

Learning Goals

- Assess whether $\mathbb{Z}$, $\mathbb{R}$, etc. choices impact DP runtime, correctness

Knapsack Problem $\mathbb{N}$

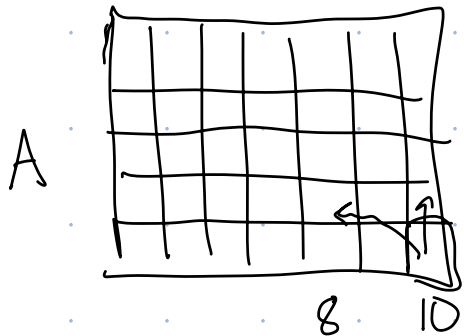
Input:

- n items
 - $v_i \in \mathbb{N}$ is value of i^{th} item
 - $w_i \in \mathbb{N}$ is weight of i^{th} item
- Capacity W max weight $\in \mathbb{N}$

Recurrence:

$$A[n, w] = \max \left\{ A[n-1, w], A[n-1, w - w_n] + v_n \right\}$$

ex:



Knapsack Problem ~~$\mathbb{N}$~~ $\mathbb{R}$

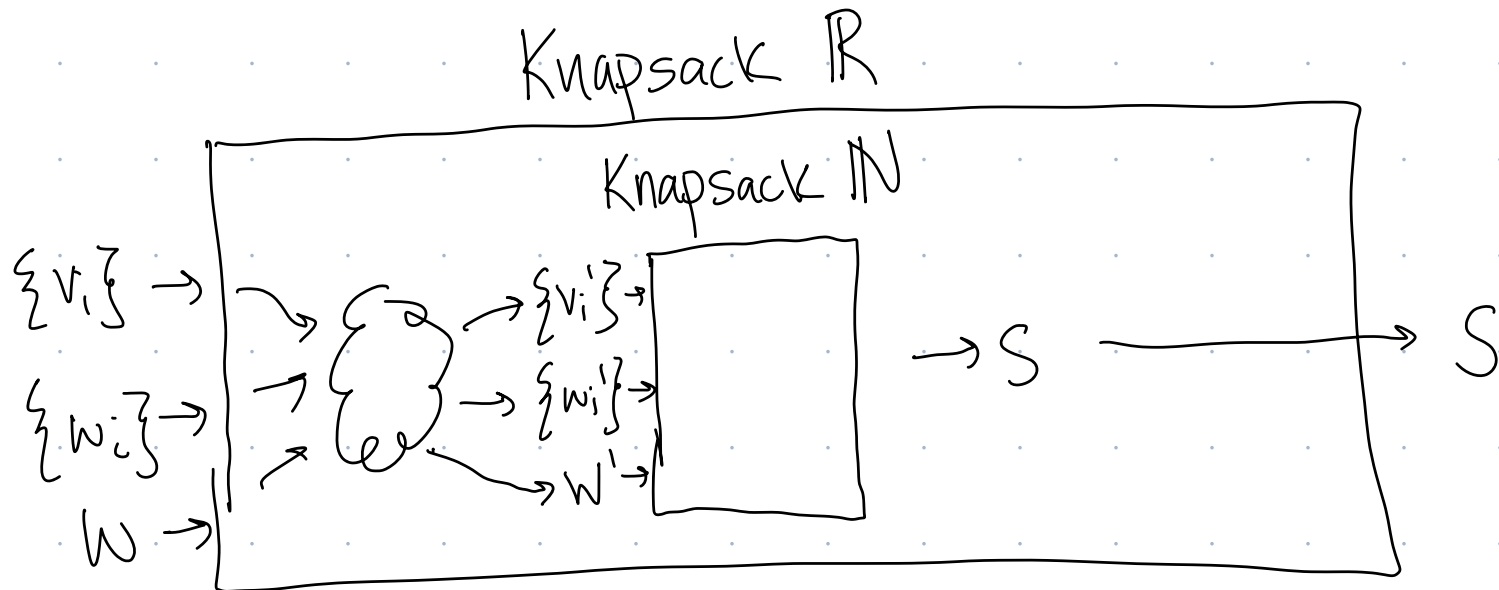
Input:

- n items
 - $v_i \in \mathbb{R}$ is value of i^{th} item
 - $w_i \in \mathbb{R}$ is weight of i^{th} item
- Capacity W max weight $\in \mathbb{R}$

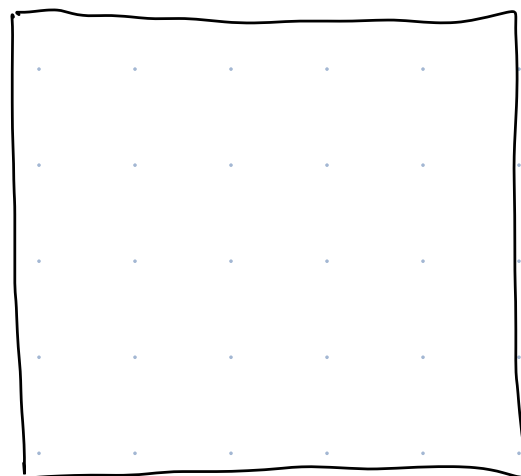
Output:

$$S \subseteq [n] \quad [n] = \{1, 2, \dots, n\}$$
$$\text{s.t. } V(S) = \sum_{i \in S} v_i \text{ is maximized}$$
$$W(S) = \sum_{i \in S} w_i \leq W$$

Reduce Knapsack $\mathbb{R}$ to Knapsack $\mathbb{N}$



How can you improve your approximate alg? (At cost of time.)



W

w_1

w_2

w_3

$\dots$

Memoization