

National University of Singapore
School of Computing
CS1101S: Programming Methodology
Semester I, 2024/2025

S9-in-class
Mutable Data and Environment Model

Problems:

1. **[In-class only]** Ben Bitdiddle decides to write a function to count the number of pairs in any list structure. “It’s easy,” he reasons. “The number of pairs in any structure is the number in the head plus the number in the tail plus one more to count the current pair.” So Ben writes the following function:

```
function count_pairs(x) {  
  if (!is_pair(x)) {  
    return 0;  
  } else {  
    return 1 + count_pairs(head(x)) + count_pairs(tail(x));  
  }  
}
```

Show that this function is not correct. In particular, draw box-and-pointer diagrams representing list structures made up of exactly three pairs for which Ben’s procedure would return 3, return 4, return 7, or never return at all.

Devise a correct version of `count_pairs` that returns the number of distinct pairs in any structure. (Hint: Traverse the structure, maintaining an auxiliary data structure that is used to keep track of which pairs have already been counted.)