best weight = 1697.83, cur score = 1427.33, worse accepted = 66.00%
Gen #61: temp = 54.72, best = 1756.52, best weight = 1697.83, cur score = 1547.88, worse accepted = 62.79%
Gen #62: temp = 54.17, best = 1756.52, best weight = 1697.83, cur score = 1433.74, worse accepted = 63.86%
Gen #63: temp = 53.63, best = 1756.52, best weight = 1697.83, cur score = 1639.89, worse accepted = 64.59%
Gen #64: temp = 53.09, best = 1756.52, best weight = 1697.83, cur score = 1508.53, worse accepted = 64.98%
Gen #65: temp = 52.56, best = 1756.52, best weight = 1697.83, cur score = 1677.75, worse accepted = 59.11%
Gen #66: temp = 52.03, best = 1756.52, best weight = 1697.83, cur score = 1582.28, worse accepted = 60.13%
Gen #67: temp = 51.51, best = 1756.52, best weight = 1697.83, cur score = 1560.12, worse accepted = 64.38%
Gen #68: temp = 51.00, best = 1756.52, best weight = 1697.83, cur score = 1446.40, worse accepted = 59.65%
Gen #69: temp = 50.49, best = 1756.52, best weight = 1697.83, cur score = 1530.09, worse accepted = 61.87%
Gen #70: temp = 49.98, best = 1756.52, best weight = 1697.83, cur score = 1593.09, worse accepted = 64.19%
Gen #71: temp = 49.48, best = 1756.52, best weight = 1697.83, cur score = 1573.48, worse accepted = 62.62%
Gen #72: temp = 48.99, best = 1756.52, best weight = 1697.83, cur score =

1698.44, worse accepted = 64.03%
Gen #73: temp = 48.50, best = 1756.52, best weight = 1697.83, cur score = 1575.69, worse accepted = 61.39%
Gen #74: temp = 48.01, best = 1756.52, best weight = 1697.83, cur score = 1642.06, worse accepted = 60.71%
Gen #75: temp = 47.53, best = 1756.52, best weight = 1697.83, cur score = 1654.50, worse accepted = 56.79%
Gen #76: temp = 47.06, best = 1756.52, best weight = 1697.83, cur score = 1541.12, worse accepted = 63.05%
Gen #77: temp = 46.59, best = 1756.52, best weight = 1697.83, cur score = 1500.25, worse accepted = 60.51%
Gen #78: temp = 46.12, best = 1756.52, best weight = 1697.83, cur score = 1608.88, worse accepted = 53.65%
Gen #79: temp = 45.66, best = 1756.52, best weight = 1697.83, cur score = 1449.36, worse accepted = 59.91%
Gen #80: temp = 45.20, best = 1756.52, best weight = 1697.83, cur score = 1436.64, worse accepted = 61.00%
Gen #81: temp = 44.75, best = 1756.52, best weight = 1697.83, cur score = 1548.91, worse accepted = 58.86%
Gen #82: temp = 44.30, best = 1756.52, best weight = 1697.83, cur score = 1636.61, worse accepted = 59.81%
Gen #83: temp = 43.86, best = 1756.52, best weight = 1697.83, cur score = 1666.22, worse accepted = 56.83%
Gen #84: temp = 43.42, best = 1756.52, best weight = 1697.83, cur score = 1589.57, worse accepted = 54.45%
Gen #85: temp = 42.99, best = 1756.52, best weight = 1697.83, cur score = 1580.12, worse accepted = 55.04%
Gen #86: temp = 42.56, best = 1756.52, best weight = 1697.83, cur score = 1489.49, worse accepted = 56.29%
Gen #87: temp = 42.13, best = 1756.52, best weight = 1697.83, cur score = 1550.38, worse accepted = 53.62%
Gen #88: temp = 41.71, best = 1756.52, best weight = 1697.83, cur score = 1517.41, worse accepted = 53.30%
Gen #89: temp = 41.29, best = 1756.52, best weight = 1697.83, cur score = 1534.69, worse accepted = 59.33%
Gen #90: temp = 40.88, best = 1756.52, best weight = 1697.83, cur score = 1671.78, worse accepted = 53.91%
Gen #91: temp = 40.47, best = 1756.52, best weight = 1697.83, cur score = 1676.88, worse accepted = 51.22%
Gen #92: temp = 40.07, best = 1756.52, best weight = 1697.83, cur score = 1553.29, worse accepted = 51.36%
Gen #93: temp = 39.67, best = 1775.28, best weight = 1711.20, cur score = 1475.51, worse accepted = 53.96%
Gen #94: temp = 39.27, best = 1775.28, best weight = 1711.20, cur score = 1619.56, worse accepted = 52.81%
Gen #95: temp = 38.88, best = 1775.28, best weight = 1711.20, cur score = 1654.47, worse accepted = 54.93%
Gen #96: temp = 38.49, best = 1792.44, best weight = 1686.45, cur score =

1723.09, worse accepted = 48.36%
Gen #97: temp = 38.10, best = 1792.44, best weight = 1686.45, cur score = 1664.01, worse accepted = 52.05%
Gen #98: temp = 37.72, best = 1792.44, best weight = 1686.45, cur score = 1584.97, worse accepted = 55.92%
Gen #99: temp = 37.35, best = 1792.44, best weight = 1686.45, cur score = 1656.19, worse accepted = 51.87%
Gen #100: temp = 36.97, best = 1792.44, best weight = 1686.45, cur score = 1604.40, worse accepted = 45.34%
Gen #101: temp = 36.60, best = 1792.44, best weight = 1686.45, cur score = 1618.91, worse accepted = 47.44%
Gen #102: temp = 36.24, best = 1792.44, best weight = 1686.45, cur score = 1642.24, worse accepted = 50.00%
Gen #103: temp = 35.87, best = 1792.44, best weight = 1686.45, cur score = 1597.04, worse accepted = 45.48%
Gen #104: temp = 35.52, best = 1792.44, best weight = 1686.45, cur score = 1566.52, worse accepted = 47.94%
Gen #105: temp = 35.16, best = 1792.44, best weight = 1686.45, cur score = 1614.82, worse accepted = 51.20%
Gen #106: temp = 34.81, best = 1792.44, best weight = 1686.45, cur score = 1551.67, worse accepted = 49.10%
Gen #107: temp = 34.46, best = 1792.44, best weight = 1686.45, cur score = 1486.83, worse accepted = 52.27%
Gen #108: temp = 34.12, best = 1792.44, best weight = 1686.45, cur score = 1576.08, worse accepted = 48.28%
Gen #109: temp = 33.78, best = 1792.44, best weight = 1686.45, cur score = 1528.47, worse accepted = 47.58%
Gen #110: temp = 33.44, best = 1792.44, best weight = 1686.45, cur score = 1671.88, worse accepted = 49.92%
Gen #111: temp = 33.10, best = 1792.44, best weight = 1686.45, cur score = 1699.20, worse accepted = 47.58%
Gen #112: temp = 32.77, best = 1792.44, best weight = 1686.45, cur score = 1653.09, worse accepted = 44.94%
Gen #113: temp = 32.44, best = 1792.44, best weight = 1686.45, cur score = 1575.03, worse accepted = 44.76%
Gen #114: temp = 32.12, best = 1792.44, best weight = 1686.45, cur score = 1461.49, worse accepted = 45.44%
Gen #115: temp = 31.80, best = 1792.44, best weight = 1686.45, cur score = 1647.50, worse accepted = 42.47%
Gen #116: temp = 31.48, best = 1792.44, best weight = 1686.45, cur score = 1651.12, worse accepted = 46.40%
Gen #117: temp = 31.17, best = 1792.44, best weight = 1686.45, cur score = 1760.52, worse accepted = 47.50%
Gen #118: temp = 30.85, best = 1792.44, best weight = 1686.45, cur score = 1520.07, worse accepted = 45.90%
Gen #119: temp = 30.55, best = 1792.44, best weight = 1686.45, cur score = 1700.66, worse accepted = 44.56%
Gen #120: temp = 30.24, best = 1792.44, best weight = 1686.45, cur score =

1678.20, worse accepted = 44.95%
Gen #121: temp = 29.94, best = 1792.44, best weight = 1686.45, cur score = 1654.59, worse accepted = 42.31%
Gen #122: temp = 29.64, best = 1792.44, best weight = 1686.45, cur score = 1607.72, worse accepted = 41.90%
Gen #123: temp = 29.34, best = 1792.44, best weight = 1686.45, cur score = 1550.54, worse accepted = 42.28%
Gen #124: temp = 29.05, best = 1792.44, best weight = 1686.45, cur score = 1578.64, worse accepted = 45.60%
Gen #125: temp = 28.76, best = 1792.44, best weight = 1686.45, cur score = 1567.52, worse accepted = 44.62%
Gen #126: temp = 28.47, best = 1792.44, best weight = 1686.45, cur score = 1721.47, worse accepted = 40.97%
Gen #127: temp = 28.19, best = 1792.44, best weight = 1686.45, cur score = 1561.63, worse accepted = 43.89%
Gen #128: temp = 27.90, best = 1807.60, best weight = 1709.07, cur score = 1617.22, worse accepted = 39.14%
Gen #129: temp = 27.63, best = 1807.60, best weight = 1709.07, cur score = 1630.46, worse accepted = 41.33%
Gen #130: temp = 27.35, best = 1807.60, best weight = 1709.07, cur score = 1710.29, worse accepted = 43.14%
Gen #131: temp = 27.08, best = 1807.60, best weight = 1709.07, cur score = 1644.79, worse accepted = 37.24%
Gen #132: temp = 26.80, best = 1807.60, best weight = 1709.07, cur score = 1617.28, worse accepted = 37.73%
Gen #133: temp = 26.54, best = 1807.60, best weight = 1709.07, cur score = 1637.08, worse accepted = 38.67%
Gen #134: temp = 26.27, best = 1807.60, best weight = 1709.07, cur score = 1602.52, worse accepted = 37.59%
Gen #135: temp = 26.01, best = 1807.60, best weight = 1709.07, cur score = 1572.10, worse accepted = 40.42%
Gen #136: temp = 25.75, best = 1807.60, best weight = 1709.07, cur score = 1642.35, worse accepted = 34.23%
Gen #137: temp = 25.49, best = 1807.60, best weight = 1709.07, cur score = 1676.08, worse accepted = 42.21%
Gen #138: temp = 25.24, best = 1807.60, best weight = 1709.07, cur score = 1705.08, worse accepted = 38.30%
Gen #139: temp = 24.98, best = 1807.60, best weight = 1709.07, cur score = 1659.80, worse accepted = 39.52%
Gen #140: temp = 24.73, best = 1807.60, best weight = 1709.07, cur score = 1615.69, worse accepted = 33.65%
Gen #141: temp = 24.49, best = 1808.06, best weight = 1705.48, cur score = 1702.81, worse accepted = 36.43%
Gen #142: temp = 24.24, best = 1808.06, best weight = 1705.48, cur score = 1654.86, worse accepted = 35.50%
Gen #143: temp = 24.00, best = 1808.06, best weight = 1705.48, cur score = 1596.72, worse accepted = 37.67%
Gen #144: temp = 23.76, best = 1808.06, best weight = 1705.48, cur score =

1690.67, worse accepted = 36.99%
Gen #145: temp = 23.52, best = 1808.06, best weight = 1705.48, cur score =
1697.53, worse accepted = 35.12%
Gen #146: temp = 23.29, best = 1808.06, best weight = 1705.48, cur score =
1713.46, worse accepted = 35.83%
Gen #147: temp = 23.05, best = 1808.06, best weight = 1705.48, cur score =
1742.12, worse accepted = 35.61%
Gen #148: temp = 22.82, best = 1808.06, best weight = 1705.48, cur score =
1660.35, worse accepted = 34.33%
Gen #149: temp = 22.59, best = 1808.06, best weight = 1705.48, cur score =
1674.12, worse accepted = 32.28%
Gen #150: temp = 22.37, best = 1808.06, best weight = 1705.48, cur score =
1650.30, worse accepted = 33.07%
Gen #151: temp = 22.15, best = 1808.06, best weight = 1705.48, cur score =
1678.75, worse accepted = 34.78%
Gen #152: temp = 21.92, best = 1808.06, best weight = 1705.48, cur score =
1676.03, worse accepted = 32.54%
Gen #153: temp = 21.70, best = 1808.06, best weight = 1705.48, cur score =
1634.23, worse accepted = 33.38%
Gen #154: temp = 21.49, best = 1808.06, best weight = 1705.48, cur score =
1696.66, worse accepted = 32.28%
Gen #155: temp = 21.27, best = 1808.06, best weight = 1705.48, cur score =
1611.79, worse accepted = 31.27%
Gen #156: temp = 21.06, best = 1808.06, best weight = 1705.48, cur score =
1665.68, worse accepted = 32.63%
Gen #157: temp = 20.85, best = 1808.06, best weight = 1705.48, cur score =
1625.48, worse accepted = 33.51%
Gen #158: temp = 20.64, best = 1808.06, best weight = 1705.48, cur score =
1694.37, worse accepted = 29.96%
Gen #159: temp = 20.43, best = 1808.06, best weight = 1705.48, cur score =
1725.13, worse accepted = 33.73%
Gen #160: temp = 20.23, best = 1808.06, best weight = 1705.48, cur score =
1717.68, worse accepted = 28.52%
Gen #161: temp = 20.03, best = 1808.06, best weight = 1705.48, cur score =
1646.83, worse accepted = 29.18%
Gen #162: temp = 19.83, best = 1808.06, best weight = 1705.48, cur score =
1639.49, worse accepted = 29.77%
Gen #163: temp = 19.63, best = 1808.06, best weight = 1705.48, cur score =
1658.72, worse accepted = 30.74%
Gen #164: temp = 19.43, best = 1808.06, best weight = 1705.48, cur score =
1598.72, worse accepted = 29.07%
Gen #165: temp = 19.24, best = 1808.06, best weight = 1705.48, cur score =
1730.14, worse accepted = 30.57%
Gen #166: temp = 19.05, best = 1808.06, best weight = 1705.48, cur score =
1652.96, worse accepted = 31.71%
Gen #167: temp = 18.86, best = 1808.06, best weight = 1705.48, cur score =
1668.68, worse accepted = 28.87%
Gen #168: temp = 18.67, best = 1808.06, best weight = 1705.48, cur score =

1719.44, worse accepted = 29.90%
Gen #169: temp = 18.48, best = 1808.06, best weight = 1705.48, cur score = 1693.01, worse accepted = 28.99%
Gen #170: temp = 18.30, best = 1808.06, best weight = 1705.48, cur score = 1696.10, worse accepted = 26.30%
Gen #171: temp = 18.11, best = 1808.06, best weight = 1705.48, cur score = 1747.07, worse accepted = 29.87%
Gen #172: temp = 17.93, best = 1808.06, best weight = 1705.48, cur score = 1712.83, worse accepted = 29.08%
Gen #173: temp = 17.75, best = 1808.06, best weight = 1705.48, cur score = 1675.07, worse accepted = 31.34%
Gen #174: temp = 17.57, best = 1808.06, best weight = 1705.48, cur score = 1725.99, worse accepted = 26.56%
Gen #175: temp = 17.40, best = 1808.06, best weight = 1705.48, cur score = 1661.23, worse accepted = 28.43%
Gen #176: temp = 17.22, best = 1808.06, best weight = 1705.48, cur score = 1713.79, worse accepted = 25.47%
Gen #177: temp = 17.05, best = 1808.06, best weight = 1705.48, cur score = 1736.00, worse accepted = 25.35%
Gen #178: temp = 16.88, best = 1808.06, best weight = 1705.48, cur score = 1754.51, worse accepted = 24.84%
Gen #179: temp = 16.71, best = 1808.06, best weight = 1705.48, cur score = 1699.43, worse accepted = 25.69%
Gen #180: temp = 16.55, best = 1808.06, best weight = 1705.48, cur score = 1585.32, worse accepted = 24.31%
Gen #181: temp = 16.38, best = 1808.06, best weight = 1705.48, cur score = 1678.65, worse accepted = 24.56%
Gen #182: temp = 16.22, best = 1808.06, best weight = 1705.48, cur score = 1734.02, worse accepted = 26.90%
Gen #183: temp = 16.05, best = 1808.06, best weight = 1705.48, cur score = 1722.95, worse accepted = 24.29%
Gen #184: temp = 15.89, best = 1812.95, best weight = 1711.58, cur score = 1734.10, worse accepted = 23.39%
Gen #185: temp = 15.74, best = 1812.95, best weight = 1711.58, cur score = 1733.46, worse accepted = 24.56%
Gen #186: temp = 15.58, best = 1812.95, best weight = 1711.58, cur score = 1756.90, worse accepted = 21.17%
Gen #187: temp = 15.42, best = 1812.95, best weight = 1711.58, cur score = 1758.92, worse accepted = 22.62%
Gen #188: temp = 15.27, best = 1812.95, best weight = 1711.58, cur score = 1725.00, worse accepted = 21.27%
Gen #189: temp = 15.12, best = 1812.95, best weight = 1711.58, cur score = 1765.76, worse accepted = 23.18%
Gen #190: temp = 14.96, best = 1815.06, best weight = 1708.56, cur score = 1773.93, worse accepted = 23.54%
Gen #191: temp = 14.81, best = 1825.53, best weight = 1709.32, cur score = 1696.36, worse accepted = 22.44%
Gen #192: temp = 14.67, best = 1825.53, best weight = 1709.32, cur score =

1706.40, worse accepted = 20.94%
Gen #193: temp = 14.52, best = 1825.53, best weight = 1709.32, cur score = 1667.24, worse accepted = 21.24%
Gen #194: temp = 14.37, best = 1825.53, best weight = 1709.32, cur score = 1648.27, worse accepted = 20.79%
Gen #195: temp = 14.23, best = 1825.53, best weight = 1709.32, cur score = 1704.21, worse accepted = 20.53%
Gen #196: temp = 14.09, best = 1825.53, best weight = 1709.32, cur score = 1774.79, worse accepted = 20.75%
Gen #197: temp = 13.95, best = 1829.82, best weight = 1705.81, cur score = 1714.11, worse accepted = 22.03%
Gen #198: temp = 13.81, best = 1829.82, best weight = 1705.81, cur score = 1779.96, worse accepted = 18.37%
Gen #199: temp = 13.67, best = 1829.82, best weight = 1705.81, cur score = 1709.74, worse accepted = 20.81%
Gen #200: temp = 13.53, best = 1829.82, best weight = 1705.81, cur score = 1732.00, worse accepted = 18.59%
Gen #201: temp = 13.40, best = 1829.82, best weight = 1705.81, cur score = 1731.99, worse accepted = 20.43%
Gen #202: temp = 13.26, best = 1829.82, best weight = 1705.81, cur score = 1744.47, worse accepted = 19.76%
Gen #203: temp = 13.13, best = 1829.82, best weight = 1705.81, cur score = 1748.10, worse accepted = 20.00%
Gen #204: temp = 13.00, best = 1829.82, best weight = 1705.81, cur score = 1669.38, worse accepted = 17.95%
Gen #205: temp = 12.87, best = 1829.82, best weight = 1705.81, cur score = 1759.72, worse accepted = 16.76%
Gen #206: temp = 12.74, best = 1829.82, best weight = 1705.81, cur score = 1712.05, worse accepted = 18.18%
Gen #207: temp = 12.61, best = 1829.82, best weight = 1705.81, cur score = 1690.85, worse accepted = 17.00%
Gen #208: temp = 12.49, best = 1829.82, best weight = 1705.81, cur score = 1678.62, worse accepted = 18.96%
Gen #209: temp = 12.36, best = 1829.82, best weight = 1705.81, cur score = 1660.22, worse accepted = 16.86%
Gen #210: temp = 12.24, best = 1829.82, best weight = 1705.81, cur score = 1684.79, worse accepted = 18.29%
Gen #211: temp = 12.12, best = 1829.82, best weight = 1705.81, cur score = 1723.56, worse accepted = 17.49%
Gen #212: temp = 12.00, best = 1829.82, best weight = 1705.81, cur score = 1699.99, worse accepted = 16.88%
Gen #213: temp = 11.88, best = 1829.82, best weight = 1705.81, cur score = 1725.47, worse accepted = 15.64%
Gen #214: temp = 11.76, best = 1829.82, best weight = 1705.81, cur score = 1727.08, worse accepted = 16.05%
Gen #215: temp = 11.64, best = 1829.82, best weight = 1705.81, cur score = 1747.12, worse accepted = 16.94%
Gen #216: temp = 11.52, best = 1829.82, best weight = 1705.81, cur score =

1767.80, worse accepted = 15.47%
Gen #217: temp = 11.41, best = 1830.32, best weight = 1702.88, cur score = 1772.64, worse accepted = 15.77%
Gen #218: temp = 11.29, best = 1830.32, best weight = 1702.88, cur score = 1677.86, worse accepted = 15.47%
Gen #219: temp = 11.18, best = 1830.32, best weight = 1702.88, cur score = 1723.98, worse accepted = 16.41%
Gen #220: temp = 11.07, best = 1830.32, best weight = 1702.88, cur score = 1739.30, worse accepted = 14.03%
Gen #221: temp = 10.96, best = 1830.32, best weight = 1702.88, cur score = 1762.92, worse accepted = 13.86%
Gen #222: temp = 10.85, best = 1830.32, best weight = 1702.88, cur score = 1797.39, worse accepted = 14.74%
Gen #223: temp = 10.74, best = 1830.32, best weight = 1702.88, cur score = 1790.33, worse accepted = 14.16%
Gen #224: temp = 10.63, best = 1830.32, best weight = 1702.88, cur score = 1780.61, worse accepted = 12.50%
Gen #225: temp = 10.53, best = 1830.32, best weight = 1702.88, cur score = 1683.84, worse accepted = 10.78%
Gen #226: temp = 10.42, best = 1830.32, best weight = 1702.88, cur score = 1760.87, worse accepted = 14.45%
Gen #227: temp = 10.32, best = 1830.32, best weight = 1702.88, cur score = 1753.90, worse accepted = 12.36%
Gen #228: temp = 10.21, best = 1830.32, best weight = 1702.88, cur score = 1793.07, worse accepted = 13.79%
Gen #229: temp = 10.11, best = 1830.32, best weight = 1702.88, cur score = 1782.72, worse accepted = 13.66%
Gen #230: temp = 10.01, best = 1830.32, best weight = 1702.88, cur score = 1766.89, worse accepted = 15.61%
Gen #231: temp = 9.91, best = 1847.61, best weight = 1707.97, cur score = 1831.51, worse accepted = 12.58%
Gen #232: temp = 9.81, best = 1856.04, best weight = 1710.99, cur score = 1756.33, worse accepted = 12.66%
Gen #233: temp = 9.71, best = 1856.04, best weight = 1710.99, cur score = 1788.09, worse accepted = 13.24%
Gen #234: temp = 9.62, best = 1856.04, best weight = 1710.99, cur score = 1787.83, worse accepted = 13.27%
Gen #235: temp = 9.52, best = 1856.04, best weight = 1710.99, cur score = 1848.19, worse accepted = 11.61%
Gen #236: temp = 9.42, best = 1856.04, best weight = 1710.99, cur score = 1767.11, worse accepted = 13.28%
Gen #237: temp = 9.33, best = 1856.04, best weight = 1710.99, cur score = 1722.26, worse accepted = 14.71%
Gen #238: temp = 9.24, best = 1856.04, best weight = 1710.99, cur score = 1783.88, worse accepted = 12.05%
Gen #239: temp = 9.14, best = 1856.04, best weight = 1710.99, cur score = 1824.98, worse accepted = 12.47%
Gen #240: temp = 9.05, best = 1856.04, best weight = 1710.99, cur score =

1786.79, worse accepted = 10.50%
Gen #241: temp = 8.96, best = 1856.04, best weight = 1710.99, cur score = 1707.05, worse accepted = 14.07%
Gen #242: temp = 8.87, best = 1856.04, best weight = 1710.99, cur score = 1743.29, worse accepted = 13.14%
Gen #243: temp = 8.78, best = 1856.04, best weight = 1710.99, cur score = 1847.20, worse accepted = 10.73%
Gen #244: temp = 8.70, best = 1856.04, best weight = 1710.99, cur score = 1793.75, worse accepted = 11.18%
Gen #245: temp = 8.61, best = 1856.04, best weight = 1710.99, cur score = 1823.03, worse accepted = 10.52%
Gen #246: temp = 8.52, best = 1856.04, best weight = 1710.99, cur score = 1764.39, worse accepted = 9.95%
Gen #247: temp = 8.44, best = 1856.04, best weight = 1710.99, cur score = 1704.74, worse accepted = 9.51%
Gen #248: temp = 8.35, best = 1856.04, best weight = 1710.99, cur score = 1779.22, worse accepted = 9.98%
Gen #249: temp = 8.27, best = 1856.04, best weight = 1710.99, cur score = 1788.25, worse accepted = 10.84%
Gen #250: temp = 8.19, best = 1856.21, best weight = 1708.76, cur score = 1795.79, worse accepted = 9.69%
Gen #251: temp = 8.11, best = 1856.21, best weight = 1708.76, cur score = 1786.88, worse accepted = 9.03%
Gen #252: temp = 8.02, best = 1856.21, best weight = 1708.76, cur score = 1772.82, worse accepted = 9.67%
Gen #253: temp = 7.94, best = 1856.21, best weight = 1708.76, cur score = 1759.58, worse accepted = 7.92%
Gen #254: temp = 7.87, best = 1856.21, best weight = 1708.76, cur score = 1811.97, worse accepted = 9.44%
Gen #255: temp = 7.79, best = 1856.21, best weight = 1708.76, cur score = 1767.13, worse accepted = 9.16%
Gen #256: temp = 7.71, best = 1856.21, best weight = 1708.76, cur score = 1785.92, worse accepted = 8.30%
Gen #257: temp = 7.63, best = 1856.21, best weight = 1708.76, cur score = 1808.19, worse accepted = 8.97%
Gen #258: temp = 7.56, best = 1856.21, best weight = 1708.76, cur score = 1805.64, worse accepted = 8.73%
Gen #259: temp = 7.48, best = 1856.21, best weight = 1708.76, cur score = 1795.70, worse accepted = 7.52%
Gen #260: temp = 7.40, best = 1856.21, best weight = 1708.76, cur score = 1782.37, worse accepted = 8.77%
Gen #261: temp = 7.33, best = 1856.21, best weight = 1708.76, cur score = 1822.10, worse accepted = 9.79%
Gen #262: temp = 7.26, best = 1856.21, best weight = 1708.76, cur score = 1779.76, worse accepted = 7.59%
Gen #263: temp = 7.18, best = 1856.21, best weight = 1708.76, cur score = 1826.70, worse accepted = 6.47%
Gen #264: temp = 7.11, best = 1856.21, best weight = 1708.76, cur score =

1818.27, worse accepted = 8.23%
Gen #265: temp = 7.04, best = 1856.21, best weight = 1708.76, cur score = 1789.23, worse accepted = 7.79%
Gen #266: temp = 6.97, best = 1863.96, best weight = 1711.08, cur score = 1796.47, worse accepted = 7.01%
Gen #267: temp = 6.90, best = 1866.64, best weight = 1711.97, cur score = 1850.40, worse accepted = 7.18%
Gen #268: temp = 6.83, best = 1876.26, best weight = 1709.61, cur score = 1835.60, worse accepted = 5.47%
Gen #269: temp = 6.76, best = 1876.26, best weight = 1709.61, cur score = 1800.37, worse accepted = 7.74%
Gen #270: temp = 6.70, best = 1876.26, best weight = 1709.61, cur score = 1802.24, worse accepted = 6.26%
Gen #271: temp = 6.63, best = 1876.26, best weight = 1709.61, cur score = 1786.89, worse accepted = 8.34%
Gen #272: temp = 6.56, best = 1876.26, best weight = 1709.61, cur score = 1787.31, worse accepted = 6.05%
Gen #273: temp = 6.50, best = 1876.26, best weight = 1709.61, cur score = 1818.77, worse accepted = 6.79%
Gen #274: temp = 6.43, best = 1876.26, best weight = 1709.61, cur score = 1845.83, worse accepted = 6.63%
Gen #275: temp = 6.37, best = 1876.26, best weight = 1709.61, cur score = 1805.10, worse accepted = 6.17%
Gen #276: temp = 6.30, best = 1876.26, best weight = 1709.61, cur score = 1805.38, worse accepted = 6.14%
Gen #277: temp = 6.24, best = 1876.26, best weight = 1709.61, cur score = 1729.04, worse accepted = 7.88%
Gen #278: temp = 6.18, best = 1876.26, best weight = 1709.61, cur score = 1801.49, worse accepted = 6.94%
Gen #279: temp = 6.12, best = 1876.26, best weight = 1709.61, cur score = 1818.89, worse accepted = 6.07%
Gen #280: temp = 6.06, best = 1876.26, best weight = 1709.61, cur score = 1861.96, worse accepted = 6.60%
Gen #281: temp = 6.00, best = 1876.26, best weight = 1709.61, cur score = 1847.17, worse accepted = 5.81%
Gen #282: temp = 5.94, best = 1876.26, best weight = 1709.61, cur score = 1795.14, worse accepted = 6.07%
Gen #283: temp = 5.88, best = 1876.26, best weight = 1709.61, cur score = 1810.56, worse accepted = 5.98%
Gen #284: temp = 5.82, best = 1876.26, best weight = 1709.61, cur score = 1800.61, worse accepted = 6.14%
Gen #285: temp = 5.76, best = 1876.26, best weight = 1709.61, cur score = 1817.23, worse accepted = 5.86%
Gen #286: temp = 5.70, best = 1876.26, best weight = 1709.61, cur score = 1804.18, worse accepted = 5.82%
Gen #287: temp = 5.65, best = 1876.26, best weight = 1709.61, cur score = 1791.70, worse accepted = 4.85%
Gen #288: temp = 5.59, best = 1876.26, best weight = 1709.61, cur score =

1790.40, worse accepted = 5.30%
Gen #289: temp = 5.53, best = 1876.26, best weight = 1709.61, cur score = 1822.83, worse accepted = 5.05%
Gen #290: temp = 5.48, best = 1876.26, best weight = 1709.61, cur score = 1836.16, worse accepted = 3.74%
Gen #291: temp = 5.42, best = 1876.26, best weight = 1709.61, cur score = 1801.85, worse accepted = 6.24%
Gen #292: temp = 5.37, best = 1876.26, best weight = 1709.61, cur score = 1847.20, worse accepted = 5.15%
Gen #293: temp = 5.31, best = 1876.26, best weight = 1709.61, cur score = 1818.86, worse accepted = 4.74%
Gen #294: temp = 5.26, best = 1876.26, best weight = 1709.61, cur score = 1804.52, worse accepted = 4.05%
Gen #295: temp = 5.21, best = 1876.26, best weight = 1709.61, cur score = 1827.62, worse accepted = 5.19%
Gen #296: temp = 5.16, best = 1876.26, best weight = 1709.61, cur score = 1803.50, worse accepted = 2.47%
Gen #297: temp = 5.11, best = 1876.26, best weight = 1709.61, cur score = 1793.90, worse accepted = 3.43%
Gen #298: temp = 5.05, best = 1876.26, best weight = 1709.61, cur score = 1833.21, worse accepted = 5.04%
Gen #299: temp = 5.00, best = 1876.26, best weight = 1709.61, cur score = 1836.82, worse accepted = 4.94%
Gen #300: temp = 4.95, best = 1876.26, best weight = 1709.61, cur score = 1837.88, worse accepted = 4.41%
Gen #301: temp = 4.90, best = 1876.26, best weight = 1709.61, cur score = 1785.23, worse accepted = 3.72%
Gen #302: temp = 4.86, best = 1876.26, best weight = 1709.61, cur score = 1835.81, worse accepted = 4.31%
Gen #303: temp = 4.81, best = 1876.26, best weight = 1709.61, cur score = 1836.97, worse accepted = 2.77%
Gen #304: temp = 4.76, best = 1876.26, best weight = 1709.61, cur score = 1850.56, worse accepted = 4.08%
Gen #305: temp = 4.71, best = 1876.26, best weight = 1709.61, cur score = 1844.34, worse accepted = 3.84%
Gen #306: temp = 4.66, best = 1876.26, best weight = 1709.61, cur score = 1835.65, worse accepted = 3.63%
Gen #307: temp = 4.62, best = 1876.26, best weight = 1709.61, cur score = 1796.19, worse accepted = 3.72%
Gen #308: temp = 4.57, best = 1876.26, best weight = 1709.61, cur score = 1825.75, worse accepted = 3.65%
Gen #309: temp = 4.53, best = 1876.26, best weight = 1709.61, cur score = 1835.10, worse accepted = 3.95%
Gen #310: temp = 4.48, best = 1876.26, best weight = 1709.61, cur score = 1831.46, worse accepted = 4.63%
Gen #311: temp = 4.44, best = 1876.26, best weight = 1709.61, cur score = 1838.21, worse accepted = 2.78%
Gen #312: temp = 4.39, best = 1876.26, best weight = 1709.61, cur score =

1818.96, worse accepted = 5.36%
Gen #313: temp = 4.35, best = 1876.26, best weight = 1709.61, cur score =
1843.92, worse accepted = 3.10%
Gen #314: temp = 4.30, best = 1876.26, best weight = 1709.61, cur score =
1823.84, worse accepted = 4.29%
Gen #315: temp = 4.26, best = 1876.26, best weight = 1709.61, cur score =
1831.60, worse accepted = 2.79%
Gen #316: temp = 4.22, best = 1876.26, best weight = 1709.61, cur score =
1819.92, worse accepted = 3.22%
Gen #317: temp = 4.18, best = 1876.26, best weight = 1709.61, cur score =
1843.60, worse accepted = 3.73%
Gen #318: temp = 4.13, best = 1876.26, best weight = 1709.61, cur score =
1853.85, worse accepted = 3.20%
Gen #319: temp = 4.09, best = 1876.26, best weight = 1709.61, cur score =
1847.85, worse accepted = 2.25%
Gen #320: temp = 4.05, best = 1876.26, best weight = 1709.61, cur score =
1854.49, worse accepted = 2.56%
Gen #321: temp = 4.01, best = 1876.26, best weight = 1709.61, cur score =
1811.79, worse accepted = 1.93%
Gen #322: temp = 3.97, best = 1876.26, best weight = 1709.61, cur score =
1827.82, worse accepted = 2.14%
Gen #323: temp = 3.93, best = 1876.26, best weight = 1709.61, cur score =
1844.58, worse accepted = 2.76%
Gen #324: temp = 3.89, best = 1876.26, best weight = 1709.61, cur score =
1831.85, worse accepted = 2.66%
Gen #325: temp = 3.85, best = 1876.26, best weight = 1709.61, cur score =
1805.77, worse accepted = 2.88%
Gen #326: temp = 3.81, best = 1876.26, best weight = 1709.61, cur score =
1852.91, worse accepted = 2.37%
Gen #327: temp = 3.78, best = 1876.26, best weight = 1709.61, cur score =
1853.56, worse accepted = 2.25%
Gen #328: temp = 3.74, best = 1876.26, best weight = 1709.61, cur score =
1837.21, worse accepted = 1.62%
Gen #329: temp = 3.70, best = 1876.26, best weight = 1709.61, cur score =
1868.10, worse accepted = 2.16%
Gen #330: temp = 3.66, best = 1876.26, best weight = 1709.61, cur score =
1850.96, worse accepted = 1.42%
Gen #331: temp = 3.63, best = 1876.26, best weight = 1709.61, cur score =
1865.67, worse accepted = 1.94%
Gen #332: temp = 3.59, best = 1876.26, best weight = 1709.61, cur score =
1866.46, worse accepted = 1.83%
Gen #333: temp = 3.56, best = 1876.26, best weight = 1709.61, cur score =
1839.01, worse accepted = 2.57%
Gen #334: temp = 3.52, best = 1876.26, best weight = 1709.61, cur score =
1834.55, worse accepted = 2.04%
Gen #335: temp = 3.48, best = 1876.26, best weight = 1709.61, cur score =
1842.64, worse accepted = 1.11%
Gen #336: temp = 3.45, best = 1876.26, best weight = 1709.61, cur score =

1847.95, worse accepted = 1.32%
Gen #337: temp = 3.42, best = 1876.26, best weight = 1709.61, cur score =
1851.09, worse accepted = 1.73%
Gen #338: temp = 3.38, best = 1876.26, best weight = 1709.61, cur score =
1836.18, worse accepted = 1.21%
Gen #339: temp = 3.35, best = 1876.26, best weight = 1709.61, cur score =
1838.36, worse accepted = 1.73%
Gen #340: temp = 3.31, best = 1876.26, best weight = 1709.61, cur score =
1859.64, worse accepted = 2.35%
Gen #341: temp = 3.28, best = 1876.26, best weight = 1709.61, cur score =
1861.47, worse accepted = 1.62%
Gen #342: temp = 3.25, best = 1881.17, best weight = 1710.78, cur score =
1857.74, worse accepted = 1.53%
Gen #343: temp = 3.22, best = 1881.17, best weight = 1710.78, cur score =
1841.95, worse accepted = 1.94%
Gen #344: temp = 3.18, best = 1881.17, best weight = 1710.78, cur score =
1851.19, worse accepted = 1.32%
Gen #345: temp = 3.15, best = 1881.17, best weight = 1710.78, cur score =
1846.40, worse accepted = 1.93%
Gen #346: temp = 3.12, best = 1881.17, best weight = 1710.78, cur score =
1863.24, worse accepted = 1.11%
Gen #347: temp = 3.09, best = 1881.17, best weight = 1710.78, cur score =
1856.91, worse accepted = 1.73%
Gen #348: temp = 3.06, best = 1881.17, best weight = 1710.78, cur score =
1870.15, worse accepted = 1.83%
Gen #349: temp = 3.03, best = 1881.17, best weight = 1710.78, cur score =
1855.71, worse accepted = 1.32%
Gen #350: temp = 3.00, best = 1881.17, best weight = 1710.78, cur score =
1869.99, worse accepted = 1.63%
Gen #351: temp = 2.97, best = 1881.17, best weight = 1710.78, cur score =
1861.46, worse accepted = 1.43%
Gen #352: temp = 2.94, best = 1881.17, best weight = 1710.78, cur score =
1860.88, worse accepted = 1.01%
Gen #353: temp = 2.91, best = 1881.17, best weight = 1710.78, cur score =
1856.14, worse accepted = 1.43%
Gen #354: temp = 2.88, best = 1881.17, best weight = 1710.78, cur score =
1865.08, worse accepted = 1.42%
Gen #355: temp = 2.85, best = 1881.17, best weight = 1710.78, cur score =
1865.11, worse accepted = 0.40%
Gen #356: temp = 2.82, best = 1881.17, best weight = 1710.78, cur score =
1871.23, worse accepted = 0.81%
Gen #357: temp = 2.79, best = 1881.17, best weight = 1710.78, cur score =
1853.01, worse accepted = 1.01%
Gen #358: temp = 2.77, best = 1881.17, best weight = 1710.78, cur score =
1856.77, worse accepted = 0.91%
Gen #359: temp = 2.74, best = 1881.17, best weight = 1710.78, cur score =
1851.04, worse accepted = 0.91%
Gen #360: temp = 2.71, best = 1881.17, best weight = 1710.78, cur score =

1865.02, worse accepted = 1.22%
Gen #361: temp = 2.68, best = 1881.17, best weight = 1710.78, cur score =
1863.36, worse accepted = 0.20%
Gen #362: temp = 2.66, best = 1881.17, best weight = 1710.78, cur score =
1861.47, worse accepted = 0.50%
Gen #363: temp = 2.63, best = 1881.17, best weight = 1710.78, cur score =
1848.74, worse accepted = 0.70%
Gen #364: temp = 2.60, best = 1881.17, best weight = 1710.78, cur score =
1853.00, worse accepted = 0.81%
Gen #365: temp = 2.58, best = 1881.17, best weight = 1710.78, cur score =
1837.32, worse accepted = 1.73%
Gen #366: temp = 2.55, best = 1881.17, best weight = 1710.78, cur score =
1858.68, worse accepted = 1.42%
Gen #367: temp = 2.53, best = 1881.17, best weight = 1710.78, cur score =
1858.68, worse accepted = 0.20%
Gen #368: temp = 2.50, best = 1881.17, best weight = 1710.78, cur score =
1852.11, worse accepted = 0.81%
Gen #369: temp = 2.48, best = 1881.17, best weight = 1710.78, cur score =
1858.28, worse accepted = 0.91%
Gen #370: temp = 2.45, best = 1881.17, best weight = 1710.78, cur score =
1843.48, worse accepted = 0.70%
Gen #371: temp = 2.43, best = 1881.17, best weight = 1710.78, cur score =
1852.37, worse accepted = 1.32%
Gen #372: temp = 2.40, best = 1881.17, best weight = 1710.78, cur score =
1851.38, worse accepted = 0.60%
Gen #373: temp = 2.38, best = 1881.17, best weight = 1710.78, cur score =
1852.03, worse accepted = 0.81%
Gen #374: temp = 2.35, best = 1881.17, best weight = 1710.78, cur score =
1850.82, worse accepted = 0.60%
Gen #375: temp = 2.33, best = 1881.17, best weight = 1710.78, cur score =
1873.27, worse accepted = 0.81%
Gen #376: temp = 2.31, best = 1881.17, best weight = 1710.78, cur score =
1877.10, worse accepted = 0.20%
Gen #377: temp = 2.28, best = 1881.17, best weight = 1710.78, cur score =
1870.28, worse accepted = 0.50%
Gen #378: temp = 2.26, best = 1881.17, best weight = 1710.78, cur score =
1871.31, worse accepted = 0.50%
Gen #379: temp = 2.24, best = 1881.17, best weight = 1710.78, cur score =
1867.18, worse accepted = 0.30%
Gen #380: temp = 2.22, best = 1881.17, best weight = 1710.78, cur score =
1872.63, worse accepted = 0.71%
Gen #381: temp = 2.19, best = 1881.17, best weight = 1710.78, cur score =
1869.00, worse accepted = 0.20%
Gen #382: temp = 2.17, best = 1883.38, best weight = 1711.10, cur score =
1879.06, worse accepted = 0.40%
Gen #383: temp = 2.15, best = 1883.38, best weight = 1711.10, cur score =
1879.63, worse accepted = 0.30%
Gen #384: temp = 2.13, best = 1883.38, best weight = 1711.10, cur score =

1883.38, worse accepted = 0.30%
Gen #385: temp = 2.11, best = 1883.38, best weight = 1711.10, cur score = 1876.58, worse accepted = 0.91%
Gen #386: temp = 2.09, best = 1883.38, best weight = 1711.10, cur score = 1866.43, worse accepted = 0.40%
Gen #387: temp = 2.07, best = 1883.38, best weight = 1711.10, cur score = 1880.86, worse accepted = 1.32%
Gen #388: temp = 2.05, best = 1883.38, best weight = 1711.10, cur score = 1875.83, worse accepted = 0.30%
Gen #389: temp = 2.03, best = 1883.38, best weight = 1711.10, cur score = 1878.52, worse accepted = 0.40%
Gen #390: temp = 2.00, best = 1883.38, best weight = 1711.10, cur score = 1878.52, worse accepted = 0.10%
Gen #391: temp = 1.98, best = 1883.38, best weight = 1711.10, cur score = 1876.79, worse accepted = 0.30%
Gen #392: temp = 1.96, best = 1883.38, best weight = 1711.10, cur score = 1874.93, worse accepted = 0.50%
Gen #393: temp = 1.95, best = 1883.38, best weight = 1711.10, cur score = 1879.23, worse accepted = 0.10%
Gen #394: temp = 1.93, best = 1883.38, best weight = 1711.10, cur score = 1879.23, worse accepted = 0.10%
Gen #395: temp = 1.91, best = 1883.38, best weight = 1711.10, cur score = 1879.29, worse accepted = 0.30%
Gen #396: temp = 1.89, best = 1883.38, best weight = 1711.10, cur score = 1872.07, worse accepted = 0.40%
Gen #397: temp = 1.87, best = 1883.38, best weight = 1711.10, cur score = 1876.79, worse accepted = 0.60%
Gen #398: temp = 1.85, best = 1884.39, best weight = 1707.23, cur score = 1884.39, worse accepted = 0.30%
Gen #399: temp = 1.83, best = 1887.91, best weight = 1711.03, cur score = 1887.91, worse accepted = 0.20%
Gen #400: temp = 1.81, best = 1887.91, best weight = 1711.03, cur score = 1887.91, worse accepted = 0.10%
Gen #401: temp = 1.80, best = 1887.91, best weight = 1711.03, cur score = 1887.91, worse accepted = 0.00%
Gen #402: temp = 1.78, best = 1887.91, best weight = 1711.03, cur score = 1887.91, worse accepted = 0.00%
Gen #403: temp = 1.76, best = 1887.91, best weight = 1711.03, cur score = 1874.60, worse accepted = 0.40%
Gen #404: temp = 1.74, best = 1887.91, best weight = 1711.03, cur score = 1882.97, worse accepted = 0.20%
Gen #405: temp = 1.72, best = 1887.91, best weight = 1711.03, cur score = 1880.02, worse accepted = 0.50%
Gen #406: temp = 1.71, best = 1887.91, best weight = 1711.03, cur score = 1884.63, worse accepted = 1.01%
Gen #407: temp = 1.69, best = 1887.91, best weight = 1711.03, cur score = 1883.43, worse accepted = 0.81%
Gen #408: temp = 1.67, best = 1887.91, best weight = 1711.03, cur score =

1876.17, worse accepted = 0.60%
Gen #409: temp = 1.66, best = 1887.91, best weight = 1711.03, cur score = 1879.62, worse accepted = 0.50%
Gen #410: temp = 1.64, best = 1887.91, best weight = 1711.03, cur score = 1885.97, worse accepted = 0.30%
Gen #411: temp = 1.62, best = 1887.91, best weight = 1711.03, cur score = 1883.11, worse accepted = 0.30%
Gen #412: temp = 1.61, best = 1887.91, best weight = 1711.03, cur score = 1883.43, worse accepted = 0.70%
Gen #413: temp = 1.59, best = 1887.91, best weight = 1711.03, cur score = 1883.83, worse accepted = 0.10%
Gen #414: temp = 1.58, best = 1887.91, best weight = 1711.03, cur score = 1882.97, worse accepted = 0.50%
Gen #415: temp = 1.56, best = 1889.69, best weight = 1710.73, cur score = 1889.69, worse accepted = 0.20%
Gen #416: temp = 1.54, best = 1889.69, best weight = 1710.73, cur score = 1882.72, worse accepted = 0.20%
Gen #417: temp = 1.53, best = 1889.69, best weight = 1710.73, cur score = 1882.72, worse accepted = 0.00%
Gen #418: temp = 1.51, best = 1889.69, best weight = 1710.73, cur score = 1885.16, worse accepted = 0.20%
Gen #419: temp = 1.50, best = 1889.69, best weight = 1710.73, cur score = 1887.62, worse accepted = 0.50%
Gen #420: temp = 1.48, best = 1889.69, best weight = 1710.73, cur score = 1887.62, worse accepted = 0.10%
Gen #421: temp = 1.47, best = 1889.69, best weight = 1710.73, cur score = 1880.13, worse accepted = 0.20%
Gen #422: temp = 1.45, best = 1889.69, best weight = 1710.73, cur score = 1886.07, worse accepted = 0.60%
Gen #423: temp = 1.44, best = 1889.69, best weight = 1710.73, cur score = 1887.95, worse accepted = 0.40%
Gen #424: temp = 1.42, best = 1889.69, best weight = 1710.73, cur score = 1887.95, worse accepted = 0.10%
Gen #425: temp = 1.41, best = 1889.69, best weight = 1710.73, cur score = 1884.32, worse accepted = 0.10%
Gen #426: temp = 1.40, best = 1889.69, best weight = 1710.73, cur score = 1880.02, worse accepted = 0.10%
Gen #427: temp = 1.38, best = 1889.69, best weight = 1710.73, cur score = 1884.32, worse accepted = 0.00%
Gen #428: temp = 1.37, best = 1889.69, best weight = 1710.73, cur score = 1884.32, worse accepted = 0.00%
Gen #429: temp = 1.35, best = 1889.69, best weight = 1710.73, cur score = 1883.65, worse accepted = 0.30%
Gen #430: temp = 1.34, best = 1889.69, best weight = 1710.73, cur score = 1887.95, worse accepted = 0.10%
Gen #431: temp = 1.33, best = 1889.69, best weight = 1710.73, cur score = 1887.95, worse accepted = 0.00%
Gen #432: temp = 1.31, best = 1889.69, best weight = 1710.73, cur score =

1887.95, worse accepted = 0.10%
Gen #433: temp = 1.30, best = 1889.69, best weight = 1710.73, cur score =
1887.95, worse accepted = 0.00%
Gen #434: temp = 1.29, best = 1890.30, best weight = 1709.43, cur score =
1890.30, worse accepted = 0.30%
Gen #435: temp = 1.28, best = 1890.30, best weight = 1709.43, cur score =
1890.30, worse accepted = 0.00%
Gen #436: temp = 1.26, best = 1890.30, best weight = 1709.43, cur score =
1888.38, worse accepted = 0.10%
Gen #437: temp = 1.25, best = 1890.30, best weight = 1709.43, cur score =
1890.30, worse accepted = 0.50%
Gen #438: temp = 1.24, best = 1890.30, best weight = 1709.43, cur score =
1890.30, worse accepted = 0.10%
Gen #439: temp = 1.23, best = 1890.30, best weight = 1709.43, cur score =
1888.23, worse accepted = 0.10%
Gen #440: temp = 1.21, best = 1890.30, best weight = 1709.43, cur score =
1888.23, worse accepted = 0.00%
Gen #441: temp = 1.20, best = 1890.30, best weight = 1709.43, cur score =
1888.23, worse accepted = 0.00%
Gen #442: temp = 1.19, best = 1890.30, best weight = 1709.43, cur score =
1888.23, worse accepted = 0.00%
Gen #443: temp = 1.18, best = 1890.30, best weight = 1709.43, cur score =
1888.23, worse accepted = 0.00%
Gen #444: temp = 1.17, best = 1890.30, best weight = 1709.43, cur score =
1888.23, worse accepted = 0.00%
Gen #445: temp = 1.15, best = 1890.30, best weight = 1709.43, cur score =
1888.23, worse accepted = 0.00%
Gen #446: temp = 1.14, best = 1890.30, best weight = 1709.43, cur score =
1888.23, worse accepted = 0.00%
Gen #447: temp = 1.13, best = 1890.30, best weight = 1709.43, cur score =
1888.23, worse accepted = 0.00%
Gen #448: temp = 1.12, best = 1890.30, best weight = 1709.43, cur score =
1888.23, worse accepted = 0.00%
Gen #449: temp = 1.11, best = 1890.30, best weight = 1709.43, cur score =
1888.23, worse accepted = 0.50%
Gen #450: temp = 1.10, best = 1890.30, best weight = 1709.43, cur score =
1888.23, worse accepted = 0.00%
Gen #451: temp = 1.09, best = 1890.30, best weight = 1709.43, cur score =
1888.23, worse accepted = 0.00%
Gen #452: temp = 1.08, best = 1890.30, best weight = 1709.43, cur score =
1887.61, worse accepted = 0.20%
Gen #453: temp = 1.06, best = 1890.30, best weight = 1709.43, cur score =
1888.53, worse accepted = 0.30%
Gen #454: temp = 1.05, best = 1890.30, best weight = 1709.43, cur score =
1888.53, worse accepted = 0.00%
Gen #455: temp = 1.04, best = 1890.30, best weight = 1709.43, cur score =
1888.53, worse accepted = 0.00%
Gen #456: temp = 1.03, best = 1890.30, best weight = 1709.43, cur score =

1888.53, worse accepted = 0.00%
Gen #457: temp = 1.02, best = 1890.30, best weight = 1709.43, cur score =
1888.53, worse accepted = 0.00%
Gen #458: temp = 1.01, best = 1890.30, best weight = 1709.43, cur score =
1890.30, worse accepted = 0.10%
Gen #459: temp = 1.00, best = 1890.30, best weight = 1709.43, cur score =
1890.30, worse accepted = 0.00%
Gen #460: temp = 0.99, best = 1890.30, best weight = 1709.43, cur score =
1890.30, worse accepted = 0.00%
Gen #461: temp = 0.98, best = 1890.30, best weight = 1709.43, cur score =
1890.30, worse accepted = 0.00%
Gen #462: temp = 0.97, best = 1890.30, best weight = 1709.43, cur score =
1890.30, worse accepted = 0.00%
Gen #463: temp = 0.96, best = 1890.30, best weight = 1709.43, cur score =
1890.30, worse accepted = 0.00%
Gen #464: temp = 0.95, best = 1890.30, best weight = 1709.43, cur score =
1890.30, worse accepted = 0.10%
Gen #465: temp = 0.94, best = 1890.30, best weight = 1709.43, cur score =
1890.30, worse accepted = 0.00%
Gen #466: temp = 0.93, best = 1890.30, best weight = 1709.43, cur score =
1890.30, worse accepted = 0.00%
Gen #467: temp = 0.92, best = 1890.30, best weight = 1709.43, cur score =
1890.30, worse accepted = 0.00%
Gen #468: temp = 0.92, best = 1890.30, best weight = 1709.43, cur score =
1890.30, worse accepted = 0.00%
Gen #469: temp = 0.91, best = 1890.30, best weight = 1709.43, cur score =
1890.30, worse accepted = 0.00%
Gen #470: temp = 0.90, best = 1890.30, best weight = 1709.43, cur score =
1890.30, worse accepted = 0.00%
Gen #471: temp = 0.89, best = 1890.30, best weight = 1709.43, cur score =
1890.30, worse accepted = 0.00%
Gen #472: temp = 0.88, best = 1890.30, best weight = 1709.43, cur score =
1890.30, worse accepted = 0.00%
Gen #473: temp = 0.87, best = 1890.30, best weight = 1709.43, cur score =
1890.30, worse accepted = 0.00%
Gen #474: temp = 0.86, best = 1890.30, best weight = 1709.43, cur score =
1890.30, worse accepted = 0.10%
Gen #475: temp = 0.85, best = 1890.30, best weight = 1709.43, cur score =
1890.30, worse accepted = 0.00%
Gen #476: temp = 0.84, best = 1890.30, best weight = 1709.43, cur score =
1890.30, worse accepted = 0.00%
Gen #477: temp = 0.84, best = 1890.30, best weight = 1709.43, cur score =
1890.30, worse accepted = 0.00%
Gen #478: temp = 0.83, best = 1890.30, best weight = 1709.43, cur score =
1890.30, worse accepted = 0.00%
Gen #479: temp = 0.82, best = 1890.30, best weight = 1709.43, cur score =
1890.30, worse accepted = 0.00%
Gen #480: temp = 0.81, best = 1890.30, best weight = 1709.43, cur score =

1890.30, worse accepted = 0.00%
Gen #745: temp = 0.06, best = 1890.30, best weight = 1709.43, cur score =
1890.30, worse accepted = 0.00%
Gen #746: temp = 0.06, best = 1890.30, best weight = 1709.43, cur score =
1890.30, worse accepted = 0.00%
Gen #747: temp = 0.06, best = 1890.30, best weight = 1709.43, cur score =
1890.30, worse accepted = 0.00%
Gen #748: temp = 0.05, best = 1890.30, best weight = 1709.43, cur score =
1890.30, worse accepted = 0.00%
Gen #749: temp = 0.05, best = 1890.30, best weight = 1709.43, cur score =
1890.30, worse accepted = 0.00%
Gen #750: temp = 0.05, best = 1890.30, best weight = 1709.43, cur score =
1890.30, worse accepted = 0.00%
Gen #751: temp = 0.05, best = 1890.30, best weight = 1709.43, cur score =
1890.30, worse accepted = 0.00%
Gen #752: temp = 0.05, best = 1890.30, best weight = 1709.43, cur score =
1890.30, worse accepted = 0.00%
Gen #753: temp = 0.05, best = 1890.30, best weight = 1709.43, cur score =
1890.30, worse accepted = 0.00%
Gen #754: temp = 0.05, best = 1890.30, best weight = 1709.43, cur score =
1890.30, worse accepted = 0.00%
Gen #755: temp = 0.05, best = 1890.30, best weight = 1709.43, cur score =
1890.30, worse accepted = 0.00%
Gen #756: temp = 0.05, best = 1890.30, best weight = 1709.43, cur score =
1890.30, worse accepted = 0.00%
Gen #757: temp = 0.05, best = 1890.30, best weight = 1709.43, cur score =
1890.30, worse accepted = 0.00%

[123]: best_sol

[123]: {0,
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```

```
[102]: greedy_solution(items, capacity)
```

```
[102]: {5, 8}
```

```
[103]: best_score
```

```
[103]: 255.32999999999998
```

```
[105]: score(greedy_solution(items, capacity), items)
```

[105]: 42.35

[]:

[]:

[]:

[]:

[]: