- **Problem**
  Small-window long-tail latency (SWLT)
  Long tail latency at extremely small timescales (e.g., 1 minute, even 1 second) for web services deployed in container based microservice platforms

- **Solution**
  **ε-Diagnosis**
  - Selecting two samples from the snapshot
  - Two-sample null hypothesis test
  - c-Statistics (Energy distance correlation)

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  Algorithm 1 Pseudo-code for the ε-Diagnosis algorithm
  Input: small-window long-tail latency, N time-series metrics of N containers, confidence threshold α, alarm window
  Output: candidate root-cause metrics, problematic containers
  1. procedure ε-DIAGNOSIS
  2. for ContainerN \( \leftarrow 1 \) to \( N \) do
  3. \( S_A = \text{getAnomalySample} \)
  4. \( S_N = \text{getNormalSample} \)
  5. for MetricM \( \leftarrow 1 \) to \( M \) do
  6. \((\rho(S_A, S_N), P) = \text{Calculate Energy distance correlation coefficient of } S_A \text{ and } S_N \text{ using Equation (3)} \) with P-value
  7. if \( P < \alpha \) then
  8. \( '/' \text{ Reject Hypothesis } S_A \neq S_N '/' \)
  9. add MetricM as a candidate root-cause metric
  10. end if
  11. else
  12. \( '/' \text{ Accept Hypothesis } S_A = S_N '/' \)
  13. end if
  14. end for
  15. end procedure
  ```

  Energy distance correlation
  \[
  \rho^2(S_A, S_N) = \frac{\sigma^2(S_A) \cdot \sigma^2(S_N)}{\sqrt{\sigma^2(S_A) + \sigma^2(S_N)}}
  \]

- **Evaluations**
  **Baseline**
  - Pearson’s distance
  - K-NN: K-Nearest Neighbor
  - MST: Minimal Spanning Tree

  *ε-Diagnosis*: energy distance correlation
  - Energy can reach 100% recall quickly as \( \alpha \) increases

- **Operational Results in Real-Production**
  - c-Diagnosis(Energy) reduces metrics to approximately 10%

- **Conclusion and Future Works**
  - c-Diagnosis finished to diagnose metrics anomaly of each container in large-scale microservice platforms
  - Further root-cause diagnosis will extend other use cases for microservice–based web applications at JD.com