

Pairwise Testing

- **Necessary condition**
 - For each pair of input parameters, every combination of valid values of these two parameters be covered
- **Example**
 - Parameter A has values A1 and A2
 - Parameter B has values B1 and B2
 - Parameter C has values C1 and C2
- **Discussion**

Some Test Cases

- $\{(A1, B1, C1), (A1, B2, C2), (A2, B1, C3), (A2, B2, C1), (A2, B1, C2), (A1, B2, C3)\}$
- $\{(A1, B1, C1), (A1, B2, C1), (A2, B1, C2), (A2, B2, C3), (A2, B1, C1), (A1, B2, C2), (A1, B1, C3)\}$
- $\{(A1, B1, C1), (A1, B2, C1), (A2, B1, C2), (A2, B2, C2), (A2, B1, C1), (A1, B1, C2), (A1, B1, C3), (A2, B2, C3)\}$

Growth Terms

- **Horizontal**
 - Let T be a pairwise test set for parameters p_1, p_2, \dots, p_{n-1}
 - Horizontal growth of T for parameter p_i is to extend each test in T by adding the value of p_i .
- **Vertical**
 - After applying horizontal growth
 - Let T be a test set for p_1, p_2, \dots, p_i
 - Let π be the set of tests not covered by T
 - The vertical growth of T according to π is to construct new tests for pairs in π and add them to T

Horizontal Growth

Algorithm $IPO_H(T, p_i)$

```
//  $T$  is a test set. But  $T$  is also treated as a list with elements in arbitrary order
{
  assume that the domain of  $p_i$  contains values  $v_1, v_2, \dots,$  and  $v_q$ ;
   $\pi = \{ \text{pairs between values of } p_i \text{ and values of } p_1, p_2, \dots, \text{ and } p_{i-1} \}$ ;
  if ( $|\mathcal{T}| \leq q$ )
  {
    for  $1 \leq j \leq |\mathcal{T}|$ , extend the  $j$ th test in  $\mathcal{T}$  by adding value  $v_j$  and
      remove from  $\pi$  pairs covered by the extended test;
  }
  else
  {
    for  $1 \leq j \leq q$ , extend the  $j$ th test in  $\mathcal{T}$  by adding value  $v_j$  and
      remove from  $\pi$  pairs covered by the extended test;
    for  $q < j \leq |\mathcal{T}|$ , extend the  $j$ th test in  $\mathcal{T}$  by adding one value of  $p_i$ 
      such that the resulting test covers the most number of pairs in  $\pi$ , and
      remove from  $\pi$  pairs covered by the extended test;
  }
}
```

Vertical Growth

Algorithm $IPO_V(\mathcal{T}, \pi)$

```
{ let  $\mathcal{T}'$  be an empty set;
  for each pair in  $\pi$ 
  { assume that the pair contains value  $w$  of  $p_k$ ,  $1 \leq k < i$ , and value  $u$  of  $p_i$ ;
    if ( $\mathcal{T}'$  contains a test with “-” as the value of  $p_k$  and  $u$  as the value of  $p_i$ )
      modify this test by replacing the “-” with  $w$ ;
    else
      add a new test to  $\mathcal{T}'$  that has  $w$  as the value of  $p_k$ ,  $u$  as the value of  $p_i$ ,
      and “-” as the value of every other parameter;
  };
   $\mathcal{T} = \mathcal{T} \cup \mathcal{T}'$ ;
};
```