

## Program 2 Report

### 1. Introduction

I chose Python for this assignment. I am taking CS490 - Python and Deep Learning Programming course. I learned NumPy (a library) and jupyter notebook (a tool) from the class. I submitted '.ipynb' file which is supported by jupyter notebook that has high readability for codes and comments. I use it for Python programming since it is easy for programmers to understand what I did rather than writing many paragraphs in documents.

### 2. Data structure

I used a 2d array for storing each item's data because it is more simple and faster than using two lists/arrays. Also, in Python, we can use NumPy which is the most efficient library to deal 2d arrays. You can imagine a 2d array as a table. If you use NumPy, you can calculate sum, max, min, or mean of each column or row without iterations. I used `numpy.sum()` function to calculate the sum of each column (the first column is utility, and the second one is weight).

### 3. Features of my codes

I used `numpy.random.select` for random selections. It takes two parameters `n` and `k` then returns a list has `n` integers that are randomly selected from `range(0, k)` without repeating. I used the integers as the index of 2d array. I believe it is faster than using a container of 0 and 1. That is one of the advantages of numpy. As I mentioned, numpy has more useful functions.

To get a good value for number of packed items, I get the mean of weights and divided 500 by the mean. I am not sure if you expect that, but we can get the real value which is the total utilities with almost 500 pounds weight for any input datas.

The other thing is the value of temperature. When I calculate the probability of changing  $E(x)$  to  $E(y)$ , I need to care about overflow. I decrease the temperature by multiplying constant (0.99 in my code), so if the temperature becomes, for example,  $10^{-7}$ , overflow will occur since the temperature is a denominator. At first, I had not known why overflow was happening. I had tried testing with other values and figured out the temperature was the cause. Finally, I added a condition to my function so that the probability would be 0 if the temperature is less than 1. No overflow occurred after that.

### 4. Possible changes

- Temperature value should be higher: I set very large number to the temperature, but it should be much higher to get more accurate result.

- More efficient way for random selections: I think `numpy.random.select` is a more simple and faster way than vectors of booleans, but there might be much better ways in Python.

## **5. My result**

- Input: Program2Input.txt
- Temperature: 60000
- Constant: 0.99
- Number of packed items: 46
- Number of changes: 482
- Number of trials: 40000