CS744A1

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1 Part C

Question 1. I ensure the resource are efficiently used by monitoring the Spark dashboard. As shown in Figure 1, all cores of the four workers are active and each worker has 1GB memory in use.

Regarding the network bandwidth, I only compute the transmit size as the transmit time cannot be estimated from the application completion time. More precisely, computing the bandwidth is in fact computing the throughput (TransmitSize / IOTime). Assume the latency is negligible, the bandwidth is approximately equal to the throughput. Each configuration are run three times and the average value is taken. I vary the partitioning size (Table 5- 8). From the results, 10 partitions in RDD has the minimum completion time. I will choose RDD partitioning size = 10 for question 2 and question 3.

hosts	Completion time (s)	Network Transmit Size (MiB)		Disk Bandwidth (MB/s)		Number of tasks
		Receive	Transmit	Read	Write	
vm-21-1	75.0	1.47	1.12	4.15	1.40	23
vm-21-2		0.32	112.52	9.36	1.63	
vm-21-3		0.09	0.24	4.58	1.74	
vm-21-4		117.25	0.78	4.10	4.23	
vm-21-5		0.09	0.24	4.70	1.16	

Table 1: Qeustion 1 Page Rank

Question 2. I use two customed partitions, RangePartitioner and HashPartitioner. The metrics are shown in Table 2, 3. The application completion times with and without customed partitioning are nearly the same. Regarding the page rank algorithm, the customed partitioning is slightly faster. However there is an overhead to partition the data. For Range partitioner, the application consists of two jobs. One is range partitioning, which takes 16s. The other is pagerank, which takes 29s.

Question 3. As there is no improvement using the customed partitioning, in this question I use the partitioning scheme in Question 1. Fix the RDD partition size as 10, cache the variable graph. The experimental

Workers

Worker Id	Address	State	Cores	Memory
worker-20170925020848-10.254.0.132-33025	10.254.0.132:33025	ALIVE	4 (4 Used)	18.6 GB (1024.0 MB Used)
worker-20170925020848-10.254.0.133-33895	10.254.0.133:33895	ALIVE	4 (4 Used)	18.6 GB (1024.0 MB Used)
worker-20170925020851-10.254.0.135-40578	10.254.0.135:40578	ALIVE	4 (4 Used)	18.6 GB (1024.0 MB Used)
worker-20170927013239-10.254.0.134-51462	10.254.0.134:51462	ALIVE	4 (4 Used)	18.6 GB (1024.0 MB Used)

Figure 1: Caption

hosts	Completion time (s)	Network Transmit Size (MiB)		Disk Bandwidth (MB/s)		Number of tasks
		Receive	Transmit	Read	Write	
vm-21-1	41.9	3.70	3.25	4.14	1.49	225
vm-21-2		140.83	255.12	7.08	2.37	
vm-21-3		208.00	64.79	3.36	3.12	
vm-21-4		144.78	291.07	3.66	2.51	
vm-21-5		199.62	58.62	3.41	3.43	

Table 2: Qeustion 2 Page Rank with Hash Partitioner

hosts	Completion time (s)	Network Transmit Size (MiB)		Disk Bandwidth (MB/s)		Number of tasks
		Receive	Transmit	Read	Write	
vm-21-1	45.2	3.00	3.02	4.28	1.31	227
vm-21-2		121.97	228.55	8.26	2.52	
vm-21-3		176.77	55.26	3.52	2.91	
vm-21-4		143.68	250.42	3.81	2.53	
vm-21-5		168.06	55.06	3.67	3.21	

Table 3: Qeustion 2 Page Rank with Range Partitioner

result is in Table 4. The application with cached graph is only 0.4s faster than the uncached one. The reason is not clear. I suspect Spark do some optimization by automatically storing the graph variable in memory.

hosts	Completion time (s)	Network Transmit Size (MiB)		Disk Bandwidth (MB/s)		Number of tasks
		Receive	Transmit	Read	Write	
vm-21-1	41.8	3.06	2.98	4.36	1.35	215
vm-21-2		188.82	158.37	8.70	3.01	
vm-21-3		185.58	45.10	4.66	2.67	
vm-21-4		121.92	406.97	4.09	2.17	
vm-21-5		181.96	44.66	4.82	2.72	

Table 4: Qeustion 3 Page Rank

Question 4. In this question, I experimented over four different paritionings i.e. 2, 10, 100, 300. From the results (Table 5-8), when RDD partition size is 10 the applicaton completion time is minimum. When the partition size increases, the parallelism increases so that the application completion time decrease. However, when the partition size are too large, the network transmit overhead will dominate and make the application completion time longer.

Question 5. See Figure 2. Same for all three application because they have the same algorithm. The difference in the partitioning and cache does not have an impact on the lineage graph.

Question 6. Figure 3. All applications have the same DAGs. The reason is they share the same repartitioning size (10) and the same algorithm. Impact: if we have a repartition step, we will distributed the data across the workers so all the workers will be used. This increases parallelism and speeds up the application.

Question 7. In this question, I failed vm-21-4 for all cases. The result is in Table 9. The impact of clearing cache is not obvious. The spark jobs are executed as the normal case. However killing one running worker increase the completion time much, especially when the failure is at 75% progress. The reason is on killing the worker, the ongoing stage failed and Spark will retry it on other workers. For example, in the case where the failure b happens at 75% for question 1's app, to deal with the failure, spark runs 7 more stages (14 more tasks) and the overhead is about 35s.

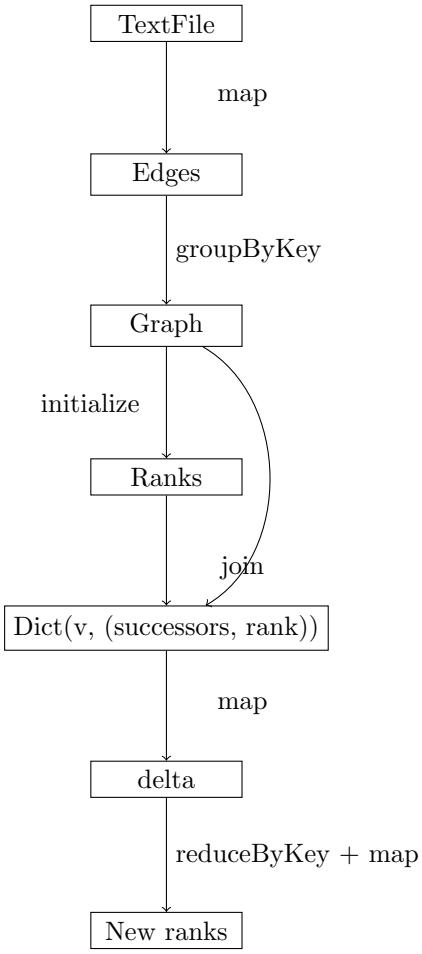
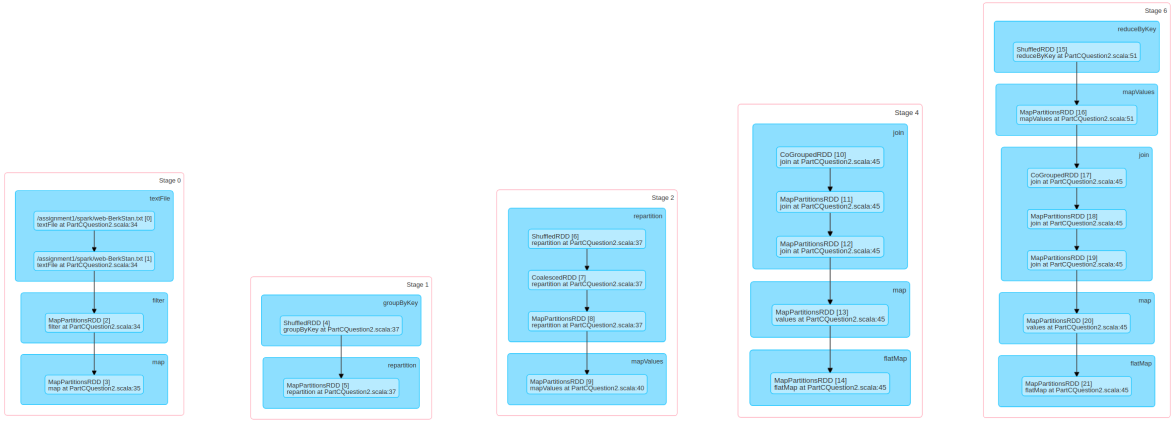


Figure 2: Lineage graph for Question 3



(a) Stage 0 (b) Stage 1 (c) Stage 2 (d) Stage 4 (e) Stage 6

Figure 3: Question 2/3 Stage-level DAGs

hosts	Completion time (s)	Network Transmit Size (MiB)		Disk Bandwidth (MB/s)		Number of tasks
		Receive	Transmit	Read	Write	
vm-21-1	81.6	1.43	1.35	4.60	1.66	47
vm-21-2		94.57	191.65	9.37	2.48	
vm-21-3		94.26	79.12	4.50	2.57	
vm-21-4		362.50	271.52	4.01	2.96	
vm-21-5		94.05	78.73	4.93	2.35	

Table 5: Qeustion 4 Number pf partitions = 2

hosts	Completion time (s)	Network Transmit Size (MiB)		Disk Bandwidth (MB/s)		Number of tasks
		Receive	Transmit	Read	Write	
vm-21-1	42.2	3.07	2.88	5.00	1.79	215
vm-21-2		222.59	175.95	9.04	2.94	
vm-21-3		174.27	71.74	4.77	2.83	
vm-21-4		180.48	398.66	3.97	2.30	
vm-21-5		166.13	70.75	4.68	3.32	

Table 6: Qeustion 4 Number pf partitions = 10

hosts	Completion time (s)	Network Transmit Size (MiB)		Disk Bandwidth (MB/s)		Number of tasks
		Receive	Transmit	Read	Write	
vm-21-1	50.8	18.24	18.96	5.53	3.31	2105
vm-21-2		235.60	275.60	8.94	2.29	
vm-21-3		190.84	139.12	4.80	2.60	
vm-21-4		407.09	504.37	3.74	2.46	
vm-21-5		274.00	154.27	4.79	2.84	

Table 7: Qeustion 4 Number pf partitions = 100

hosts	Completion time (s)	Network Transmit Size (MiB)		Disk Bandwidth (MB/s)		Number of tasks
		Receive	Transmit	Read	Write	
vm-21-1	80.8	54.41	56.77	4.21	4.69	6305
vm-21-2		461.86	443.06	8.77	1.89	
vm-21-3		456.85	316.62	4.38	1.93	
vm-21-4		467.47	728.71	3.94	2.28	
vm-21-5		456.67	328.13	4.45	2.05	

Table 8: Qeustion 4 Number pf partitions = 300

	failure a at 25%	failure a at 75%	failure b at 25%	failure b at 75%
Q1	71.3s	75.3s	73.3s	108.4s
Q3	44.2s	42.2s	52.2s	54.2s

Table 9: Completion time