**BDT – cs523**

**Assignment 4 – Day 4 (*By Sujiv Shrestha*)**

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* Submit your *own work* on time. No credit will be given if the assignment is submitted after the due date.
* Note that the completed assignment should be submitted in .doc, .docx, .rtf or .pdf format only.
  + - 1. Write an in-mapper combiner algorithm for the “average problem”.   
         (Pseudo code only; show reducer method too.)

ANS:

class Mapper

method setup:

H←new HashMap<String, Pair<Int,Int>>

method map(String key, Int r):

Pair p = H{key}

if (p is null) then

p = new Pair(r,1)

else

p.Key ← p.Key+r

p.Value ←p.Value+1

H.put(key, p)

method cleanup:

for each Entry E in H:

Emit(E.Key, E.Value)

class Reducer

method reduce(String key, pairs [(s1,c1),(s2,c2),…]):

sum ←0

cnt ← 0

for all pair (s,c) in pairs:

sum ←sum+s

cnt ← cnt+c

avg←sum/cnt

Emit(key,avg)

1. Assume that there are three reducers. Note that Reducer 1 runs on Machine1. Reducer 2 runs on Machine2. Reducer 3 runs on Machine3.  
   Further, let the partitioner assign all words starting from letter ‘a-j’ to Reducer 1, all words starting from letter ‘k-q’ to reducer 2 and everything else to Reducer 3.  
   Also assume that there are six input splits as follows:

Input split1 : [cherry mango olive cherry]  
 [plum cherry banana cherry]

Input split2 : [cherry banana radish radish]  
 [carrot banana mango cherry]

Input split3 : [banana kiwi plum banana]  
 [mango cherry kiwi banana]

Input split4 : [apple mango carrot plum]  
 [radish kiwi banana olive]

Input split5 : [olive banana radish kiwi]  
 [cherry kiwi olive cherry]

Input split6 : [banana radish plum banana]  
 [olive cherry banana radish]

Input splits 1,2 are on Machine 1, input splits 3,4 are on Machine 2 and input splits 5,6 are on Machine 3.

1. Illustrate the word count algorithm with no combiner, no in-mapper combining.  
   *show mapper o/p, reducer i/p and reducer o/p*
2. Illustrate the word count algorithm with combiner, no in-mapper combining.  
   *show mapper o/p, combiner o/p, reducer i/p and reducer o/p*
3. Illustrate the word count algorithm with in mapper combiner.  
   *show mapper o/p, reducer i/p and reducer o/p*

Remember to show the sorted mapper output that gets stored locally.   
*Note: Illustrate means show mapper o/p, combiner o/p (if using combiners), reducer i/p and reducer o/p.*

**Answers:**

1. No combiner, no in mapper combining

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| **Machine 1** | | **Machine 2** | | **Machine 3** | |
| **Mapper 1 – Input Split 1- output** | | **Mapper 3 – Input Split 3- output** | | **Mapper 5 – Input Split 5- output** | |
| <cherry,1>  <mango,1>  <olive,1>  <cherry,1> | <plum,1> <cherry,1> <banana,1> <cherry,1> | <banana,1>  <kiwi,1>  <plum,1>  <banana,1> | <mango,1>  <cherry,1>  <kiwi,1>  <banana,1> | <olive,1>  <banana,1>  <radish,1>  <kiwi,1> | <cherry,1>  <kiwi,1>  <olive,1>  <cherry,1> |
| **Mapper 1 – output file** | | **Mapper 3 – output file** | | **Mapper 5 – output file** | |
| cherry 1  mango 1  olive 1  cherry 1  plum 1  cherry 1  banana 1  cherry 1 | | banana 1  kiwi 1  plum 1  banana 1  mango 1  cherry 1  kiwi 1  banana 1 | | olive 1  banana 1  radish 1  kiwi 1  cherry 1  kiwi 1  olive 1  cherry 1 | |
| **Mapper 2–Input Split 2 –output** | | **Mapper 4 – Input Split 4- output** | | **Mapper 6 – Input Split 6- output** | |
| <cherry,1>  <banana,1>  <radish,1>  <radish,1> | <carrot,1>  <banana,1>  <mango,1>  <cherry,1> | <apple,1>  <mango,1>  <carrot,1>  <plum,1> | <radish,1>  <kiwi,1>  <banana,1>  <olive,1> | <banana,1>  <radish,1>  <plum,1>  <banana,1> | <olive,1>  <cherry,1>  <banana,1>  <radish,1> |
| **Mapper 2 – output file** | | **Mapper 4 – output file** | | **Mapper 6 – output file** | |
| cherry 1  banana 1  radish 1  radish 1  carrot 1  banana 1  mango 1  cherry 1 | | apple 1  mango 1  carrot 1  plum 1  radish 1  kiwi 1  banana 1  olive 1 | | banana 1  radish 1  plum 1  banana 1  olive 1  cherry 1  banana 1  radish 1 | |
| **Shuffle & Sort** | | | | | |
| **Reducer 1 input** | | **Reducer 2 input** | | **Reducer 3 input** | |
| <apple,[1]>  <banana,[1,1,1,1,1,1,1,1,1,1,1]>  <carrot,[1,1]>  <cherry,[1,1,1,1,1,1,1,1,1,1]> | | <kiwi,[1,1,1,1,1]>  <mango,[1,1,1,1]>  <olive,[1,1,1,1,1]>  <plum,[1,1,1,1]> | | <radish,[1,1,1,1,1,1]> | |

Reducer output is the same for all the cases:

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| --- | --- | --- |
| **Reducer 1 output** | **Reducer 2 output** | **Reducer 3 output** |
| apple 1  banana 11  carrot 2  cherry 10 | kiwi 5  mango 4  olive 5  plum 4 | radish 6 |

1. With combiner, no in mapper combining (assume that the combiner will work all the time)

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| **Machine 1** | | **Machine 2** | | **Machine 3** | |
| **Mapper 1 – Input Split 1- output** | | **Mapper 3 – Input Split 3- output** | | **Mapper 5 – Input Split 5- output** | |
| <cherry,1>  <mango,1>  <olive,1>  <cherry,1> | <plum,1> <cherry,1> <banana,1> <cherry,1> | <banana,1>  <kiwi,1>  <plum,1>  <banana,1> | <mango,1>  <cherry,1>  <kiwi,1>  <banana,1> | <olive,1>  <banana,1>  <radish,1>  <kiwi,1> | <cherry,1>  <kiwi,1>  <olive,1>  <cherry,1> |
|  | |  | |  | |
| **Combiner 1 output– saved locally as mapper1 output file** | | **Combiner 3 output– saved locally as mapper3 output file** | | **Combiner 5 output– saved locally as mapper 5 output file** | |
| <cherry,4>  <mango,1>  <olive,1>  <plum,1>  <banana,1> | | <banana,3>  <kiwi,2>  <plum,1>  <mango,1>  <cherry,1> | | <olive,2>  <banana,1>  <radish,1>  <kiwi,2>  <cherry,2> | |
|  | |  | |  | |
| **Mapper 2–Input Split 2 –output** | | **Mapper 4 – Input Split 4- output** | | **Mapper 6 – Input Split 6- output** | |
| <cherry,1>  <banana,1>  <radish,1>  <radish,1> | <carrot,1>  <banana,1>  <mango,1>  <cherry,1> | <apple,1>  <mango,1>  <carrot,1>  <plum,1> | <radish,1>  <kiwi,1>  <banana,1>  <olive,1> | <banana,1>  <radish,1>  <plum,1>  <banana,1> | <olive,1>  <cherry,1>  <banana,1>  <radish,1> |
|  | |  | |  | |
| **Combiner 2 output– saved locally as mapper2 output file** | | **Combiner 4 output– saved locally as mapper4 output file** | | **Combiner 6 output– saved locally as mapper6 output file** | |
| <cherry,2>  <banana,2>  <radish,2>  <carrot,1>  <mango,1> | | <apple,1>  <mango,1>  <carrot,1>  <plum,1>  <radish,1>  <kiwi,1>  <banana,1>  <olive,1> | | <banana,3>  <radish,1>  <plum,1>  <olive,1>  <cherry,1>  <radish,1> | |
| **Shuffle & Sort** | | | | | |
| **Reducer 1 input** | | **Reducer 2 input** | | **Reducer 3 input** | |
| <apple,[1]>  <banana,[2,1,3,1,3,1]>  <carrot,[1,1]>  <cherry,[2,1,4,1,2]> | | <kiwi,[1,2,2]>  <mango,[1,1,1,1]>  <olive,[1,1,1,2]>  <plum,[1,1,1,1]> | | <radish,[2,1,1,1,1]> | |

1. With in-mapper combining

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| **Machine 1** | **Machine 2** | **Machine 3** |
| **Mapper 1 – Input Split 1- output file** | **Mapper 3 – Input Split 3- output file** | **Mapper 5 – Input Split 5- output file** |
| <cherry,4>  <mango,1>  <olive,1>  <plum,1>  <banana,1> | <banana,3>  <kiwi,2>  <plum,1>  <mango,1>  <cherry,1> | <olive,2>  <banana,1>  <radish,1>  <kiwi,2>  <cherry,2> |
|  |  |  |
| **Mapper 2–Input Split 2 –output file** | **Mapper 4 – Input Split 4- output file** | **Mapper 6 – Input Split 6- output file** |
| <cherry,2>  <banana,2>  <radish,2>  <carrot,1>  <mango,1> | <apple,1>  <mango,1>  <carrot,1>  <plum,1>  <radish,1>  <kiwi,1>  <banana,1>  <olive,1> | <banana,3>  <radish,1>  <plum,1>  <olive,1>  <cherry,1>  <radish,1> |
| **Shuffle & Sort** | | |
| **Reducer 1 input** | **Reducer 2 input** | **Reducer 3 input** |
| <apple,[1]>  <banana,[2,1,3,1,3,1]>  <carrot,[1,1]>  <cherry,[2,1,4,1,2]> | <kiwi,[1,2,2]>  <mango,[1,1,1,1]>  <olive,[1,1,1,2]>  <plum,[1,1,1,1]> | <radish,[2,1,1,1,1]> |