- Matrix $A$ of size $n \times W$.
- Nested for loop to fill matrix.
- Run Time: $O(n \cdot W)$ - Pseudopolynomial $W$ may be $2^n$.

### Example

<table>
<thead>
<tr>
<th></th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>100</td>
<td>0</td>
<td>10 + 0</td>
<td>10</td>
<td>10</td>
<td>0</td>
</tr>
<tr>
<td>item 2</td>
<td>0</td>
<td>-10 -</td>
<td>50 + 10</td>
<td>0</td>
<td>50</td>
<td>0</td>
</tr>
<tr>
<td>item 3</td>
<td>0</td>
<td>-10 -</td>
<td>-50 -</td>
<td>0</td>
<td>50</td>
<td>0</td>
</tr>
<tr>
<td>item 4</td>
<td>0</td>
<td>-10 -</td>
<td>-50 -</td>
<td>0</td>
<td>50</td>
<td>0</td>
</tr>
</tbody>
</table>

### Key
- Leave value (too heavy) (A)
- Leave value, take value (B)

Optimal value: 90

Notice: optimal substructure ex. $A[3,47]$ is optimal value for first 3 items vs. weight limit 47.

How to find these items?
1. Create empty array \( I \) of size \( n \)
2. Start at \( i = n, j = W \)
3. If \( A[i, j] \) was "leave"
   4. // Go to \( A[i-1, j] \)
5. \( i = i - 1 \)
6. Else // \( A[i, j] \) was "take"
7. Add \( i \) to \( I \)
8. // Go to \( A[i-1, j - W] \)
9. (Set) \( i = i - 1, j = j - W \)
10. Repeat from (3) while \( i \) and \( j \) > 0

\[
\begin{array}{c|c|c|c}
 i & j & \text{take/leave} & \text{I: } \\ hline
 4 & 5 & \text{take} & 4 \ 2 \ hline
 3 & 2 & \text{leave} & 3 \ hline
 2 & \text{take} & & \ hline
 1 & 0 & & \end{array}
\]

Notice: Incorrect to just find all \( i \)'s s.t. \( A[i, j] > A[i-1, j - W] \)

\( 80 > 50 \)

But not optimal to take item 3!
Text Verification Problem

Possibly corrupted text file. Does it correspond to real text?

Given string $S$ of length $n$:
1. Determine if $S$ is "valid" text (i.e., made up of valid words)
2. If so, "reconstruct" $S$ - split into valid words

Assumptions:
1. All lowercase
2. No punctuation
3. Given a dictionary that takes as input string $w$

$$\text{Dict}(w) = \begin{cases} 
\text{true} & \text{if } w \text{ is a valid word (including "a" and "I")} \\
\text{true} & \text{if } w \text{ is empty string} \\
\text{false} & \text{otherwise}
\end{cases}$$

Note: $S = \text{"thi nknot"}$ - 2 correct solutions: think not thin knot

Ex. $S = \text{think nothing}$

Possible to solve in $O(n^2)$, $(n = 181)$