A Verifier for The UPC Memory Consistency Model

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Overview

- P and NP
- Reducibility
- NP-complete problems
- Satisfiability problem (SAT)
- The UPC Memory Consistency Model
- The verifier
Computational complexity

• Computational resources
  
• P
  – Solution is found in polynomial time
    • Bubble sort: $O(n^2)$
    • Quick sort: $O(n \log n)$

• NP
  – Solution is verified in polynomial time
    • Subset sum
    • Hamiltonian Cycle
    • Vertex Cover
NP-complete and reduction

• In NP
• Is NP-Hard
  – All problems in NP can reduce to it
  – How to prove this?

• Reduce from another NP-complete problem
Satisfiability

- The problem of finding a satisfying variable assignment to a boolean formula.
- The first problem to be proven to be a NP-complete problem
- Can be reduced to the CNF-SAT problem.
  - Many good solvers
  - Versatile
UPC Memory Model
Problem description

• Create an observed ordering for each thread
• Set of operation tuples <obs, pc, op, cons, var, data, iss, id>
  – Id: unique id
  – Obs: Observing thread
  – Pc: Program Counter
  – Op: operation type (Read, Write)
  – Cons: coherence type (Strict, Relaxed)
  – Var: shared memory variable
  – Data: a read or stored value
  – Iss: issuing thread
SAT representation

- Variable = pair of operations
- Variable assignment will give the ordering
Ordering rules

• AllStrict
• TransitiveOrder
• IrreflexiveOrder
• ProgramOrder
• ReadValue
• TotalOrder