Implementation of CI/CD Automation and Orchestration in CMS Monitoring Kubernetes Clusters

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IRIS-Hep Fellows Final presentation

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Outline

- Project & Objectives
  - Migrate CMSSpark jobs to Kubernetes
    - Implement testing utilities for Spark job output (HDFS, ES, Local storage)
    - Apply testing utilities individually to each CMSSpark job
    - Migrate CMSSpark cronjobs to Kubernetes
    - Explore and implement continuous deployment/integration options
- Overview of the work
- Summary
Global overview

Input data

LHC

WLCG Infrastructure (storage, computing, network)

CMS Monitoring services

CERN IT & Monit services

CMS Computing services

CMS Monitoring

Welcome to the CMS Monitoring project

CMS logo
cms-comp-monitor@cern.ch / @CMSMONITOR @HEP | DOCUMENTATION

CMSSD | CMSSWEB | CRAB | Jobs | PAIR | DM Dye | SI | Sites | SLS | Tier0 | VO|CMS | WMA | Xrootd | Kib | Alerts | Others

| Production | Development | Playground | Contacts | Meetings | Migrations | Data popularity | CRSG | Plots | Archive

Tier0

- CMS Tier0 Jobs Production
- CMS Tier0 Production
- CMS Tier0 Replay vooms011 Production
- CMS Tier0 Replay vooms015 Production
- CMS Tier0 Replay vooms047 Production

Jobs

- CMS Job Monitoring - 12h Production

CRAB

- CRAB ASM Metrics Production
- CRAB Metrics Production
- CRAB overflow timer
- CRAB overflow via JobFetcher Production
- CRAB Overview Production

WMAgent

- CMS WMAgent Monitoring Production

Rucio monitoring

- Rucio datasets daily status [CBS] (in review) Production
- Rucio file deletions Production
- Rucio Monitoring - Recently not accessed datasets Production
- Rucio used space in disk and tape Production

cmweb

- cmweb all clusters node exporter metrics Production
- cmweb FE rels clusters Production

Status Boards

- CMS Monitoring Data Source Status Production
- CMS Monitoring KEYS Clusters Status Production

OTHERS

- WLC Grafana Dashboards
- Kibana dashboards
  - Running corros by campaign (Rima Plot)
  - User jobs (xrdcp62)
  - Spider error messages (visible only inside CERN)
Global overview

Input data

LHC →

- WLCG Infrastructure (storage, computing, network)
- CERN IT & Monit services
- CMS Computing services

CMS Monitoring
Global overview

Input data
- WLCG Infrastructure (storage, computing, network)
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- CMS Computing services

CMS Monitoring

September 28, 2022     IRIS-HEP Fellow Kyrylo Meliushko
CMS Monitoring infrastructure

Data Providers
- HTCondor
- WMAgent
- CRAB

Data injection
- ActiveMQ
- HTTP
- Logstash

Data transport and processing
- Kafka
- Spark

Data storage
- ElasticSearch
- InfluxDB
- HDFS

Data access
- Kibana
- Grafana
- SWAN

Automation … of CMSSpark in Kubernetes
Example workflow of a cronjob

Data storage
- ElasticSearch
- InfluxDB
- HDFS

→ Spark
→ Apache AQ
→ elasticsearch
Technologies used

- Git, Github - coordinating work, collaborating, version control
- Bash - writing testing scripts
- PySpark - analysis of CMSSpark cronjobs
- HDFS, ElasticSearch - data storage
- Prometheus, pushgateway - event monitoring and alerting
- Kubernetes - container orchestration, automatic deployment
- Helm charts - single package all kubernetes manifests
- FluxCD - continuous deployment of Helm Charts
- LxPlus - remote work in cloud using ssh
GitHub Repositories

**CMSSpark**
General purpose framework to run CMS experiment workflows on HDFS/Spark platform
- Python
- GitHub stars: 13
- GitHub forks: 20

**dmwm/CMSKubernetes**
Set of instructions and examples to deploy CMS data-services to Kubernetes cluster
- Shell
- GitHub stars: 11
- GitHub forks: 32

HDFS/Spark data parsing scripts
Kubernetes adapted scripts
(1) Implement testing utilities for HDFS, ElasticSearch and files

Add ES document amount testing #96

Merged mrcyhn merged 5 commits into dmwm/master from kyrylogy:add_testing_utils on Aug 1

Conversation 4 Commits 5 Checks 0 Files changed 1

kyrylogy commented on Jul 15 • edited

Created a function to compare current amount of documents in specified ES index with given value.

I suppose that it is also needed to catch monit exceptions in case of wrong dbname/Grafana token etc., while jq isn't supposed to fail because its query is constant.

Also directory where monit is stored in k8s ought to be changed (downloads latest monit release if it doesn't exist).

#94

dmwm/CMSSpark#96
(2) Modify each CMSSpark cronjobs with testing utilities

Apply check utilities to cron jobs #100

Draft

kyrylogy wants to merge 7 commits into dmwm/master from kyrylogy/apply-cron-checks

Conversation 0 Commits 7 Checks 0 Files changed 10

kyrylogy commented on Aug 8 • edited

#99
Progress:

- cron4ucio_daily.sh - Changed sourcing check_utils.sh in cron4ucio_daily.sh to directly calling it as it caused exit code to be 0 in each case.
- cron4dbs_condor - Won't work properly until we fix Last day of the month is not processed in bin/cron4dbs_condor #104, it's also good to refactor how exit codes are handled
- cron4dbs_condor_df - Many of the recently generated datasets appear to be empty, it's important to know why
- cron4dbs_events

dmwm/CMSSpark#100
(2) Modify each CMSSpark cronjobs with testing utilities

```
0 2022-07-28 06:12 /cms/dbs_condor/release/2022/07/27
0 2022-07-29 06:13 /cms/dbs_condor/release/2022/07/28
0 2022-07-30 06:12 /cms/dbs_condor/release/2022/07/29
0 2022-07-31 06:14 /cms/dbs_condor/release/2022/07/30
hadoop fs -ls /cms/dbs_condor/release/2022/08
0 2022-08-02 06:10 /cms/dbs_condor/release/2022/08/01
0 2022-08-03 06:11 /cms/dbs_condor/release/2022/08/02
0 2022-08-04 06:11 /cms/dbs_condor/release/2022/08/03
0 2022-08-05 06:16 /cms/dbs_condor/release/2022/08/04
```

1 missing file

cron4dbs_condor output for July and August
(3) Fix cron4dbs_condor script ignoring one day of data

Fix cron4dbs_condor ignoring last day of the month #109

Merged mrceyhun merged 1 commit into dmwm:master from kyrylogy:fix-dbs-condor 11 days ago

Conversation 2  Commits 1  Checks 0  Files changed 1

kyrylogy commented on Aug 23 • edited

#104
Fixes cron4dbs_condor bug that skips last day of the month when parsing data. The problem here is that we only list current month and take 1 file before the .tmp. On 31st day of the month data for day 30 will be collected. On the first day of the month, no data will be collected as there is only single .tmp file.

mrcyeun marked this pull request as ready for review 13 days ago

dmwm/CMSSpark#109
(4) Monitor cronjob status with Prometheus

Add cronjob pushgateway utilities #101

mrcuhn merged 1 commit into dmwm:mast3r from kyrylog3:cr0n-main-script 6 days ago

kyrylogy commented on Aug 11 • edited

#98
Created utilities for sending cronjob data to pushgateway. Pushgateway allows us to expose batch metrics to Prometheus, i.e. metrics of jobs that complete thus continuously pulling from them is impossible.

dmwm/CMSSPark#101
(5) Create Kubernetes manifests for CMSSpark cronjobs

Add main CMSSSpark cronjobs to k8s #1206

Mrceyhun merged 9 commits into dmwm:master from kyrylogy:f-casmon-cjs 18 days ago

Conversation 5 Commits 9 Checks 0 Files changed 10

Kyrylogy commented 20 days ago • edited

This PR includes several Kubernetes CronJob yaml files (not including dbs_condor, aggregation, which are still being refactored) Schedules and outputs are set according to cronjobs which are running in production.

Apply only after ensuring that services are created.

#1198

Mrceyhun reviewed 20 days ago

Mrceyhun left a comment
(6) One Helm Chart to rule them all

Create a helm chart for cmsmonitoring spark running cronjobs

@mrceyhun
This helm chart simplifies deployment of multiple spark running cronjobs.

Notes:
- Replaced configmap.yaml with a script template in helpers.tpl
  Command and arguments for each cronjob can be specified individually in corresponding fields.
- Added test field to run cronjobs with --test flag
- EOS Access is granted to cronjobs with eosEnabled parameter
- spark.driver and spark.driver.blockManager pulled out to service field
- NodePorts are assigned according to the amount of cronjobs specified
  (However, I suggest looking at https://helm.sh/docs/chart_template_guide/functions_and_pipelines/#using-the-lookup-function to figure out which ports we can use and building on that)
Implement FluxCD for CMS Monitoring cron jobs #1216

mrceyun commented 6 days ago

Monitoring cron jobs deployment will be automatized with FluxCD. After cron jobs, all services will be automatized, but first implementation will include only CronJobs.

We may need a test github repo to easily test.

Helm charts issue: #1214 and its PR by @kyrylogy #1215
Summary

- CMS Monitoring - ready for Kubernetes & Helm Charts
- Adapted CMSSpark scripts
- Gained real world development experience
- Worked with awesome team members
- Newest open-source technologies hands-on
Thank you for your attention!