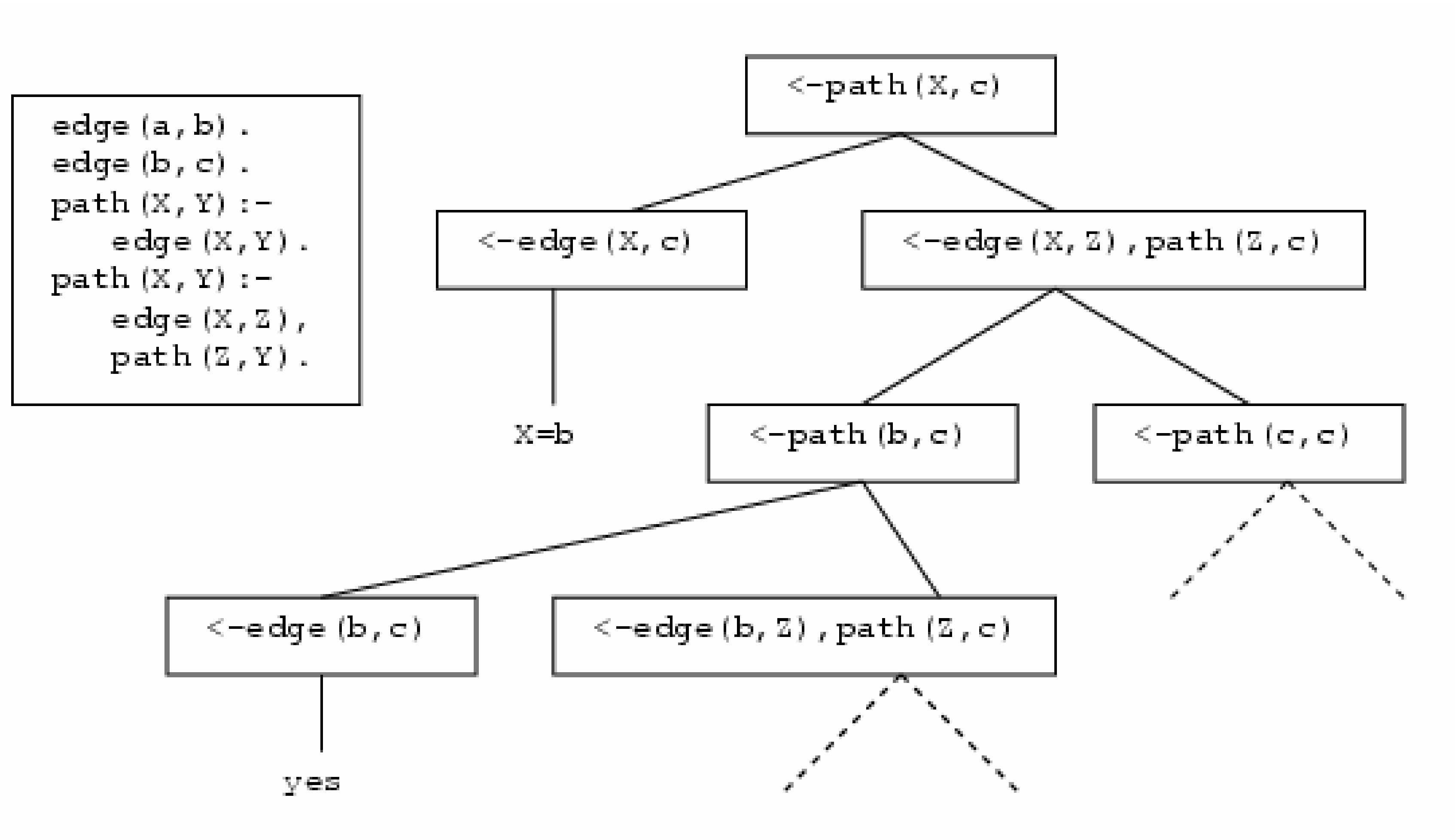
A Methodology for Order-Sensitive Execution of Non-deterministic Languages on Beowulf Clusters

K. Villaverde[1], E. Pontelli[1],
H.F. Guo[2], G. Gupta[3]

1. Dept. Computer Science, New Mexico State University
2. Dept. Computer Science, University of Nebraska at Omaha
3. Dept. Computer Science University of Texas at Dallas

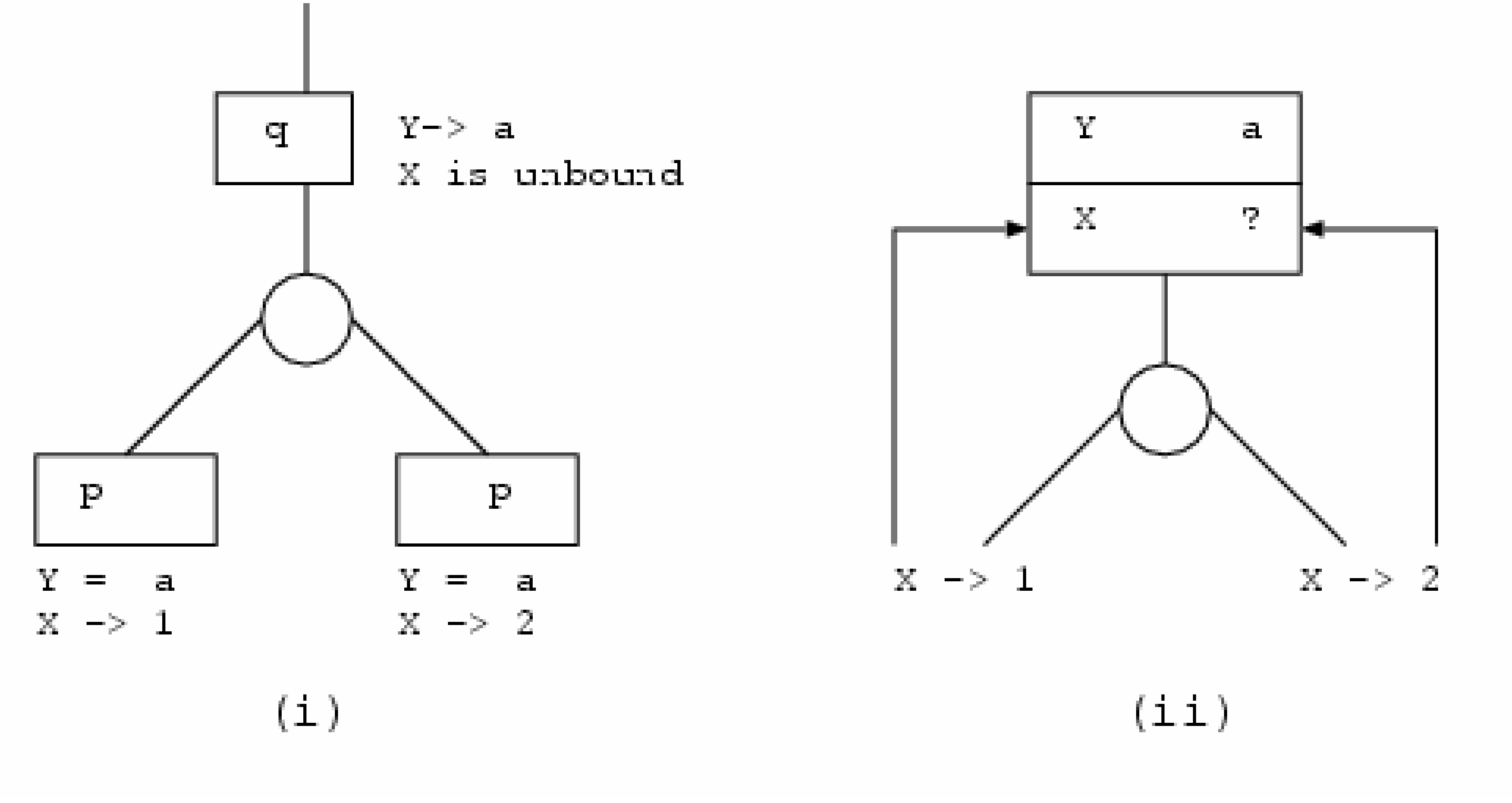
OR-Parallelism: executing in parallel the different alternatives of select clause



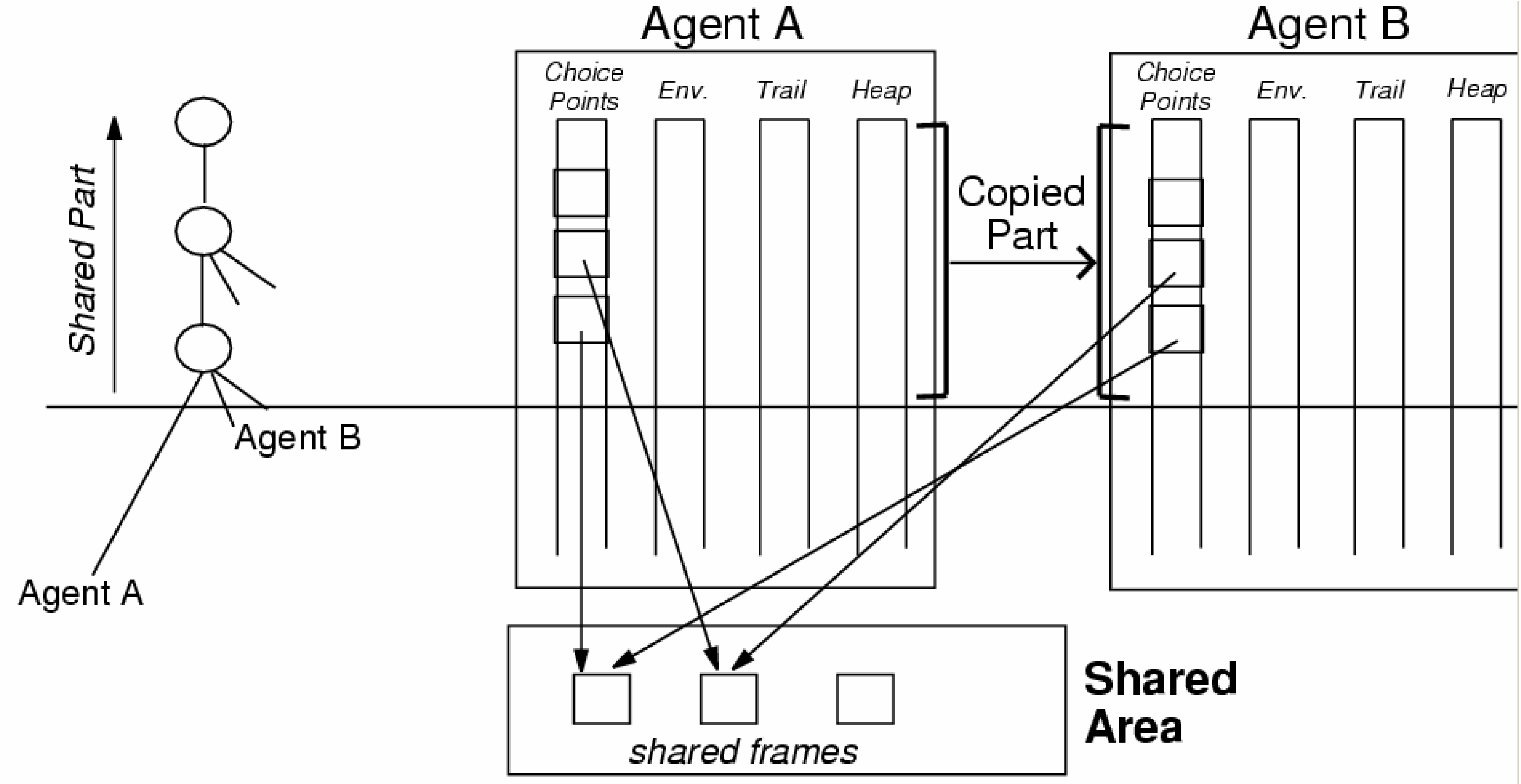
```
edge(a,b).
edge(b,c).
path(X,Y):-
   edge(X,Y).
path(X,Y):-
   edge(X,Z),
   path(Z,Y).
```

Environment Representation Problem in OR-Parallelism

```
:- q(Y,X),p(Y,X).
p(a,1).
p(a,2).
```



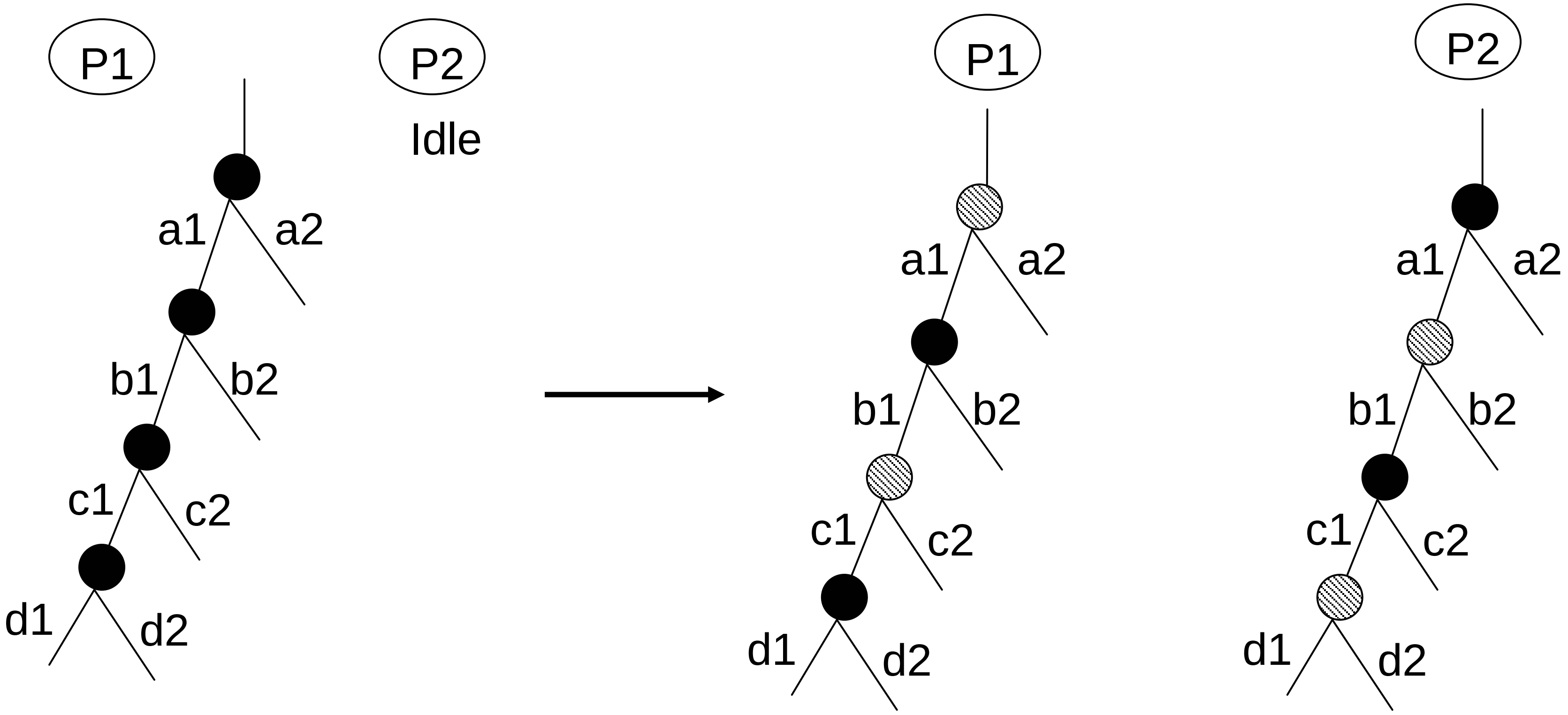
Stack-Copying on Shared Memory Platforms



Stack splitting is an evolution of the stack copying method

Extend stack splitting to handle order sensitive executions

Stack splitting

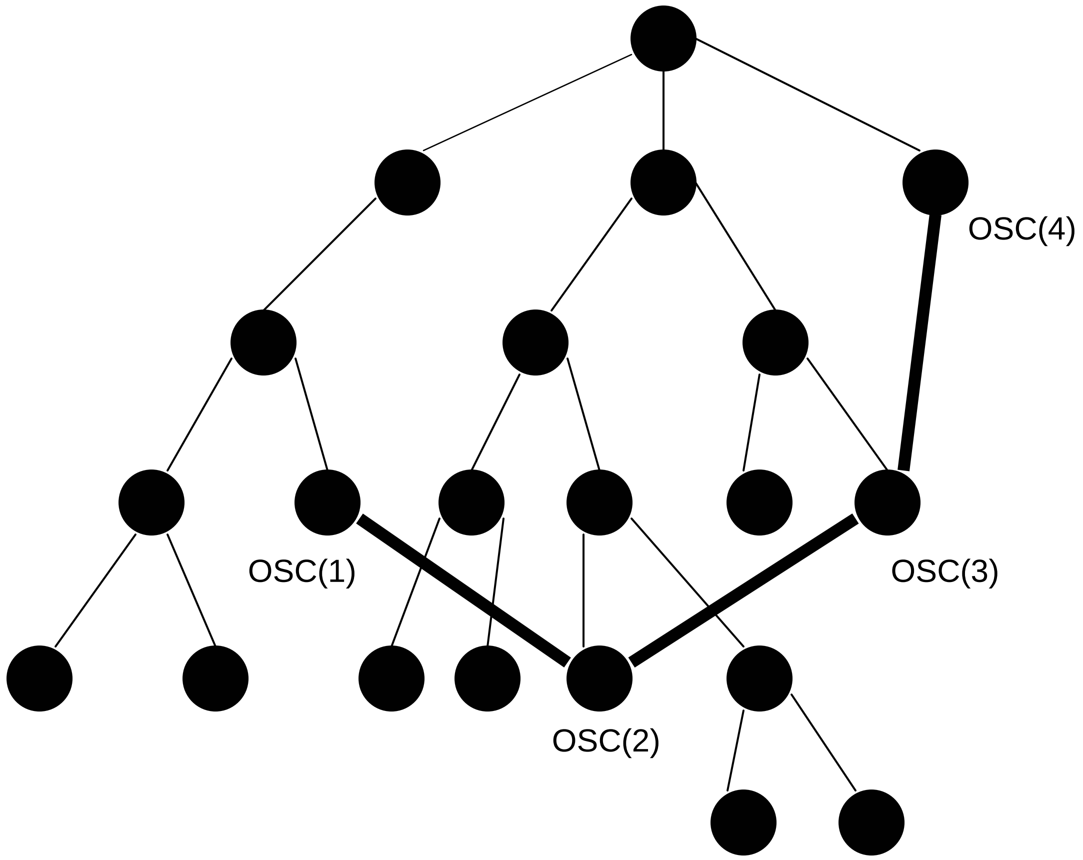


LEGEND:

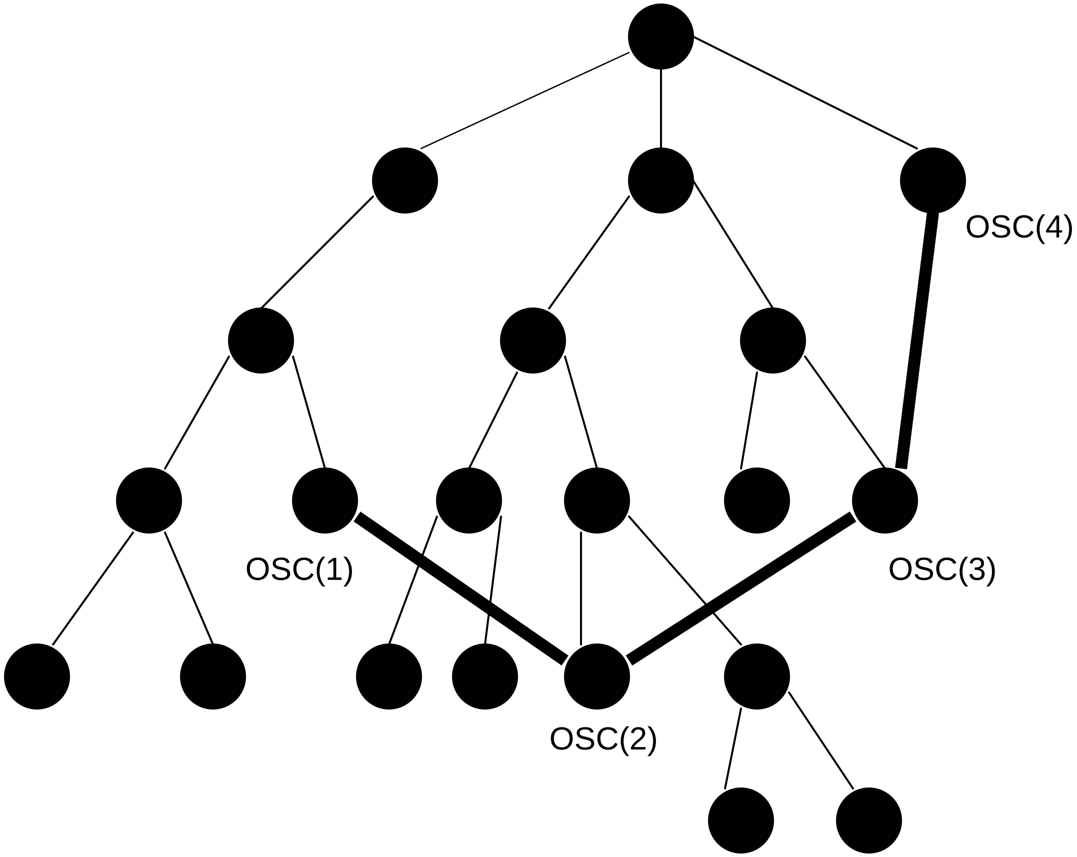
● Choice point

▨ Empty choice point

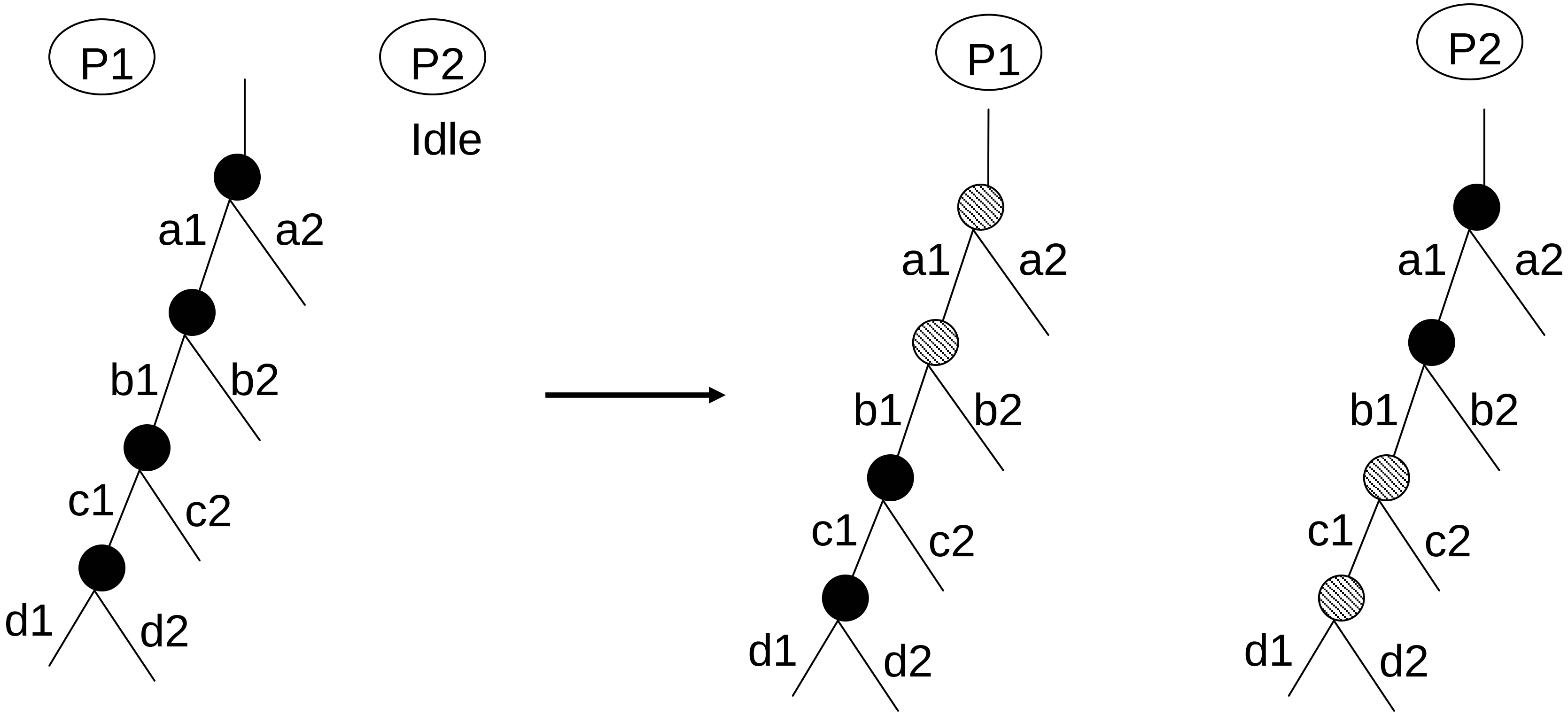
A specific order sensitive component (OSC) can be safely executed only if all the OSC that precede it in the in-order traversal have been completed.



The most commonly used approximation is to execute a OSC only when the branch containing the OSC becomes the left most branch in the search tree.



Modified stack splitting



LEGEND:

● Choice point

▨ Empty choice point

Data Structures

Linear vector

0	2	4	3	1

Maintains processors ordering

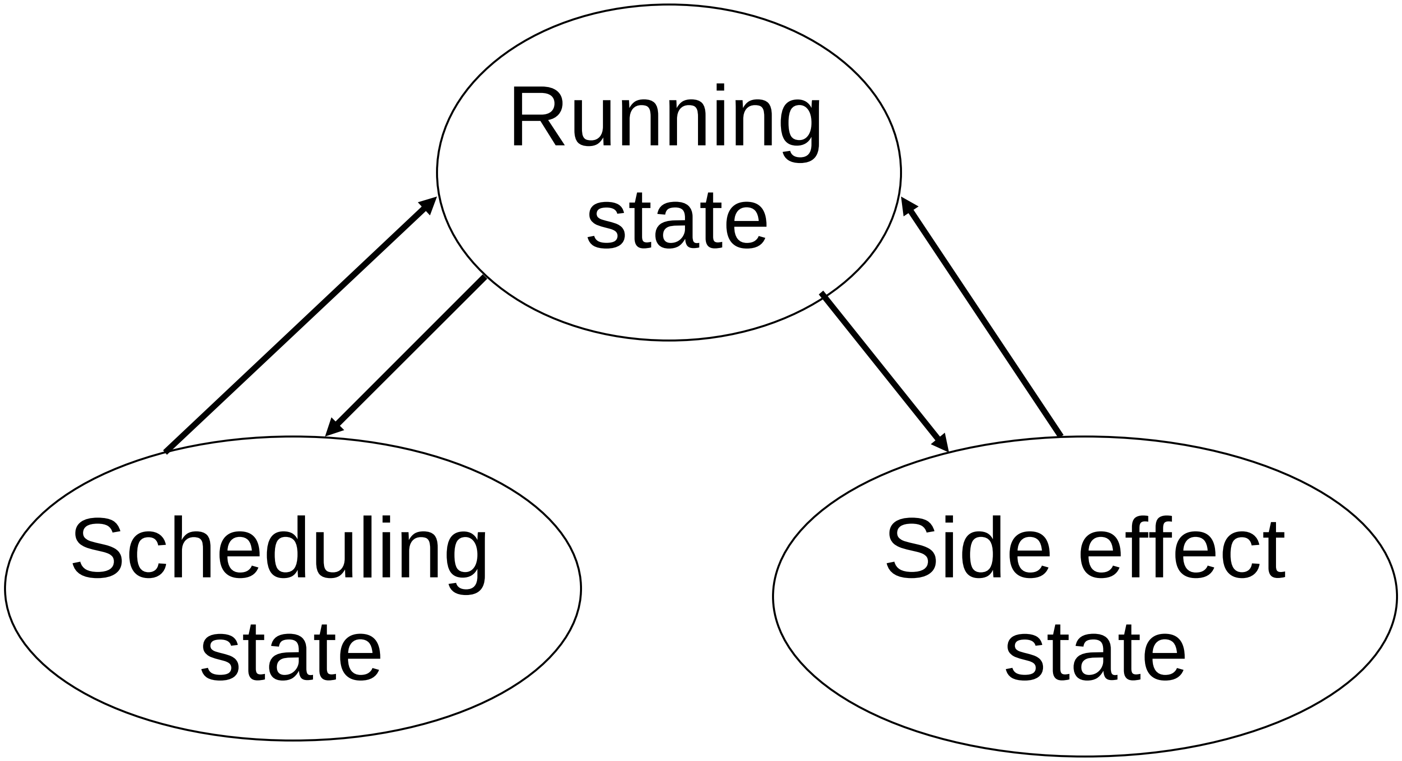
Side effects execute only if there are no processors to the left

Waiting queue

Set of processors waiting to execute side effect

When out of work, processors in waiting queue are informed

Procedure

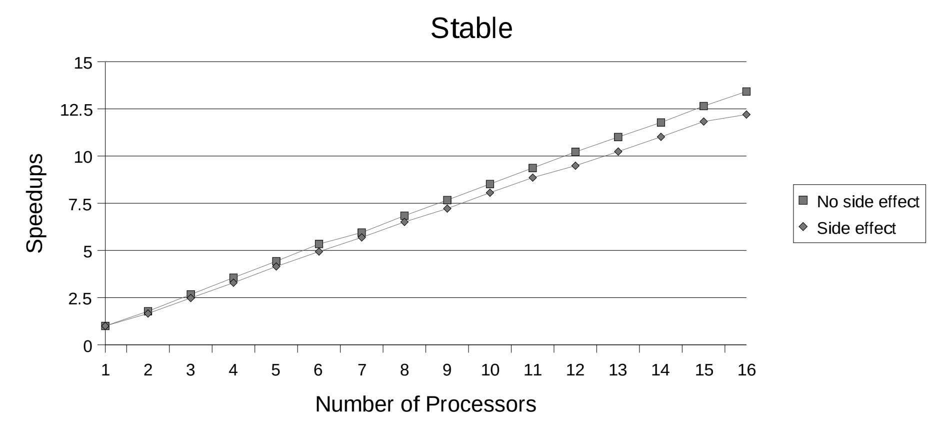


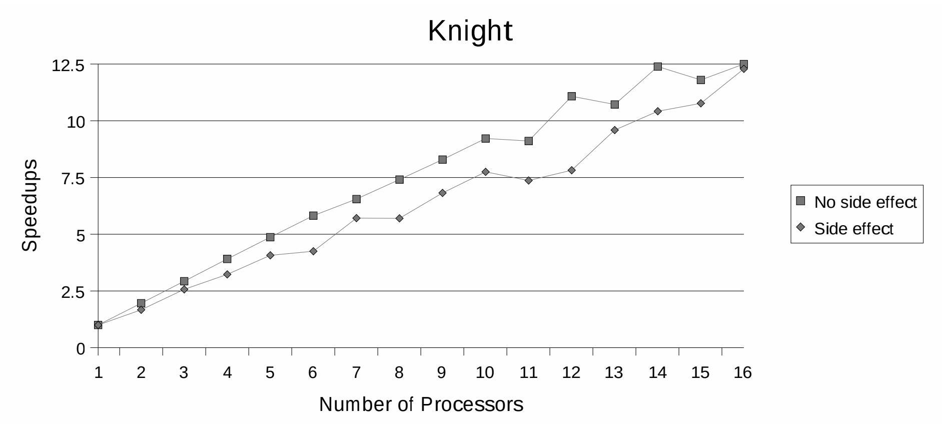
Running state

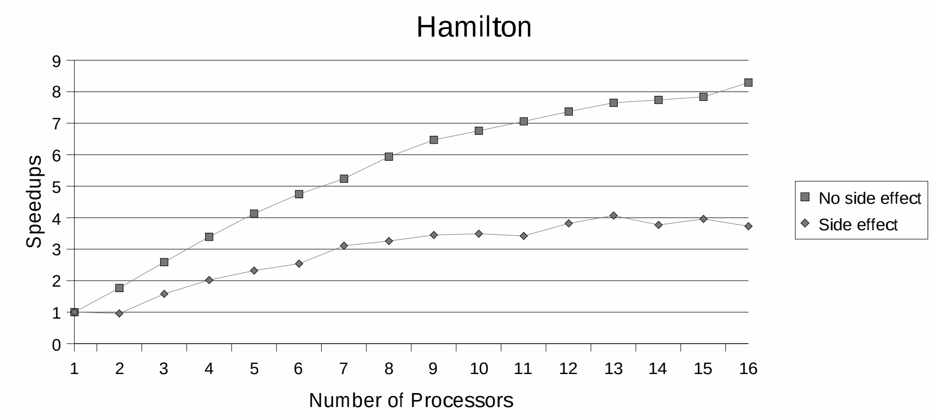
Scheduling state

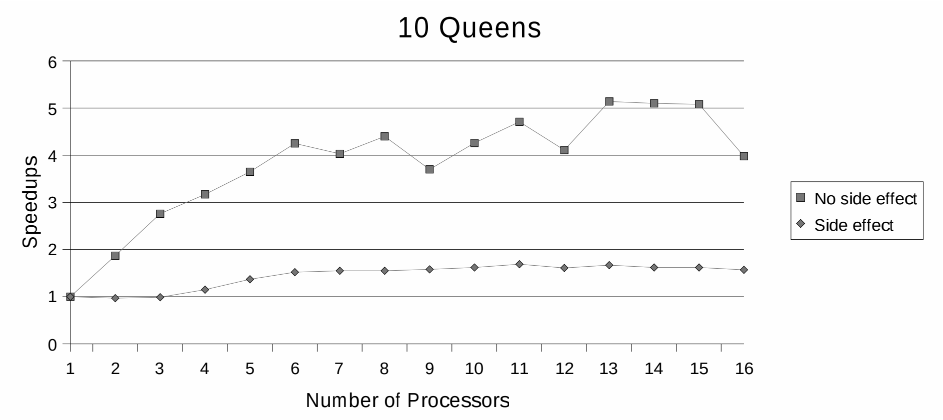
Side effect state

Results

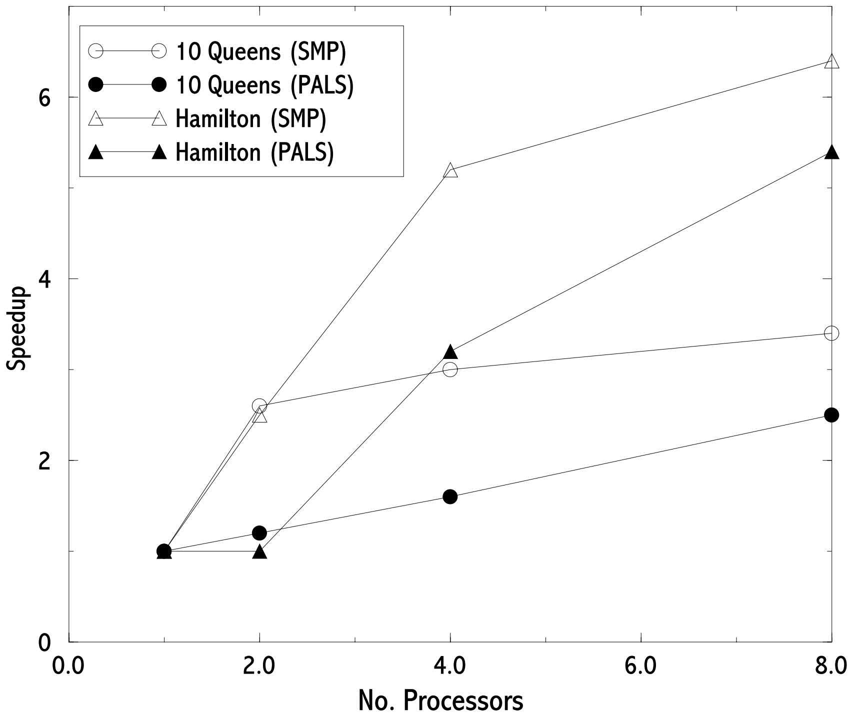

Stable
15
12.5
10
7.5
5
2.5
0
Speedups
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
Number of Processors
■ No side effect
◆ Side effect

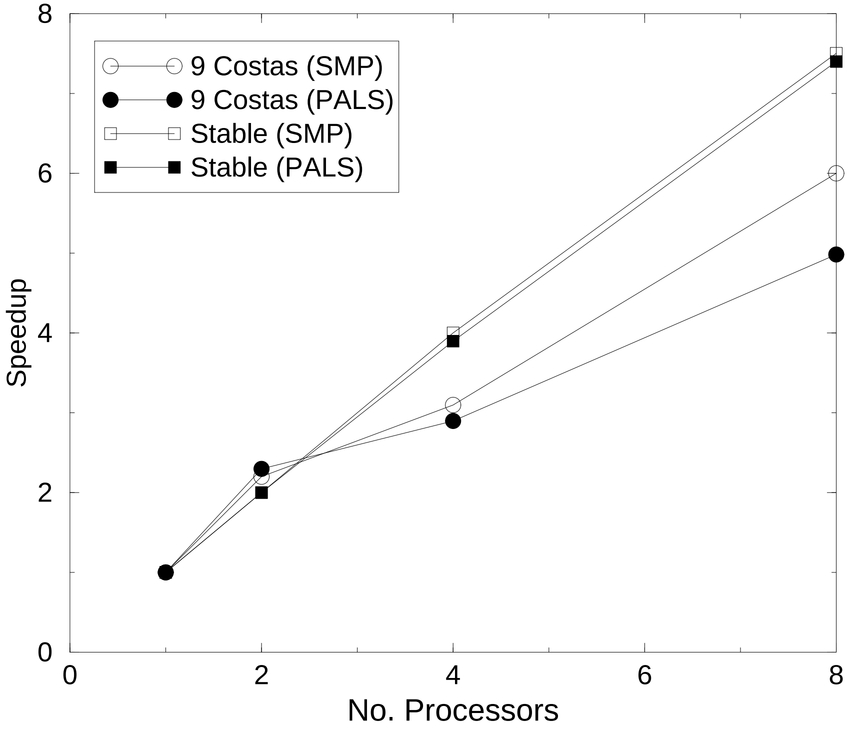

Knight
12.5
10
7.5
5
2.5
0
Speedups
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
Number of Processors
■ No side effect
◆ Side effect


Hamilton
9
8
7
6
5
4
3
2
1
0
Speedups
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
Number of Processors
■ No side effect
◆ Side effect


10 Queens
6
5
4
3
2
1
0
Speedups
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
Number of Processors
■ No side effect
◆ Side effect

Comparison with MUSE





Conclusions and Future Work

- PALS Or-Parallel Prolog system
  - Excellent results
  - Minimal degradation

- Validate on Jmodels system for non monotonic reasoning
- Explore theoretical properties