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

S10-in-class
Searching and Sorting II; Memoization

Problems:

1. **[In-class only]** Consider the cc (coin change) function presented in Lecture L3A:

```
function cc(amount, kinds_of_coins) {
    return amount === 0
           ? 1
           : amount < 0 || kinds_of_coins === 0
           ? 0
           : cc(amount, kinds_of_coins - 1)
             +
             cc(amount - first_denomination(kinds_of_coins),
               kinds_of_coins);
}

function first_denomination(kinds_of_coins) {
    return kinds_of_coins === 1 ?   5 :
           kinds_of_coins === 2 ?  10 :
           kinds_of_coins === 3 ?  20 :
           kinds_of_coins === 4 ?  50 :
           kinds_of_coins === 5 ? 100 : 0;
}
```

   (a) Is function cc a good candidate for memoization? Support your answer with an example.

   (b) If memoization is suitable for function cc, provide the implementation.

   (c) What are the orders of growth in *time* and *space* of the memoized version?