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

S5

For this sheet, draw the box-and-pointer diagrams by hand (e.g. using pen and paper) and bring the drawings to your Studio.

Problems:

1. Draw box-and-pointer for the values of the following expressions. Also give box and list notation.

```
list(list(1, 2, list(3)), list(4, 5), pair(6, 7));

pair(1, list(2, 3, pair(4, null)));

pair(1, pair(2, list(3, list(4, 5))));
```

2. The function `list_ref` can be applied to a list `xs` and a number `n`, and returns the `n`-th element of the list, starting counting at 0. So `list_ref(list(1, 2, 3), 2)` evaluates to 3. The position of an element in the list is called its *rank*; we say that the number 3 has rank 2 in the list. Write a Source function called `every_second` that takes a list as its only argument and returns a list containing all the elements of odd rank (i.e. every second element) from the input list.

```
every_second(list("a", "x", "b", "y", "c", "z", "d"));
// Value: ["x", ["y", ["z", null]]]

function every_second(items) {
    ...
}
```

3. Write expressions using `lst`, `head` and `tail` that will return 1 when the `lst` is bound to the following values:

```
list(7, list(6, 5, 4), 3, list(2, 1));

list(list(7), list(6, 5, 4), list(3, 2), 1);

list(7, list(6), list(5, list(4)), list(3, list(2, list(1))));

list(7, list(list(6, 5), list(4), 3, 2), list(list(1)));
```