Birkbeck

(University of London)

BSc/FD EXAMINATION

Department of Computer Science and Information Systems

Cloud Computing Concepts (BUCI028H6)

CREDIT VALUE: 15 credits

Date of examination: Friday, 2nd June 2017
Duration of paper: 2:30pm – 4:30pm (2 hours)

RUBRIC

1. *This paper contains* five *questions for a total of* 100 *marks.*
2. *Students should attempt to answer* ***all*** *of them.*
3. *This paper is not prior-disclosed.*
4. *The use of non-programmable electronic calculators is permitted.*

1. **(20 marks)**

Give brief answers to the following questions.

(a) What are the major service models of cloud computing? Which one is closest to the level of computer hardware? Which one is closest to the level of common users? (5 marks)

(b) What is utility computing? Which are its main benefits? (5 marks)

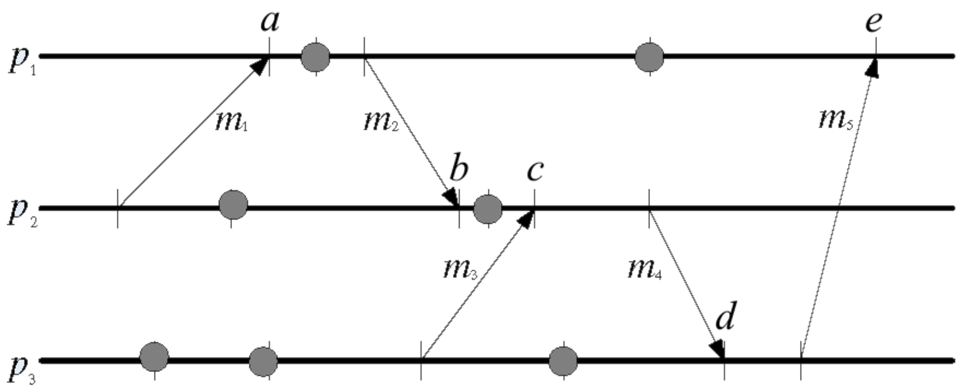
(c) What types of applications are not very suitable to be put in the cloud? (5 marks)

(d) What is a hybrid cloud? When should we consider using a hybrid cloud? (5 marks)

2. **(20 marks)**

Give brief answers (in a few sentences) to the following questions.

(a) What are the Lamport timestamps of the events a, b, c, d and e respectively in the following space-time diagram? (5 marks)



(b) What is the difference between crash failure and Byzantine failure? Which one is more disruptive? (5 marks)

(c) What is eventual consistency? Why don't we insist on strong consistency in all distributed systems? (5 marks)

(d) In RESTful APIs, what do the constraints "stateless" and "cacheable" mean respectively? (5 marks)

3. **(20 marks)**

Give brief answers (in a few sentences) to the following questions.

(a) What are the pros and cons of the "stripes" design pattern compared with the "pairs" design pattern? (5 marks)

(b) What is the "order inversion" design pattern used for? What is the "value-to-key conversion" design pattern used for? (5 marks)

(c) What is the prerequisite for the usage of map-side join? What is the prerequisite for the usage of in-memory join? (5 marks)

(d) Why is MapReduce inefficient for complex iterative applications and interactive queries? What is the Discretized Stream (D-Stream) model of Spark? (5 marks)

4. **(20 marks)**

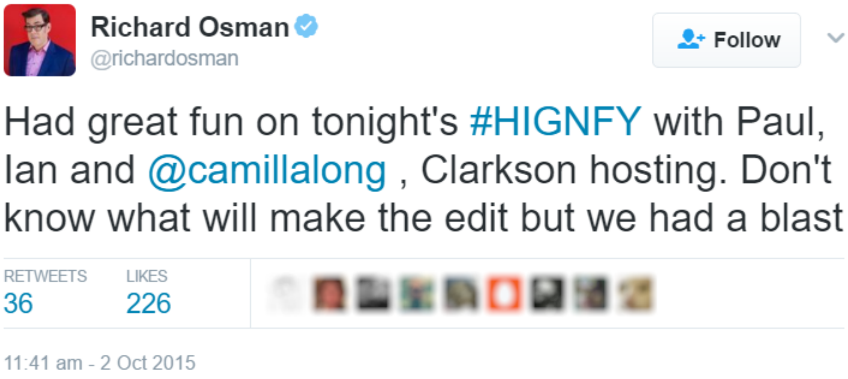
There is a large text file that contains all tweets about BBC programmes collected from Twitter in 2011–2015. It is stored in an HDFS over a number of machines.
Each line of this file describes one tweet in the following format, where the different fields are separated by the | character (assuming that it does not occur in any tweet).

user | *text* | *retweets* | *likes* | *date*

For example, the line

> richardosman | *Had great fun on tonight's #HIGNFY with Paul, Ian and @camillalong , Clarkson hosting. Don't know what will make the edit but we had a blast* | 36 | 226 | 02/10/2015

represents the tweet as shown in the following figure.



Richard Osman
@richardosman

Had great fun on tonight's #HIGNFY with Paul, Ian and @camillalong , Clarkson hosting. Don't know what will make the edit but we had a blast

RETWEETS 36
LIKES 226

11:41 am - 2 Oct 2015

A tweet could contain hashtags (such as "*#HIGNFY*") and mention usernames (such as "*@camillalong*") in its text.

Write a MapReduce program (in pseudo-code) to calculate for each user the average number of likes of his/her tweets in 2015.
A combiner should be implemented to accelerate the computation.

5. **(20 marks)**

Consider the same large data file as described in the previous question.

Write a MapReduce program (in pseudo-code), using the "pairs" pattern, to calculate for each hashtag the number of co-occurrences with another hashtag if they have occurred in the same tweet before. For example, the output corresponding to the hashtag *#HIGNFY* could be as follows.

#HIGNFY, #brexit: 300
#HIGNFY, #trump: 200
#HIGNFY, #TransportforLondon: 100

The “in-mapper combining” pattern should be implemented to accelerate the computation.