Exact Satisfiability and Phase Transition Analysis of the Regular (k,d)-CNF Formula

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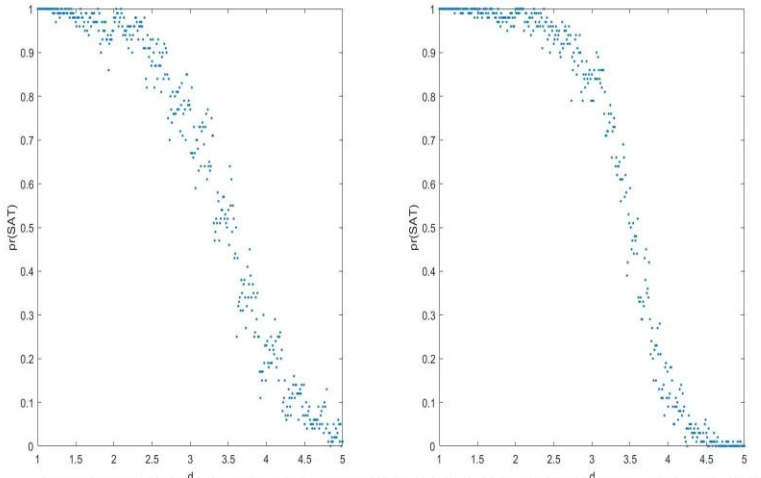
Problems & Ideas

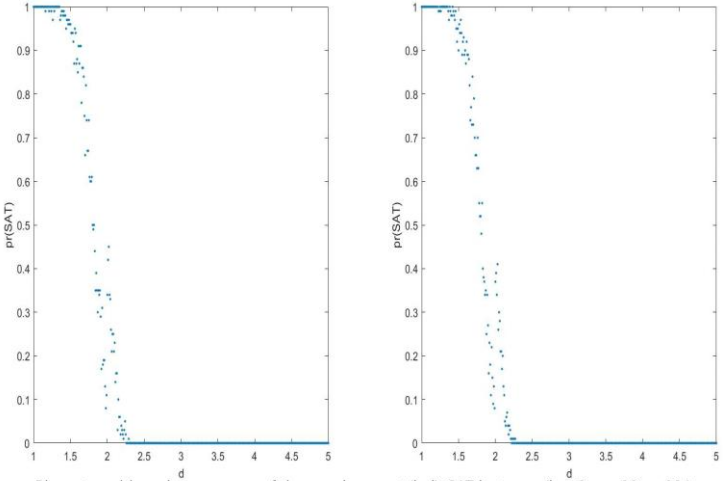
- In real life, it is often necessary to assign values to the partial variables and the whole variables of a problem:
  - Let F be a (k,d)-CNF formula with a variable set V, V' is a proper subset of V, the regular partial exact (k,d)-SAT problem involves determining whether a truth assignment set on V' exists such that only a literal in each clause is true.
  - Let F be a (k,d)-CNF formula with a variable set V, the regular exact (k,d)-SAT problem involves determining whether a truth assignment set on V exists such that only a literal in each clause is true.
- Ideas: construct the satisfying assignment of the formula by the property of factor graph and analyze the phase transition points of the two problems by adopting the first and second moment methods.

Main Contributions

- Contributions:
  - We give the construction method of (k,d)-CNF formula satisfying assignment ;
  - We give the phase transition point of the regular partial exact (k,d)-SAT problem ;
  - We give the phase transition point of the regular exact (k,d)-SAT problem.



Phase transition phenomenon of the regular partial exact (k,d)-SAT instance (k = 3,n = 10 , 20)



Phase transition phenomenon of the regular exact (k,d)-SAT instance (k = 3,n = 80 , 90)

The verification results reveal that the theoretical results agree with the experimental results, and, with an increasing problem scale, the upper and lower bounds of the instances that are satisfied and unsatisfied became clearer.