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**Algorithm 2** Proposed new algorithm for assignment of a  $p$ -value for neuron responsiveness

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**Part 1: create a repository of test statistics for null data**

```
for  $b$  in  $\{1, 2, \dots, B\}$  do
  (*)  $i^* \leftarrow$  random number from 1 to the number of neurons
  for  $j$  in  $\{1, 2, \dots, \text{number of trials}\}$  do
    (**)
     $\tilde{Y}_{b,j} \leftarrow \text{wrap}(Y_{i^*,j})$ 
     $W_{b,j}^* \leftarrow$  Wilcoxon signed rank test statistic with  $\tilde{Y}_{b,j}$ 
  end for
   $\tilde{W}_b \leftarrow \sum_j W_{b,j}^*$ 
end for
```

**Part 2: calculate observed test statistics and get  $p$ -values**

```
for  $i$  in  $\{1, 2, \dots, \text{number of neurons}\}$  do
  for  $j$  in  $\{1, 2, \dots, \text{number of trials}\}$  do
     $W_{i,j}^{\text{obs}} \leftarrow$  Wilcoxon signed rank test statistic
  end for
   $\tilde{W}_i^{\text{obs}} \leftarrow \sum_j W_{i,j}^{\text{obs}}$ 
   $p_i^+ \leftarrow \#\{\tilde{W}_b \geq \tilde{W}_i^{\text{obs}}\}/B$ 
   $p_i^- \leftarrow \#\{\tilde{W}_b \leq \tilde{W}_i^{\text{obs}}\}/B$ 
   $p_i \leftarrow 2\min(p_i^+, p_i^-)$ 
end for
```

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