Now we turn our attention to applications of the analysis in Section 6.12 and discuss scheduling of

MapReduce applications on the cloud subject to deadlines. Several options for scheduling Apache

Hadoop, an open-source implementation of the MapReduce algorithm, are:

• The default FIFO schedule.

• The Fair Scheduler [383].

• The Capacity Scheduler.

• The Dynamic Proportional Scheduler [315].

A recent paper [186] applies the deadline scheduling framework analyzed to Hadoop tasks. Table 6.8

summarizes the notations used for the analysis of Hadoop; the termslots is equivalent with nodes and

means the number of instances.

We make two assumptions for our initial derivation:

• The system is homogeneous; this means that ρm and ρr , the cost of processing a unit data by the

map and the reduce task, respectively, are the same for all servers.

• Load equipartition.

Under these conditions the duration of the job J with input of size σ is

E(nm, nr, σ) = σ

ρm

nm

+ φ

ρr

nr

+ τ

. (6.86)

Thus, the condition that query Q = (A, σ, D) with arrival time A meets the deadline D can be

expressed as

t0m

+ σ

ρm

nm

+ φ

ρr

nr

+ τ

  A + D. (6.87)

It follows immediately that the maximum value for the start-up time of the reduce task is

tmax

r

= A + D − σφ

ρr

nr

+ τ

. (6.88)

We now plug the expression of the maximum value for the start-up time of the reduce task into the

condition to meet the deadline

t0m

+ σ

ρm

nm

  tmax

r . (6.89)

It follows immediately that nmin

m , the minimum number of slots for the map task, satisfies the condition

nmin

m   σρm

tmax

r

− t0m

, thus, nmin

m

= σρm

tmax

r

− t0m

 . (6.90)

The assumption of homogeneity of the servers can be relaxed and we assume that individual servers

have different costs for processing a unit workload ρim

 = ρ

jm

and ρi

t

 = ρ

j

t . In this case we can use the

minimum values ρm = min ρim and ρr = min ρir

in the expression we derived. A Constraints Scheduler based on this analysis and an evaluation of the effectiveness of this scheduler

are presented in [186].