

# Ctest4J: A Practical Configuration Testing Framework for Java

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# Misconfiguration is one dominating root cause of software failures

## Investigation Regarding Misconfigured Microsoft Storage Location

MSRC / By MSRC / October 19, 2022 / 4 min read

October 28, 2022 update: Added a Customer FAQ section.

### Summary

Security researchers at SOCRadar informed Microsoft. This misconfiguration resulted in the potential for unauthorized access to data corresponding to interactions between Microsoft and its customers. The misconfiguration impacted the implementation of a security control.

Upon authentication notification

Post Incident Review (PIR) – DNS resolution issues impacted Azure in China

Tracking ID: V\_BH-7DZ

Watch our 'Azure Incident Retrospective' video about this incident: [https://aka.ms/AIR/V\\_BH-7DZ](https://aka.ms/AIR/V_BH-7DZ)

### What happened?

Between 03:45 CST and 06:00 CST on 23 Apr 2024, a configuration change performed through a domain registrar resulted in a service disruption to 2 system domains (chinacloudapp.cn and chinacloudsites.cn) that are critical in our cloud operations in China. This caused the following impact in the Azure China regions:

Customers may have had issues connecting to multiple Azure services including Cosmos DB, Azure Virtual Desktop, Azure Databricks, Backup, Site Recovery, Azure IoT Hub, Service Bus, Logic Apps, Data Factory, Azure Kubernetes Services, Azure Policy, Azure AI Speech, Azure Machine Learning, API Management, Azure Container Registry, and Azure Data Explorer.

### Explainer

## Facebook outage: what went so long to get it down?

...ticing they could not... would be more than... ay confirming that th... the backbone routers... network traffic between the company's data centres, which... effect, bringing all Facebook services to a halt.

## Google cloud misconfiguration poses risk to customers

Cloud security vendor Mitiga discovered 'dangerous functionality' in the Google Cloud Platform that could allow attackers to compromise virtual machines.

By Arielle Waldman, News Writer

Published: 05 May 2022

Google Cloud Platform could allow attackers to gain complete control over... disabling legitimate features within the system, according to new...

June 22, 2022

## Cloudflare Massive Outage Due To Network Configuration Error



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- 1. Cloudflare's Busiest Areas Were Affected By Outage



Read Time: 1 Minute, 30 Second

Cloudflare claims that a major outage that affected more than a dozen data centers and hundreds of online platforms and services was due to a change that should have improved network resilience. Cloudflare stated that it experienced an outage today, June 21, 2022. This affected traffic in 19 data centers.

# Configuration testing for config changes

- Ctest: test production configuration changes together with code [1]
  - Key contribution: specify which Ctest uses which configuration parameters



Prior Ctest scripts were hard to use and inefficient.

# Cumbersome: Hard to use & maintain Ctests

- Manual configuration API instrumentation to:
  - Connect configuration under test to each Ctest
  - Track configuration usage of each Ctest
- External configuration usage mapping files for each Ctests

```
public class Configuration {  
    ...  
    static {  
        loadConfigurationFrom("default.xml");  
        loadConfigurationFrom("ctest.xml"); // Load Ctest configuration  
    }  
  
    public String get(String name) {  
        ...  
        LOG.warn("[CTEST][GET-API] " + ctestParam);  
    }  
}
```

Logs are parsed into external configuration usage files for each individual Ctest

# Inefficient: No parallel Ctest execution

- All Ctests read configuration changes from the same file

```
public class Configuration {  
    ...  
    static {  
        addDefaultResource("default.xml");  
        addDefaultResource("ctest.xml"); // Load Ctest configuration  
    }  
}
```



## Production configuration change

- hbase.http.max.threads = 10

+ hbase.http.max.threads = 5

# Ctest4J: Our new tool for Ctests

- **Maintainability:** Ctest4J provides source-code annotations to make Ctests easy to maintain
- **Automation:** Ctest4J uses AspectJ to automate the configuration API instrumentation
- **Parallel Execution:** Ctest4J supports running Ctests with different configurations in parallel
- **Generality:** Ctest4J supports JUnit4, JUnit5, and TestNG; can be easily extended to other Java testing frameworks

# Ctest4J annotations

- Source-code annotations to store configuration usage information
  - **@CtestClass** for class-level usage and **@Ctest** for method level usage
  - Optional to maintain external usage mapping files

```
┌ @Test  
│ public void testGetMasterInfoPort() {...}  
└ @Ctest({"hbase.http.max.threads", ...})  
  public void testGetMasterInfoPort() {...}
```

- Ctest4J runner parses the annotations to connect *used* configuration parameter values to Ctests

# Ctest4J configuration connector

- Connect configurations to Ctest through configuration object
  - Each Ctest has its own configuration identified by Ctest method name
  - Different Ctests can be executed in parallel with different configurations

```
public Configuration () {  
    this(true); // Load default configuration  
    Ctest4J.connectProdConfig((name, value) -> set(name, value));  
}
```

- AspectJ is used to automate configuration API instrumentations



# Ctest4J Main Results

- Evaluated Ctest4J with 12 popular large, widely used open-source projects
- Can Ctest4J effectively execute Ctest?
  - Speed up the Ctest execution by **3.4X** on average over original Ctest scripts
- What is the overhead of running Ctest with Ctest4J?
  - Take only **20** lines of code on average to enable Ctest across 12 Java projects
  - Run only **~3%** slower on average than a regular unit test



# Ctest4J Main Results

- Evaluated Ctest4J with 12 popular large, widely used open-source projects

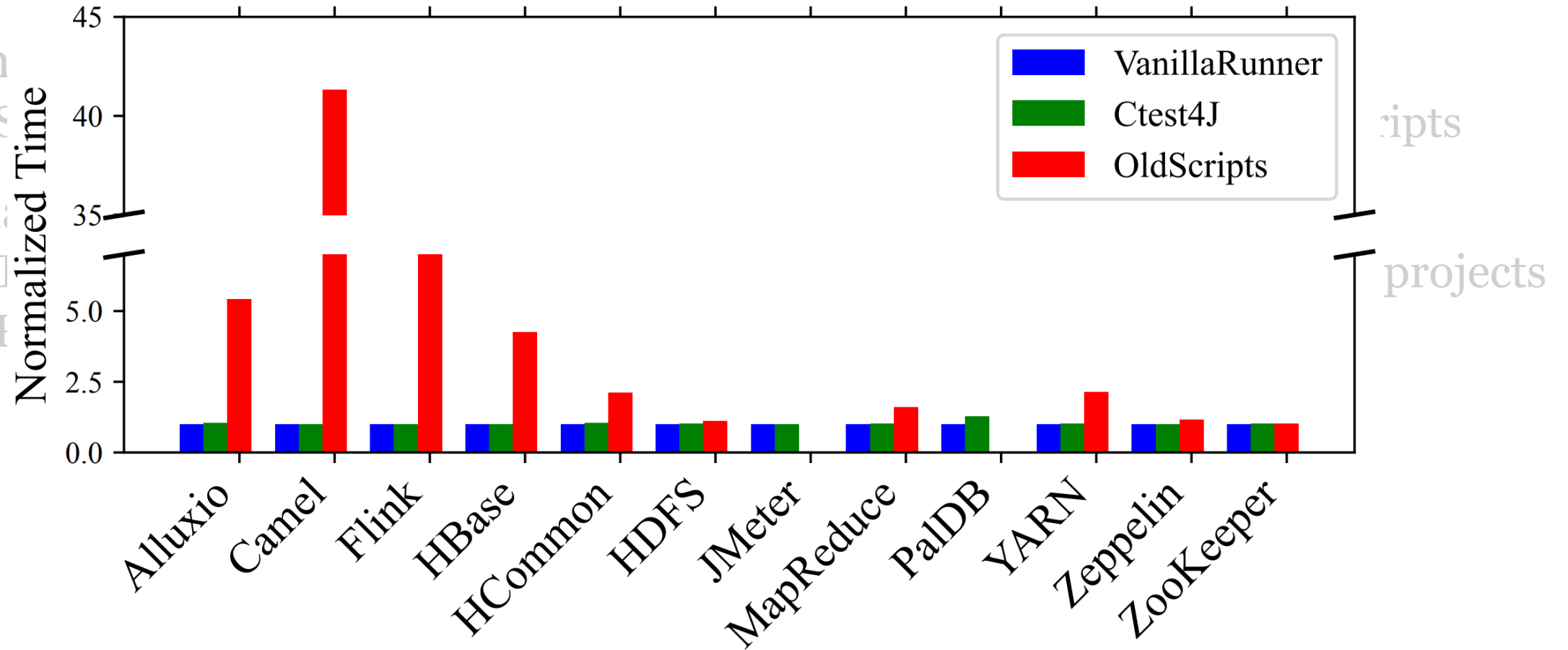
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# Conclusion

- Ctest4J eases the effort to write, run, and maintain Ctests
- Transforming existing tests to Ctests is still challenging:
  - How to generalize test assertions to only fail under misconfigurations
- **Data/code release:** <https://github.com/xlab-uiuc/ctest4j>

QR code:

