

MapReduce

Use pseudocode to write MapReduce functions necessary to solve the problems below. Also, make sure to fill out the correct data types. Some tips:

- The input to each MapReduce job is given by the signature of the **map()** function.
- The function **emit(key k, value v)** outputs the key-value pair (**k**, **v**).
- The **for(var in list)** syntax can be used to iterate through **Iterables** or you can call the **hasNext()** and **next()** functions.
- Usable data types: **int**, **float**, **String**. You may also use lists and custom data types composed of the aforementioned types.
- The method **intersection(list1, list2)** returns a list that is the intersection of **list1** and **list2**.

1. Given the student's name and the course taken, output each student's name and total GPA.

Declare any custom data types here: <pre>CourseData: int courseID float studentGrade // a number from 0-4</pre>	
map(String student, CourseData value):	reduce(_____key, Iterable< _____> values):

2. Given a person's unique **int** ID and a list of the IDs of their friends, compute the list of mutual friends between each pair of friends in a social network.

Declare any custom data types here:	
map(int personID, list<int> friendIDs):	reduce(_____key, Iterable< _____> values):

3. A. Given a set of coins and each coin's owner, compute the number of coins of each denomination that a person has.

Declare any custom data types here:	
map(String person, String coinType):	reduce(_____key, Iterable< _____> values):

B. Using the output of the first MapReduce, compute the amount of money each person has. The function `valueOfCoin(String coinType)` returns a float corresponding to the dollar value of the coin.

map(_____key, _____amount):	reduce(_____key, Iterable< _____> values):
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Warehouse-Scale Computing

Power Usage Effectiveness (PUE) = (Total Building Power) / (IT Equipment Power)

Total Building Power = IT Equipment + Power supplies + Networking equipment + Cooling equipment

Sources speculate Google has over 1 million servers. Assume each of the 1 million servers draw an average of 200W, and that Google pays an average of 6 cents per kilowatt-hour for datacenter electricity.

- Estimate Google's annual power bill for its datacenters. Ignore the power cost of networking equipment. Assume 365 days (8760 hours) in a year.
- Google reduced the PUE of a 50,000 machine datacenter from 1.5 to 1.25 without decreasing the power supplied to the servers. What's the cost savings per year?