

National University of Singapore
 School of Computing
 CS3243: Introduction to Artificial Intelligence
 Tutorial 6

Readings: AIMA Chapter 8

1. The *WalkSAT* algorithm is a local search algorithm used to determine whether a proposition is entailed by a *KB* (whether the resulting *KB* is satisfiable). It is similar to simulated annealing in that it uses randomness and allows steps that generate more conflicts to be taken with some probability. The algorithm is shown below.

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function WALKSAT(clauses, p, max-flips) returns a satisfying model or failure
  inputs: clauses, a set of clauses in propositional logic
           p, the probability of choosing to do a “random walk” move,
           typically around 0.5,
           max-flips, number of flips allowed before giving up

  model ← a random assignment of true/false to the symbols in clauses
  for i = 1 to max-flips do
    if model satisfies clauses then return model
    clause ← a randomly selected clause from clauses that is false in model
    with probability p flip the value in model of a randomly selected symbol
    from clause
    else flip whichever symbol in clause maximizes the number of satisfied
    clauses
  return failure
  
```

On the other hand, DPLL is a deterministic model checking algorithm. It uses pure symbols and unit clauses as the basis for heuristics that attempt to converge to a solution quicker than the standard **TT-Entails**.

- (a) How you would modify the WalkSAT algorithm to use the heuristics of pure symbols and unit clauses.
 - (b) How would such a modification affect the performance of the resulting algorithm? How does it impact time complexity?
2. (Question 8.2 from AIMA) Consider a knowledge base containing just two sentences: $P(a)$ and $P(b)$. Does this knowledge base entail $\forall x P(x)$? Explain your answer in terms of models.
 3. (Question 8.3 from AIMA) Is the sentence $\exists x, y x = y$ valid? Explain.
 4. (Wumpus World) Represent the following English sentences in first-order logic:
 - (a) Anyone who meets the wumpus is killed by it.
 - (b) Anything that glitters is gold.
 - (c) Not every square contains a pit.

5. (Modified Question 8.26 from AIMA) Represent the following sentences in first-order logic, using a consistent vocabulary that you must define:
 - (a) Some students took French in Spring 2010.
 - (b) Every student who takes French passes it.
 - (c) Only one student took Greek in Spring 2010.
 - (d) The best score in Greek is always higher than the best score in French.
 - (e) Everyone who buys a policy is smart.
 - (f) No person buys an expensive policy.
 - (g) There is an agent who sells policies only to those people who are not insured.
 - (h) There is a barber who shaves all men in town who do not shave himself.

6. Represent the sentence “All Germans speak the same languages” in predicate calculus. Use $Speaks(x, l)$ to specify that a person x speaks language l and $isGerman(x)$ to specify that a person x is a German.