# 1 Monotonicity introduction

## 1.1 Union vs. union, KNN

| Dataset | S% | B% | R% | O% |
|---|---|---|---|---|
| balance_scale | 73.26 | 26.74 | | |
| breast-cancer_nm | 21.18 | 38.82 | 25.88 | 14.12 |
| breast-w | 91.29 | 6.64 | 1.24 | 0.83 |
| breast-w_nm | 90.46 | 7.05 | 1.66 | 0.83 |
| car | 75.92 | 21.39 | 0.58 | 2.12 |
| cpu | 76.70 | 21.84 | 0.97 | 0.49 |
| dataset1_noid | 64.22 | 25.23 | 4.13 | 6.42 |
| dataset3 | 50.15 | 40.73 | 5.38 | 3.74 |
| denbosch | 61.02 | 33.90 | | 5.08 |
| ERA_n | 0.62 | 35.71 | 24.98 | 38.69 |
| ESL_n | 37.50 | 37.50 | 10.14 | 14.86 |
| housing | 59.56 | 29.48 | 5.18 | 5.78 |
| LEV_n | 32.50 | 35.43 | 14.37 | 17.71 |
| SWD_n | 28.75 | 40.28 | 15.64 | 15.32 |
| windsor | 34.25 | 46.04 | 9.58 | 10.13 |

Table 1: Union vs. union - KNN

| Dataset | S% | B% | R% | O% |
|---|---|---|---|---|
| balance_scale | 72.40 | 27.60 | | |
| breast-cancer_nm | 5.88 | 45.88 | 34.12 | 14.12 |
| breast-w | 44.40 | 47.72 | 7.05 | 0.83 |
| breast-w_nm | 43.98 | 47.30 | 7.88 | 0.83 |
| car | 44.32 | 52.99 | 0.58 | 2.12 |
| cpu | 22.82 | 67.48 | 9.22 | 0.49 |
| dataset1_noid | 17.89 | 59.17 | 16.51 | 6.42 |
| dataset3 | 13.75 | 65.40 | 17.12 | 3.74 |
| denbosch | 35.59 | 49.15 | 10.17 | 5.08 |
| ERA_n | 0.62 | 35.71 | 24.98 | 38.69 |
| ESL_n | 24.64 | 47.64 | 12.86 | 14.86 |
| housing | 17.73 | 59.36 | 17.13 | 5.78 |
| LEV_n | 32.50 | 35.43 | 14.37 | 17.71 |
| SWD_n | 28.28 | 40.76 | 15.64 | 15.32 |
| windsor | 11.97 | 58.01 | 19.89 | 10.13 |

Table 2: Union vs. union - KNN - Monotonic

| Dataset | S% | B% | R% | O% |
|---|---|---|---|---|
| balance_scale | 0.87 | 0.87 | 0 | 0 |
| breast-cancer_nm | 15.29 | 7.06 | 8.24 | 0 |
| breast-w | 46.89 | 41.08 | 5.81 | 0 |
| breast-w_nm | 46.47 | 40.25 | 6.22 | 0 |
| car | 31.60 | 31.60 | 0 | 0 |
| cpu | 53.88 | 45.63 | 8.25 | 0 |
| dataset1_noid | 46.33 | 33.94 | 12.39 | 0 |
| dataset3 | 36.40 | 24.66 | 11.73 | 0 |
| denbosch | 25.42 | 15.25 | 10.17 | 0 |
| ERA_n | 0 | 0 | 0 | 0 |
| ESL_n | 12.86 | 10.14 | 2.72 | 0 |
| housing | 41.83 | 29.88 | 11.95 | 0 |
| LEV_n | 0 | 0 | 0 | 0 |
| SWD_n | 0.47 | 0.47 | 0 | 0 |
| windsor | 22.28 | 11.97 | 10.31 | 0 |

Table 3: Differences

### 1.2 Union vs. union, Kernel

| Dataset | S% | B% | R% | O% |
|---|---|---|---|---|
| balance_scale | 81.94 | 18.06 | | |
| breast-cancer_nm | 17.65 | 20.00 | 38.82 | 23.53 |
| breast-w | 67.63 | 5.39 | 0.41 | 26.56 |
| breast-w_nm | 66.80 | 4.56 | 0.41 | 28.22 |
| car | 64.35 | 8.09 | | 27.55 |
| cpu | 61.65 | 11.17 | 1.46 | 25.73 |
| dataset1_noid | 26.61 | 12.84 | 45.41 | 15.14 |
| dataset3 | 46.26 | 20.48 | 3.14 | 30.12 |
| denbosch | 62.71 | 16.95 | 1.69 | 18.64 |
| ERA_n | | | | 100.00 |
| ESL_n | 43.84 | 8.33 | 3.26 | 44.57 |
| housing | 48.41 | 18.33 | 1.99 | 31.27 |
| LEV_n | 26.64 | 15.62 | 5.16 | 52.58 |
| SWD_n | 36.65 | 39.02 | 15.80 | 8.53 |
| windsor | 31.86 | 23.76 | 3.87 | 40.52 |

Table 4: Union vs. union - Kernel

| Dataset | S% | B% | R% | O% |
|---|---|---|---|---|
| balance_scale | 94.44 | 5.56 | | |
| breast-cancer_nm | 32.94 | 16.47 | 27.06 | 23.53 |
| breast-w | 73.03 | 2.49 | | 24.48 |
| breast-w_nm | 70.95 | 2.49 | 0.41 | 26.14 |
| car | 72.45 | | | 27.55 |
| cpu | 72.33 | 1.94 | | 25.73 |
| dataset1_noid | 82.11 | 5.50 | 0.46 | 11.93 |
| dataset3 | 65.40 | 4.41 | 0.22 | 29.97 |
| denbosch | 77.97 | 3.39 | | 18.64 |
| ERA_n | | | | 100.00 |
| ESL_n | 44.75 | 7.61 | 3.08 | 44.57 |
| housing | 67.33 | 1.39 | | 31.27 |
| LEV_n | 26.64 | 15.62 | 5.16 | 52.58 |
| SWD_n | 36.65 | 39.02 | 15.80 | 8.53 |
| windsor | 42.17 | 17.13 | 0.18 | 40.52 |

Table 5: Union vs. union - Kernel - Monotonic

| Dataset | S% | B% | R% | O% |
|---|---|---|---|---|
| balance_scale | 12.50 | 12.50 | 0 | 0 |
| breast-cancer_nm | 15.29 | 3.53 | 11.76 | 0 |
| breast-w | 5.39 | 2.90 | 0.41 | 2.07 |
| breast-w_nm | 4.15 | 2.07 | 0 | 2.07 |
| car | 8.09 | 8.09 | 0 | 0 |
| cpu | 10.68 | 9.22 | 1.46 | 0 |
| dataset1_noid | 55.50 | 7.34 | 44.95 | 3.21 |
| dataset3 | 19.13 | 16.07 | 2.91 | 0.15 |
| denbosch | 15.25 | 13.56 | 1.69 | 0 |
| ERA_n | 0 | 0 | 0 | 0 |
| ESL_n | 0.91 | 0.72 | 0.18 | 0 |
| housing | 18.92 | 16.93 | 1.99 | 0 |
| LEV_n | 0 | 0 | 0 | 0 |
| SWD_n | 0 | 0 | 0 | 0 |
| windsor | 10.31 | 6.63 | 3.68 | 0 |

Table 6: Differences

### 1.3 Class vs. union, KNN

| Dataset | S% | B% | R% | O% |
|---|---|---|---|---|
| balance_scale | 62.61 | 22.85 | 1.19 | 13.35 |
| breast-cancer_nm | 21.18 | 38.82 | 25.88 | 14.12 |
| breast-w | 91.29 | 6.64 | 1.24 | 0.83 |
| breast-w_nm | 90.46 | 7.05 | 1.66 | 0.83 |
| car | 76.81 | 20.51 | 0.56 | 2.12 |
| cpu | 71.79 | 24.04 | 2.56 | 1.60 |
| dataset1_noid | 64.22 | 25.23 | 4.13 | 6.42 |
| dataset3 | 49.56 | 41.96 | 4.39 | 4.09 |
| denbosch | 61.02 | 33.90 | | 5.08 |
| ERA_n | 1.12 | 33.28 | 28.19 | 37.42 |
| ESL_n | 41.45 | 37.63 | 8.67 | 12.24 |
| housing | 45.62 | 41.25 | 7.82 | 5.31 |
| LEV_n | 32.34 | 37.14 | 13.70 | 16.82 |
| SWD_n | 29.50 | 40.44 | 15.15 | 14.91 |
| windsor | 29.95 | 47.80 | 11.74 | 10.51 |

Table 7: Class vs. union - KNN

| Dataset | S% | B% | R% | O% |
|---|---|---|---|---|
| balance_scale | 61.87 | 23.59 | 1.19 | 13.35 |
| breast-cancer_nm | 5.88 | 45.88 | 34.12 | 14.12 |
| breast-w | 44.40 | 47.72 | 7.05 | 0.83 |
| breast-w_nm | 43.98 | 47.30 | 7.88 | 0.83 |
| car | 47.49 | 49.83 | 0.56 | 2.12 |
| cpu | 24.04 | 62.50 | 11.86 | 1.60 |
| dataset1_noid | 17.89 | 59.17 | 16.51 | 6.42 |
| dataset3 | 12.87 | 65.64 | 17.40 | 4.09 |
| denbosch | 35.59 | 49.15 | 10.17 | 5.08 |
| ERA_n | 1.12 | 33.28 | 28.19 | 37.42 |
| ESL_n | 30.87 | 46.05 | 10.84 | 12.24 |
| housing | 13.13 | 61.27 | 20.29 | 5.31 |
| LEV_n | 32.34 | 37.14 | 13.70 | 16.82 |
| SWD_n | 29.01 | 40.92 | 15.15 | 14.91 |
| windsor | 9.78 | 57.95 | 21.76 | 10.51 |

Table 8: Class vs. union - KNN - Monotonic

| Dataset | S% | B% | R% | O% |
|---|---|---|---|---|
| balance_scale | 0 | 0 | 0 | 0 |
| breast-cancer_nm | 0 | 0 | 0 | 0 |
| breast-w | 0 | 0 | 0 | 0 |
| breast-w_nm | 0 | 0 | 0 | 0 |
| car | 22.22 | 22.22 | 0 | 0 |
| cpu | 33.02 | 26.42 | 6.60 | 0 |
| dataset1_noid | 0 | 0 | 0 | 0 |
| dataset3 | 38.29 | 25.81 | 12.49 | 0 |
| denbosch | 0 | 0 | 0 | 0 |
| ERA_n | 0 | 0 | 0 | 0 |
| ESL_n | 11.83 | 8.92 | 2.90 | 0 |
| housing | 19.22 | 3.53 | 15.69 | 0 |
| LEV_n | 0 | 0 | 0 | 0 |
| SWD_n | 0 | 0 | 0 | 0 |
| windsor | 4.74 | 1.82 | 6.57 | 0 |

Table 9: Differences

### 1.4 Class vs. union, Kernel

| Dataset | S% | B% | R% | O% |
|---|---|---|---|---|
| balance_scale | 70.03 | 15.43 | | 14.54 |
| breast-cancer_nm | 17.65 | 20.00 | 38.82 | 23.53 |
| breast-w | 67.63 | 5.39 | 0.41 | 26.56 |
| breast-w_nm | 66.80 | 4.56 | 0.41 | 28.22 |
| car | 71.79 | 9.36 | | 18.84 |
| cpu | 68.27 | 14.42 | 1.60 | 15.71 |
| dataset1_noid | 26.61 | 12.84 | 45.41 | 15.14 |
| dataset3 | 49.61 | 20.61 | 4.14 | 25.63 |
| denbosch | 62.71 | 16.95 | 1.69 | 18.64 |
| ERA_n | | | | 100.00 |
| ESL_n | 49.87 | 10.84 | 3.70 | 35.59 |
| housing | 54.11 | 20.42 | 2.65 | 22.81 |
| LEV_n | 23.90 | 16.36 | 5.18 | 54.57 |
| SWD_n | 36.30 | 38.90 | 16.05 | 8.75 |
| windsor | 34.72 | 28.85 | 3.18 | 33.25 |

Table 10: Class vs. union - Kernel

| Dataset | S% | B% | R% | O% |
|---|---|---|---|---|
| balance_scale | 80.71 | 4.75 | | 14.54 |
| breast-cancer_nm | 32.94 | 16.47 | 27.06 | 23.53 |
| breast-w | 73.03 | 2.49 | | 24.48 |
| breast-w_nm | 70.95 | 2.49 | 0.41 | 26.14 |
| car | 81.16 | | | 18.84 |
| cpu | 80.45 | 3.85 | | 15.71 |
| dataset1_noid | 82.11 | 5.50 | 0.46 | 11.93 |
| dataset3 | 69.40 | 4.87 | 0.29 | 25.44 |
| denbosch | 77.97 | 3.39 | | 18.64 |
| ERA_n | | | | 100.00 |
| ESL_n | 50.64 | 10.20 | 3.57 | 35.59 |
| housing | 74.80 | 2.39 | | 22.81 |
| LEV_n | 23.90 | 16.36 | 5.18 | 54.57 |
| SWD_n | 36.30 | 38.90 | 16.05 | 8.75 |
| windsor | 48.17 | 18.34 | 0.37 | 33.13 |

Table 11: Class vs. union - Kernel - Monotonic

| Dataset | S% | B% | R% | O% |
|---|---|---|---|---|
| balance_scale | 0 | 0 | 0 | 0 |
| breast-cancer_nm | 0 | 0 | 0 | 0 |
| breast-w | 0 | 0 | 0 | 0 |
| breast-w_nm | 0 | 0 | 0 | 0 |
| car | 4.95 | 4.95 | 0 | 0 |
| cpu | 11.32 | 9.91 | 1.42 | 0 |
| dataset1_noid | 0 | 0 | 0 | 0 |
| dataset3 | 12.38 | 11.76 | 0.99 | 0.36 |
| denbosch | 0 | 0 | 0 | 0 |
| ERA_n | 0 | 0 | 0 | 0 |
| ESL_n | 0.10 | 0.10 | 0 | 0 |
| housing | 22.16 | 20.39 | 1.76 | 0 |
| LEV_n | 0 | 0 | 0 | 0 |
| SWD_n | 0 | 0 | 0 | 0 |
| windsor | 12.04 | 8.94 | 2.37 | 0.73 |

Table 12: Differences