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Concepts of Programming Languages, Spring term 2019
Example
"Recommender System"

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You are given the below toy dataset where `users` is a list of the users, `items` is a list of the items that the users can buy and `purchases` is a list mapping each user to a list of all his/her previous shopping carts.

```
users = ["user1", "user2", "user3", "user4"]
items = ["item1", "item2", "item3", "item4", "item5", "item6"]
purchasesHistory =  [
                        ("user1", [["item1", "item2", "item3"], ["item1", "
                            item2", "item4"]]),
                        ("user2", [["item2", "item5"], ["item4", "item5"]])
                            ,
                        ("user3", [["item3", "item2"]]),
                        ("user4", [])
                    ]
```

Initially, you will need to create an empty frequency list for each user, where it maps each item a user could buy to an empty list as below:

```
[("item1",[]),("item2",[]),("item3",[]),("item4",[]),("item5",[]),("item6",[])]
```

Using the above list, we map each item to all the items bought previously with it along with their counts, as below for `user1`:

```
[("item1",[("item2",2),("item3",1),("item4",1)]),("item2",[("item1",2),("
    item3",1),("item4",1)]),("item3",[("item1",1),("item2",1)]),("item4",[("
    item1",1),("item2",1)]),("item5",[]),("item6",[])]
```

, where `item1` was bought once with `item3` and `item4` and twice with `item2`.

When recommending for `user1` an item

a) First A partial recommendation is made based on the cart and the previously purchased items

- If the cart is empty: we will be combining the frequency list of each item he/she bought before generating a list containing all the items `user1` bought along with their frequencies as below: `freq_list_previous= [("item2",4),("item3",2),("item4",2),("item1",4)]`, where items 1 and 2 will be recommended with a probability of 33.3% each, while items 3 and 4 will recommended with a probability 16.6% each.
- If the cart is not empty, then in addition to the frequency list of previously purchased items, we combine the the frequency lists of the items in the cart and recommend according the frequencies present. For instance, if the cart contained items 4, 6 and 2, we first get the frequency lists of each as below:

  ```
  [("item4",[("item1",1),("item2",1)]),("item6",[]),("item2",[("item1
      ",2),("item3",1),("item4",1)])]
  ```

, and combine the frequencies together producing: `freq_list_cart= [("item1",3),("item2",1),("item3",1),("item4",1)]`.

The two frequency lists `freq_list_previous` and `freq_list_cart` are combined to produce one recommendation with a probability matching the frequencies

b) Another partial recommendation is produced based on the intersection between the items they bought and what other users bought previously. `user2` bought items 2 and 4 similar to `user1`, while `user3` bought items 2 and 3 similar to `user1`.

```
[
        [
         ("item2",[("item5",1),("item1",2),("item3",1),("item4",1)]),
         ("item4",[("item5",1),("item1",1),("item2",1)])
        ],
        [
         ("item2",[("item3",2),("item1",2),("item4",1)]),
         ("item3",[("item2",2),("item1",1)])
        ],
        []
]
```

- We combine the frequency lists from above and recommend according to the number of occurrences of each item as done before.

A random choice is made between the two partial recommendations. If the two recommendations are empty, a random item is chosen.