

U.S. NAVAL ACADEMY  
COMPUTER SCIENCE DEPARTMENT  
TECHNICAL REPORT



Software Fault Tree Key Node Metric Test Cases

Needham, D M Jones, S A

USNA-CS-TR-2006-01

April 25, 2006

## Report Documentation Page

*Form Approved*  
*OMB No. 0704-0188*

Public reporting burden for the collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to a penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number.

1. REPORT DATE <b>25 APR 2006</b>	2. REPORT TYPE	3. DATES COVERED <b>00-04-2006 to 00-04-2006</b>			
4. TITLE AND SUBTITLE <b>Software Fault Tree Key Node Metric Test Cases</b>		5a. CONTRACT NUMBER			
		5b. GRANT NUMBER			
		5c. PROGRAM ELEMENT NUMBER			
6. AUTHOR(S)		5d. PROJECT NUMBER			
		5e. TASK NUMBER			
		5f. WORK UNIT NUMBER			
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) <b>U.S. Naval Academy, Computer Science Department, 572M Holloway Rd Stop 9F, Annapolis, MD, 21403</b>		8. PERFORMING ORGANIZATION REPORT NUMBER			
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)		10. SPONSOR/MONITOR'S ACRONYM(S)			
		11. SPONSOR/MONITOR'S REPORT NUMBER(S)			
12. DISTRIBUTION/AVAILABILITY STATEMENT <b>Approved for public release; distribution unlimited</b>					
13. SUPPLEMENTARY NOTES <b>The original document contains color images.</b>					
14. ABSTRACT					
15. SUBJECT TERMS					
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES <b>11</b>	19a. NAME OF RESPONSIBLE PERSON
a. REPORT <b>unclassified</b>	b. ABSTRACT <b>unclassified</b>	c. THIS PAGE <b>unclassified</b>			

# Software Fault Tree Key Node Metric Test Cases

D. M. Needham and S. A. Jones  
Computer Science Department  
United States Naval Academy  
Annapolis, MD 21402 USA

## Abstract

This report contains 70 sets of software fault trees used to test a software fault tree key node safety metric. Each page represents a set of ten trees with an identical root node hazard. To the left of the initial tree on each page are the negatively mutated trees. To the right are the positively mutated trees. Under each tree is the value produced by the metric equation, (S), when run on the tree.

The key node safety metric uses the definitions in Table I, and is given as

$$S = \frac{kh}{n^2} \sum_{i=0}^{k-1} \frac{c_i}{d_i}$$

Table I. Key node metric definitions.

key node	Any software fault tree node that allows a failure to propagate towards the tree root when multiple failure conditions exist in the node.
h (height)	Number of edges on the longest simple path from the root to a leaf plus 1.
$d_i$ (depth)	Number of edges from the root to node $i$ plus 1.
$c_i$ (subtree size)	Number of nodes in the tree rooted at node $i$ , not including node $i$ .
n (size of tree)	Number of nodes in the tree, including the root and all leaves
k (key nodes)	Number of key nodes within the fault tree
S (Safety Value)	Safety value computed by the Key Node Safety Metric

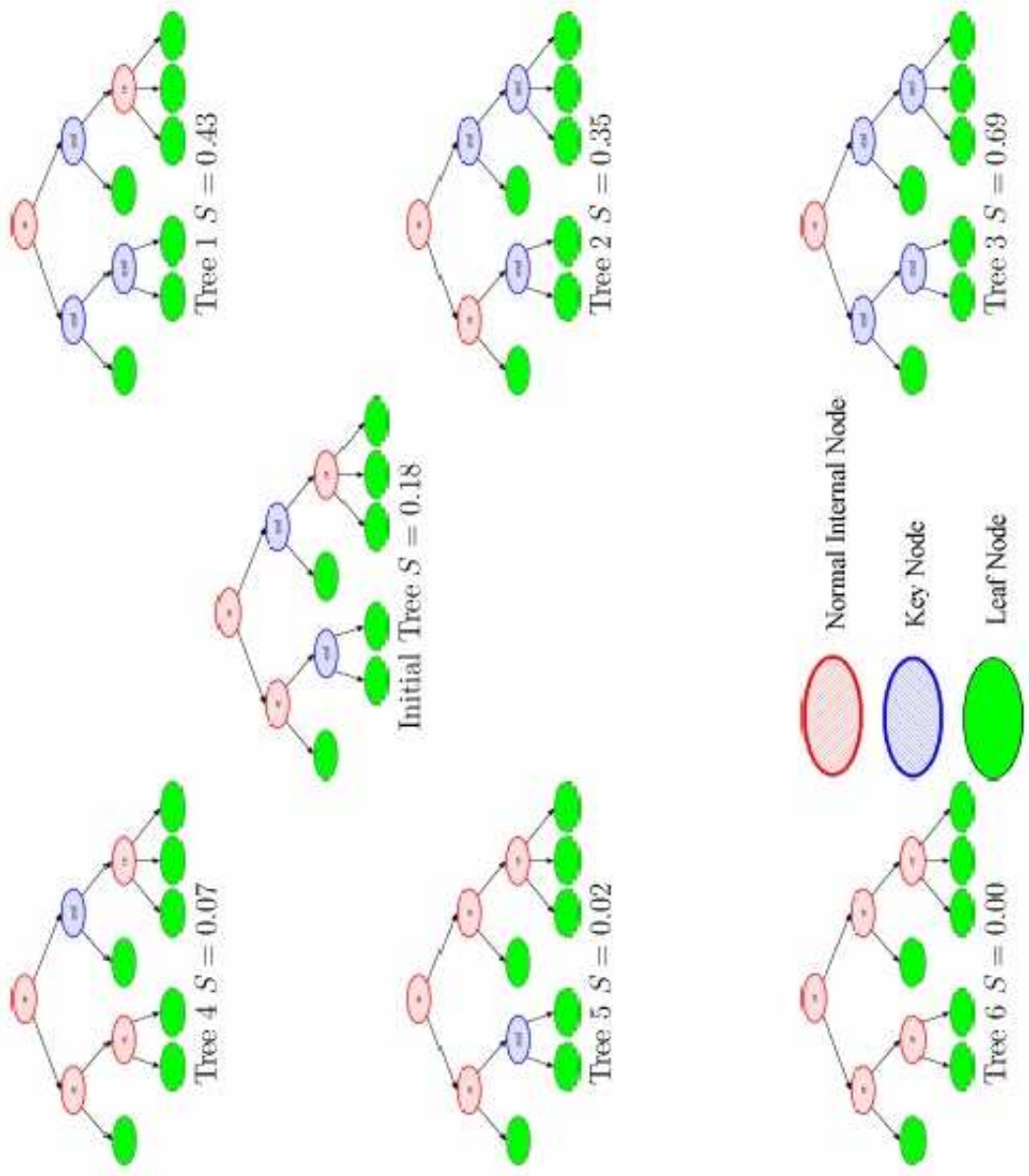


Figure C.1: Set 1

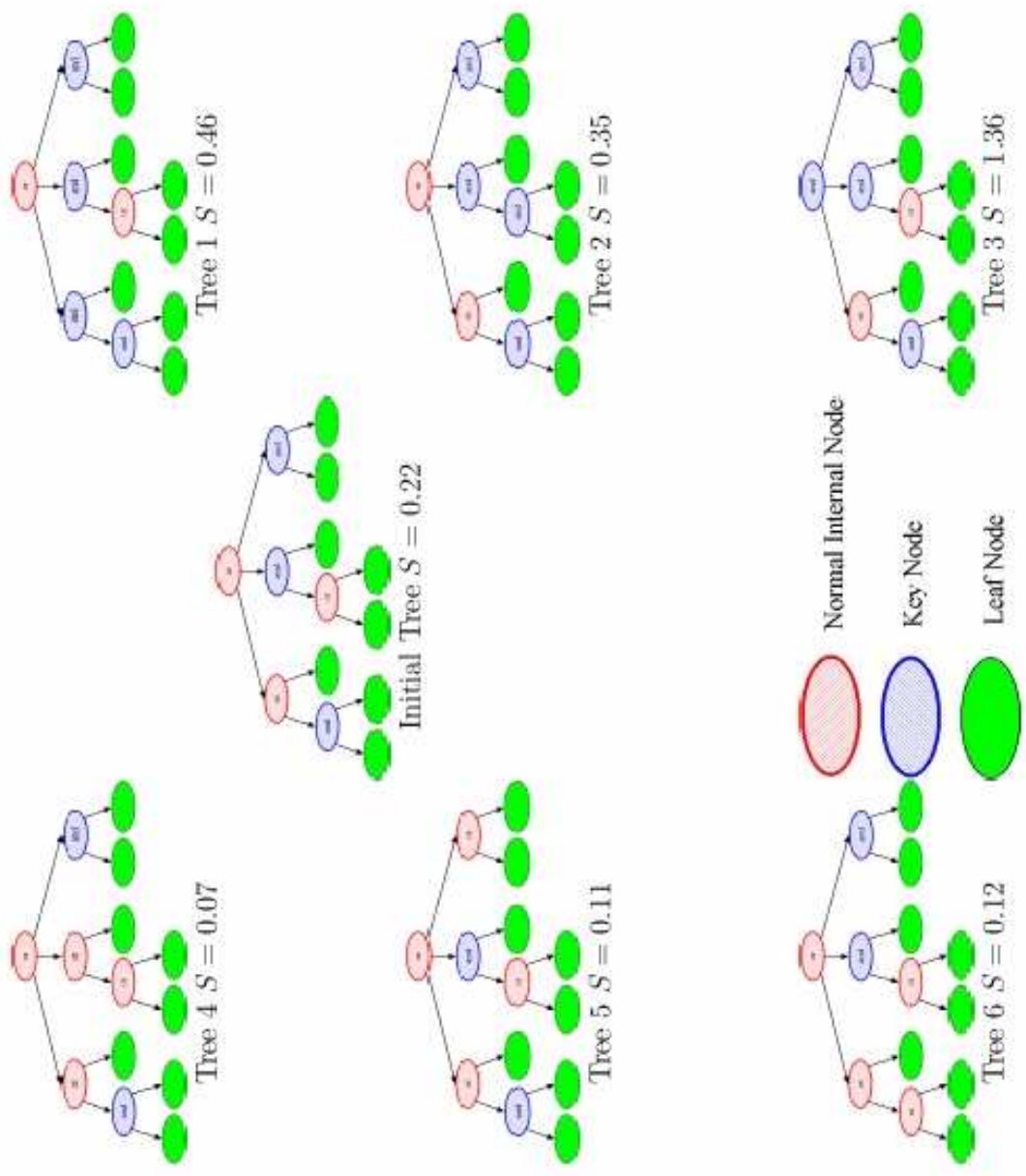


Figure C.2: Set 2

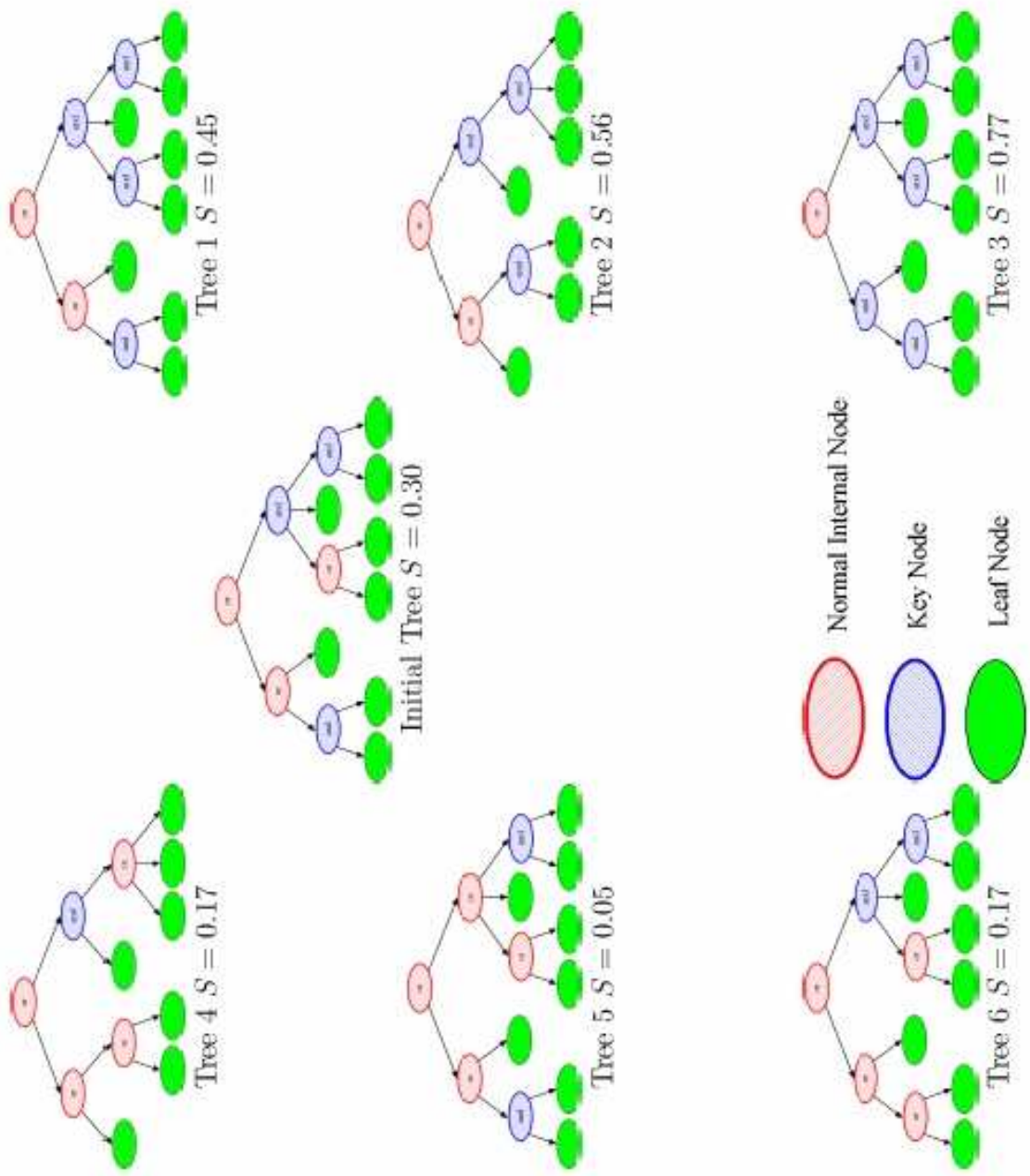


Figure C.3: Set 3

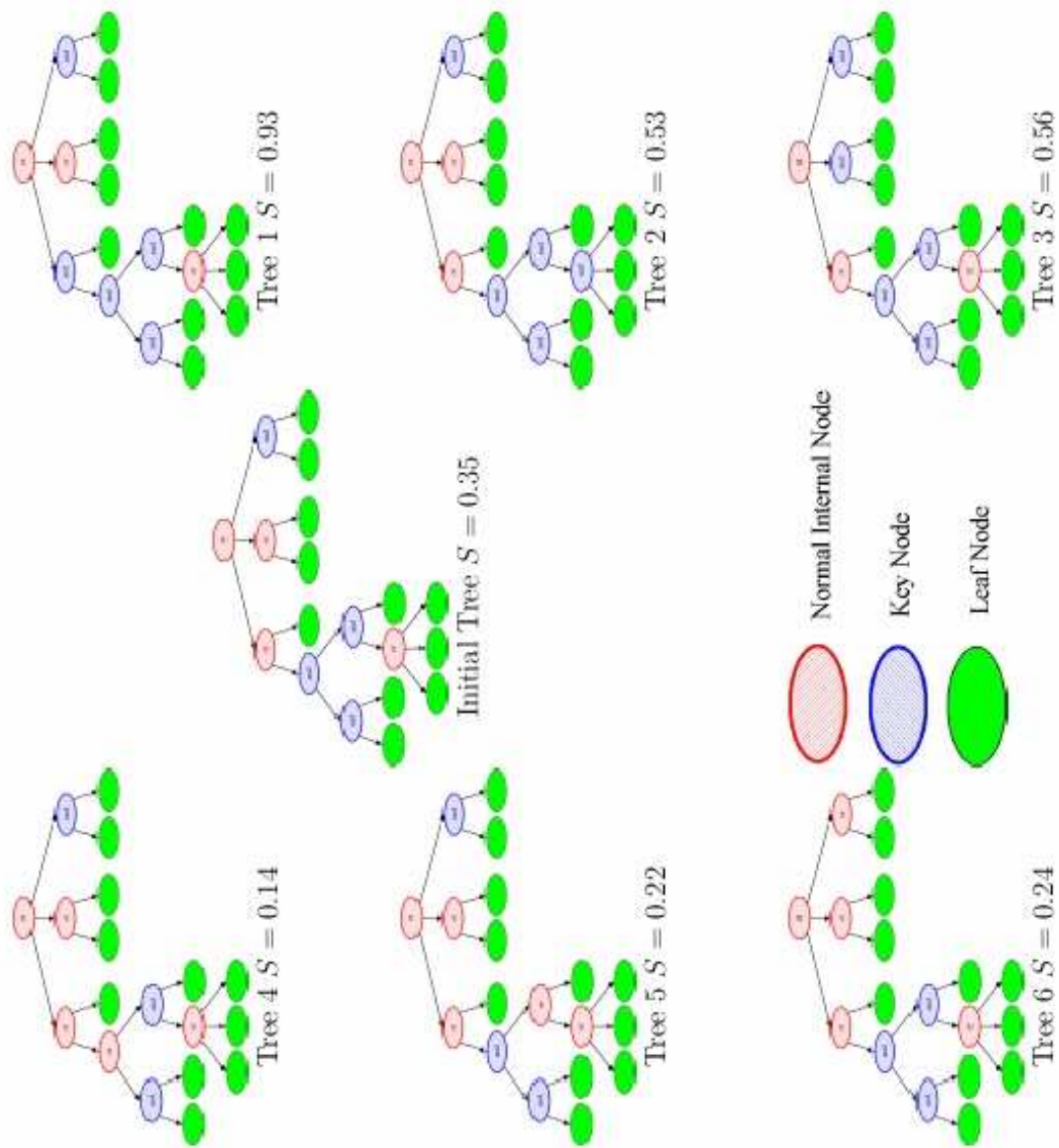


Figure C.4: Set 4

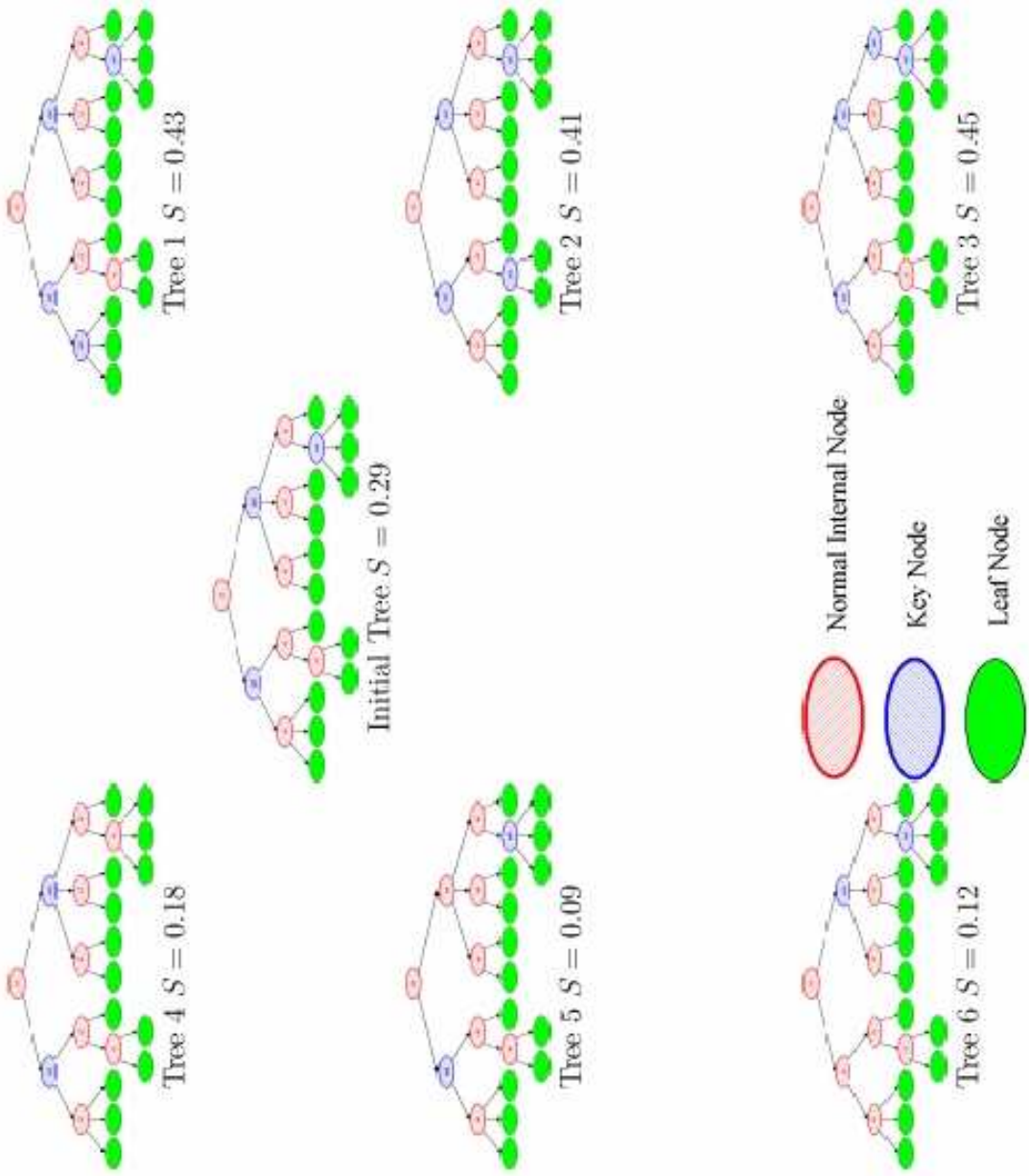


Figure C.5: Set 5



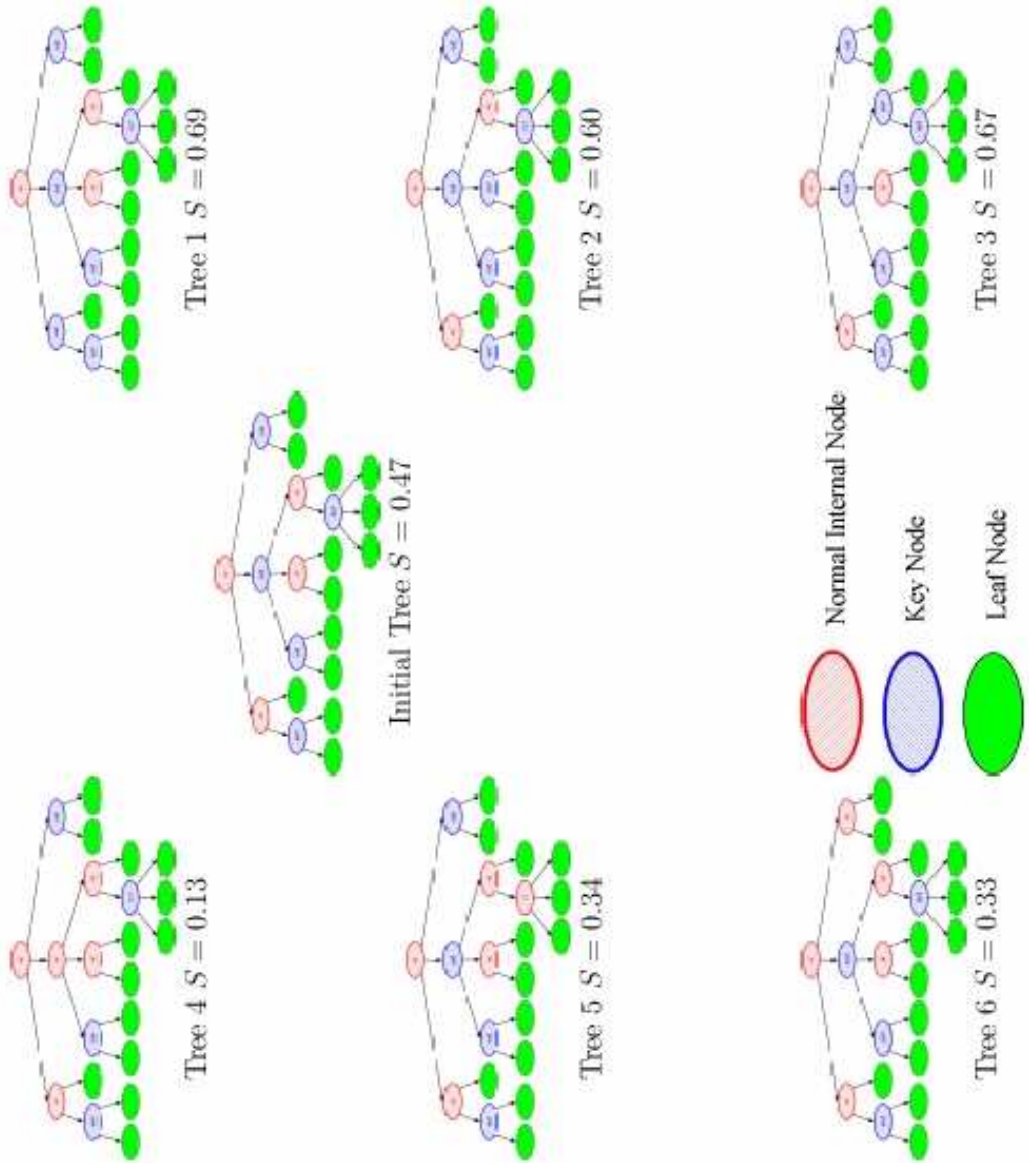


Figure C.6: Set 6

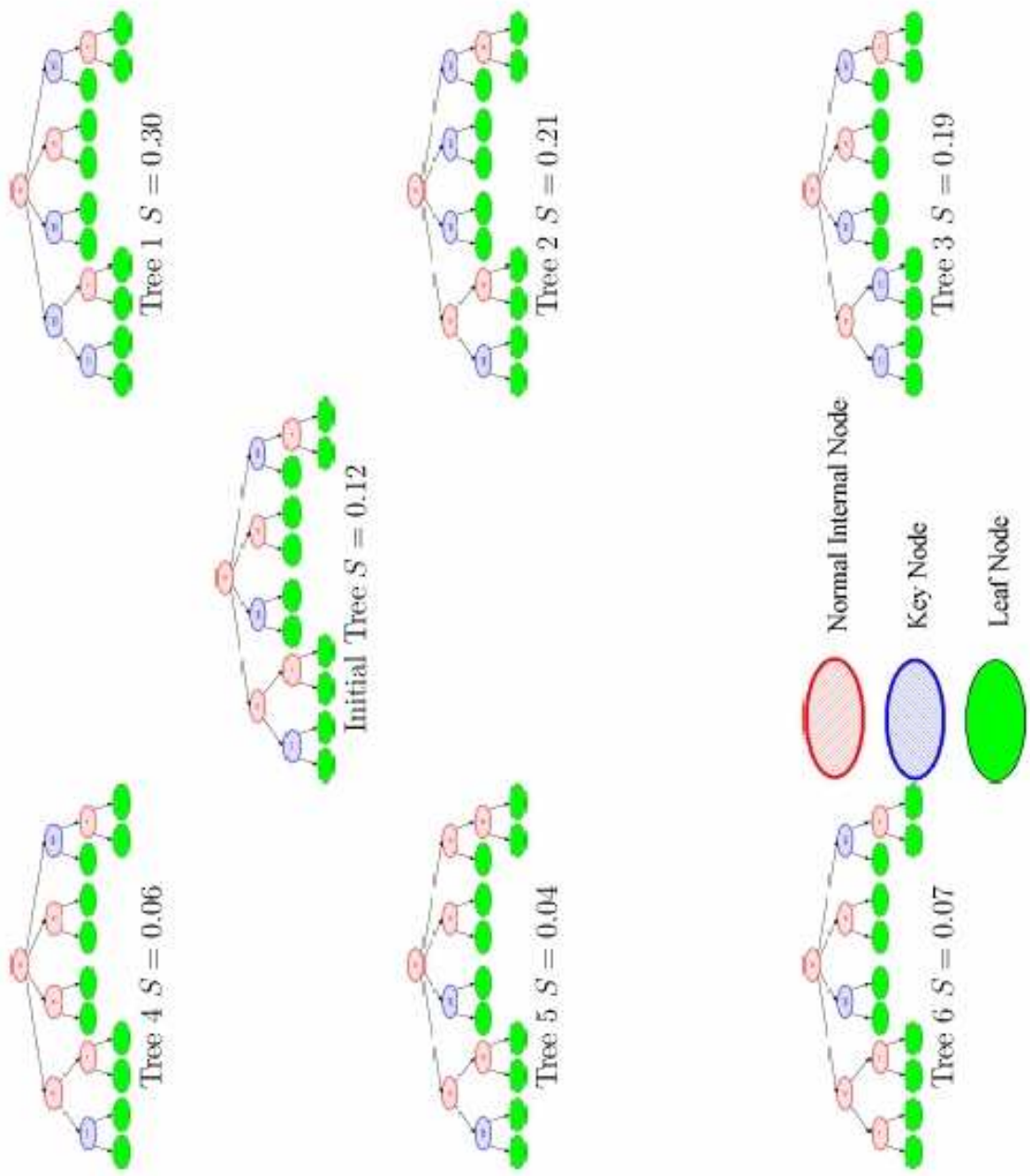


Figure C.7: Set 7

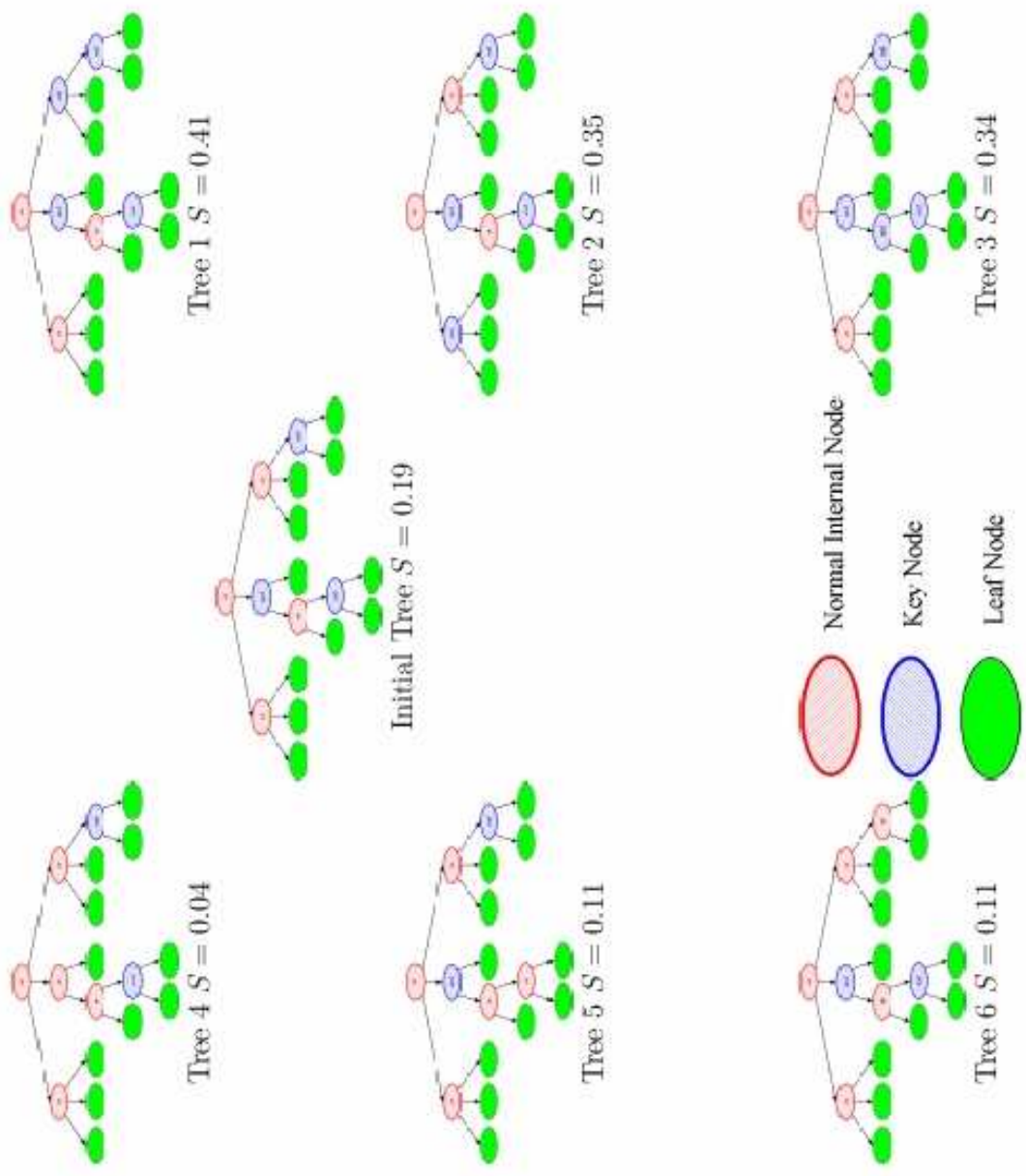


Figure C.8: Set 8

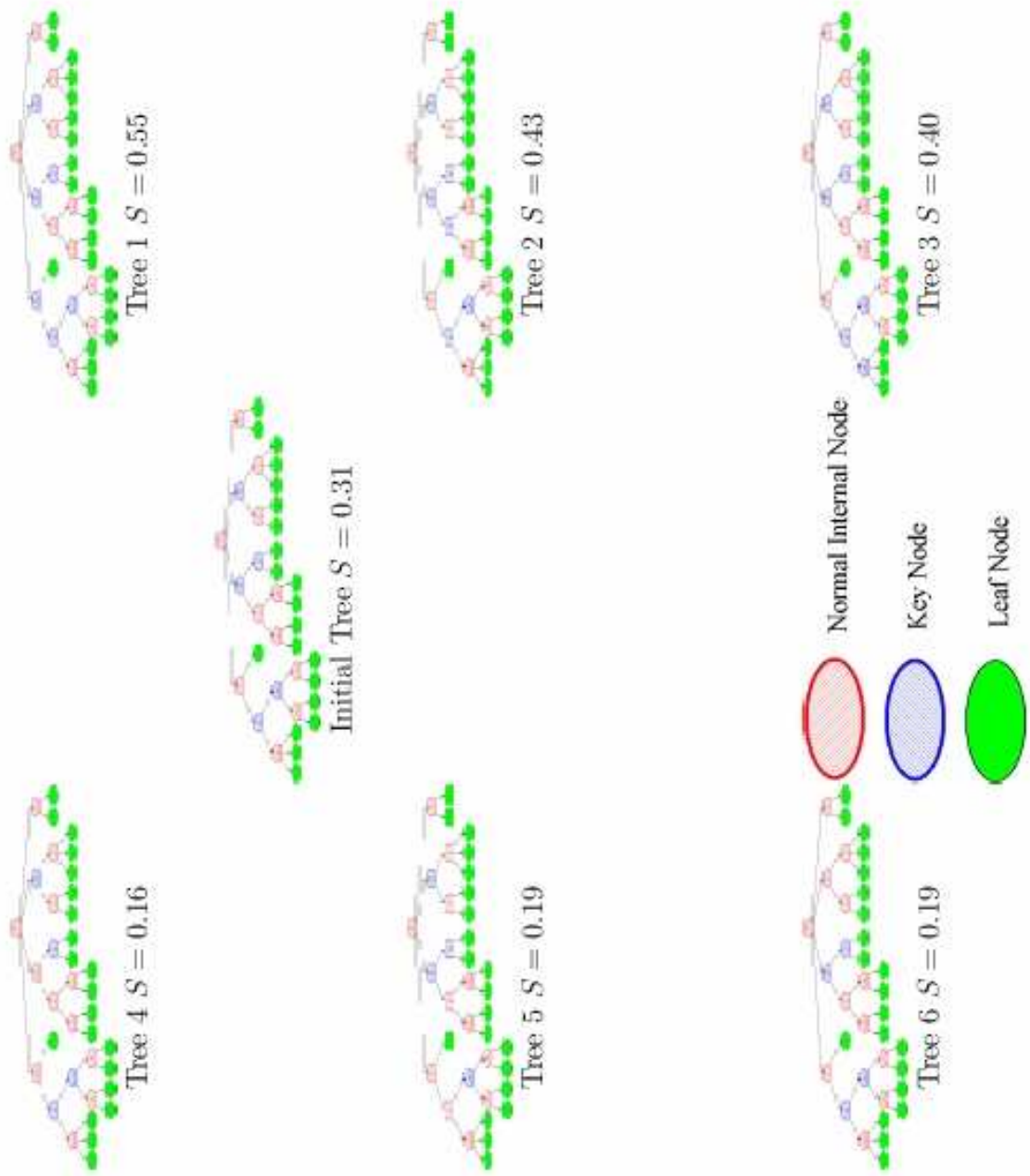


Figure C.10: Set 10