

I. Instance-based Learning

A. Non-Normalized Nearest Neighbors

1. Non-weighted Nearest Neighbors

MPG	# Cyl.	HP	Wt.	Accel.	Year	Make	Same?	Distance	NN
?	8	150	4464	12	73	chevrolet			

18	8	130	3504	12	70	chevrolet	0	960.21	3
27	4	90	2950	17.3	82	chevrolet	0	1515.23	4
34	4	88	2395	18	82	chevrolet	0	2069.96	
24	4	95	2372	15	70	toyota	1	2092.73	
28	4	75	2155	16.4	76	toyota	1	2310.23	
32	4	96	2665	13.9	82	toyota	1	1799.84	5
26	4	46	1835	20.5	70	volkswagen	1	2631.07	
29	4	70	1937	14.2	76	volkswagen	1	2528.27	
44	4	52	2130	24.6	82	volkswagen	1	2336.11	
10	8	215	4615	14	70	ford	1	164.44	2
28	4	79	2625	18.6	82	ford	1	1840.41	
16	8	149	4335	14.5	77	ford	1	129.09	1



MPG	# Cyl.	HP	Wt.	Accel.	Year	Make	Same?	Distance	NN
?	6	122	2807	13.5	73	toyota			

18	8	130	3504	12	70	chevrolet	1	697.06	
27	4	90	2950	17.3	82	chevrolet	1	146.88	2
34	4	88	2395	18	82	chevrolet	1	413.53	4
24	4	95	2372	15	70	toyota	0	435.85	5
28	4	75	2155	16.4	76	toyota	0	653.71	
32	4	96	2665	13.9	82	toyota	0	144.66	1
26	4	46	1835	20.5	70	volkswagen	1	975.00	
29	4	70	1937	14.2	76	volkswagen	1	871.56	
44	4	52	2130	24.6	82	volkswagen	1	680.76	
10	8	215	4615	14	70	ford	1	1810.39	
28	4	79	2625	18.6	82	ford	1	187.31	3
16	8	149	4335	14.5	77	ford	1	1528.25	



MPG	# Cyl.	HP	Wt.	Accel.	Year	Make	Same?	Distance	NN
?	4	60	1834	19	71	volkswagen			

18	8	130	3504	12	70	chevrolet	1	1671.49	
27	4	90	2950	17.3	82	chevrolet	1	1116.46	
34	4	88	2395	18	82	chevrolet	1	561.81	
24	4	95	2372	15	70	toyota	1	539.15	5
28	4	75	2155	16.4	76	toyota	1	321.40	4
32	4	96	2665	13.9	82	toyota	1	831.87	
26	4	46	1835	20.5	70	volkswagen	0	14.15	1
29	4	70	1937	14.2	76	volkswagen	0	103.72	2

44	4	52	2130	24.6	82	volkswagen	0	296.37	3
10	8	215	4615	14	70	ford	1	2785.32	
28	4	79	2625	18.6	82	ford	1	791.31	
16	8	149	4335	14.5	77	ford	1	2502.60	

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MPG	# Cyl.	HP	Wt.	Accel.	Year	Make	Same?	Distance	NN
	4	66	1800	14.4	78	ford			

18	8	130	3504	12	70	chevrolet	1	1705.23	
27	4	90	2950	17.3	82	chevrolet	1	1150.26	
34	4	88	2395	18	82	chevrolet	1	595.43	
24	4	95	2372	15	70	toyota	1	572.79	5
28	4	75	2155	16.4	76	toyota	1	355.13	4
32	4	96	2665	13.9	82	toyota	1	865.53	
26	4	46	1835	20.5	70	volkswagen	1	41.56	1
29	4	70	1937	14.2	76	volkswagen	1	137.08	2
44	4	52	2130	24.6	82	volkswagen	1	330.48	3
10	8	215	4615	14	70	ford	0	2818.95	
28	4	79	2625	18.6	82	ford	0	825.12	
16	8	149	4335	14.5	77	ford	0	2536.36	

2. Predictions

MPG	# Cyl.	HP	Wt.	Accel.	Year	Make	5-NN
13	8	150	4464	12	73	chevrolet	20.60
20	6	122	2807	13.5	73	toyota	29.00
27	4	60	1834	19	71	volkswagen	30.20
36.1	4	66	1800	14.4	78	ford	30.20

	5-NN Error
Root Mean-Squared Error	6.78
Mean Absolute Error	6.43

3. Weighted Nearest Neighbors

MPG	# Cyl.	HP	Wt.	Accel.	Year	Make	Same?	Distance	NN	Weight
?	8	150	4464	12	73	chevrolet				

18	8	130	3504	12	70	chevrolet	0	960.21	3	0.00104144
27	4	90	2950	17.3	82	chevrolet	0	1515.23	4	0.00065997
32	4	96	2665	13.9	82	toyota	1	1799.84	5	0.00055561
10	8	215	4615	14	70	ford	1	164.44	2	0.0060813
16	8	149	4335	14.5	77	ford	1	129.09	1	0.0077463

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MPG	# Cyl.	HP	Wt.	Accel.	Year	Make	Same?	Distance	NN	Weight
?	6	122	2807	13.5	73	toyota				

27	4	90	2950	17.3	82	chevrolet	1	146.88	2	0.00680833
34	4	88	2395	18	82	chevrolet	1	413.53	4	0.00241821
24	4	95	2372	15	70	toyota	0	435.85	5	0.00229434
32	4	96	2665	13.9	82	toyota	0	144.66	1	0.00691298
28	4	79	2625	18.6	82	ford	1	187.31	3	0.00533875



MPG	# Cyl.	HP	Wt.	Accel.	Year	Make	Same?	Distance	NN	Weight
?	4	60	1834	19	71	volkswagen				

24	4	95	2372	15	70	toyota	1	539.15	5	0.00185476
28	4	75	2155	16.4	76	toyota	1	321.40	4	0.00311138
26	4	46	1835	20.5	70	volkswagen	0	14.15	1	0.07066653
29	4	70	1937	14.2	76	volkswagen	0	103.72	2	0.0096417
44	4	52	2130	24.6	82	volkswagen	0	296.37	3	0.00337421



MPG	# Cyl.	HP	Wt.	Accel.	Year	Make	Same?	Distance	NN	Weight
	4	66	1800	14.4	78	ford				

8	4	95	2372	15	70	toyota	1	572.79	5	0.00174584
28	4	75	2155	16.4	76	toyota	1	355.13	4	0.0028159
26	4	46	1835	20.5	70	volkswagen	1	41.56	1	0.02406176
29	4	70	1937	14.2	76	volkswagen	1	137.08	2	0.00729518
44	4	52	2130	24.6	82	volkswagen	1	330.48	3	0.0030259

4. Predictions

MPG	# Cyl.	HP	Wt.	Accel.	Year	Make	5-NN
13	8	150	4464	12	73	chevrolet	14.87
20	6	122	2807	13.5	73	toyota	29.10
27	4	60	1834	19	71	volkswagen	27.04
36.1	4	66	1800	14.4	78	ford	28.02

							5-NN Error
Root Mean-Squared Error						6.40	
Mean Absolute Error						4.95	

B. Normalized Nearest Neighbors

1. Non-weighted Nearest Neighbors

MPG	# Cyl.	HP	Wt.	Accel.	Year	Make	Same?	Distance	NN
?	1.000	0.615	0.946	0.000	0.250	chevrolet			

18	1.000	0.497	0.600	0.000	0.000	chevrolet	0	0.44	1
27	0.000	0.260	0.401	0.421	1.000	chevrolet	0	1.47	4
34	0.000	0.249	0.201	0.476	1.000	chevrolet	0	1.57	5
24	0.000	0.290	0.193	0.238	0.000	toyota	1	1.67	

28	0.000	0.172	0.115	0.349	0.500	toyota	1	1.75	
32	0.000	0.296	0.299	0.151	1.000	toyota	1	1.76	
26	0.000	0.000	0.000	0.675	0.000	volkswagen	1	1.95	
29	0.000	0.142	0.037	0.175	0.500	volkswagen	1	1.77	
44	0.000	0.036	0.106	1.000	1.000	volkswagen	1	2.15	
10	1.000	1.000	1.000	0.159	0.000	ford	1	1.11	3
28	0.000	0.195	0.284	0.524	1.000	ford	1	1.86	
16	1.000	0.609	0.899	0.198	0.583	ford	1	1.07	2

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MPG	# Cyl.	HP	Wt.	Accel.	Year	Make	Same?	Distance	NN
?	0.500	0.450	0.358	0.119	0.250	toyota			

18	1.000	0.497	0.600	0.000	0.000	chevrolet	1	1.18	4
27	0.000	0.260	0.401	0.421	1.000	chevrolet	1	1.39	
34	0.000	0.249	0.201	0.476	1.000	chevrolet	1	1.42	
24	0.000	0.290	0.193	0.238	0.000	toyota	0	0.62	1
28	0.000	0.172	0.115	0.349	0.500	toyota	0	0.71	2
32	0.000	0.296	0.299	0.151	1.000	toyota	0	0.92	3
26	0.000	0.000	0.000	0.675	0.000	volkswagen	1	1.40	
29	0.000	0.142	0.037	0.175	0.500	volkswagen	1	1.23	5
44	0.000	0.036	0.106	1.000	1.000	volkswagen	1	1.68	
10	1.000	1.000	1.000	0.159	0.000	ford	1	1.42	
28	0.000	0.195	0.284	0.524	1.000	ford	1	1.43	
16	1.000	0.609	0.899	0.198	0.583	ford	1	1.30	

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MPG	# Cyl.	HP	Wt.	Accel.	Year	Make	Same?	Distance	NN
?	0.000	0.083	0.012	0.556	0.083	volkswagen			

18	1.000	0.497	0.600	0.000	0.000	chevrolet	1	1.68	
27	0.000	0.260	0.401	0.421	1.000	chevrolet	1	1.43	
34	0.000	0.249	0.201	0.476	1.000	chevrolet	1	1.38	
24	0.000	0.290	0.193	0.238	0.000	toyota	1	1.09	4
28	0.000	0.172	0.115	0.349	0.500	toyota	1	1.11	5
32	0.000	0.296	0.299	0.151	1.000	toyota	1	1.46	
26	0.000	0.000	0.000	0.675	0.000	volkswagen	0	0.17	1
29	0.000	0.142	0.037	0.175	0.500	volkswagen	0	0.57	2
44	0.000	0.036	0.106	1.000	1.000	volkswagen	0	1.02	3
10	1.000	1.000	1.000	0.159	0.000	ford	1	2.00	
28	0.000	0.195	0.284	0.524	1.000	ford	1	1.39	
16	1.000	0.609	0.899	0.198	0.583	ford	1	1.86	

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MPG	# Cyl.	HP	Wt.	Accel.	Year	Make	Same?	Distance	NN
	0.000	0.118	0.000	0.190	0.667	ford			

18	1.000	0.497	0.600	0.000	0.000	chevrolet	1	1.73	
27	0.000	0.260	0.401	0.421	1.000	chevrolet	1	1.16	
34	0.000	0.249	0.201	0.476	1.000	chevrolet	1	1.12	5
8	0.000	0.290	0.193	0.238	0.000	toyota	1	1.23	
28	0.000	0.172	0.115	0.349	0.500	toyota	1	1.03	3

32	0.000	0.296	0.299	0.151	1.000	toyota	1	1.11	4
26	0.000	0.000	0.000	0.675	0.000	volkswagen	1	1.30	
29	0.000	0.142	0.037	0.175	0.500	volkswagen	1	1.01	2
44	0.000	0.036	0.106	1.000	1.000	volkswagen	1	1.34	
10	1.000	1.000	1.000	0.159	0.000	ford	0	1.80	
28	0.000	0.195	0.284	0.524	1.000	ford	0	0.56	1
16	1.000	0.609	0.899	0.198	0.583	ford	0	1.43	

2. Predictions

MPG	# Cyl.	HP	Wt.	Accel.	Year	Make	5-NN
13	8	150	4464	12	73	chevrolet	21.00
20	6	122	2807	13.5	73	toyota	23.00
27	4	60	1834	19	71	volkswagen	30.20
36.1	4	66	1800	14.4	78	ford	30.20

							5-NN Error
Root Mean-Squared Error							5.15
Mean Absolute Error							5.01

3. Weighted Nearest Neighbors

MPG	# Cyl.	HP	Wt.	Accel.	Year	Make	Same?	Distance	NN	Weight
?	1.000	0.615	0.946	0.000	0.250	chevrolet				

18	1.000	0.497	0.600	0.000	0.000	chevrolet	0	0.44	1	2.25945326
27	0.000	0.260	0.401	0.421	1.000	chevrolet	0	1.47	4	0.68007614
34	0.000	0.249	0.201	0.476	1.000	chevrolet	0	1.57	5	0.63526507
10	1.000	1.000	1.000	0.159	0.000	ford	1	1.11	3	0.8984482
16	1.000	0.609	0.899	0.198	0.583	ford	1	1.07	2	0.93141528

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MPG	# Cyl.	HP	Wt.	Accel.	Year	Make	Same?	Distance	NN	Weight
?	0.500	0.450	0.358	0.119	0.250	toyota				

18	1.000	0.497	0.600	0.000	0.000	chevrolet	1	1.18	4	0.84891842
24	0.000	0.290	0.193	0.238	0.000	toyota	0	0.62	1	1.62334018
28	0.000	0.172	0.115	0.349	0.500	toyota	0	0.71	2	1.41139443
32	0.000	0.296	0.299	0.151	1.000	toyota	0	0.92	3	1.09056794
29	0.000	0.142	0.037	0.175	0.500	volkswagen	1	1.23	5	0.81279645

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MPG	# Cyl.	HP	Wt.	Accel.	Year	Make	Same?	Distance	NN	Weight
?	0.000	0.083	0.012	0.556	0.083	volkswagen				

24	0.000	0.290	0.193	0.238	0.000	toyota	1	1.09	4	0.91917438
28	0.000	0.172	0.115	0.349	0.500	toyota	1	1.11	5	0.89979395
26	0.000	0.000	0.000	0.675	0.000	volkswagen	0	0.17	1	5.97734792

29	0.000	0.142	0.037	0.175	0.500	volkswagen	0	0.57	2	1.75832873
44	0.000	0.036	0.106	1.000	1.000	volkswagen	0	1.02	3	0.97630061



MPG	# Cyl.	HP	Wt.	Accel.	Year	Make	Same?	Distance	NN	Weight
	0.000	0.118	0.000	0.190	0.667	ford				

34	0.000	0.249	0.201	0.476	1.000	chevrolet	1	1.12	5	0.89428152
28	0.000	0.172	0.115	0.349	0.500	toyota	1	1.03	3	0.96702655
32	0.000	0.296	0.299	0.151	1.000	toyota	1	1.11	4	0.90049961
29	0.000	0.142	0.037	0.175	0.500	volkswagen	1	1.01	2	0.98530592
28	0.000	0.195	0.284	0.524	1.000	ford	0	0.56	1	1.79883473

4. Predictions

MPG	# Cyl.	HP	Wt.	Accel.	Year	Make	5-NN
13	8	150	4464	12	73	chevrolet	19.34
20	6	122	2807	13.5	73	toyota	26.31
27	4	60	1834	19	71	volkswagen	28.17
36.1	4	66	1800	14.4	78	ford	29.78

	5-NN Error
Root Mean-Squared Error	5.51
Mean Absolute Error	5.04

II. Clustering – Simple K-Means

A. Non-Normalized K-Means

MPG	# Cyl.	HP	Wt.	Accel.	Year	Make	Same?	Distance
18	8	130	3504	12	70	chevrolet		

18	8	130	3504	12	70	chevrolet	0	0.00
27	4	90	2950	17.3	82	chevrolet	0	555.68
34	4	88	2395	18	82	chevrolet	0	1110.00
24	4	95	2372	15	70	toyota	1	1132.57
28	4	75	2155	16.4	76	toyota	1	1350.18
32	4	96	2665	13.9	82	toyota	1	839.90
26	4	46	1835	20.5	70	volkswagen	1	1671.16
29	4	70	1937	14.2	76	volkswagen	1	1568.21
44	4	52	2130	24.6	82	volkswagen	1	1376.57
10	8	215	4615	14	70	ford	1	1114.28
28	4	79	2625	18.6	82	ford	1	880.65
16	8	149	4335	14.5	77	ford	1	831.25

MPG	# Cyl.	HP	Wt.	Accel.	Year	Make	Same?	Distance
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32	4	96	2665	13.9	82	toyota
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18	8	130	3504	12	70	chevrolet	1	839.90
27	4	90	2950	17.3	82	chevrolet	1	285.13
34	4	88	2395	18	82	chevrolet	1	270.16
24	4	95	2372	15	70	toyota	0	293.36
28	4	75	2155	16.4	76	toyota	0	510.49
32	4	96	2665	13.9	82	toyota	0	0.00
26	4	46	1835	20.5	70	volkswagen	1	831.64
29	4	70	1937	14.2	76	volkswagen	1	728.50
44	4	52	2130	24.6	82	volkswagen	1	537.05
10	8	215	4615	14	70	ford	1	1953.79
28	4	79	2625	18.6	82	ford	1	43.91
16	8	149	4335	14.5	77	ford	1	1670.93

MPG	# Cyl.	HP	Wt.	Accel.	Year	Make	Same?	Distance
26	4	46	1835	20.5	70	volkswagen		

18	8	130	3504	12	70	chevrolet	1	1671.16
27	4	90	2950	17.3	82	chevrolet	1	1115.94
34	4	88	2395	18	82	chevrolet	1	561.76
24	4	95	2372	15	70	toyota	1	539.26
28	4	75	2155	16.4	76	toyota	1	321.40
32	4	96	2665	13.9	82	toyota	1	831.64
26	4	46	1835	20.5	70	volkswagen	0	0.00
29	4	70	1937	14.2	76	volkswagen	0	105.19
44	4	52	2130	24.6	82	volkswagen	0	295.88
10	8	215	4615	14	70	ford	1	2785.19
28	4	79	2625	18.6	82	ford	1	790.79
16	8	149	4335	14.5	77	ford	1	2502.16

Cluster 1:

MPG	# Cyl.	HP	Wt.	Accel.	Year	Make
18	8	130	3504	12	70	chevrolet
10	8	215	4615	14	70	ford
16	8	149	4335	14.5	77	ford

New Centroid 1:

14.66667	8	164.66667	4151.333	13.5	72.33333	ford
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Cluster 2:

27	4	90	2950	17.3	82	chevrolet
34	4	88	2395	18	82	chevrolet
24	4	95	2372	15	70	toyota
32	4	96	2665	13.9	82	toyota
28	4	79	2625	18.6	82	ford

New Centroid 2:

29	4	89.6	2601.4	16.56	79.6	chevrolet
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Cluster 3:

28	4	75	2155	16.4	76	toyota
26	4	46	1835	20.5	70	volkswagen

29	4	70	1937	14.2	76	volkswagen
44	4	52	2130	24.6	82	volkswagen

New Centroid 3:

31.75	4	60.75	2014.25	18.925	76	volkswagen
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MPG	# Cyl.	HP	Wt.	Accel.	Year	Make	Same?	Distance
14.667	8.000	164.667	4151.333	13.500	72.333	ford		

18	8	130	3504	12	70	chevrolet	1	648.28
27	4	90	2950	17.3	82	chevrolet	1	1203.77
34	4	88	2395	18	82	chevrolet	1	1758.15
24	4	95	2372	15	70	toyota	1	1780.73
28	4	75	2155	16.4	76	toyota	1	1998.40
32	4	96	2665	13.9	82	toyota	1	1488.06
26	4	46	1835	20.5	70	volkswagen	1	2319.41
29	4	70	1937	14.2	76	volkswagen	1	2216.41
44	4	52	2130	24.6	82	volkswagen	1	2024.74
10	8	215	4615	14	70	ford	0	466.42
28	4	79	2625	18.6	82	ford	0	1528.84
16	8	149	4335	14.5	77	ford	0	184.40

MPG	# Cyl.	HP	Wt.	Accel.	Year	Make	Same?	Distance
29.000	4.000	89.600	2601.400	16.560	79.600	chevrolet		

18	8	130	3504	12	70	chevrolet	0	903.64
27	4	90	2950	17.3	82	chevrolet	0	348.62
34	4	88	2395	18	82	chevrolet	0	206.49
24	4	95	2372	15	70	toyota	1	229.73
28	4	75	2155	16.4	76	toyota	1	446.66
32	4	96	2665	13.9	82	toyota	1	64.10
26	4	46	1835	20.5	70	volkswagen	1	767.72
29	4	70	1937	14.2	76	volkswagen	1	664.70
44	4	52	2130	24.6	82	volkswagen	1	473.21
10	8	215	4615	14	70	ford	1	2017.62
28	4	79	2625	18.6	82	ford	1	26.10
16	8	149	4335	14.5	77	ford	1	1734.67

MPG	# Cyl.	HP	Wt.	Accel.	Year	Make	Same?	Distance
31.750	4.000	60.750	2014.250	18.925	76.000	volkswagen		

18	8	130	3504	12	70	chevrolet	1	1491.46
27	4	90	2950	17.3	82	chevrolet	1	936.24
34	4	88	2395	18	82	chevrolet	1	381.78
24	4	95	2372	15	70	toyota	1	359.54
28	4	75	2155	16.4	76	toyota	1	141.55
32	4	96	2665	13.9	82	toyota	1	651.75
26	4	46	1835	20.5	70	volkswagen	0	180.05

29	4	70	1937	14.2	76	volkswagen	0	77.99
44	4	52	2130	24.6	82	volkswagen	0	117.02
10	8	215	4615	14	70	ford	1	2605.43
28	4	79	2625	18.6	82	ford	1	611.06
16	8	149	4335	14.5	77	ford	1	2322.49

Cluster 1:

MPG	# Cyl.	HP	Wt.	Accel.	Year	Make
18	8	130	3504	12	70	chevrolet
10	8	215	4615	14	70	ford
16	8	149	4335	14.5	77	ford

New Centroid 1:

14.667	8.000	164.667	4151.333	13.500	72.333	ford
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Cluster 2:

27	4	90	2950	17.3	82	chevrolet
34	4	88	2395	18	82	chevrolet
24	4	95	2372	15	70	toyota
32	4	96	2665	13.9	82	toyota
28	4	79	2625	18.6	82	ford

New Centroid 2:

29.000	4.000	89.600	2601.400	16.560	79.600	chevrolet
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Cluster 3:

28	4	75	2155	16.4	76	toyota
26	4	46	1835	20.5	70	volkswagen
29	4	70	1937	14.2	76	volkswagen
44	4	52	2130	24.6	82	volkswagen

New Centroid 3:

31.750	4.000	60.750	2014.250	18.925	76.000	volkswagen
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B. Normalized K-Means

MPG	# Cyl.	HP	Wt.	Accel.	Year	Make	Same?	Distance
0.235	1.000	0.497	0.605	0.000	0.000	chevrolet		

0.235	1.000	0.497	0.605	0.000	0.000	chevrolet	0	0.00
0.500	0.000	0.260	0.409	0.421	1.000	chevrolet	0	1.53
0.706	0.000	0.249	0.211	0.476	1.000	chevrolet	0	1.63
0.412	0.000	0.290	0.203	0.238	0.000	toyota	1	1.51
0.529	0.000	0.172	0.126	0.349	0.500	toyota	1	1.67
0.647	0.000	0.296	0.307	0.151	1.000	toyota	1	1.82
0.471	0.000	0.000	0.012	0.675	0.000	volkswagen	1	1.76
0.559	0.000	0.142	0.049	0.175	0.500	volkswagen	1	1.68
1.000	0.000	0.036	0.117	1.000	1.000	volkswagen	1	2.24
0.000	1.000	1.000	1.000	0.159	0.000	ford	1	1.22
0.529	0.000	0.195	0.293	0.524	1.000	ford	1	1.88
0.176	1.000	0.609	0.901	0.198	0.583	ford	1	1.22

MPG	# Cyl.	HP	Wt.	Accel.	Year	Make	Same?	Distance
0.647	0.000	0.296	0.307	0.151	1.000	toyota		

0.235	1.000	0.497	0.605	0.000	0.000	chevrolet	1	1.82
0.500	0.000	0.260	0.409	0.421	1.000	chevrolet	1	1.05
0.706	0.000	0.249	0.211	0.476	1.000	chevrolet	1	1.06
0.412	0.000	0.290	0.203	0.238	0.000	toyota	0	1.04
0.529	0.000	0.172	0.126	0.349	0.500	toyota	0	0.59
0.647	0.000	0.296	0.307	0.151	1.000	toyota	0	0.00
0.471	0.000	0.000	0.012	0.675	0.000	volkswagen	1	1.57
0.559	0.000	0.142	0.049	0.175	0.500	volkswagen	1	1.16
1.000	0.000	0.036	0.117	1.000	1.000	volkswagen	1	1.40
0.000	1.000	1.000	1.000	0.159	0.000	ford	1	2.10
0.529	0.000	0.195	0.293	0.524	1.000	ford	1	1.08
0.176	1.000	0.609	0.901	0.198	0.583	ford	1	1.69

MPG	# Cyl.	HP	Wt.	Accel.	Year	Make	Same?	Distance
0.471	0.000	0.000	0.012	0.675	0.000	volkswagen		

0.235	1.000	0.497	0.605	0.000	0.000	chevrolet	1	1.76
0.500	0.000	0.260	0.409	0.421	1.000	chevrolet	1	1.51
0.706	0.000	0.249	0.211	0.476	1.000	chevrolet	1	1.48
0.412	0.000	0.290	0.203	0.238	0.000	toyota	1	1.15
0.529	0.000	0.172	0.126	0.349	0.500	toyota	1	1.18
0.647	0.000	0.296	0.307	0.151	1.000	toyota	1	1.57
0.471	0.000	0.000	0.012	0.675	0.000	volkswagen	0	0.00
0.559	0.000	0.142	0.049	0.175	0.500	volkswagen	0	0.73
1.000	0.000	0.036	0.117	1.000	1.000	volkswagen	0	1.18
0.000	1.000	1.000	1.000	0.159	0.000	ford	1	2.11
0.529	0.000	0.195	0.293	0.524	1.000	ford	1	1.46
0.176	1.000	0.609	0.901	0.198	0.583	ford	1	1.95

Cluster 1:

MPG	# Cyl.	HP	Wt.	Accel.	Year	Make
0.235	1.000	0.497	0.605	0.000	0.000	chevrolet
0.000	1.000	1.000	1.000	0.159	0.000	ford
0.176	1.000	0.609	0.901	0.198	0.583	ford

New Centroid 1:

0.137	1.000	0.702	0.835	0.119	0.194	ford
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Cluster 2:

0.500	0.000	0.260	0.409	0.421	1.000	chevrolet
0.706	0.000	0.249	0.211	0.476	1.000	chevrolet
0.412	0.000	0.290	0.203	0.238	0.000	toyota
0.529	0.000	0.172	0.126	0.349	0.500	toyota
0.647	0.000	0.296	0.307	0.151	1.000	toyota
0.529	0.000	0.195	0.293	0.524	1.000	ford

New Centroid 2:

0.554	0.000	0.244	0.258	0.360	0.750	toyota
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Cluster 3:

0.471	0.000	0.000	0.012	0.675	0.000	volkswagen
0.559	0.000	0.142	0.049	0.175	0.500	volkswagen
1.000	0.000	0.036	0.117	1.000	1.000	volkswagen

New Centroid 3:

0.676	0.000	0.059	0.059	0.616	0.500	volkswagen
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MPG	# Cyl.	HP	Wt.	Accel.	Year	Make	Same?	Distance
0.137	1.000	0.702	0.835	0.119	0.194	ford		

0.235	1.000	0.497	0.605	0.000	0.000	chevrolet	1	1.07
0.500	0.000	0.260	0.409	0.421	1.000	chevrolet	1	1.78
0.706	0.000	0.249	0.211	0.476	1.000	chevrolet	1	1.88
0.412	0.000	0.290	0.203	0.238	0.000	toyota	1	1.62
0.529	0.000	0.172	0.126	0.349	0.500	toyota	1	1.72
0.647	0.000	0.296	0.307	0.151	1.000	toyota	1	1.79
0.471	0.000	0.000	0.012	0.675	0.000	volkswagen	1	1.88
0.559	0.000	0.142	0.049	0.175	0.500	volkswagen	1	1.76
1.000	0.000	0.036	0.117	1.000	1.000	volkswagen	1	2.20
0.000	1.000	1.000	1.000	0.159	0.000	ford	0	0.51
0.529	0.000	0.195	0.293	0.524	1.000	ford	0	1.55
0.176	1.000	0.609	0.901	0.198	0.583	ford	0	0.44

MPG	# Cyl.	HP	Wt.	Accel.	Year	Make	Same?	Distance
0.554	0.000	0.244	0.258	0.360	0.750	toyota		

0.235	1.000	0.497	0.605	0.000	0.000	chevrolet	1	1.73
0.500	0.000	0.260	0.409	0.421	1.000	chevrolet	1	1.04
0.706	0.000	0.249	0.211	0.476	1.000	chevrolet	1	1.05
0.412	0.000	0.290	0.203	0.238	0.000	toyota	0	0.78
0.529	0.000	0.172	0.126	0.349	0.500	toyota	0	0.29
0.647	0.000	0.296	0.307	0.151	1.000	toyota	0	0.35
0.471	0.000	0.000	0.012	0.675	0.000	volkswagen	1	1.34
0.559	0.000	0.142	0.049	0.175	0.500	volkswagen	1	1.07
1.000	0.000	0.036	0.117	1.000	1.000	volkswagen	1	1.32
0.000	1.000	1.000	1.000	0.159	0.000	ford	1	2.01
0.529	0.000	0.195	0.293	0.524	1.000	ford	1	1.05
0.176	1.000	0.609	0.901	0.198	0.583	ford	1	1.66

MPG	# Cyl.	HP	Wt.	Accel.	Year	Make	Same?	Distance
0.676	0.000	0.059	0.059	0.616	0.500	volkswagen		

0.235	1.000	0.497	0.605	0.000	0.000	chevrolet	1	1.82
0.500	0.000	0.260	0.409	0.421	1.000	chevrolet	1	1.22
0.706	0.000	0.249	0.211	0.476	1.000	chevrolet	1	1.15
0.412	0.000	0.290	0.203	0.238	0.000	toyota	1	1.24
0.529	0.000	0.172	0.126	0.349	0.500	toyota	1	1.05
0.647	0.000	0.296	0.307	0.151	1.000	toyota	1	1.26
0.471	0.000	0.000	0.012	0.675	0.000	volkswagen	0	0.55

0.559	0.000	0.142	0.049	0.175	0.500	volkswagen	0	0.46
1.000	0.000	0.036	0.117	1.000	1.000	volkswagen	0	0.71
0.000	1.000	1.000	1.000	0.159	0.000	ford	1	2.16
0.529	0.000	0.195	0.293	0.524	1.000	ford	1	1.16
0.176	1.000	0.609	0.901	0.198	0.583	ford	1	1.86

Cluster 1:

MPG	# Cyl.	HP	Wt.	Accel.	Year	Make
0.235	1.000	0.497	0.605	0.000	0.000	chevrolet
0.000	1.000	1.000	1.000	0.159	0.000	ford
0.176	1.000	0.609	0.901	0.198	0.583	ford

New Centroid 1:

0.137	1.000	0.702	0.835	0.119	0.194	ford
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Cluster 2:

0.500	0.000	0.260	0.409	0.421	1.000	chevrolet
0.706	0.000	0.249	0.211	0.476	1.000	chevrolet
0.412	0.000	0.290	0.203	0.238	0.000	toyota
0.529	0.000	0.172	0.126	0.349	0.500	toyota
0.647	0.000	0.296	0.307	0.151	1.000	toyota
0.529	0.000	0.195	0.293	0.524	1.000	ford

New Centroid 2:

0.554	0.000	0.244	0.258	0.360	0.750	toyota
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Cluster 3:

0.471	0.000	0.000	0.012	0.675	0.000	volkswagen
0.559	0.000	0.142	0.049	0.175	0.500	volkswagen
1.000	0.000	0.036	0.117	1.000	1.000	volkswagen

New Centroid 3:

0.676	0.000	0.059	0.059	0.616	0.500	volkswagen
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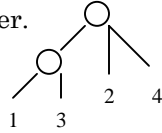
III. Hierarchical Clustering

#	mpg	cylinders	horsepower	weight	accel.	year	make
1	18	8	130	3504	12	70	chevrolet
2	27	4	90	2950	17.3	82	chevrolet
3	34	4	88	2395	18	82	chevrolet
4	24	4	95	2372	15	70	toyota
5	28	4	75	2155	16.4	76	toyota
6	32	4	96	2665	13.9	82	toyota
7	26	4	46	1835	20.5	70	volkswagen
8	29	4	70	1937	14.2	76	volkswagen
9	44	4	52	2130	24.6	82	volkswagen
10	10	8	215	4615	14	70	ford
11	28	4	79	2625	18.6	82	ford
12	16	8	149	4335	14.5	77	ford

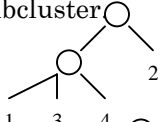
A. The algorithm considers 8 possible alternatives.

B. Alternatives:

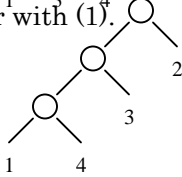
1. Join root cluster.



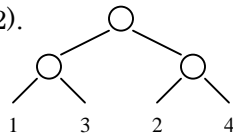
2. Join subcluster



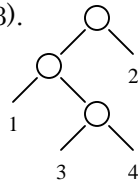
3. Cluster with (1).



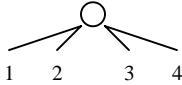
4. Cluster with (2).



5. Cluster with (3).



6. Split second node.



- C. The Cobweb/Classit algorithm chooses based on Category Utility, a quadratic loss function that calculates the “goodness” of grouping two particular elements together versus not grouping them together. This allows the algorithm to decide whether a particular choice will lead to greater predictive abilities.