

***Test Generation with  
Context Free Grammars and  
Covering Arrays:  
A Teaching Tool***

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# Topics

- Covering arrays
  - covering arrays in pairwise testing
  - mixed strength covering arrays
- Context free grammars
  - rules and derivations
  - derivation trees and generation
- Tagged grammars
  - depth
  - covering array
- Tool demo

# *Pairwise Testing*

- Select a set of  $N$  parameter domains
  - each  $N$ -tuple is a test case
- Consider the cartesian product of the domains
- Generate a subset containing all pairwise combinations of the domain elements

# Pairwise Testing

|    | Caller OS | Server OS | Callee OS |
|----|-----------|-----------|-----------|
| 1  | Macintosh | Linux     | Macintosh |
| 2  | Macintosh | Linux     | Windows   |
| 3  | Macintosh | SunOS     | Macintosh |
| 4  | Macintosh | SunOS     | Windows   |
| 5  | Macintosh | Windows   | Macintosh |
| 6  | Macintosh | Windows   | Windows   |
| 7  | Windows   | Linux     | Macintosh |
| 8  | Windows   | Linux     | Windows   |
| 9  | Windows   | SunOS     | Macintosh |
| 10 | Windows   | SunOS     | Windows   |
| 11 | Windows   | Windows   | Macintosh |
| 12 | Windows   | Windows   | Windows   |

# *Mixed Strength Covering Arrays*

- Strength:  $1..N$  where  $N$  is the number of columns
- Restricted to subset of the columns
- Supply one or more mixed strength specifications

# Mixed Strength Examples

- 1-cover: all columns

|    | <b>Caller OS</b> | <b>Server OS</b> | <b>Callee OS</b> |
|----|------------------|------------------|------------------|
| 1  | Macintosh        | Linux            | Macintosh        |
| 10 | Windows          | SunOS            | Windows          |
| 12 | Windows          | Windows          | Windows          |

- 2-cover: Caller OS/Callee OS; 1-cover: Server OS

|    | <b>Caller OS</b> | <b>Server OS</b> | <b>Callee OS</b> |
|----|------------------|------------------|------------------|
| 1  | Macintosh        | Linux            | Macintosh        |
| 4  | Macintosh        | SunOS            | Windows          |
| 11 | Windows          | Windows          | Macintosh        |
| 12 | Windows          | Windows          | Windows          |

# Context Free Grammars

- Call grammar

Call ::= CallerOS ServerOS CalleeOS

CallerOS ::= Macintosh

CallerOS ::= Windows

ServerOS ::= Linux

ServerOs ::= SunOS

ServerOS ::= Windows

CalleeOS ::= Macintosh

CalleeOS ::= Windows

- Derivation

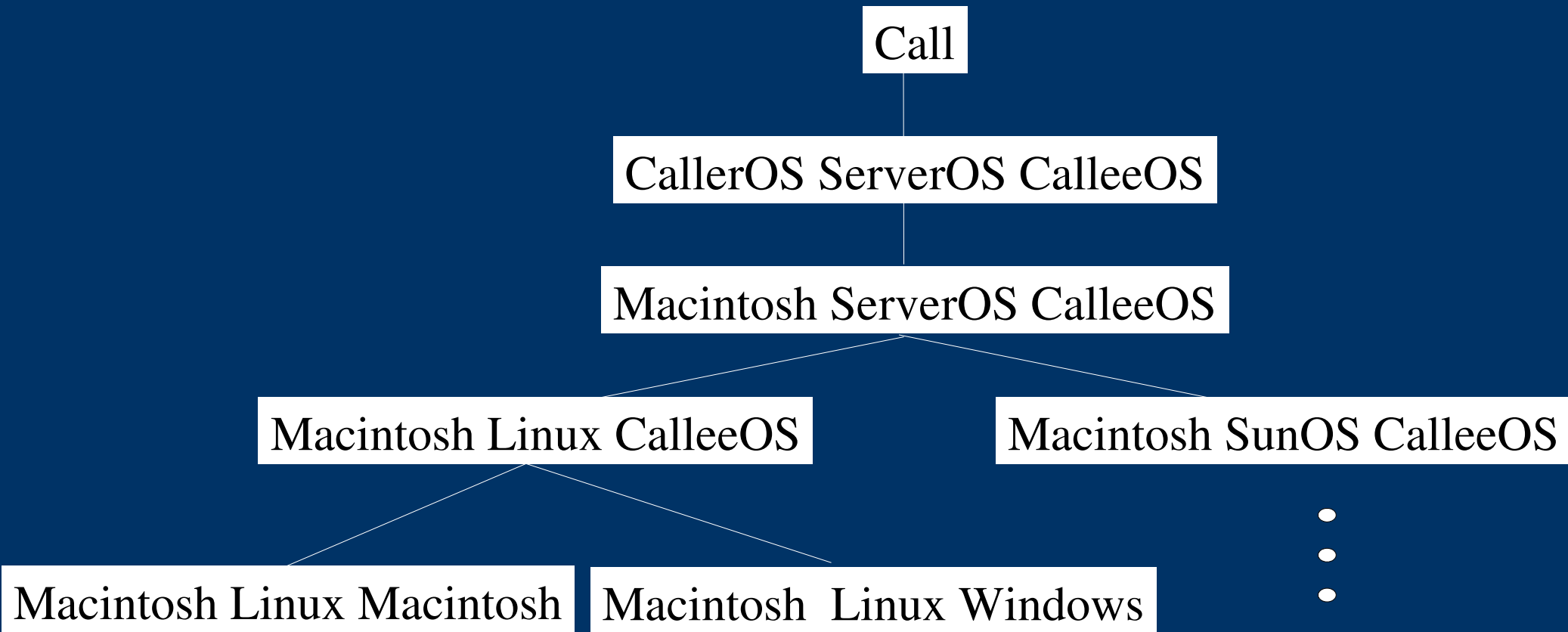
Call  $\Rightarrow$  CallerOS ServerOS CalleeOS

$\Rightarrow$  Macintosh ServerOS CalleeOS

$\Rightarrow$  Macintosh Linux CalleeOS

$\Rightarrow$  Macintosh Linux Macintosh

# Derivation Trees



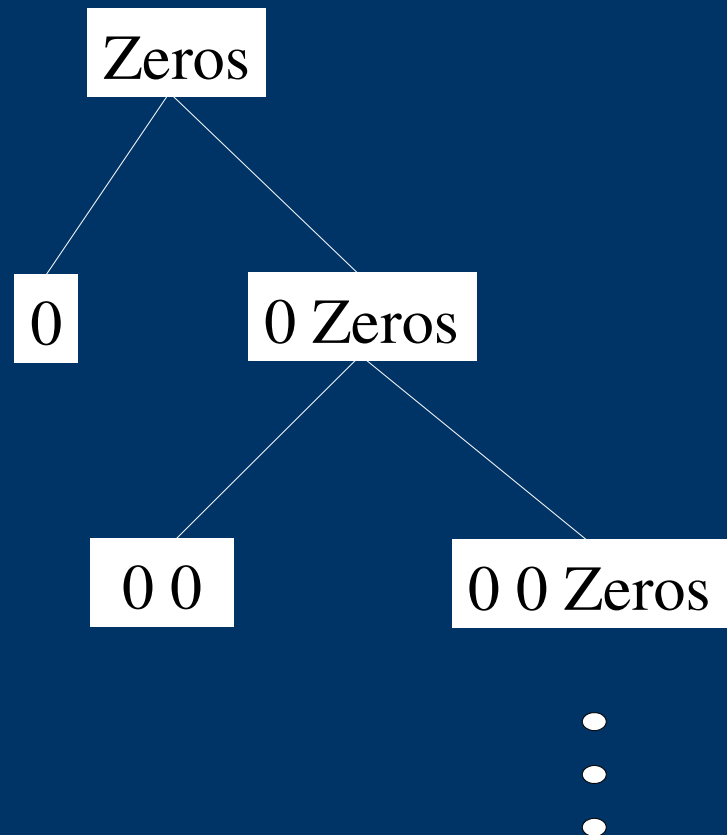


# Recursive Grammars

- Zeros grammar

$\text{Zeros} ::= 0 \text{ Zeros}$

$\text{Zeros} ::= 0$



# *Tagged Grammars*

- Usually grammars generate too many test cases
  - tags are used to prune the derivation tree
- Common tags
  - count: limit the total number of cases
  - depth: limit the length of the derivation
  - covering array: select from “all combinations”

# Depth and Coverage Tags

- Depth

{depth 5} Zeros ::= 0 Zeros

Zeros ::= 0

- Coverage

{ cov ({0,2},2), ({1},1) } Call ::= CallerOS ServerOS CalleeOS

CallerOS ::= Macintosh

CallerOS ::= Windows

ServerOS ::= Linux

ServerOs ::= SunOS

ServerOS ::= Windows

CalleeOS ::= Macintosh

CalleeOS ::= Macintosh

# *Tool Demo*