WBC dataset: Features are computed from a digitized image of a fine needle aspirate (FNA) of a breast mass. They describe characteristics of the cell nuclei present in the image.

Data Set Characteristics:	Multivariate	**Number of Instances:**	1080	**Area:**	Life
Attribute Characteristics:	Real	**Number of Attributes:**	30	**Date Donated**	1995-11-01
Associated Tasks:	Classification	**Anomaly ratio**	0.02	**Number of Web Hits:**	1408511

Attribute Information:

1-30)

Ten real-valued features are computed for each cell nucleus:

a) radius (mean of distances from center to points on the perimeter)

b) texture (standard deviation of gray-scale values)

c) perimeter

d) area

e) smoothness (local variation in radius lengths)

f) compactness (perimeter^2 / area - 1.0)

g) concavity (severity of concave portions of the contour)

h) concave points (number of concave portions of the contour)

i) symmetry

j) fractal dimension ("coastline approximation" - 1)

Sample rule explanation：

Anomaly Data：

Example: perimeter = 20.6, **radius_01** = 29.33, **radius_02** = 140.1, **radius_03** = 1265, **radius_04** = 0.1178, **texture_01** = 0.277, **texture_02** = 0.3514, **texture_03** = 0.152, **texture_04** = 0.2397, **permeter** = 0.07016, **area_01** = 0.726, **area_02** = 1.595, **area_03** = 5.772, **smoothness_01** = 86.22, **smoothness_02** = 0.006522, **compactness_01** = 0.06158, **compactness_02** = 0.07117, **compactness_03** = 0.01664, **compactness_04** = 0.02324, **compactness_05** = 0.006185, **compactness_06** = 25.74, **concavity_01** = 39.42, **concavity_02** = 184.6, **concavity_03** = 1821, **concave_points** = 0.165, **symmetry_01** = 0.8681, **symmetry_02** = 0.9387, **symmetry_03** = 0.265, **fractal_dimension_01** = 0.4087, **fractal_dimension_02** = 0.124

constraint rule 1：perimeter = 20.6, radius_01 = 29.33, radius_02 = 140.1, radius_04 = 0.1178, texture_01 = 0.277, texture_02 = 0.3514, texture_03 = 0.152, texture_04 = 0.2397, permeter = 0.07016, area_01 = 0.726, area_02 = 1.595, area_03 = 5.772, smoothness_01 = 86.22, smoothness_02 = 0.006522, compactness_01 = 0.06158, compactness_02 = 0.07117, compactness_03 = 0.01664, compactness_04 = 0.02324, compactness_05 = 0.006185, compactness_06 = 25.74, concavity_01 = 39.42, concavity_02 = 184.6, concave_points = 0.165, symmetry_01 =

0.8681, symmetry_02 = 0.9387, symmetry_03 = 0.265, fractal_dimension_01 = 0.4087, fractal_dimension_02 = 0.124 ⟹ **radius_03 / perimeter = [24.27, 48.54] concavity_03 = 0**

This means that when (perimeter = 20.6, radius_01 = 29.33, radius_02 = 140.1, radius_04 = 0.1178, texture_01 = 0.277, texture_02 = 0.3514, texture_03 = 0.152, texture_04 = 0.2397, permeter = 0.07016, area_01 = 0.726, area_02 = 1.595, area_03 = 5.772, smoothness_01 = 86.22, smoothness_02 = 0.006522, compactness_01 = 0.06158, compactness_02 = 0.07117, compactness_03 = 0.01664, compactness_04 = 0.02324, compactness_05 = 0.006185, compactness_06 = 25.74, concavity_01 = 39.42, concavity_02 = 184.6, concave_points = 0.165, symmetry_01 = 0.8681, symmetry_02 = 0.9387, symmetry_03 = 0.265, fractal_dimension_01 = 0.4087, fractal_dimension_02 = 0.124), attribute **concavity_03** = 0 and attribute **radius_03** divided by attribute **perimeter** should be between **24.27** and **48.54**, while attribute **concavity_03** is 1821 and attribute **radius_03** divided by attribute **perimeter** is **61.4** which is not within the normal value range, so the data is abnormal.

Constraint rules for discovery:

constraint rule 1 : perimeter = 20.6, radius_01 = 29.33, radius_02 = 140.1, radius_03 = 1265.0, radius_04 = 0.1178, texture_01 = 0.277, texture_02 = 0.3514, texture_03 = 0.152, texture_04 = 0.2397, permeter = 0.07016, area_01 = 0.726, area_02 = 1.595, area_03 = 5.772, smoothness_01 = 86.22, smoothness_02 = 0.006522, compactness_01 = 0.06158, compactness_02 = 0.07117, compactness_03 = 0.01664, compactness_04 = 0.02324, compactness_05 = 0.006185, compactness_06 = 25.74, concavity_01 = 39.42, concavity_02 = 184.6,

concave_points = 0.165, symmetry_01 = 0.8681, symmetry_02 = 0.9387, symmetry_03 = 0.265, fractal_dimension_01 = 0.4087, fractal_dimension_02 = 0.124, $\Longrightarrow$ concavity_03 / compactness_06 = [16.51, 49.57]

constraint rule 2 : perimeter = 13.54, radius_01 = 14.36, radius_02 = 87.46, radius_04 = 0.09779, texture_01 = 0.08129, texture_02 = 0.06664, texture_03 = 0.04781, texture_04 = 0.1885, permeter = 0.05766, area_01 = 0.2699, area_02 = 0.7886, area_03 = 2.058, smoothness_01 = 23.56, smoothness_02 = 0.008462, compactness_01 = 0.0146, compactness_02 = 0.02387, compactness_03 = 0.01315, compactness_04 = 0.0198, compactness_05 = 0.0023, compactness_06 = 15.11, concavity_01 = 19.26, concavity_02 = 99.7, concavity_03 = 711.2, concave_points = 0.144, symmetry_01 = 0.1773, symmetry_02 = 0.239, symmetry_03 = 0.1288, fractal_dimension_01 = 0.2977, fractal_dimension_02 = 0.07259, $\Longrightarrow$ radius_03 / perimeter = [36.93, 73.86]

constraint rule 3 : perimeter = 13.08, radius_01 = 15.71, radius_02 = 85.63, radius_04 = 0.1075, texture_01 = 0.127, texture_02 = 0.04568, texture_03 = 0.0311, texture_04 = 0.1967, permeter = 0.06811, area_01 = 0.1852, area_02 = 0.7477, area_03 = 1.383, smoothness_01 = 14.67, smoothness_02 = 0.004097, compactness_01 = 0.01898, compactness_02 = 0.01698, compactness_03 = 0.00649, compactness_04 = 0.01678, compactness_05 = 0.002425, compactness_06 = 14.5, concavity_01 = 20.49, concavity_02 = 96.09, concave_points = 0.1312, symmetry_01 = 0.2776, symmetry_02 = 0.189, symmetry_03 = 0.07283, fractal_dimension_01 = 0.3184, fractal_dimension_02 = 0.08183, $\Longrightarrow$ radius_03 = 0 concavity_03 / compactness_06 = [29.31, 88.0]

constraint rule 4 : perimeter = 9.504, radius_01 = 12.44, radius_02 = 60.34, radius_04 = 0.1024, texture_01 = 0.06492, texture_02 = 0.02956, texture_03 = 0.02076, texture_04 = 0.1815, permeter = 0.06905, area_01 = 0.2773, area_02 = 0.9768, area_03 = 1.909, smoothness_01 = 15.7, smoothness_02 = 0.009606, compactness_01 = 0.01432, compactness_02 = 0.01985, compactness_03 = 0.01421, compactness_04 =

0.02027, compactness_05 = 0.002968, compactness_06 = 10.23, concavity_01 = 15.66, concavity_02 = 65.13, concave_points = 0.1324, symmetry_01 = 0.1148, symmetry_02 = 0.08867, symmetry_03 = 0.06227, fractal_dimension_01 = 0.245, fractal_dimension_02 = 0.07773, $\Longrightarrow$ radius_03 / perimeter = [52.61, 105.22] concavity_03 = 0

constraint rule 5 : perimeter = 10.96, radius_01 = 17.62, radius_02 = 70.79, radius_04 = 0.09687, texture_01 = 0.09752, texture_02 = 0.05263, texture_03 = 0.02788, texture_04 = 0.1619, permeter = 0.06408, area_01 = 0.1507, area_02 = 1.583, area_03 = 1.165, smoothness_01 = 10.09, smoothness_02 = 0.009501, compactness_01 = 0.03378, compactness_02 = 0.04401, compactness_03 = 0.01346, compactness_04 = 0.01322, compactness_05 = 0.003534, compactness_06 = 11.62, concavity_01 = 26.51, concavity_02 = 76.43, concave_points = 0.1428, symmetry_01 = 0.251, symmetry_02 = 0.2123, symmetry_03 = 0.09861, fractal_dimension_01 = 0.2289, fractal_dimension_02 = 0.08278, $\Longrightarrow$ radius_03 = 0 concavity_03 / compactness_06 = [36.57, 109.81]

constraint rule 6 : perimeter = 13.03, radius_01 = 18.42, radius_02 = 82.61, radius_04 = 0.08983, texture_01 = 0.03766, texture_02 = 0.02562, texture_03 = 0.02923, texture_04 = 0.1467, permeter = 0.05863, area_01 = 0.1839, area_02 = 2.342, area_03 = 1.17, smoothness_01 = 14.16, smoothness_02 = 0.004352, compactness_01 = 0.004899, compactness_02 = 0.01343, compactness_03 = 0.01164, compactness_04 = 0.02671, compactness_05 = 0.001777, compactness_06 = 13.3, concavity_01 = 22.81, concavity_02 = 84.46, concavity_03 = 545.9, concave_points = 0.09701, symmetry_01 = 0.04619, symmetry_02 = 0.04833, symmetry_03 = 0.05013, fractal_dimension_01 = 0.1987, fractal_dimension_02 = 0.06169, $\Longrightarrow$ radius_03 / perimeter = [38.37, 76.75]

constraint rule 7 : perimeter = 12.19, radius_01 = 13.29, radius_02 = 79.08, radius_04 = 0.1066, texture_01 = 0.09509, texture_02 = 0.02855, texture_03 = 0.02882, texture_04 = 0.188, permeter = 0.06471, area_01 = 0.2005, area_02 = 0.8163, area_03 = 1.973, smoothness_01

= 15.24, smoothness_02 = 0.006773, compactness_01 = 0.02456, compactness_02 = 0.01018, compactness_03 = 0.008094, compactness_04 = 0.02662, compactness_05 = 0.004143, compactness_06 = 13.34, concavity_01 = 17.81, concavity_02 = 91.38, concavity_03 = 545.2, concave_points = 0.1427, symmetry_01 = 0.2585, symmetry_02 = 0.09915, symmetry_03 = 0.08187, fractal_dimension_01 = 0.3469, fractal_dimension_02 = 0.09241, $\Longrightarrow$ radius_03 / perimeter = [41.02, 82.03]

constraint rule 8 : perimeter = 15.71, radius_01 = 13.93, radius_02 = 102.0, radius_03 = 761.7, radius_04 = 0.09462, texture_01 = 0.09462, texture_02 = 0.07135, texture_03 = 0.05933, texture_04 = 0.1816, permeter = 0.05723, area_01 = 0.3117, area_02 = 0.8155, area_03 = 1.972, smoothness_01 = 27.94, smoothness_02 = 0.005217, compactness_01 = 0.01515, compactness_02 = 0.01678, compactness_03 = 0.01268, compactness_04 = 0.01669, compactness_05 = 0.00233, compactness_06 = 17.5, concavity_01 = 19.25, concavity_02 = 114.3, concave_points = 0.1223, symmetry_01 = 0.1949, symmetry_02 = 0.1709, symmetry_03 = 0.1374, fractal_dimension_01 = 0.2723, fractal_dimension_02 = 0.07071, $\Longrightarrow$ concavity_03 / compactness_06 = [24.29, 72.91]

constraint rule 9 : perimeter = 15.1, radius_01 = 16.39, radius_02 = 99.58, radius_04 = 0.115, texture_01 = 0.1807, texture_02 = 0.1138, texture_03 = 0.08534, texture_04 = 0.2001, permeter = 0.06467, area_01 = 0.4309, area_02 = 1.068, area_03 = 2.796, smoothness_01 = 39.84, smoothness_02 = 0.009006, compactness_01 = 0.04185, compactness_02 = 0.03204, compactness_03 = 0.02258, compactness_04 = 0.02353, compactness_05 = 0.004984, compactness_06 = 16.11, concavity_01 = 18.33, concavity_02 = 105.9, concavity_03 = 762.6, concave_points = 0.1386, symmetry_01 = 0.2883, symmetry_02 = 0.196, symmetry_03 = 0.1423, fractal_dimension_01 = 0.259, fractal_dimension_02 = 0.07779, $\Longrightarrow$ radius_03 / perimeter = [33.11, 66.23]

constraint rule 10 : perimeter = 11.41, radius_01 = 10.82, radius_02 = 73.34, radius_04 = 0.09373, texture_01 = 0.06685, texture_02 =

0.03512, texture_03 = 0.02623, texture_04 = 0.1667, permeter = 0.06113, area_01 = 0.1408, area_02 = 0.4607, area_03 = 1.103, smoothness_01 = 10.5, smoothness_02 = 0.00604, compactness_01 = 0.01529, compactness_02 = 0.01514, compactness_03 = 0.00646, compactness_04 = 0.01344, compactness_05 = 0.002206, compactness_06 = 12.82, concavity_01 = 15.97, concavity_02 = 83.74, concave_points = 0.1548, symmetry_01 = 0.239, symmetry_02 = 0.2102, symmetry_03 = 0.08958, fractal_dimension_01 = 0.3016, fractal_dimension_02 = 0.08523, $\Longrightarrow$ radius_03 / perimeter = [43.82, 87.64] concavity_03 = 0

constraint rule 11 : perimeter = 11.64, radius_01 = 18.33, radius_02 = 75.17, radius_03 = 412.5, radius_04 = 0.1142, texture_01 = 0.1017, texture_02 = 0.0707, texture_03 = 0.03485, texture_04 = 0.1801, permeter = 0.0652, area_01 = 0.306, area_02 = 1.657, area_03 = 2.155, smoothness_01 = 20.62, smoothness_02 = 0.00854, compactness_01 = 0.0231, compactness_02 = 0.02945, compactness_03 = 0.01398, compactness_04 = 0.01565, compactness_05 = 0.00384, compactness_06 = 13.14, concavity_01 = 29.26, concavity_02 = 85.51, concave_points = 0.1688, symmetry_01 = 0.266, symmetry_02 = 0.2873, symmetry_03 = 0.1218, fractal_dimension_01 = 0.2806, fractal_dimension_02 = 0.09097, $\Longrightarrow$ concavity_03 / compactness_06 = [32.34, 97.11]

constraint rule 12 : perimeter = 12.36, radius_01 = 18.54, radius_02 = 79.01, radius_04 = 0.08477, texture_01 = 0.06815, texture_02 = 0.02643, texture_03 = 0.01921, texture_04 = 0.1602, permeter = 0.06066, area_01 = 0.1199, area_02 = 0.8944, area_03 = 0.8484, smoothness_01 = 9.227, smoothness_02 = 0.003457, compactness_01 = 0.01047, compactness_02 = 0.01167, compactness_03 = 0.005558, compactness_04 = 0.01251, compactness_05 = 0.001356, compactness_06 = 13.29, concavity_01 = 27.49, concavity_02 = 85.56, concavity_03 = 544.1, concave_points = 0.1184, symmetry_01 = 0.1963, symmetry_02 = 0.1937, symmetry_03 = 0.08442, fractal_dimension_01 = 0.2983, fractal_dimension_02 = 0.07185, $\Longrightarrow$ radius_03 / perimeter = [40.45, 80.91]

constraint rule 13 : perimeter = 12.18, radius_01 = 17.84, radius_02 = 77.79, radius_04 = 0.1045, texture_01 = 0.07057, texture_02 = 0.0249, texture_03 = 0.02941, texture_04 = 0.19, permeter = 0.06635, area_01 = 0.3661, area_02 = 1.511, area_03 = 2.41, smoothness_01 = 24.44, smoothness_02 = 0.005433, compactness_01 = 0.01179, compactness_02 = 0.01131, compactness_03 = 0.01519, compactness_04 = 0.0222, compactness_05 = 0.003408, compactness_06 = 12.83, concavity_01 = 20.92, concavity_02 = 82.14, concave_points = 0.114, symmetry_01 = 0.09358, symmetry_02 = 0.0498, symmetry_03 = 0.05882, fractal_dimension_01 = 0.2227, fractal_dimension_02 = 0.07376, $\Longrightarrow$ radius_03 = 0 concavity_03 / compactness_06 = [33.13, 99.45]

constraint rule 14 : perimeter = 9.787, radius_01 = 19.94, radius_02 = 62.11, radius_04 = 0.1024, texture_01 = 0.05301, texture_02 = 0.006829, texture_03 = 0.007937, texture_04 = 0.135, permeter = 0.0689, area_01 = 0.335, area_02 = 2.043, area_03 = 2.132, smoothness_01 = 20.05, smoothness_02 = 0.01113, compactness_01 = 0.01463, compactness_02 = 0.005308, compactness_03 = 0.00525, compactness_04 = 0.01801, compactness_05 = 0.005667, compactness_06 = 10.92, concavity_01 = 26.29, concavity_02 = 68.81, concavity_03 = 366.1, concave_points = 0.1316, symmetry_01 = 0.09473, symmetry_02 = 0.02049, symmetry_03 = 0.02381, fractal_dimension_01 = 0.1934, fractal_dimension_02 = 0.08988, $\Longrightarrow$ radius_03 / perimeter = [51.09, 102.18]

constraint rule 15 : perimeter = 11.6, radius_01 = 12.84, radius_02 = 74.34, radius_03 = 412.6, radius_04 = 0.08983, texture_01 = 0.07525, texture_02 = 0.04196, texture_03 = 0.0335, texture_04 = 0.162, permeter = 0.06582, area_01 = 0.2315, area_02 = 0.5391, area_03 = 1.475, smoothness_01 = 15.75, smoothness_02 = 0.006153, compactness_01 = 0.0133, compactness_02 = 0.01693, compactness_03 = 0.006884, compactness_04 = 0.01651, compactness_05 = 0.002551, compactness_06 = 13.06, concavity_01 = 17.16, concavity_02 = 82.96, concave_points = 0.1431, symmetry_01 = 0.1851, symmetry_02 = 0.1922, symmetry_03 = 0.08449, fractal_dimension_01 = 0.2772,

fractal_dimension_02 = 0.08756, ⟹ concavity_03 / compactness_06 = [32.54, 97.7]

constraint rule 16 : perimeter = 13.27, radius_01 = 14.76, radius_02 = 84.74, radius_04 = 0.07355, texture_01 = 0.05055, texture_02 = 0.03261, texture_03 = 0.02648, texture_04 = 0.1386, permeter = 0.05318, area_01 = 0.4057, area_02 = 1.153, area_03 = 2.701, smoothness_01 = 36.35, smoothness_02 = 0.004481, compactness_01 = 0.01038, compactness_02 = 0.01358, compactness_03 = 0.01082, compactness_04 = 0.01069, compactness_05 = 0.001435, compactness_06 = 16.36, concavity_01 = 22.35, concavity_02 = 104.5, concavity_03 = 830.6, concave_points = 0.1006, symmetry_01 = 0.1238, symmetry_02 = 0.135, symmetry_03 = 0.1001, fractal_dimension_01 = 0.2027, fractal_dimension_02 = 0.06206, ⟹ radius_03 / perimeter = [37.68, 75.36]

constraint rule 17 : perimeter = 13.45, radius_01 = 18.3, radius_02 = 86.6, radius_04 = 0.1022, texture_01 = 0.08165, texture_02 = 0.03974, texture_03 = 0.0278, texture_04 = 0.1638, permeter = 0.0571, area_01 = 0.295, area_02 = 1.373, area_03 = 2.099, smoothness_01 = 25.22, smoothness_02 = 0.005884, compactness_01 = 0.01491, compactness_02 = 0.01872, compactness_03 = 0.009366, compactness_04 = 0.01884, compactness_05 = 0.001817, compactness_06 = 15.1, concavity_01 = 25.94, concavity_02 = 97.59, concave_points = 0.1339, symmetry_01 = 0.1751, symmetry_02 = 0.1381, symmetry_03 = 0.07911, fractal_dimension_01 = 0.2678, fractal_dimension_02 = 0.06603, ⟹ radius_03 = 0 concavity_03 / compactness_06 = [28.15, 84.5]

constraint rule 18 : perimeter = 8.196, radius_01 = 16.84, radius_02 = 51.71, radius_04 = 0.086, texture_01 = 0.05943, texture_02 = 0.01588, texture_03 = 0.005917, texture_04 = 0.1769, permeter = 0.06503, area_01 = 0.1563, area_02 = 0.9567, area_03 = 1.094, smoothness_01 = 8.205, smoothness_02 = 0.008968, compactness_01 = 0.01646, compactness_02 = 0.01588, compactness_03 = 0.005917, compactness_04 = 0.02574, compactness_05 = 0.002582, compactness_06 = 8.964, concavity_01 = 21.96, concavity_02 = 57.26,

concave_points = 0.1297, symmetry_01 = 0.1357, symmetry_02 = 0.0688, symmetry_03 = 0.02564, fractal_dimension_01 = 0.3105, fractal_dimension_02 = 0.07409, $\Longrightarrow$ radius_03 / perimeter = [61.01, 122.01] concavity_03 = 0

constraint rule 19 : perimeter = 9.173, radius_01 = 13.86, radius_02 = 59.2, radius_03 = 260.9, radius_04 = 0.07721, texture_01 = 0.08751, texture_02 = 0.05988, texture_03 = 0.0218, texture_04 = 0.2341, permeter = 0.06963, area_01 = 0.4098, area_02 = 2.265, area_03 = 2.608, smoothness_01 = 23.52, smoothness_02 = 0.008738, compactness_01 = 0.03938, compactness_02 = 0.04312, compactness_03 = 0.0156, compactness_04 = 0.04192, compactness_05 = 0.005822, compactness_06 = 10.01, concavity_01 = 19.23, concavity_02 = 65.59, concave_points = 0.09836, symmetry_01 = 0.1678, symmetry_02 = 0.1397, symmetry_03 = 0.05087, fractal_dimension_01 = 0.3282, fractal_dimension_02 = 0.0849, $\Longrightarrow$ concavity_03 / compactness_06 = [42.46, 127.47]

constraint rule 20 : perimeter = 8.888, radius_01 = 14.64, radius_02 = 58.79, radius_04 = 0.09783, texture_01 = 0.1531, texture_02 = 0.08606, texture_03 = 0.02872, texture_04 = 0.1902, permeter = 0.0898, area_01 = 0.5262, area_02 = 0.8522, area_03 = 3.168, smoothness_01 = 25.44, smoothness_02 = 0.01721, compactness_01 = 0.09368, compactness_02 = 0.05671, compactness_03 = 0.01766, compactness_04 = 0.02541, compactness_05 = 0.02193, compactness_06 = 9.733, concavity_01 = 15.67, concavity_02 = 62.56, concave_points = 0.1207, symmetry_01 = 0.2436, symmetry_02 = 0.1434, symmetry_03 = 0.04786, fractal_dimension_01 = 0.2254, fractal_dimension_02 = 0.1084, $\Longrightarrow$ radius_03 / perimeter = [56.26, 112.51] concavity_03 = 0

constraint rule 21 : perimeter = 12.31, radius_01 = 16.52, radius_02 = 79.19, radius_03 = 470.9, radius_04 = 0.09172, texture_01 = 0.06829, texture_02 = 0.03372, texture_03 = 0.02272, texture_04 = 0.172, permeter = 0.05914, area_01 = 0.2505, area_02 = 1.025, area_03 = 1.74, smoothness_01 = 19.68, smoothness_02 = 0.004854, compactness_01 = 0.01819, compactness_02 = 0.01826, compactness_03 =

0.007965, compactness_04 = 0.01386, compactness_05 = 0.002304, compactness_06 = 14.11, concavity_01 = 23.21, concavity_02 = 89.71, concave_points = 0.1176, symmetry_01 = 0.1843, symmetry_02 = 0.1703, symmetry_03 = 0.0866, fractal_dimension_01 = 0.2618, fractal_dimension_02 = 0.07609, $\Longrightarrow$ concavity_03 / compactness_06 = [30.12, 90.43]

constraint rule 22 : perimeter = 13.53, radius_01 = 10.94, radius_02 = 87.91, radius_03 = 559.2, radius_04 = 0.1291, texture_01 = 0.1047, texture_02 = 0.06877, texture_03 = 0.06556, texture_04 = 0.2403, permeter = 0.06641, area_01 = 0.4101, area_02 = 1.014, area_03 = 2.652, smoothness_01 = 32.65, smoothness_02 = 0.0134, compactness_01 = 0.02839, compactness_02 = 0.01162, compactness_03 = 0.008239, compactness_04 = 0.02572, compactness_05 = 0.006164, compactness_06 = 14.08, concavity_01 = 12.49, concavity_02 = 91.36, concave_points = 0.1451, symmetry_01 = 0.1379, symmetry_02 = 0.08539, symmetry_03 = 0.07407, fractal_dimension_01 = 0.271, fractal_dimension_02 = 0.07191, $\Longrightarrow$ concavity_03 / compactness_06 = [30.18, 90.62]

constraint rule 23 : perimeter = 12.0, radius_01 = 15.65, radius_02 = 76.95, radius_04 = 0.09723, texture_01 = 0.07165, texture_02 = 0.04151, texture_03 = 0.01863, texture_04 = 0.2079, permeter = 0.05968, area_01 = 0.2271, area_02 = 1.255, area_03 = 1.441, smoothness_01 = 16.16, smoothness_02 = 0.005969, compactness_01 = 0.01812, compactness_02 = 0.02007, compactness_03 = 0.007027, compactness_04 = 0.01972, compactness_05 = 0.002607, compactness_06 = 13.67, concavity_01 = 24.9, concavity_02 = 87.78, concavity_03 = 567.9, concave_points = 0.1377, symmetry_01 = 0.2003, symmetry_02 = 0.2267, symmetry_03 = 0.07632, fractal_dimension_01 = 0.3379, fractal_dimension_02 = 0.07924, $\Longrightarrow$ radius_03 / perimeter = [41.67, 83.33]

Lymphography dataset: This is one of three domains provided by the Oncology Institute that has repeatedly appeared in the machine learning literature.

Data Set Characteristics:	Multivariate	**Number of Instances:**	5000	**Area:**	Life
Attribute Characteristics:	Categorical	**Number of Attributes:**	18	**Date Donated**	1988-11-01
Associated Tasks:	Classification	**Anomaly ratio**	0.0036	**Number of Web Hits:**	94762

Attribute Information:

1. lymphatics: normal, arched, deformed, displaced
2. block of affere: no, yes
3. bl. of lymph. c: no, yes
4. bl. of lymph. s: no, yes
5. by pass: no, yes
6. extravasates: no, yes
7. regeneration of: no, yes
8. early uptake in: no, yes
9. lym.nodes dimin: 0-3

10. lym.nodes enlar: 1-4
11. changes in lym.: bean, oval, round
12. defect in node: no, lacunar, lac. marginal, lac. central
13. changes in node: no, lacunar, lac. margin, lac. central
14. changes in stru: no, grainy, drop-like, coarse, diluted, reticular, stripped, faint,
15. special forms: no, chalices, vesicles
16. dislocation of: no, yes
17. exclusion of no: no, yes
18. no. of nodes in: 0-9, 10-19, 20-29, 30-39, 40-49, 50-59, 60-69, >=70

Constraint rules for discovery:

constraint rule 1 : block of affere = 1, bl.of lymph.c = 1, bl.of lymph.s = 1, by_pass = 1, extravasates = 1, regeneration_of = 1, early_uptake_in = 1, lym.nodes_dimin = 1, lym.nodes_enlar = 1, changes_in_lym = 1, defect_in_node = 1, changes_in_node = 1, changes_in_stru = 1, special_forms = 1, dislocation_of = 1, exclusion_of_no = 1, no_of_nodes_in = 1, $\Longrightarrow$ lymphatics = 0.0

constraint rule 2 : block of affere = 1, bl.of lymph.c = 1, bl.of lymph.s = 1, by_pass = 1, extravasates = 2, regeneration_of = 1, early_uptake_in = 2, lym.nodes_dimin = 1, lym.nodes_enlar = 2, changes_in_lym = 2, defect_in_node = 1, changes_in_node = 1,

changes_in_stru = 2, special_forms = 1, dislocation_of = 1, exclusion_of_no = 1, no_of_nodes_in = 2, ⟹ lymphatics = 0.0

constraint rule 3 : lymphatics = 3, block of affere = 2, bl.of lymph.c = 2, bl.of lymph.s = 2, by_pass = 2, extravasates = 2, regeneration_of = 2, early_uptake_in = 2, lym.nodes_dimin = 3, lym.nodes_enlar = 1, changes_in_lym = 1, defect_in_node = 2, changes_in_node = 2, special_forms = 1, dislocation_of = 2, exclusion_of_no = 2, ⟹ changes_in_stru = 2 no_of_nodes_in = 0

constraint rule 4 : lymphatics = 3, block of affere = 2, bl.of lymph.c = 2, bl.of lymph.s = 2, by_pass = 2, extravasates = 2, regeneration_of = 2, early_uptake_in = 1, lym.nodes_dimin = 2, lym.nodes_enlar = 2, changes_in_lym = 2, defect_in_node = 4, changes_in_node = 2, special_forms = 3, dislocation_of = 2, exclusion_of_no = 2, no_of_nodes_in = 7, ⟹ changes_in_stru = 0.0

constraint rule 5 : lymphatics = 3, block of affere = 1, bl.of lymph.c = 1, bl.of lymph.s = 1, by_pass = 2, extravasates = 2, regeneration_of = 2, early_uptake_in = 1, lym.nodes_dimin = 3, lym.nodes_enlar = 1, changes_in_lym = 1, defect_in_node = 2, changes_in_node = 1, special_forms = 3, dislocation_of = 1, exclusion_of_no = 1, ⟹ changes_in_stru = 0 no_of_nodes_in = 1