CS381 Homework 2 Problem 1

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February 5, 2026

1 Exercise 5.13

subs(k, h, v): Given parameters k, a set of bids (a bid is a tuple of x, the order price, and y, the inches of sub that fulfills the order), h, the inches of ham sub left, and v, the inches of veggie sub left, returns the maximum profit from selling the two sandwiches to the set of bidders.

1. If k is empty, Return 0
2. $b = k[0]$
3. if b is a bid for ham and $h \geq b_y$
   A. Return $Max($
   $b_x - \texttt{cost}(b_y) + \texttt{subs}(k \setminus b,\ h - b_y,\ v)$, // Take the bid
   $\texttt{subs}(k \setminus b,\ h,\ v)$ // Don't take the bid
   $)$
4. if b is a bid for veggie and $v \geq b_y$
   A. Return $Max($
   $b_x - \texttt{cost}(b_y) + \texttt{subs}(k \setminus b,\ h,\ v - b_y)$, // Take the bid
   $\texttt{subs}(k \setminus b,\ h,\ v)$ // Don't take the bid
   $)$
5. If b is disjunctive and $h \geq b_y$ and $v \geq b_y$
   A. Return $Max($
   $b_x - \texttt{cost}(b_y) + \texttt{subs}(k \setminus b,\ h - b_y,\ v)$, // Take the ham bid
   $b_x - \texttt{cost}(b_y) + \texttt{subs}(k \setminus b,\ h,\ v - b_y)$, // Take the veggie bid
   $\texttt{subs}(k \setminus b,\ h,\ v)$ // Don't take the bid
   $)$
6. If b is disjunctive and $h \geq b_y$
   A. Return $Max($
   $b_x - \texttt{cost}(b_y) + \texttt{subs}(k \setminus b,\ h - b_y,\ v)$, // Take the ham bid
   $\texttt{subs}(k \setminus b,\ h,\ v)$ // Don't take the bid
   $)$
7. If b is disjunctive and $v \geq b_y$
   A. Return $Max($
   $b_x - \texttt{cost}(b_y) + \texttt{subs}(k \setminus b,\ h,\ v - b_y)$, // Take the veggie bid
   $\texttt{subs}(k \setminus b,\ h,\ v)$ // Don't take the bid
   $)$

8. Return `subs(`$k \setminus b$`, `h`, `v`)` // Unable to take bid

Given a ham sub m inches long and a veggie sub n inches long, find the maximum profit from selling the subs to a set of k bidders by calling `subs(`k`, `m`, `n`)`. The total number of calls that will be made is the size of the powerset of the set of bids, so the runtime is $O(2^k)$.