Parallel Matlab: `parfor`

Circuit Satisfiability Example

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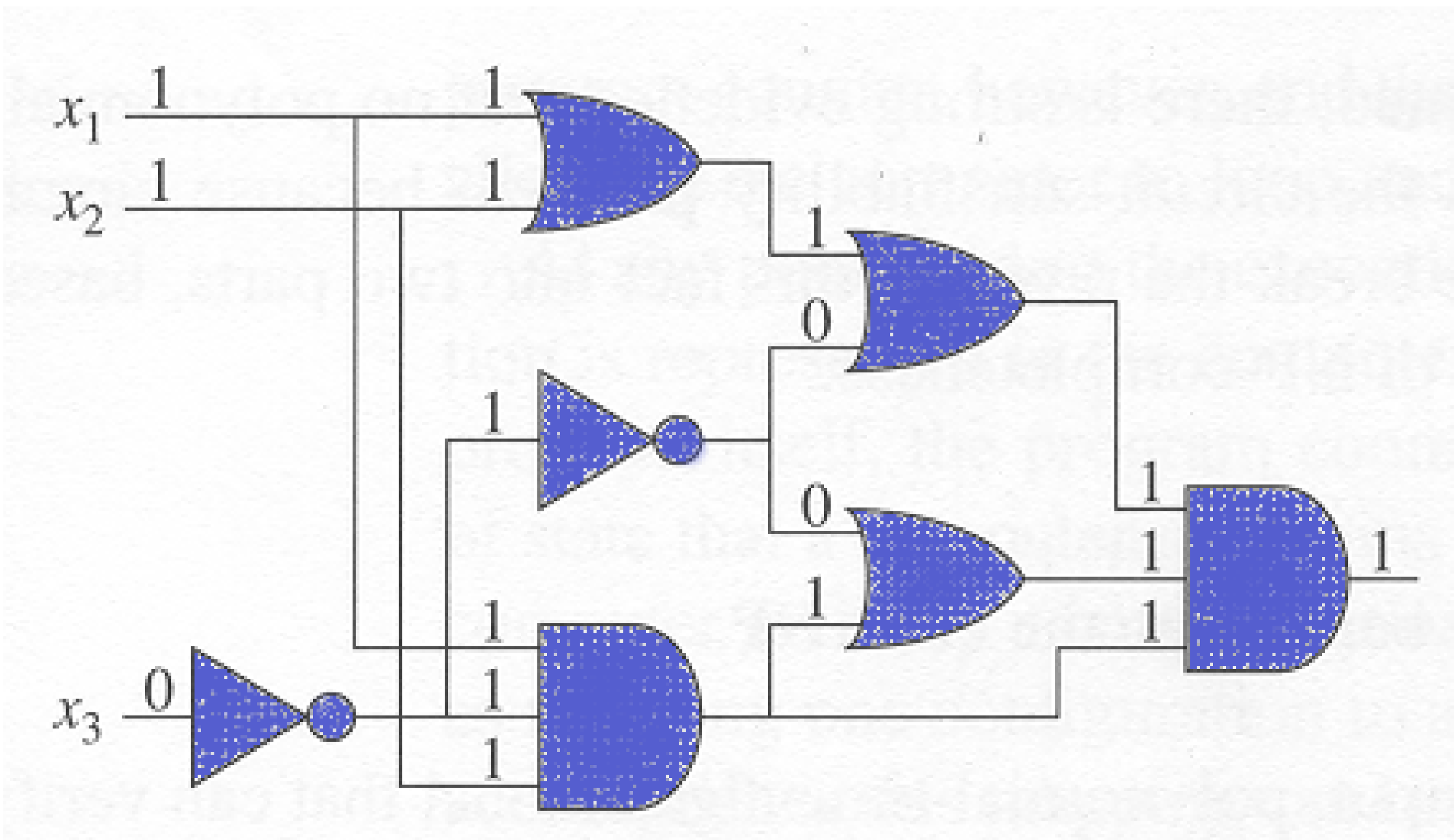
Configuration



This logical formula $y = f(x_1, x_2, x_3)$ is **satisfied** by input values such as (TRUE,TRUE,FALSE) which produce a result of TRUE.

Model Problem

Our model formula uses 31 clauses in 23 variables, and begins:

$$y = (x_1 \vee x_2) \wedge (-x_2 \vee -x_4) \wedge (x_3 \vee x_4) \wedge ...$$

There are 2^{23} different choices for X.
Only 15 of these result in a value of TRUE.

Finding all inputs with a TRUE result is the **circuit satisfiability problem**.

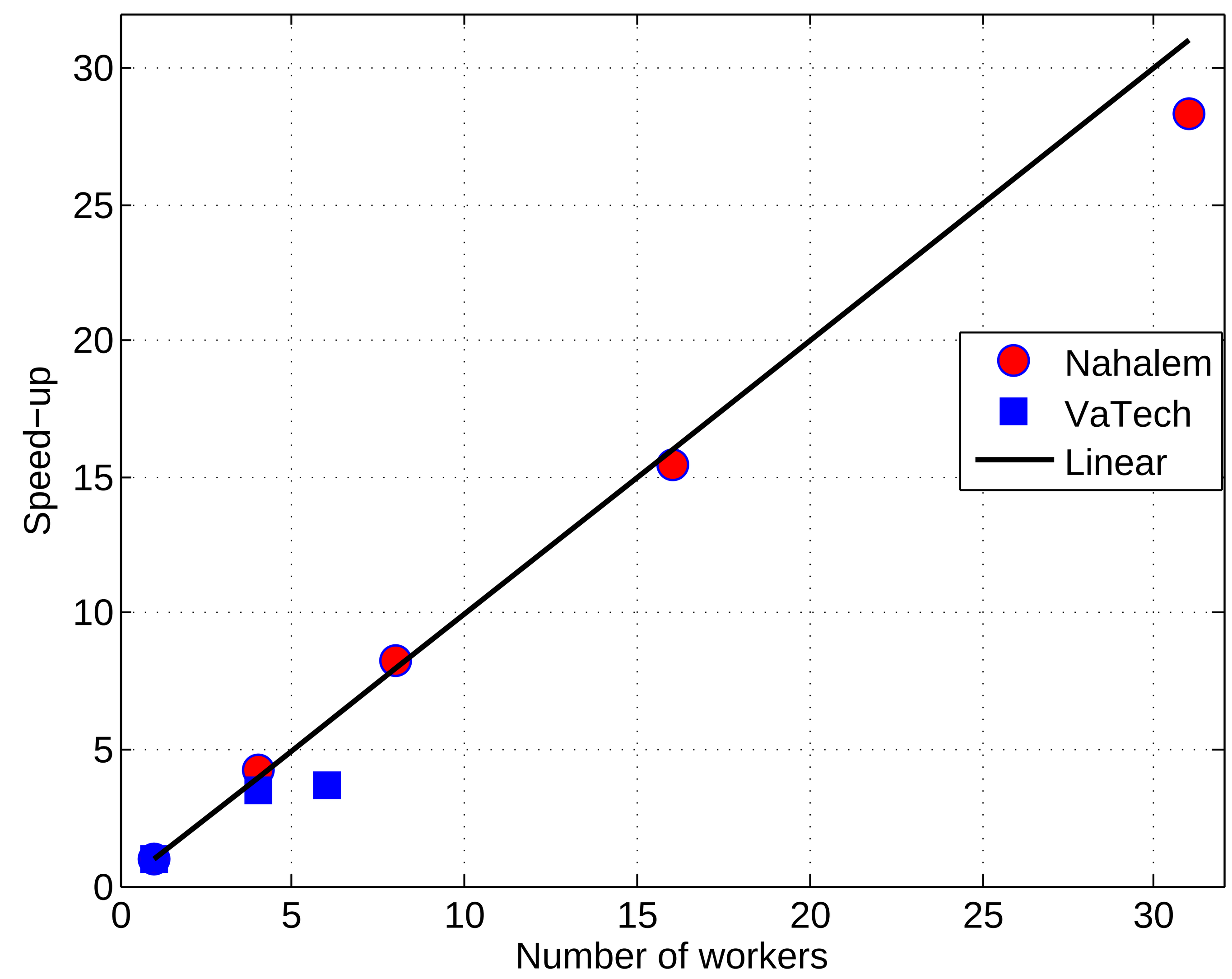
Our solution is an exhaustive search: generate and test every possible input.

If multiple workers are available, they can search in parallel.

Code Fragment

```
n = 23;
sol_num = 0;
parfor i = 0 : 2^n - 1
  % Binary I yields logical X;
  x = i4_to_bvec ( i, n );
  value = circuit_value ( n, x );
  if ( value == 1 )
    sol_num = sol_num + 1;
    print_bvec ( x );
  end
end
```

Timing



Discussion

The small Virginia Tech cluster got the expected parallel improvement with 4 workers, but could not take much advantage of 8. The Nehalem cluster showed a near perfect parallel improvement across the range of workers investigated. This problem is an ideal case for parallel processing; there is no interaction between workers except to report the solutions.

Reference

http://people.sc.fsu.edu/~burkardt/...

- Burkardt, Cliff, Snow, *MATLAB Parallel Programming: Timing Results on an Intel Nehalem Cluster*, ...pdf/nehalem_matlab.pdf.
- ...m_src/md_parallel/md_parallel.html.
- .../m_src/satisfiability_parallel /satisfiability_parallel.html.