MAXIMALLY PARALLEL SEESAW SEARCH FOR MAX-SAT

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OBJECTIVE
To develop a randomization based algorithm to solve MAX-SAT problems, that is faster than exponential time complexity exhaustive search algorithms.

MAX-SAT
Find a Boolean assignment to variables, that satisfies maximum number of clauses in the Conjunctive Normal Form (CNF).

\[
\text{CNF} = (\overline{a} \lor \overline{b}) \land (a \lor b) \land (a \lor \overline{b}) \land (a \lor b)
\]

Solution: At the most 3 out of 4 clauses can be satisfied for any combination of values for 'a', and 'b'.

SEESAW SEARCH
Seesaw Search is a technique, consisting of 2 phase:
Optimization phase: Try to optimize the solution, until it cannot be optimized further.
Constraining phase: Fixes invalid constraints, without caring for optimality of the solution.
The search keeps 'seesawing' between these 2 phases for some 'max-tries' number of times, hence the name Seesaw Search.

SEESAW SEARCH FOR MAX-SAT
The search starts with assigning random Boolean values to the variables.
Optimization phase: Randomly pick a clause from the CNF, and keep on adding it to the solution until FALSE clause is encountered. If it is FALSE, move to Constraining phase.
Constraining phase: Try to make the false clause evaluate to TRUE, by flipping a random variable in it, or by simply removing the false clause.

MASSIVELY PARALLEL SEESAW SEARCH FOR MAX-SAT

VALUES FOR ALL VARIABLES IN CNF.

Randomly generated variable values

Values for all variables in CNF.

SOLUTION

REDUCTION OPERATION
(Choose variables that give best solution)

M iterations?

The algorithm was tested for different input sizes. If the values in columns for 'Clauses' and 'Satisfied Clauses' is equal, it means the result obtained was optimal.

RESULTS

<table>
<thead>
<tr>
<th>Variables</th>
<th>Clauses</th>
<th>Satisfied Clauses</th>
<th>Run time</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td>91</td>
<td>91</td>
<td>10 seconds</td>
</tr>
<tr>
<td>50</td>
<td>218</td>
<td>218</td>
<td>15 seconds</td>
</tr>
<tr>
<td>75</td>
<td>325</td>
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</tr>
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</tr>
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<tr>
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<td>1065</td>
<td>8 minutes</td>
</tr>
</tbody>
</table>

CONCLUSION
Seesaw Search is able to get optimal results in a significantly less amount of time, as compared to exhaustive search.

REFERENCES