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

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

Growth Terms

- **Horizontal**
  - Let T be a pairwise test set for parameters p₁, p₂, ..., pₙ-1
  - Horizontal growth of T for parameter Pᵢ is to extend each test in T by adding the value of Pᵢ
- **Vertical**
  - After applying horizontal growth
  - Let T be a test set for p₁, p₂, ..., Pᵢ
  - Let \( \pi \) be the set of tests not covered by T
  - The vertical growth of T according to \( \pi \) is to construct new tests for pairs in \( \pi \) and add them to T

Horizontal Growth

Algorithm HPO\_H(T, pᵢ)

\[
\text{let } T' \text{ be an empty set; for each pair in } \pi \\
\text{if } T' \text{ contains a test with } ^\sim \text{ as the value of } pᵢ \text{ and } w \text{ as the value of } pᵢ \\
\text{\hspace{1cm} modify this test by replacing the } ^\sim \text{ with } w; \\
\text{else } \\
\text{\hspace{1cm} add a new test to } T' \text{ that has } w \text{ as the value of } pᵢ, w \text{ as the value of } pᵢ \\
\text{\hspace{1cm} and } ^\sim \text{ as the value of every other parameter}; \\
\text{\hspace{1cm} add these tests to } T' \\
\text{\hspace{1cm} and remove from } \pi \text{ pairs covered by the extended test; }
\]

Vertical Growth

Algorithm HPO\_V(T, \pi)

\[
\text{let } T' \text{ be an empty set; for each pair in } \pi \\
\text{\hspace{1cm} assume that the pair contains value } w \text{ of } pᵢ, 1 ≤ k < i, \text{ and value } w' \text{ of } pᵢ \\
\text{\hspace{1cm} if } T' \text{ contains a test with } ^\sim \text{ as the value of } pᵢ \text{ and } u \text{ as the value of } pᵢ \\
\text{\hspace{1cm} modify this test by replacing the } ^\sim \text{ with } w; \\
\text{else } \\
\text{\hspace{1cm} add a new test to } T' \text{ that has } u \text{ as the value of } pᵢ, u \text{ as the value of } pᵢ \\
\text{\hspace{1cm} and } ^\sim \text{ as the value of every other parameter}; \\
\text{\hspace{1cm} add these tests to } T' \\
\text{\hspace{1cm} and remove from } \pi \text{ pairs covered by the extended test; }
\]

\[
\text{let } \pi = \{ \text{pairs between values of } pᵢ \text{ and values of } pᵢ, pᵢ, ..., pᵢ \}; \\
\text{if } |T| ≤ q \\
\text{\hspace{1cm} for } 1 ≤ j ≤ |T| \text{, extend the } j\text{th test in } T \text{ by adding value } v_j \text{ and remove from } \pi \text{ pairs covered by the extended test; }
\]

\[
\text{else } \\
\text{\hspace{1cm} for } 1 ≤ j ≤ q \text{, extend the } j\text{th test in } T \text{ by adding value } v_j \text{ and remove from } \pi \text{ pairs covered by the extended test; }
\]

\[
\text{for } q < j ≤ |T| \text{, extend the } j\text{th test in } T \text{ by adding one value of } pᵢ \text{ such that the resulting test covers the most number of pairs in } \pi \text{, and remove from } \pi \text{ pairs covered by the extended test; }
\]