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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
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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
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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
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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
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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
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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
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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
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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
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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
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tree= 1, node=129, feature=-1, thr= -1.00, gain=0.000000
tree= 1, node=134, feature=-1, thr= -1.00, gain=0.000000

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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
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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
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Test stage:

classification accuracy=0.7581

Task – 2

A.

Let,

Number of people who decided to wait (K_1) = 80

Number of people who decided not to wait (K_2) = 20

Now, we know that,

Entropy is given by:

$$H\left(\frac{K1}{K}, \frac{K2}{K}, \dots, \frac{KN}{K}\right) = \sum_{i=1}^N -\frac{Ki}{K} \log_2 \frac{Ki}{K}$$

Initial entropy is given by:

$$H(A) = -\frac{80}{100} \log_2 \frac{80}{100} - \frac{20}{100} \log_2 \frac{20}{100}$$

$$= -0.8 * (-0.3219) - 0.2 * (-2.3219) = \mathbf{0.7219}.$$

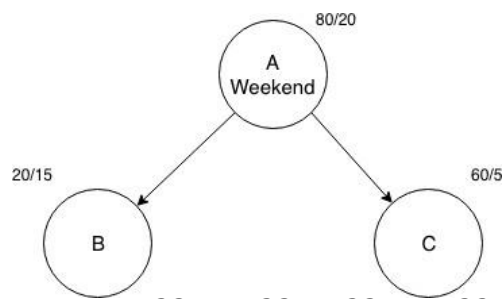
B.

We know that,

Information Gain is given by:

$$I(E, L) = H(E) - \sum_{i=1}^L \frac{Ki}{K} H(E_i)$$

Graph,



$$= -0.5714 * (-0.8073) - 0.4286 * (-1.2223) = \mathbf{0.9852}$$

$$H(C) = -\frac{60}{65} \log_2 \frac{60}{65} - \frac{5}{65} \log_2 \frac{5}{65}$$

$$= -0.5714 * (-0.1154) - 0.0769 * (-3.7009) = \mathbf{0.3911}$$

Thus, Information Gain is given by:

$$I(E, L) = 0.7219 - \frac{35}{100} * 0.9852 - \frac{65}{100} 0.3911$$

$$I(E, L) = 0.7219 - 0.34482 - 0.254215$$

$$I(E, L) = \mathbf{0.122865}$$

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

$$H(E) = -\frac{5}{10} \log_2 \frac{5}{10} - \frac{5}{10} \log_2 \frac{5}{10} \\ = 2 * (-0.5 * -1) = 1$$

Information gain for attribute ‘A’:

$$H(E1) = -\frac{3}{3} \log_2 \frac{3}{3} - \frac{0}{3} \log_2 \frac{0}{3} = 0$$

$$H(E2) = -\frac{1}{4} \log_2 \frac{1}{4} - \frac{3}{4} \log_2 \frac{3}{4} = 0.5 + 0.3113 = 0.8113$$

$$H(E3) = -\frac{1}{3} \log_2 \frac{1}{3} - \frac{2}{3} \log_2 \frac{2}{3} = 0.5283 + .03899 = 0.9182$$

$$I_A = 1 - ((3/10*0) + (4/10*0.8113) + (3/10*0.9182)) = 1 - (0+0.324 + 0.276) = \mathbf{0.4}$$

Information gain for attribute ‘B’:

$$H(E1) = -\frac{1}{4} \log_2 \frac{1}{4} - \frac{3}{4} \log_2 \frac{3}{4} = 0.5 + 0.3113 = 0.8113$$

$$H(E2) = -\frac{3}{4} \log_2 \frac{3}{4} - \frac{1}{4} \log_2 \frac{1}{4} = 0.3113 + 0.5 = 0.8113$$

$$H(E3) = -\frac{1}{2} \log_2 \frac{1}{2} - \frac{1}{2} \log_2 \frac{1}{2} = 1$$

$$I_B = 1 - ((4/10*0.8113) + (4/10*0.8113) + (2/10*1)) = 1 - (0.32452 + 0.32452 + 0.2) = \mathbf{0.15}$$

Information gain for attribute ‘C’:

$$H(E1) = -\frac{1}{5} \log_2 \frac{1}{5} - \frac{4}{5} \log_2 \frac{4}{5} = 0.4644 + 0.2575 = 0.7219$$

$$H(E2) = -\frac{3}{4} \log_2 \frac{3}{4} - \frac{1}{4} \log_2 \frac{1}{4} = 0.3113 + 0.5 = 0.8113$$

$$H(E3) = -\frac{1}{1} \log_2 \frac{1}{1} - \frac{0}{1} \log_2 \frac{0}{1} = 0$$

$$I_C = 1 - ((5/10 * 0.7219) + (4/10 * 0.8113) + (1/10 * 0)) = 1 - (0.36095 + 0.32452 + 0) = \mathbf{0.32}$$

Attribute 'A' achieves the highest information gain.

Task – 4

A.

- a) Highest possible entropy at node N is 2 when 1000 training examples are equally distributed among class A, B, C, D.
- b) Lowest possible entropy at node N is 0 when all the training examples belong to a particular class.

B.

- a) 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.
- b) 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.