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

S3
Recursion; Iterative and Recursive Processes

For this sheet, it is essential that you recall (or review) Lecture L2A. Prepare for the studio by manually writing your solutions on two separate A4 sheets.

Problems:

1. Consider the following Source program:

```
function f1(rune_1, n, rune_2) {
    return n === 0
      ? rune_2
      : f1(rune_1, n - 1, beside(rune_1,stack(blank, rune_2)));

}
show(f1(square, 3, heart));
```

   Use the substitution model on runes demonstrated during Lecture L2A in order to manually evaluate the expression `f1(square, 3, heart)`. The evaluation proceeds as demonstrated in L2A. For the primitive rune `square`, you should draw a solid box ■ and for the primitive rune `blank`, you should draw an empty box □.

   Of course as the computation proceeds according to the substitution model, the pictures within your expressions will become more complex. Try to get the proportions right and draw the pictures as large as necessary.

2. Consider the following Source program:

```
function f2(rune, n) {
    return n === 0
      ? rune
      : stack(beside(blank, f2(rune, n - 1)),
              square);
}
show(f2(heart, 3));
```

Use the substitution model on runes demonstrated during Lecture L2A in order to manually evaluate the expression `f2(heart, 3)`. The evaluation proceeds as demonstrated in L2A. For the primitive rune `square`, you should draw a solid box ■ and for the primitive rune `blank`, you should draw and empty box □.

Of course as the computation proceeds according to the substitution model, the pictures within your expressions will become more complex. Try to get the proportions right and draw the pictures as large as necessary.