**REPORT for ASSIGNMENT 05 (SAT Comparison)**

*By* NAME ROLL\_NUMBER

**Abstract**

The report focuses on conducting SAT analysis for "Charging Scheduling on Electric Vehicles." It involves generating DIMAC files in two different formats:

* Option 1: Using variables in the form of x\_ijt (i*th* vehicle at j*th* port at time t)
* Option 2: Using a combination of x\_ij (i*th* vehicle at j*th* port) and y\_it(i*th* vehicle at time t)

To solve the SAT problem, we utilize three solvers: Z3, Glucose, and Lingeling. The analysis is performed using Python, and the results are obtained by executing SAT solvers on the generated DIMACS files. Comparison of DIMAC files are also done.

**Topic Page no.**

1. **Input 2**
2. **DIMAC file comparison 2**
3. **SAT Analysis 3-4**
4. **Z3 3**
5. **Glucose 3**
6. **Lingeling 4**
7. **Conclusion 4**
8. **All comparison are done using given input below:-**

NumPorts 5

NumVehicles 10

V 1 4 10 3

V 2 7 20 6

V 3 8 27 10

V 4 5 15 4

V 5 10 25 8

V 6 12 30 5

V 7 3 12 6

V 8 9 18 7

V 9 6 22 9

V 10 11 28 4

1. **DIMAC FILE COMPARIOSN (Option1.cnf , Option2.cnf):-**

For Option 1 Scheme (x\_ijt)

Variables: 400

Clauses: 23885

Option1 CNF file size: 292.96 kB

Clauses with 2 literals: 23875

Clauses with 3 literals: 0

Clauses with 3+ literals: 10

For Option 2 Scheme (x\_ij, y\_it)

Variables: 130

Clauses: 7667

Option2 CNF file size: 142.82 kB

Clauses with 2 literals: 447

Clauses with 3 literals: 1

Clauses with 3+ literals: 7219

Option 1 ratio Option 2 w.r.t. variables: 3.0769x

Option 1 ratio Option 2 w.r.t. clauses: 3.1153x

Option 1 ratio Option 2 w.r.t. file size: 2.0513x

1. **SAT Solvers used**
2. Z3
3. Glucose
4. Lingeling

**=== Analysis For Z3 ===**

Scheme 1 (x\_ijt):

Computation time: 2.1134 seconds

Memory usage: 21.7227 MB

Satisfiability: True

Scheme 2 (x\_ij, y\_it):

Computation time: 1.1739 seconds

Memory usage: 1.7305 MB

Satisfiability: True

Comparison ratio of Option 1 to Option 2 For Z3 :

Option 1 ratio Option 2 w.r.t. computation time: 1.8003x

Option 1 ratio Option 2 w.r.t. memory usage: 12.5530x

**=== Analysis For Glucose ===**

Scheme 1 (x\_ijt):

Computation time: 0.0249 seconds

Memory usage: 1.5898 MB

Satisfiability: True

Scheme 2 (x\_ij, y\_it):

Computation time: 0.0150 seconds

Memory usage: 0.8516 MB

Satisfiability: True

Comparison ratio of Option 1 to Option 2 For Glucose3 :

Option 1 ratio Option 2 w.r.t. computation time: 1.6666x

Option 1 ratio Option 2 w.r.t. memory usage: 1.8670x

**=== Analysis For Lingeling ===**

Scheme 1 (x\_ijt):

Computation time: 0.0259 seconds

Memory usage: 1.9180 MB

Satisfiability: True

Scheme 2 (x\_ij, y\_it):

Computation time: 0.0120 seconds

Memory usage: 1.0742 MB

Satisfiability: True

Comparison ratio of Option 1 to Option 2 For Lingeling :

Option 1 ratio Option 2 w.r.t. computation time: 2.1667x

Option 1 ratio Option 2 w.r.t. memory usage: 1.7855x

1. **Conclusion**
2. Option 1 schema (x\_ijt) generates more variables and clauses that Option 2 schema (x\_ij, y\_it).
3. All SAT Solvers (Z3, Glucose, Lingeling) take more computation time and memory in operating Option 1 schema than Option 2 schema.

*Note : - Absolute quantity measurement of computation time and memory may vary with each run time on a given input. But overall conclusions remain same, i.e., option 1 schema is more time and memory consuming than option 2 schema.*