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CSE 318

Offline 2: Solving Partially Filled Latin Square as an CSP

Value Ordering Heuristic:

Values are randomly chosen from the domain of a specific node. This heuristic works a bit better than taking the values in the ascending or descending orders.

Variable Ordering Heuristic:

For each grid we have used 5 different heuristics as follows:

VAH1: The variable chosen is the one with the smallest domain

VAH2: The variable chosen is the one with the maximum degree to unassigned variables. Also, called max-forward-degree

VAH3: The variable chosen by VAH1, Ties are broken by VAH2

VAH4: The variable chosen is the one that minimizes the VAH1 / VAH2

VAH5: A random unassigned variable is chosen

Table:

| Problem | Solver | VAH | #Node | #BT | Runtime(s) |
|---------|--------|------|-------------|--------|------------|
| d-10-01 | BT | VAH1 | 105 | 3 | 0 |
| | | VAH2 | Intractable | | |
| | | VAH3 | 151 | 6 | 0 |
| | | VAH4 | 7618 | 2097 | 0 |
| | | VAH5 | 107 | 17 | 0 |
| | FC | VAH1 | 102 | 3 | 0 |
| | | VAH2 | 1144468 | 930125 | 9 |
| | | VAH3 | 145 | 6 | 0 |
| | | VAH4 | 1834 | 834 | 0 |
| | | VAH5 | 323894 | 259222 | 1 |
| d-10-06 | BT | VAH1 | 177 | 11 | 0 |

| | | | | | |
|---------|----|------|-------------|---------|----|
| | | VAH2 | Intractable | | |
| | | VAH3 | 83 | 2 | 0 |
| | | VAH4 | 18037 | 4744 | 0 |
| | | VAH5 | 93 | 14 | 0 |
| | | VAH1 | 166 | 11 | 0 |
| | FC | VAH2 | 108439 | 70387 | 0 |
| | | VAH3 | 82 | 2 | 0 |
| | | VAH4 | 3776 | 1730 | 0 |
| | | VAH5 | 4202 | 2983 | 0 |
| | | | | | |
| d-10-07 | BT | VAH1 | 697 | 60 | 0 |
| | | VAH2 | Intractable | | |
| | | VAH3 | 265 | 21 | 0 |
| | | VAH4 | 31544 | 9606 | 0 |
| | | VAH5 | 86 | 11 | 0 |
| | FC | VAH1 | 637 | 60 | 0 |
| | | VAH2 | 1390574 | 1090870 | 11 |
| | | VAH3 | 244 | 21 | 0 |
| | | VAH4 | 7973 | 3943 | 0 |
| | | VAH5 | 5862 | 4412 | 0 |
| d-10-08 | BT | VAH1 | 61 | 1 | 0 |
| | | VAH2 | Intractable | | |
| | | VAH3 | 1101 | 116 | 0 |
| | | VAH4 | 1206 | 350 | 0 |
| | | VAH5 | 84 | 9 | 0 |
| | FC | VAH1 | 60 | 1 | 0 |
| | | VAH2 | 390920 | 324567 | 4 |
| | | VAH3 | 985 | 116 | 0 |
| | | VAH4 | 786 | 333 | 0 |
| | | VAH5 | 1723 | 1253 | 0 |
| d-10-09 | BT | VAH1 | 70 | 4 | 0 |
| | | VAH2 | Intractable | | |
| | | VAH3 | 108 | 9 | 0 |
| | | VAH4 | 1747 | 622 | 0 |
| | | VAH5 | 91 | 15 | 0 |
| | FC | VAH1 | 67 | 4 | 0 |
| | | VAH2 | 1136548 | 1115571 | 9 |

| | | | | | |
|---------|----|------|-------------|----------|------|
| d-15-01 | | VAH3 | 99 | 9 | 0 |
| | | VAH4 | 696 | 453 | 0 |
| | | VAH5 | 203696 | 152584 | 0 |
| | BT | VAH1 | 1951672 | 216953 | 15 |
| | | VAH2 | Intractable | | |
| | | VAH3 | 248696 | 23911 | 3 |
| | | VAH4 | 35809367 | 35809260 | 1468 |
| | | VAH5 | 208 | 21 | 0 |
| | FC | VAH1 | 1734721 | 216953 | 10 |
| | | VAH2 | Intractable | | |
| | | VAH3 | 224785 | 23911 | 2 |
| | | VAH4 | 6819715 | 3786202 | 276 |
| | | VAH5 | Intractable | | |

Conclusion:

Since we are doing some pre-calculations in case of Forward Checking, obviously, Forward Checking performs better than Backtracking. Out of the variable ordering heuristics, we can see that VAH1 and VAH3 perform relatively better than the other heuristics. Out of these two though, for some grids VAH1 performs better than VAH3, and vice versa for the others. VAH5 sometimes perform very well, but other times it performs very badly. Some of the grids are marked as intractable, as we could not get the result within an hour of running the code with the aforementioned input.