Name: Yunika Upadhayaya

ID: 1001631183

Assignment – 5

**Task – 1**

**Optimized:**

**Training Stage:**

tree= 1, node= 1, feature=15, thr= 21.57, gain=0.621424

tree= 1, node= 2, feature= 4, thr= 41.18, gain=0.587628

tree= 1, node= 3, feature=13, thr= 58.82, gain=0.697235

tree= 1, node= 4, feature= 9, thr= 15.69, gain=0.670083

tree= 1, node= 5, feature=10, thr= 39.22, gain=0.629044

tree= 1, node= 6, feature= 0, thr= 35.29, gain=0.712500

tree= 1, node= 7, feature= 8, thr= 56.86, gain=0.814218

tree= 1, node= 8, feature=14, thr= 60.78, gain=0.475710

tree= 1, node= 9, feature= 5, thr= 64.71, gain=0.620325

tree= 1, node= 10, feature=14, thr= 37.25, gain=0.224713

tree= 1, node= 11, feature= 3, thr= 90.20, gain=0.686759

tree= 1, node= 12, feature=14, thr= 37.25, gain=0.281171

tree= 1, node= 13, feature=10, thr= 29.41, gain=0.584898

tree= 1, node= 14, feature=14, thr= 96.08, gain=0.737506

tree= 1, node= 15, feature= 7, thr= 24.33, gain=0.205385

tree= 1, node= 16, feature= 1, thr= 73.53, gain=0.027989

tree= 1, node= 17, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node= 18, feature=15, thr= 0.41, gain=0.188928

tree= 1, node= 19, feature= 9, thr= 60.47, gain=0.530651

tree= 1, node= 20, feature=12, thr= 30.06, gain=0.640257

tree= 1, node= 21, feature= 8, thr= 34.59, gain=0.140904

tree= 1, node= 22, feature= 6, thr= 72.55, gain=0.509615

tree= 1, node= 23, feature= 7, thr= 77.10, gain=0.409412

tree= 1, node= 24, feature= 1, thr= 84.51, gain=0.550957

tree= 1, node= 25, feature=13, thr= 14.78, gain=0.131381

tree= 1, node= 26, feature=15, thr= 31.18, gain=0.222560

tree= 1, node= 27, feature= 9, thr= 19.61, gain=0.464511

tree= 1, node= 28, feature=11, thr= 31.67, gain=0.157508

tree= 1, node= 29, feature=13, thr= 71.06, gain=0.344859

tree= 1, node= 30, feature= 2, thr= 54.90, gain=0.092930

tree= 1, node= 31, feature= 9, thr= 58.82, gain=0.918296

tree= 1, node= 32, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node= 33, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node= 36, feature= 7, thr= 66.47, gain=0.110097

tree= 1, node= 37, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node= 38, feature=14, thr= 25.49, gain=0.773333

tree= 1, node= 39, feature= 0, thr= 39.22, gain=0.203813

tree= 1, node= 40, feature= 3, thr= 96.71, gain=0.374672

tree= 1, node= 41, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node= 42, feature= 9, thr= 1.43, gain=0.077936

tree= 1, node= 43, feature= 6, thr= 68.14, gain=0.274080

tree= 1, node= 44, feature=14, thr= 96.08, gain=0.341335

tree= 1, node= 45, feature= 1, thr= 82.35, gain=0.324193

tree= 1, node= 46, feature= 2, thr= 88.59, gain=0.253482

tree= 1, node= 47, feature= 5, thr= 89.29, gain=0.811518

tree= 1, node= 48, feature= 8, thr= 76.47, gain=0.650022

tree= 1, node= 49, feature= 6, thr= 50.47, gain=0.757526

tree= 1, node= 50, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node= 51, feature= 3, thr= 87.45, gain=0.051386

tree= 1, node= 52, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node= 53, feature= 0, thr= 53.57, gain=0.129949

tree= 1, node= 54, feature=15, thr= 67.29, gain=0.265884

tree= 1, node= 55, feature=10, thr= 67.06, gain=0.773029

tree= 1, node= 56, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node= 57, feature=12, thr= 21.57, gain=0.159034

tree= 1, node= 58, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node= 59, feature= 5, thr= 54.41, gain=0.006884

tree= 1, node= 60, feature= 6, thr= 96.08, gain=0.024998

tree= 1, node= 61, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node= 62, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node= 63, feature= 1, thr= 3.92, gain=0.998846

tree= 1, node= 72, feature= 5, thr= 13.35, gain=0.035341

tree= 1, node= 73, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node= 76, feature= 7, thr= 71.86, gain=0.496889

tree= 1, node= 77, feature=10, thr= 60.78, gain=0.864204

tree= 1, node= 78, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node= 79, feature= 1, thr= 92.47, gain=0.078528

tree= 1, node= 80, feature= 5, thr= 68.63, gain=0.135036

tree= 1, node= 81, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node= 84, feature= 8, thr= 18.67, gain=0.368566

tree= 1, node= 85, feature= 7, thr= 73.02, gain=0.050120

tree= 1, node= 86, feature=12, thr= 55.47, gain=0.287642

tree= 1, node= 87, feature= 8, thr= 49.82, gain=0.208356

tree= 1, node= 88, feature= 1, thr= 39.18, gain=0.308576

tree= 1, node= 89, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node= 90, feature= 5, thr= 15.69, gain=0.106446

tree= 1, node= 91, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node= 92, feature= 0, thr= 78.43, gain=0.174910

tree= 1, node= 93, feature= 5, thr= 84.31, gain=0.901825

tree= 1, node= 94, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node= 95, feature= 6, thr= 70.59, gain=0.988057

tree= 1, node= 96, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node= 97, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node= 98, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node= 99, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=102, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=103, feature= 8, thr= 1.96, gain=0.027154

tree= 1, node=106, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=107, feature=14, thr= 1.96, gain=0.057144

tree= 1, node=108, feature= 4, thr= 62.75, gain=0.149994

tree= 1, node=109, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=110, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=111, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=114, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=115, feature= 1, thr= 26.47, gain=0.028970

tree= 1, node=118, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=119, feature= 6, thr= 45.33, gain=0.097300

tree= 1, node=120, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=121, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=126, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=127, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=144, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=145, feature=13, thr= 6.08, gain=0.024501

tree= 1, node=152, feature=13, thr= 5.10, gain=0.465185

tree= 1, node=153, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=154, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=155, feature= 7, thr= 54.53, gain=0.349184

tree= 1, node=158, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=159, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=160, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=161, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=168, feature= 5, thr= 74.55, gain=0.060896

tree= 1, node=169, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=170, feature= 9, thr= 5.61, gain=0.007149

tree= 1, node=171, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=172, feature= 6, thr= 58.29, gain=0.175730

tree= 1, node=173, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=174, feature= 0, thr= 73.33, gain=0.054012

tree= 1, node=175, feature=11, thr= 9.06, gain=0.541116

tree= 1, node=176, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=177, feature= 7, thr= 67.06, gain=0.321696

tree= 1, node=180, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=181, feature= 0, thr= 60.78, gain=0.098830

tree= 1, node=184, feature= 9, thr= 18.55, gain=0.134335

tree= 1, node=185, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=186, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=187, feature= 1, thr= 79.29, gain=0.678954

tree= 1, node=190, feature= 4, thr= 48.04, gain=0.291818

tree= 1, node=191, feature=11, thr= 39.69, gain=0.517478

tree= 1, node=206, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=207, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=214, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=215, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=216, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=217, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=230, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=231, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=238, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=239, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=290, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=291, feature= 9, thr= 88.47, gain=0.008575

tree= 1, node=304, feature= 6, thr= 67.45, gain=0.250919

tree= 1, node=305, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=310, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=311, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=336, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=337, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=340, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=341, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=344, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=345, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=348, feature= 1, thr= 89.59, gain=0.025926

tree= 1, node=349, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=350, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=351, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=354, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=355, feature= 3, thr= 89.02, gain=0.028237

tree= 1, node=362, feature= 8, thr= 24.51, gain=0.021367

tree= 1, node=363, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=368, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=369, feature=14, thr= 52.94, gain=0.111623

tree= 1, node=374, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=375, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=380, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=381, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=382, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=383, feature= 2, thr= 45.71, gain=0.103275

tree= 1, node=582, feature= 7, thr= 17.69, gain=0.008314

tree= 1, node=583, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=608, feature= 1, thr= 81.37, gain=0.056120

tree= 1, node=609, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=696, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=697, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=710, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=711, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=724, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=725, feature=15, thr= 9.12, gain=0.021405

tree= 1, node=738, feature= 6, thr= 21.57, gain=0.053910

tree= 1, node=739, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=766, feature= 1, thr= 66.67, gain=0.077022

tree= 1, node=767, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=1164, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=1165, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=1216, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=1217, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=1450, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=1451, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=1476, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=1477, feature= 3, thr= 99.12, gain=0.041635

tree= 1, node=1532, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=1533, feature= 2, thr= 41.47, gain=0.067329

tree= 1, node=2954, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=2955, feature= 2, thr= 86.33, gain=0.018695

tree= 1, node=3066, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=3067, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=5910, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=5911, feature=-1, thr= -1.00, gain=0.000000

**Testing stage:**

classification accuracy=0.8714

**Randomized:**

**Training stage:**

tree= 1, node= 1, feature= 4, thr= 43.14, gain=0.537612

tree= 1, node= 2, feature= 2, thr= 25.49, gain=0.300562

tree= 1, node= 3, feature= 1, thr= 76.47, gain=0.336627

tree= 1, node= 4, feature= 7, thr= 21.57, gain=0.671260

tree= 1, node= 5, feature=10, thr= 49.02, gain=0.364655

tree= 1, node= 6, feature=13, thr= 31.37, gain=0.411688

tree= 1, node= 7, feature= 8, thr= 47.06, gain=0.427994

tree= 1, node= 8, feature=15, thr= 39.22, gain=0.345276

tree= 1, node= 9, feature= 4, thr= 16.02, gain=0.305659

tree= 1, node= 10, feature= 7, thr= 17.65, gain=0.330660

tree= 1, node= 11, feature= 8, thr= 72.55, gain=0.455263

tree= 1, node= 12, feature=10, thr= 37.25, gain=0.502473

tree= 1, node= 13, feature= 5, thr= 25.49, gain=0.554770

tree= 1, node= 14, feature= 9, thr= 37.88, gain=0.228226

tree= 1, node= 15, feature= 4, thr= 64.86, gain=0.105695

tree= 1, node= 16, feature= 0, thr= 38.65, gain=0.398130

tree= 1, node= 17, feature= 4, thr= 34.57, gain=0.226124

tree= 1, node= 18, feature= 2, thr= 16.18, gain=0.036884

tree= 1, node= 19, feature=12, thr= 37.25, gain=0.170581

tree= 1, node= 20, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node= 21, feature= 0, thr= 98.04, gain=0.383615

tree= 1, node= 22, feature=14, thr= 35.29, gain=0.506264

tree= 1, node= 23, feature=14, thr= 13.73, gain=0.373562

tree= 1, node= 24, feature= 8, thr= 37.65, gain=0.241607

tree= 1, node= 25, feature= 6, thr= 74.51, gain=0.413046

tree= 1, node= 26, feature= 6, thr= 78.43, gain=0.994030

tree= 1, node= 27, feature=15, thr= 25.49, gain=0.615352

tree= 1, node= 28, feature=12, thr= 68.63, gain=0.402635

tree= 1, node= 29, feature= 5, thr= 66.67, gain=0.151923

tree= 1, node= 30, feature=13, thr= 17.65, gain=0.632107

tree= 1, node= 31, feature=13, thr= 15.69, gain=0.759793

tree= 1, node= 32, feature= 2, thr= 4.24, gain=0.615493

tree= 1, node= 33, feature=11, thr= 37.88, gain=0.611822

tree= 1, node= 34, feature= 1, thr= 97.61, gain=0.009157

tree= 1, node= 35, feature= 7, thr= 2.06, gain=0.316186

tree= 1, node= 36, feature= 1, thr= 91.08, gain=0.203930

tree= 1, node= 37, feature= 7, thr= 66.35, gain=0.309543

tree= 1, node= 38, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node= 39, feature= 7, thr= 72.47, gain=0.696683

tree= 1, node= 42, feature= 9, thr= 2.35, gain=0.289426

tree= 1, node= 43, feature= 4, thr= 20.24, gain=0.385669

tree= 1, node= 44, feature= 1, thr= 98.53, gain=0.265841

tree= 1, node= 45, feature= 2, thr= 73.88, gain=0.169810

tree= 1, node= 46, feature= 1, thr= 93.82, gain=0.434982

tree= 1, node= 47, feature= 9, thr= 66.67, gain=0.599693

tree= 1, node= 48, feature= 2, thr= 63.86, gain=0.075368

tree= 1, node= 49, feature=12, thr= 24.59, gain=0.194114

tree= 1, node= 50, feature=15, thr= 9.88, gain=0.558104

tree= 1, node= 51, feature=11, thr= 39.53, gain=0.183371

tree= 1, node= 52, feature=11, thr= 64.45, gain=0.067257

tree= 1, node= 53, feature= 3, thr= 0.67, gain=0.044126

tree= 1, node= 54, feature=14, thr= 31.67, gain=0.126143

tree= 1, node= 55, feature= 7, thr= 48.94, gain=0.423077

tree= 1, node= 56, feature= 0, thr= 5.88, gain=0.277702

tree= 1, node= 57, feature=15, thr= 43.14, gain=0.609107

tree= 1, node= 58, feature= 6, thr= 33.33, gain=0.211026

tree= 1, node= 59, feature=13, thr= 19.61, gain=0.649647

tree= 1, node= 60, feature= 5, thr= 86.00, gain=0.411888

tree= 1, node= 61, feature=10, thr= 62.75, gain=0.191551

tree= 1, node= 62, feature= 8, thr= 71.45, gain=0.130072

tree= 1, node= 63, feature=15, thr= 1.96, gain=0.276862

tree= 1, node= 64, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node= 65, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node= 66, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node= 67, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node= 68, feature= 0, thr= 60.78, gain=0.085709

tree= 1, node= 69, feature=11, thr= 52.24, gain=0.081456

tree= 1, node= 70, feature= 7, thr= 0.04, gain=0.025262

tree= 1, node= 71, feature= 9, thr= 1.39, gain=0.776773

tree= 1, node= 72, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node= 73, feature=10, thr= 47.06, gain=0.152096

tree= 1, node= 74, feature=10, thr= 41.18, gain=0.368767

tree= 1, node= 75, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node= 78, feature=15, thr= 1.96, gain=0.738129

tree= 1, node= 79, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node= 84, feature=10, thr= 0.88, gain=0.016711

tree= 1, node= 85, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node= 86, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node= 87, feature= 8, thr= 12.49, gain=0.719311

tree= 1, node= 88, feature=10, thr= 99.16, gain=0.194573

tree= 1, node= 89, feature= 8, thr= 53.65, gain=0.070408

tree= 1, node= 90, feature= 4, thr= 18.63, gain=0.151823

tree= 1, node= 91, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node= 92, feature=11, thr= 22.69, gain=0.142240

tree= 1, node= 93, feature= 7, thr= 23.53, gain=0.900485

tree= 1, node= 94, feature=13, thr= 52.94, gain=0.159350

tree= 1, node= 95, feature=11, thr= 78.43, gain=0.111805

tree= 1, node= 96, feature= 5, thr= 87.53, gain=0.040278

tree= 1, node= 97, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node= 98, feature= 6, thr= 51.06, gain=0.311280

tree= 1, node= 99, feature=11, thr= 11.22, gain=0.104354

tree= 1, node=100, feature= 6, thr= 46.43, gain=0.582175

tree= 1, node=101, feature=11, thr= 20.31, gain=0.313319

tree= 1, node=102, feature= 7, thr= 80.08, gain=0.181713

tree= 1, node=103, feature= 2, thr= 13.73, gain=0.037566

tree= 1, node=104, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=105, feature= 3, thr= 53.12, gain=0.028882

tree= 1, node=106, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=107, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=108, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=109, feature=13, thr= 36.12, gain=0.103403

tree= 1, node=110, feature= 2, thr= 13.04, gain=0.177112

tree= 1, node=111, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=112, feature=10, thr= 60.78, gain=0.063495

tree= 1, node=113, feature= 6, thr= 49.02, gain=0.117420

tree= 1, node=114, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=115, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=116, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=117, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=118, feature=11, thr= 27.06, gain=0.435468

tree= 1, node=119, feature= 0, thr= 5.71, gain=0.130286

tree= 1, node=120, feature= 8, thr= 73.25, gain=0.173353

tree= 1, node=121, feature=-1, thr= -1.00, gain=0.000000

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tree= 1, node=123, feature=12, thr= 40.00, gain=0.521256

tree= 1, node=124, feature=15, thr= 18.00, gain=0.185937

tree= 1, node=125, feature= 3, thr= 91.18, gain=0.488052

tree= 1, node=126, feature= 4, thr= 89.02, gain=0.189515

tree= 1, node=127, feature= 1, thr= 77.45, gain=0.033248

tree= 1, node=136, feature= 9, thr= 1.27, gain=0.019314

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tree= 1, node=138, feature= 4, thr= 7.53, gain=0.347128

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tree= 1, node=177, feature= 4, thr= 11.80, gain=0.199494

tree= 1, node=178, feature= 6, thr= 6.12, gain=0.003523

tree= 1, node=179, feature= 6, thr= 0.82, gain=0.090072

tree= 1, node=180, feature= 2, thr= 41.24, gain=0.081388

tree= 1, node=181, feature= 6, thr= 2.25, gain=0.099402

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tree= 1, node=6045, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=6360, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=6361, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=7184, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=7185, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=7186, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=7187, feature= 8, thr= 3.71, gain=0.058657

tree= 1, node=7242, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=7243, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=7254, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=7255, feature= 5, thr= 79.25, gain=0.069159

tree= 1, node=7272, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=7273, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=7276, feature= 8, thr= 40.55, gain=0.043527

tree= 1, node=7277, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=7938, feature=13, thr= 9.12, gain=0.088316

tree= 1, node=7939, feature=14, thr= 25.25, gain=0.591673

tree= 1, node=8048, feature= 9, thr= 28.71, gain=0.048303

tree= 1, node=8049, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=8180, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=8181, feature= 3, thr=100.00, gain=0.000000

tree= 1, node=14374, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=14375, feature= 3, thr= 99.12, gain=0.071549

tree= 1, node=14510, feature= 1, thr= 82.35, gain=0.014523

tree= 1, node=14511, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=14552, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=14553, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=15876, feature= 1, thr= 83.27, gain=0.132910

tree= 1, node=15877, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=15878, feature=10, thr= 80.16, gain=0.075433

tree= 1, node=15879, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=16096, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=16097, feature= 6, thr= 80.78, gain=0.039625

tree= 1, node=16362, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=16363, feature= 2, thr= 71.24, gain=0.040223

tree= 1, node=28750, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=28751, feature= 7, thr= 48.06, gain=0.664570

tree= 1, node=29020, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=29021, feature= 5, thr= 69.08, gain=0.042555

tree= 1, node=31752, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=31753, feature= 9, thr= 45.39, gain=0.341486

tree= 1, node=31756, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=31757, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=32194, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=32195, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=32726, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=32727, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=57502, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=57503, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=58042, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=58043, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=63506, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=63507, feature=-1, thr= -1.00, gain=0.000000

**Testing stage:**

classification accuracy=0.7922

**forest3:**

**Training stage:**

tree= 1, node= 1, feature=15, thr= 21.57, gain=0.621424

tree= 1, node= 2, feature= 9, thr= 31.37, gain=0.467217

tree= 1, node= 3, feature= 2, thr= 25.49, gain=0.428446

tree= 1, node= 4, feature= 7, thr= 34.12, gain=0.319374

tree= 1, node= 5, feature= 0, thr= 1.96, gain=0.353593

tree= 1, node= 6, feature= 5, thr= 29.41, gain=0.420553

tree= 1, node= 7, feature=10, thr= 56.86, gain=0.289761

tree= 1, node= 8, feature= 8, thr= 37.25, gain=0.438306

tree= 1, node= 9, feature=15, thr= 12.35, gain=0.214560

tree= 1, node= 10, feature= 6, thr= 75.27, gain=0.379544

tree= 1, node= 11, feature=10, thr= 50.98, gain=0.262779

tree= 1, node= 12, feature=15, thr= 84.71, gain=0.131698

tree= 1, node= 13, feature= 5, thr= 60.20, gain=0.226236

tree= 1, node= 14, feature=13, thr= 52.94, gain=0.515996

tree= 1, node= 15, feature= 1, thr= 98.04, gain=0.533262

tree= 1, node= 16, feature= 4, thr= 41.18, gain=0.646679

tree= 1, node= 17, feature= 3, thr= 97.06, gain=0.128694

tree= 1, node= 18, feature= 3, thr= 97.96, gain=0.251584

tree= 1, node= 19, feature= 5, thr= 79.76, gain=0.530899

tree= 1, node= 20, feature= 1, thr= 70.59, gain=0.428316

tree= 1, node= 21, feature=14, thr= 62.75, gain=0.173565

tree= 1, node= 22, feature=11, thr= 27.45, gain=0.511563

tree= 1, node= 23, feature= 7, thr= 49.02, gain=0.504839

tree= 1, node= 24, feature=13, thr= 91.71, gain=0.003728

tree= 1, node= 25, feature=15, thr= 98.24, gain=0.077253

tree= 1, node= 26, feature= 7, thr= 9.80, gain=0.096804

tree= 1, node= 27, feature=14, thr= 68.63, gain=0.261810

tree= 1, node= 28, feature=10, thr= 2.20, gain=0.107008

tree= 1, node= 29, feature=10, thr= 36.24, gain=0.272955

tree= 1, node= 30, feature= 1, thr= 82.63, gain=0.255225

tree= 1, node= 31, feature= 7, thr= 1.90, gain=0.261181

tree= 1, node= 32, feature= 9, thr= 9.06, gain=0.162413

tree= 1, node= 33, feature=12, thr= 46.67, gain=0.168101

tree= 1, node= 34, feature=14, thr= 39.22, gain=0.815936

tree= 1, node= 35, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node= 36, feature=13, thr= 8.47, gain=0.740599

tree= 1, node= 37, feature=12, thr= 72.55, gain=0.128893

tree= 1, node= 38, feature=10, thr= 72.55, gain=0.374146

tree= 1, node= 39, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node= 40, feature= 9, thr= 49.33, gain=0.461382

tree= 1, node= 41, feature= 8, thr= 49.53, gain=0.459316

tree= 1, node= 42, feature=11, thr= 37.55, gain=0.285887

tree= 1, node= 43, feature=15, thr= 0.18, gain=0.091066

tree= 1, node= 44, feature= 3, thr= 78.86, gain=0.589754

tree= 1, node= 45, feature= 9, thr= 68.14, gain=0.409406

tree= 1, node= 46, feature=15, thr= 0.41, gain=0.370857

tree= 1, node= 47, feature= 8, thr= 60.78, gain=0.155687

tree= 1, node= 48, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node= 49, feature= 8, thr= 56.86, gain=0.101337

tree= 1, node= 50, feature= 0, thr= 29.18, gain=0.034341

tree= 1, node= 51, feature= 2, thr= 10.29, gain=0.430539

tree= 1, node= 52, feature= 8, thr= 45.10, gain=0.852718

tree= 1, node= 53, feature= 9, thr= 1.22, gain=0.050736

tree= 1, node= 54, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node= 55, feature= 2, thr= 17.16, gain=0.379660

tree= 1, node= 56, feature= 0, thr= 35.29, gain=0.739817

tree= 1, node= 57, feature=15, thr= 55.65, gain=0.198009

tree= 1, node= 58, feature= 5, thr= 46.90, gain=0.750695

tree= 1, node= 59, feature=12, thr= 37.25, gain=0.485461

tree= 1, node= 60, feature= 3, thr= 25.49, gain=0.411576

tree= 1, node= 61, feature= 1, thr= 90.06, gain=0.094831

tree= 1, node= 62, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node= 63, feature=12, thr= 92.16, gain=0.112728

tree= 1, node= 64, feature=10, thr= 35.76, gain=0.361569

tree= 1, node= 65, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node= 66, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node= 67, feature= 7, thr= 20.67, gain=0.044711

tree= 1, node= 68, feature=12, thr= 47.80, gain=0.015984

tree= 1, node= 69, feature=12, thr= 28.43, gain=0.078856

tree= 1, node= 72, feature= 6, thr= 68.71, gain=0.115588

tree= 1, node= 73, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node= 74, feature=12, thr= 48.00, gain=0.121137

tree= 1, node= 75, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node= 76, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node= 77, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node= 80, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node= 81, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node= 82, feature= 0, thr= 0.02, gain=0.050339

tree= 1, node= 83, feature= 8, thr= 60.78, gain=0.094287

tree= 1, node= 84, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node= 85, feature=15, thr= 0.39, gain=0.113552

tree= 1, node= 86, feature= 6, thr= 87.29, gain=0.066775

tree= 1, node= 87, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node= 88, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node= 89, feature= 1, thr= 91.24, gain=0.053968

tree= 1, node= 90, feature= 9, thr= 61.53, gain=0.192245

tree= 1, node= 91, feature= 0, thr= 36.59, gain=0.554574

tree= 1, node= 92, feature=11, thr= 25.06, gain=0.053093

tree= 1, node= 93, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node= 94, feature= 0, thr= 28.90, gain=0.145943

tree= 1, node= 95, feature= 2, thr= 43.14, gain=0.216354

tree= 1, node= 98, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node= 99, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=100, feature=14, thr= 70.59, gain=0.606448

tree= 1, node=101, feature=11, thr= 65.35, gain=0.099870

tree= 1, node=102, feature=11, thr= 72.76, gain=0.325851

tree= 1, node=103, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=104, feature=11, thr= 69.55, gain=0.142845

tree= 1, node=105, feature= 4, thr= 2.20, gain=0.024393

tree= 1, node=106, feature= 0, thr= 45.10, gain=0.510653

tree= 1, node=107, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=110, feature= 0, thr= 54.90, gain=0.705553

tree= 1, node=111, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=112, feature= 2, thr= 53.41, gain=0.065074

tree= 1, node=113, feature= 1, thr= 81.00, gain=0.161093

tree= 1, node=114, feature= 2, thr= 55.02, gain=0.142411

tree= 1, node=115, feature= 3, thr= 95.29, gain=0.094018

tree= 1, node=116, feature=11, thr= 91.22, gain=0.210170

tree= 1, node=117, feature= 6, thr= 71.76, gain=0.051022

tree= 1, node=118, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=119, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=120, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=121, feature=11, thr= 13.73, gain=0.205479

tree= 1, node=122, feature=15, thr= 52.59, gain=0.948375

tree= 1, node=123, feature=15, thr= 60.24, gain=0.794007

tree= 1, node=126, feature= 7, thr= 47.24, gain=0.272614

tree= 1, node=127, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=128, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=129, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=134, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=135, feature= 7, thr= 33.24, gain=0.023949

tree= 1, node=136, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=137, feature= 0, thr= 69.41, gain=0.038001

tree= 1, node=138, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=139, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=144, feature= 3, thr= 94.12, gain=0.055845

tree= 1, node=145, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=148, feature= 1, thr= 79.24, gain=0.300607

tree= 1, node=149, feature= 2, thr= 41.18, gain=0.032170

tree= 1, node=164, feature= 8, thr= 24.53, gain=0.285836

tree= 1, node=165, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=166, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=167, feature=12, thr= 78.25, gain=0.277623

tree= 1, node=170, feature= 8, thr= 72.24, gain=0.068226

tree= 1, node=171, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=172, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=173, feature=10, thr= 58.12, gain=0.336763

tree= 1, node=178, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=179, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=180, feature= 2, thr= 29.41, gain=0.087037

tree= 1, node=181, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=182, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=183, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=184, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=185, feature=13, thr= 52.43, gain=0.014475

tree= 1, node=188, feature= 4, thr= 70.59, gain=0.298285

tree= 1, node=189, feature= 9, thr= 61.18, gain=0.327503

tree= 1, node=190, feature=12, thr= 64.37, gain=0.074680

tree= 1, node=191, feature=11, thr= 30.24, gain=0.460978

tree= 1, node=200, feature= 3, thr= 49.65, gain=0.033997

tree= 1, node=201, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=202, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=203, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=204, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=205, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=208, feature=15, thr= 95.06, gain=0.147584

tree= 1, node=209, feature=12, thr= 56.12, gain=0.096945

tree= 1, node=210, feature=12, thr= 62.12, gain=0.139582

tree= 1, node=211, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=212, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=213, feature= 2, thr= 13.24, gain=0.433898

tree= 1, node=220, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=221, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=224, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=225, feature=13, thr= 46.45, gain=0.048571

tree= 1, node=226, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=227, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=228, feature= 3, thr= 68.76, gain=0.209866

tree= 1, node=229, feature=14, thr= 49.02, gain=0.774161

tree= 1, node=230, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=231, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=232, feature=12, thr= 56.49, gain=0.073419

tree= 1, node=233, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=234, feature= 5, thr= 56.63, gain=0.138230

tree= 1, node=235, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=242, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=243, feature= 7, thr= 1.96, gain=0.064097

tree= 1, node=244, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=245, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=246, feature=10, thr= 95.78, gain=0.202617

tree= 1, node=247, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=252, feature=11, thr= 22.59, gain=0.082093

tree= 1, node=253, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=270, feature= 6, thr= 40.00, gain=0.070397

tree= 1, node=271, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=274, feature= 5, thr= 20.80, gain=0.072104

tree= 1, node=275, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=288, feature=10, thr= 13.73, gain=0.016392

tree= 1, node=289, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=296, feature=15, thr= 8.24, gain=0.092888

tree= 1, node=297, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=298, feature=14, thr= 37.25, gain=0.127419

tree= 1, node=299, feature= 3, thr= 99.02, gain=0.002078

tree= 1, node=328, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=329, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=334, feature=11, thr= 36.94, gain=0.235193

tree= 1, node=335, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=340, feature= 5, thr= 89.41, gain=0.171792

tree= 1, node=341, feature=13, thr= 22.02, gain=0.066096

tree= 1, node=346, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=347, feature= 7, thr= 88.39, gain=0.023931

tree= 1, node=360, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=361, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=370, feature= 4, thr= 0.88, gain=0.001779

tree= 1, node=371, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=376, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=377, feature= 2, thr= 72.55, gain=0.308006

tree= 1, node=378, feature=15, thr= 0.35, gain=0.086042

tree= 1, node=379, feature= 8, thr= 8.24, gain=0.119439

tree= 1, node=380, feature= 2, thr= 0.84, gain=0.279050

tree= 1, node=381, feature=13, thr= 20.10, gain=0.307913

tree= 1, node=382, feature=15, thr= 7.41, gain=0.025538

tree= 1, node=383, feature=14, thr= 1.96, gain=0.082418

tree= 1, node=400, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=401, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=416, feature= 8, thr= 3.53, gain=0.055244

tree= 1, node=417, feature= 3, thr= 69.41, gain=0.309570

tree= 1, node=418, feature= 9, thr= 17.59, gain=0.035082

tree= 1, node=419, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=420, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=421, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=426, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=427, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=450, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=451, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=456, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=457, feature= 6, thr= 45.10, gain=0.114304

tree= 1, node=458, feature= 5, thr= 93.10, gain=0.473573

tree= 1, node=459, feature=14, thr= 98.08, gain=0.008306

tree= 1, node=464, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=465, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=468, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=469, feature=13, thr= 57.33, gain=0.043007

tree= 1, node=486, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=487, feature= 0, thr= 60.78, gain=0.464046

tree= 1, node=492, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=493, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=504, feature= 0, thr= 5.88, gain=0.146094

tree= 1, node=505, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=540, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=541, feature= 0, thr= 16.67, gain=0.054602

tree= 1, node=548, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=549, feature= 5, thr= 57.43, gain=0.089222

tree= 1, node=576, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=577, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=592, feature= 7, thr= 53.20, gain=0.091361

tree= 1, node=593, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=596, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=597, feature= 9, thr= 4.25, gain=0.047578

tree= 1, node=598, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=599, feature= 6, thr= 8.63, gain=0.139778

tree= 1, node=668, feature= 6, thr= 73.82, gain=0.076293

tree= 1, node=669, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=680, feature=-1, thr= -1.00, gain=0.000000

tree= 1, node=681, feature=-1, thr= -1.00, gain=0.000000

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tree= 1, node=756, feature=11, thr= 47.24, gain=0.660523

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tree= 1, node=760, feature=14, thr= 37.25, gain=0.177803

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tree= 1, node=764, feature= 1, thr= 74.90, gain=0.218328

tree= 1, node=765, feature=11, thr= 19.41, gain=0.238210

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tree= 1, node=767, feature= 8, thr= 99.24, gain=0.083234

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tree= 2, node=112, feature= 4, thr= 39.22, gain=0.290721

tree= 2, node=113, feature= 2, thr= 88.24, gain=0.329230

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tree= 3, node= 24, feature=12, thr= 98.18, gain=0.371879

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tree= 3, node= 27, feature= 0, thr= 88.24, gain=0.501701

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tree= 3, node= 31, feature= 4, thr= 29.41, gain=0.478773

tree= 3, node= 32, feature= 8, thr= 11.53, gain=0.125273

tree= 3, node= 33, feature= 5, thr= 99.02, gain=0.026228

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tree= 3, node= 35, feature= 9, thr= 16.47, gain=0.977418

tree= 3, node= 36, feature=13, thr= 77.41, gain=0.092942

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tree= 3, node= 39, feature=10, thr= 13.25, gain=0.041829

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tree= 3, node= 44, feature=12, thr= 13.33, gain=0.141871

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tree= 3, node=639, feature= 1, thr= 85.33, gain=0.019989

tree= 3, node=666, feature=-1, thr= -1.00, gain=0.000000

tree= 3, node=667, feature=10, thr= 76.04, gain=0.025077

tree= 3, node=676, feature=-1, thr= -1.00, gain=0.000000

tree= 3, node=677, feature= 4, thr= 0.94, gain=0.008508

tree= 3, node=696, feature=13, thr= 99.02, gain=0.003677

tree= 3, node=697, feature=-1, thr= -1.00, gain=0.000000

tree= 3, node=698, feature=-1, thr= -1.00, gain=0.000000

tree= 3, node=699, feature= 7, thr= 5.10, gain=0.157288

tree= 3, node=714, feature=-1, thr= -1.00, gain=0.000000

tree= 3, node=715, feature= 9, thr= 53.33, gain=0.375340

tree= 3, node=716, feature=-1, thr= -1.00, gain=0.000000

tree= 3, node=717, feature= 4, thr= 19.61, gain=0.032163

tree= 3, node=732, feature=-1, thr= -1.00, gain=0.000000

tree= 3, node=733, feature=-1, thr= -1.00, gain=0.000000

tree= 3, node=754, feature=14, thr= 1.96, gain=0.349184

tree= 3, node=755, feature= 7, thr= 83.82, gain=0.386299

tree= 3, node=756, feature=-1, thr= -1.00, gain=0.000000

tree= 3, node=757, feature=10, thr= 71.24, gain=0.234773

tree= 3, node=758, feature=-1, thr= -1.00, gain=0.000000

tree= 3, node=759, feature=-1, thr= -1.00, gain=0.000000

tree= 3, node=760, feature=-1, thr= -1.00, gain=0.000000

tree= 3, node=761, feature= 5, thr= 92.47, gain=0.151964

tree= 3, node=762, feature=14, thr= 0.12, gain=0.001345

tree= 3, node=763, feature=12, thr= 65.41, gain=0.011646

tree= 3, node=764, feature= 1, thr= 98.12, gain=0.242708

tree= 3, node=765, feature=-1, thr= -1.00, gain=0.000000

tree= 3, node=766, feature=10, thr= 96.24, gain=0.025760

tree= 3, node=767, feature=-1, thr= -1.00, gain=0.000000

tree= 3, node=772, feature= 3, thr= 38.24, gain=0.195909

tree= 3, node=773, feature=-1, thr= -1.00, gain=0.000000

tree= 3, node=778, feature=-1, thr= -1.00, gain=0.000000

tree= 3, node=779, feature= 8, thr= 57.69, gain=0.366578

tree= 3, node=824, feature=-1, thr= -1.00, gain=0.000000

tree= 3, node=825, feature= 9, thr= 11.86, gain=0.735509

tree= 3, node=826, feature= 0, thr= 1.65, gain=0.045890

tree= 3, node=827, feature=-1, thr= -1.00, gain=0.000000

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tree= 3, node=921, feature=-1, thr= -1.00, gain=0.000000

tree= 3, node=1046, feature= 5, thr= 82.33, gain=0.024536

tree= 3, node=1047, feature= 8, thr= 43.20, gain=0.027154

tree= 3, node=1074, feature=-1, thr= -1.00, gain=0.000000

tree= 3, node=1075, feature=-1, thr= -1.00, gain=0.000000

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tree= 3, node=1259, feature= 4, thr= 57.39, gain=0.085035

tree= 3, node=1278, feature=-1, thr= -1.00, gain=0.000000

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tree= 3, node=1335, feature= 6, thr= 70.59, gain=0.105968

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tree= 3, node=1393, feature= 9, thr= 48.61, gain=0.014334

tree= 3, node=1398, feature=15, thr= 82.49, gain=0.016499

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tree= 3, node=1431, feature=-1, thr= -1.00, gain=0.000000

tree= 3, node=1434, feature=-1, thr= -1.00, gain=0.000000

tree= 3, node=1435, feature=-1, thr= -1.00, gain=0.000000

tree= 3, node=1508, feature= 4, thr= 47.65, gain=0.461086

tree= 3, node=1509, feature=-1, thr= -1.00, gain=0.000000

tree= 3, node=1510, feature=15, thr= 0.35, gain=0.284159

tree= 3, node=1511, feature=-1, thr= -1.00, gain=0.000000

tree= 3, node=1514, feature=-1, thr= -1.00, gain=0.000000

tree= 3, node=1515, feature= 5, thr= 79.29, gain=0.326577

tree= 3, node=1522, feature=10, thr= 99.06, gain=0.055925

tree= 3, node=1523, feature=12, thr= 57.12, gain=0.087016

tree= 3, node=1524, feature= 4, thr= 49.39, gain=0.380947

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tree= 3, node=1533, feature= 0, thr= 47.16, gain=0.163429

tree= 3, node=1544, feature=-1, thr= -1.00, gain=0.000000

tree= 3, node=1545, feature= 3, thr= 99.18, gain=0.051401

tree= 3, node=1558, feature=10, thr= 1.96, gain=0.231813

tree= 3, node=1559, feature=-1, thr= -1.00, gain=0.000000

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tree= 3, node=1652, feature=-1, thr= -1.00, gain=0.000000

tree= 3, node=1653, feature=-1, thr= -1.00, gain=0.000000

tree= 3, node=2092, feature= 1, thr= 99.20, gain=0.107977

tree= 3, node=2093, feature= 2, thr= 70.84, gain=0.146907

tree= 3, node=2094, feature=11, thr= 32.65, gain=0.064519

tree= 3, node=2095, feature=-1, thr= -1.00, gain=0.000000

tree= 3, node=2518, feature=-1, thr= -1.00, gain=0.000000

tree= 3, node=2519, feature= 1, thr= 84.22, gain=0.047538

tree= 3, node=2670, feature= 6, thr= 1.37, gain=0.039376

tree= 3, node=2671, feature=-1, thr= -1.00, gain=0.000000

tree= 3, node=2786, feature=-1, thr= -1.00, gain=0.000000

tree= 3, node=2787, feature=-1, thr= -1.00, gain=0.000000

tree= 3, node=2796, feature=13, thr= 99.24, gain=0.013104

tree= 3, node=2797, feature=-1, thr= -1.00, gain=0.000000

tree= 3, node=3016, feature=-1, thr= -1.00, gain=0.000000

tree= 3, node=3017, feature= 9, thr= 50.14, gain=0.121441

tree= 3, node=3020, feature=-1, thr= -1.00, gain=0.000000

tree= 3, node=3021, feature=-1, thr= -1.00, gain=0.000000

tree= 3, node=3030, feature=-1, thr= -1.00, gain=0.000000

tree= 3, node=3031, feature=-1, thr= -1.00, gain=0.000000

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tree= 3, node=3053, feature=-1, thr= -1.00, gain=0.000000

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tree= 3, node=3066, feature= 0, thr= 27.65, gain=0.140376

tree= 3, node=3067, feature=-1, thr= -1.00, gain=0.000000

tree= 3, node=3090, feature=-1, thr= -1.00, gain=0.000000

tree= 3, node=3091, feature=-1, thr= -1.00, gain=0.000000

tree= 3, node=3116, feature=-1, thr= -1.00, gain=0.000000

tree= 3, node=3117, feature=-1, thr= -1.00, gain=0.000000

tree= 3, node=4184, feature=13, thr= 1.02, gain=0.063135

tree= 3, node=4185, feature=-1, thr= -1.00, gain=0.000000

tree= 3, node=4186, feature=12, thr= 50.35, gain=0.065245

tree= 3, node=4187, feature=-1, thr= -1.00, gain=0.000000

tree= 3, node=4188, feature= 5, thr= 86.06, gain=0.023727

tree= 3, node=4189, feature=-1, thr= -1.00, gain=0.000000

tree= 3, node=5038, feature=-1, thr= -1.00, gain=0.000000

tree= 3, node=5039, feature= 4, thr= 82.71, gain=0.008414

tree= 3, node=5340, feature=-1, thr= -1.00, gain=0.000000

tree= 3, node=5341, feature=-1, thr= -1.00, gain=0.000000

tree= 3, node=5592, feature=-1, thr= -1.00, gain=0.000000

tree= 3, node=5593, feature= 6, thr= 45.86, gain=0.023987

tree= 3, node=6034, feature=12, thr= 36.14, gain=0.009685

tree= 3, node=6035, feature=-1, thr= -1.00, gain=0.000000

tree= 3, node=6104, feature= 5, thr= 87.06, gain=0.078357

tree= 3, node=6105, feature= 6, thr= 52.12, gain=0.094484

tree= 3, node=6132, feature= 1, thr= 95.06, gain=0.165858

tree= 3, node=6133, feature=-1, thr= -1.00, gain=0.000000

tree= 3, node=8368, feature=-1, thr= -1.00, gain=0.000000

tree= 3, node=8369, feature=-1, thr= -1.00, gain=0.000000

tree= 3, node=8372, feature=14, thr= 99.33, gain=0.052870

tree= 3, node=8373, feature=-1, thr= -1.00, gain=0.000000

tree= 3, node=8376, feature=11, thr= 28.24, gain=0.043529

tree= 3, node=8377, feature=-1, thr= -1.00, gain=0.000000

tree= 3, node=10078, feature=-1, thr= -1.00, gain=0.000000

tree= 3, node=10079, feature= 3, thr= 98.04, gain=0.068206

tree= 3, node=11186, feature=-1, thr= -1.00, gain=0.000000

tree= 3, node=11187, feature= 3, thr= 42.53, gain=0.049997

tree= 3, node=12068, feature=10, thr= 72.29, gain=0.039504

tree= 3, node=12069, feature=-1, thr= -1.00, gain=0.000000

tree= 3, node=12208, feature= 5, thr= 68.18, gain=0.070727

tree= 3, node=12209, feature=-1, thr= -1.00, gain=0.000000

tree= 3, node=12210, feature=-1, thr= -1.00, gain=0.000000

tree= 3, node=12211, feature= 8, thr= 80.00, gain=0.170093

tree= 3, node=12264, feature=-1, thr= -1.00, gain=0.000000

tree= 3, node=12265, feature=-1, thr= -1.00, gain=0.000000

tree= 3, node=16744, feature=-1, thr= -1.00, gain=0.000000

tree= 3, node=16745, feature= 1, thr= 73.24, gain=0.182132

tree= 3, node=16752, feature=-1, thr= -1.00, gain=0.000000

tree= 3, node=16753, feature=-1, thr= -1.00, gain=0.000000

tree= 3, node=20158, feature=-1, thr= -1.00, gain=0.000000

tree= 3, node=20159, feature=-1, thr= -1.00, gain=0.000000

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tree= 3, node=24137, feature=-1, thr= -1.00, gain=0.000000

tree= 3, node=24416, feature=-1, thr= -1.00, gain=0.000000

tree= 3, node=24417, feature= 5, thr= 71.33, gain=0.015512

tree= 3, node=24422, feature=-1, thr= -1.00, gain=0.000000

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tree= 3, node=33491, feature=-1, thr= -1.00, gain=0.000000

tree= 3, node=48834, feature=-1, thr= -1.00, gain=0.000000

tree= 3, node=48835, feature=11, thr= 23.02, gain=0.234508

tree= 3, node=97670, feature=15, thr= 5.12, gain=0.096108

tree= 3, node=97671, feature=-1, thr= -1.00, gain=0.000000

tree= 3, node=195340, feature=-1, thr= -1.00, gain=0.000000

tree= 3, node=195341, feature=-1, thr= -1.00, gain=0.000000

**Test stage:**

classification accuracy=0.7581

**Task – 2**

A.

Let,

Number of people who decided to wait (K1) = 80

Number of people who decided not to wait (K2) = 20

Now, we know that,

Entropy is given by:

Initial entropy is given by:

B.

We know that,

Information Gain is given by:

Graph,

A picture containing text, lawn mower, clipart

Description automatically generated

H(A) = 0.7219

Thus, Information Gain is given by:

𝐼(𝐸, 𝐿) = 0.7219

𝐼 (𝐸, 𝐿) = 0.7219 − 0.34482 − 0.254215

𝑰(𝑬, 𝑳) = 𝟎. 𝟏𝟐𝟐𝟖𝟔𝟓

C.

The information gain at Node E, of using the weekend test will be 0 because all the records at node E will be classified as “Yes” for the weekend test. It is because weekend test has already been applied at node A.

D.

A test case of a hungry patron who came in on a rainy Tuesday will end up in Node F. The decision tree will output “will wait”.

E.

A test case of a not hungry patron who come in on a sunny Saturday will end up in Node H. The decision tree will output “will not wait”.

**Task – 3**

Information gain for attribute ‘A’:

**IA**= 1 – ((3/10\*0) +(4/10\*0.8113) +(3/10\*0.9182)) = 1 – (0+0.324 + 0.276) = **0.4**

Information gain for attribute ‘B’:

**IB**= 1 – ((4/10\*0.8113) +(4/10\*0.8113) +(2/10\*1)) = 1 – (0.32452 + 0.32452 + 0.2) = **0.15**

Information gain for attribute ‘C’:

**IC**= 1 – ((5/10\*0.7219) +(4/10\*0.8113) +(1/10\*0)) = 1 – (0.36095 + 0.32452 + 0) = **0.32**

Attribute **‘A’** achieves the highest information gain.

**Task – 4**

A.

1. Highest possible entropy at node N is 2 when 1000 training examples are equally distributed among class A, B, C, D.
2. Lowest possible entropy at node N is 0 when all the training examples belong to a particular class.

B.

1. Highest possible information gain will be same i.e., 2 as the entropy of parent node N when we chose attribute K. It happens when the entropy of each children node is 0. i.e., all the records in each children node belongs to one class.
2. Lowest information gain will be 0 when the entropy of each children node is 1. It is possible when records in each children node is equally distributed among all the classes (A, B, C, D).

**Task – 5**

The accuracy of the current classifier is 28%. We can achieve (100-28) = 72% accurate binary classifier.

We can achieve this by just swapping the class output of the classifier.

Yes, I can guarantee achieving better than 60% accuracy.