# CSC373 Winter 2015 Problem Set # 3

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(a) Subproblems: Determine whether or not you can purchase exactly $N-3$ or $N-10$ or $N-25$ Tofu Nuggets given that you can only purchase boxes of 3, 10 or 25.
Solution to the problem: If one of three subproblems is true, then the solution to this problem is true. Otherwise, it is false.

Suppose you can purchase exactly $N$ Tofu Nuggets. Then "last" box of Tofu Nuggets purchased is of size 3 or 10 or 25. So the problem can be reduced to whether or not you can purchase exactly $N-3$ or $N-10$ or $N-25$ Tofu Nuggets.

(b) Define array $T$ such that:
The indices of $T$ are from $-24$ to $N$.
Each element in $T$ is the boolean value TRUE or FALSE
$T[0]$ = TRUE
$T[i]$ = FALSE for $-24 \leq i \leq -1$
$T[i] = T[i-3]$ or $T[i-10]$ or $T[i-25]$ for $i > 0$

(c) Base cases: $T[0]$ = TRUE and $T[i]$ = FALSE for $-24 \leq i \leq -1$.
General cases: $T[i] = T[i-3]$ or $T[i-10]$ or $T[i-25]$ for $i > 0$

(d)
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1  for i in −24, ..., −1
2        T[i] = FALSE
3  T[0] = TRUE
4  for i in 1, ..., N
5        T[i] = T[i − 3] or T[i − 10] or T[i − 25]
6  return T[N]
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Worst case complexity: $\Theta(N)$
It is in polynomial time.
Explanation: The first loop (line 1 to line 2) takes 24 steps which is constant time. Line 3 takes constant time to run. The second loop (line 4 to line 5) takes $(3+1)N = 4N$ (3 for accessing array indices and 1 for getting the boolean value of "or"). Therefore in total, the algorithm takes $\Theta(N)$ time to run. It is in polynomial time.