Optimizing WorkflowScheduling using Max-Min and Min-Min Algorithmin Cloud Environment

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ABSTRACT: **Cloud Computinghasgained popularityinrecenttimes.Cloudcomputing nowisknown as aproviderofdynamic services usingverylargescalable,on demand,virtualized resourcesoverthe internet.Italsomakesitpossibleto access applicationsand associateddatafrom anywhere.Cloud computingisatechnology allows consumersandbusinesses touse application withoutinstallation and access theirpersonalfilesatanycomputer withthe helpofinternet.Therearea massof researches on the issue of scheduling in cloud computing, most of them, however, are focused on workflow and job scheduling. A cloudworkflow systemisa typeofplatform servicewhichfacilitatesthe automation of distributed applications based on the novel cloud infrastructure. Mostof thealgorithmsthat are currentlyin useare ignoring thedependentand independenttasks thatdirectlyinfluencethe overall executiontime. Processingof Workflowwhichis independent to each other,in parallelreduces theexecution time. Wehaveimplemented thealgorithmfor schedulingofresources fordifferent workflowsthatfocusedontheconsidering ofdependentand independenttasksthat directlygives profitinminimizing computationtime.**

General Terms: Cloud Computing, Scheduling Algorithms,workflowmanagement system.

I. INTRODUCTION

CloudComputing isatermthat involve delivering hostedservicesovertheinternet.In cloud computing, we can store information on cloudserverspermanently withthehelpof clients like laptops,computersetc.Cloudcomputing providesdifferentkindofservices likePlatform-as-a-service, Infrastructure-as-a- service and Software-as-a-service. Infrastructure-as-a-serviceprovides on-demand infrastructureservice to customer with rentable deviceslikeprocessing power,storage, processing cycles.Platform-as-a-service providesawholeplatformtothe users comprisingof hardware and softwaresystem to check, develop and host applications. Software-as-a-service provides software System as a service to the users by paying cloudhostas perhis usage[1][2].Cloud Computing opensnewwaysfornumerous applications from whichprocessingofscientificworkflowsismostcr ucial. The scientificworkflowslikeMontage, Cyber Shake,Siphtetc.requiresheavy processingof datathatisonly possiblewiththedeployment ofCloudComputing resources.However,the optimizedscheduling oftheindividualtasksof workflowisstill anissueyettosolve.The numerousalgorithmsareproposed and implemented such asFirstComeFirstServe, Data-aware algorithm,Min-Min algorithm, Round-Robinalgorithmetc., buttheseare unable to consider theindependent and dependenttasksindividually andschedulethe tasksinsuchaway thattheindependenttasks can process simultaneously.

A.SCHEDULING

Whenacomputerisrunning morethanone processes thatcompetes withoneanotherfor theCPUresourcessimultaneously,thenthere isaneedtomakeadecisionby Operating Systemthatwhichprocesstorun next.the process of managing resources for the processesiscalled scheduling.Schedularis processof operatingwhichmakesachoices about thenextprocess. Schedulingalgorithm is usedforperforming scheduling.in cloud computing,maintermistaskscheduling of subtasks ofworkflow.inthis itarrangethejob and processesin queue andprovidethemwhichrequiredresourceswhich areusefulin executing theseprocess.Withthehelpof technology ofvirtualization,alltheresources thatarephysically availablecanbemade virtualizedandtransparentfor users. Additionally, more than one virtualmachine areabletooperateonasinglehostcomputer sothattherateofemploymentofresources has beeneffectively enhanced [3], [4].Supplying resourcesunder Cloud Computing environmentis flexible;weincreaseorreduce the supplying of resourcesbased on requirementof workflows.

B.Algorithmsof Scheduling

(i)FirstComeFirstServe(FCFS)
Inthisalgorithm, tasksare comparedonthe basis oftheirarrivaltimeandthetaskwhich comesfirstintheready queueisservedfirst. Advantageofthisalgorithmisitssimplicity and fast execution behavior. But themain disadvantage ofthis algorithm is that sometimesdue to the execution of a longer job, which comesin thequeuefirst, small jobshave towaitforits completion.Duetothis problem thewaiting timeof tasksincreased andoverall performanceoftheworkflow execution decreases [5].

(ii) Min-MinAlgorithm
Inthis algorithm,smalltaskis executedfirstso thatlargetaskdelaysforlong time.Algorithm beginswithby sortingthesetofallunmapped tasksinincreasingorderoftheircompletion Time. Then the taskshaving theminimum completion isscheduled from the unmapped tasksetandthemappedtaskhas beenremoved from unmapped task list, and the process repeats untilallthetasks ofunmappedlistis mapped tothecorresponding available resources[5] .

(iii)Max-min Algorithm
Inthis algorithm,largetaskis executedfirstso thatsmalltaskdelaysforlong time.This algorithm isvery similar toMin-min algorithm,insteadofsorting thetaskinthe increasing orderof completion time.This algorithmsortsthetasksindecreasingorder oftheircompletiontime.Thenthetaskwith theoverallmaximum completiontimeis selectedfrom thistasklistand scheduled tothe corresponding availableresource. Thenthe scheduled taskhasbeenremoved from unmapped task set and theprocessrepeatsuntil alltasksof unmapped list ismapped [5].

(iv) Round-RobinAlgorithm

Itissecondmostcommonlyusedalgorithmfor assigningtheresources,whilescheduling,to thedifferentrequestssubmittedforexecution. Itisalsoimplementedforutilizing cloud computingresourcesfordifferentworkflows. Inthis algorithmthebasicprinciple is that assignsomepredefinedtimeslotsto the submittedrequests.Itdoes notconsider dependency andindependency thatexists between different tasks [5].

C. Workflow ManagementSystem

Scheduling isprocessesthatmapsand manage the executionof interdepended task on distributed resources. Workflow can manage the businessprocessefficiently to satisfyingthemodern enterprise.Workflow Management System (WFMS) providesan framework for theset-up,performance andmonitoring ofa definedsequenceoftasks,whicharearranged asaworkflow.

Workflowdesign describeshowcomponents of workflowcanbedefined and composed. The relationshipsbetweenthetasksof workflow are described with t h e help of

Workflowstructure. There aretwo typesof workflowstructure: DirectedAcyclicGraph (DAG) and NonDirected Acyclic Graph (DAG)[6].

Workflowis generallydefined asa directedAcyclic Graph. Every task in workflow contains aprogramandsetoffactorsthatare requiredfor completingatask.A single execution unitiscalledatask. They shows theirflow dependences inprocesses likethe outputofoneexecutionunitortaskmay be used asthe inputofanother task[6,7].

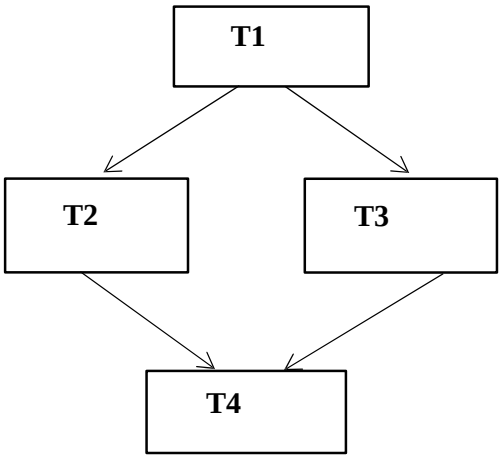

Figure1.Directed AcyclicGraph

D. Workflow Sim

WorkflowSimisasimulatorthatutilizesthe o-DAGmodeltosimulate largescale workflows.However,anexactmodel agenda forscientificworkflows is essentialtoproduce soundresults,mainly consideringthatthe overallsystemoverheadactasubstantialrole intheworkflowsexecution time.Thereare many layersofcomponentsparticipatein formulating andimplementing aworkflow. Clustering Engine,FailureGeneratorand FailureMonitorhavebeenintroduced.Figure2. Shows architecture ofWorkflowSim and dotted lineshows work of Cloud Sim.

i)ClusteringEngine: Theobjectiveof Clustering Engineisto mergetasksinto jobsto lessen thescheduling4over-heads.

ii)FailureGenerator:FailureGenerator is invented to insert task failures at each Executionsite. FailureGenerator aimlessly createstaskfailuresafterwardthecompleting of each job founded on thedistribution and averagefailuredegree thatauser has specified.

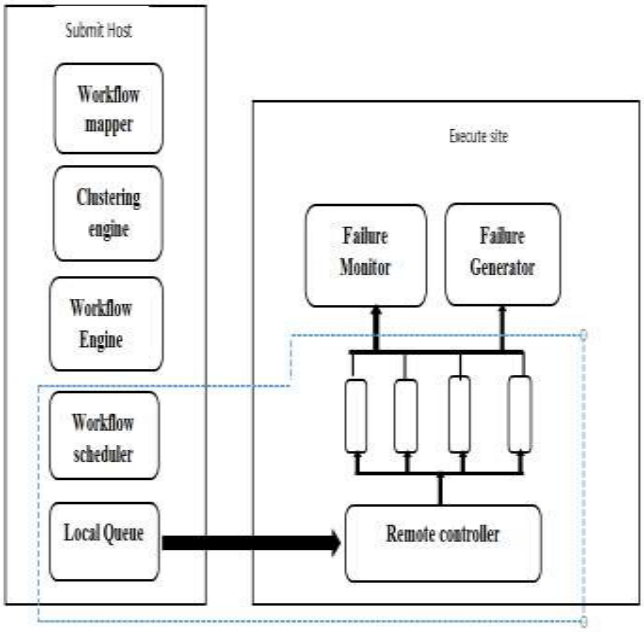

Figure 2: WorkflowSimProcess

iv)FailureMonitor: MainaimofFailure Monitoris togatherfailurearchives (e.g., resourceid,job id,taskid) andsendthemback tothe workflow management systemsothatit can change theschedulingpoliciesvigorously.

II. METHODOLOGY

During implement,twotypesofInput workflows areused likeCybershakeand Montage.

STEP 1: Input workflows

There are two typesofworkflowswhichareusedas input: cyber shake, montage.

i) Cyber shakeis a geophysical scienceapplicationthatcomputesProbabilisti c unstableHazardcurves forgeographicsites in theSouthern Californiaregion [6].

ii)Montageisanastronomy applicationthatis used to build huge copymosaicsof thesky [6].

STEP2:AllocateResources

For these workflows, some are basic resources are allocated.Virtualmachine,datacenters, cloud

broker and cloudlet areincluded asresources.

STEP3: ApplyAlgorithm

Fourtypes algorithmFCFS,ROUND ROBIN,MIN-MIN andMAX-MINwhichareappliedin this experiment.

STEP4: ComputeCalculatedTime

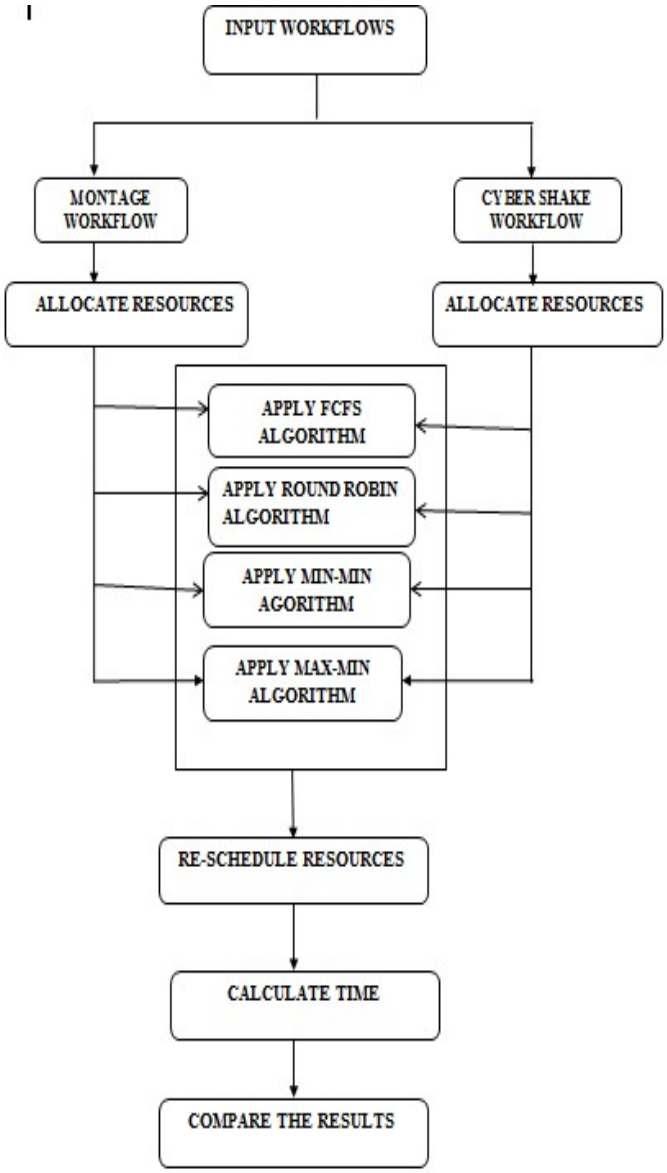

Figure3: Methodologyof workflow

III. RESULTS

Wehaveused theCybershake_100 and Montage_100workflowstotestour algorithm. Toevaluate theperformance ofalgorithm,we haveusedaverageutilization and timespanare used.Thetimespanofworkflow is the time takenfromits submissiontothecloduntilthe completion itstask.

TABLE I. COMPUTATIONTIMEWHEN100 NODES OF CYBERSHAKEWORKFLOWAREPROCESSES

Level	FCFS	ROUND ROBIN	MIN-MIN	Max-MIN
0	2.62	0.11	0.13	0.11
1	4494.78	203.78	1503.6	811.46
2	5287.78	417.25	1418.79	1038.42
3	4937.5	454.25	1349.57	984.03
4	0.48	0.34	0.39	0.36

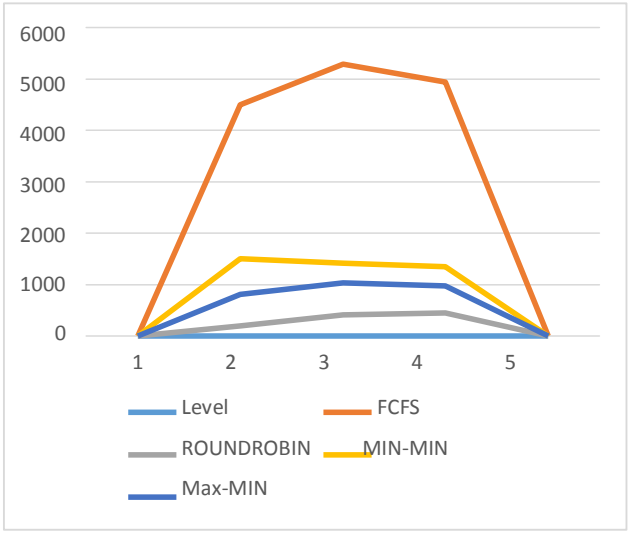

Figure6: computation timeforCyberShakeworkflow

TABLEII.COMPUTATIONTIMEWHEN100NODES OF MONTAGEWORKFLOWAREPROCESSED

LEVEL	FCFS	ROUND ROBIN	MAX-MIN	MIN-MIN
0	0.22	0.11	0.18	0.14
1	138.67	13.85	117.22	280.07
2	456.96	41.7	318.69	310.43
3	9.6	10.3	8.28	6.13
4	10.51	5.34	8.9	6.59
5	109.38	10.96	93.68	86.62
6	17.52	7.63	14.57	11.01
7	18.89	9.6	16.02	11.85
8	13.6	6.91	11.48	8.53

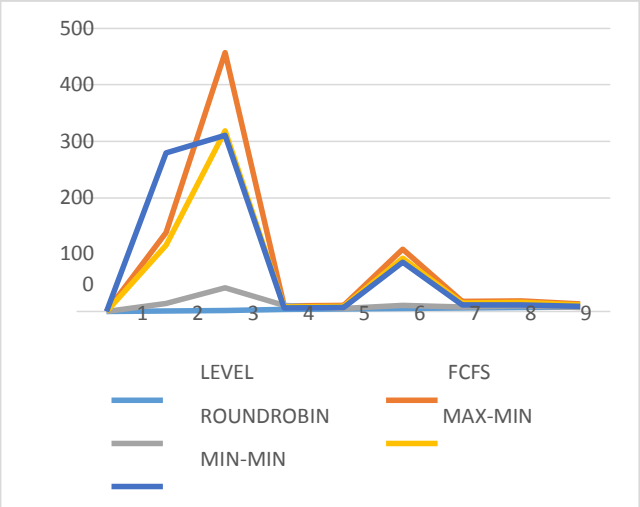

Figure 7: Computation time for montage workflow

IV. CONCLUSION

Thispaperrepresentsanoptimizedworkflow Scheduling.Workflowscheduling isoneofthe key issuesinthemanagementofworkflow executionincloud environment.wehave deployed thevariousexisting workflow scheduling algorithmsFCFS,ROUND ROBIN,MAX_MIN,MIN incloudcomputing. Parameterswhich are included to optimization istimedelay.MAX-MINgiveagood performance in Cyber Shake. If we analysisthisresult weconclude thatthose workflow whichhavelongestprocessgreaterthan low time process and low time process time Coveredin long timeprocesslike cybershake thereMax-min algorithmwork good because execute longerprocessfirst and meanwhile processlowtimedelayprocess

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