

Miao Du

Interaction Traces Mining for Efficient System Responses Generation





Agenda

Introduction

Background & Motivation

Approach

Evaluation

Future Work

Conclusion



Introduction

- Realistic interaction trace collection is informative
 - Interactive data
 - Basis for system/service emulation technique
- Challenge: Searching the entire interaction collection during runtime
 - Time-consuming
 - Impractical
- Our approach:
 - Using mining techniques to accelerate the searching process



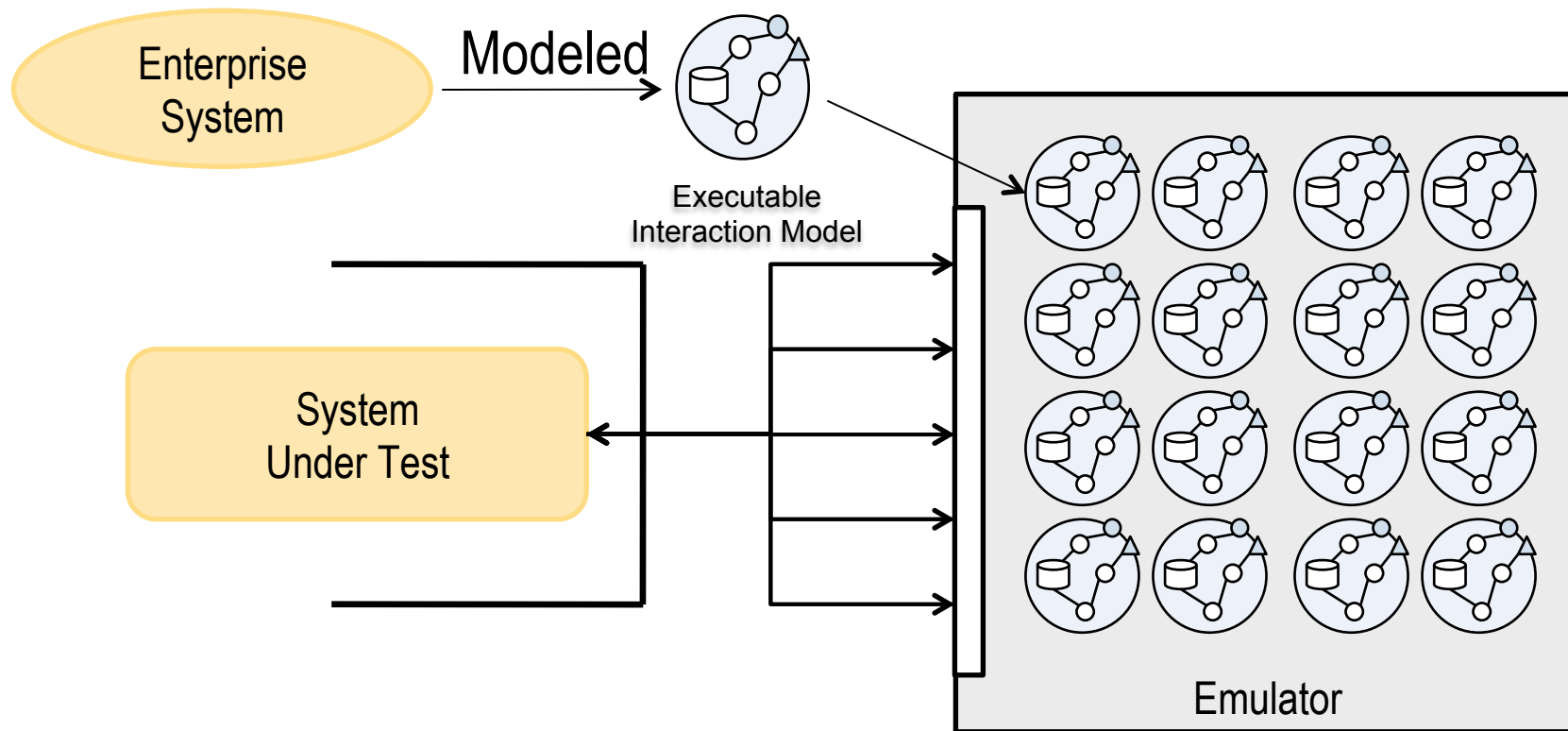
Background & Motivation

- Modern software systems
 - Large
 - Often rely on third party services/systems
 - Complex interactions among systems
- Quality assurance becomes a problem
- Provision of an emulation environment, which is
 - Executable
 - Interactive
 - Less resource requirement



Background & Motivation

- Configuration of the Emulation Environment



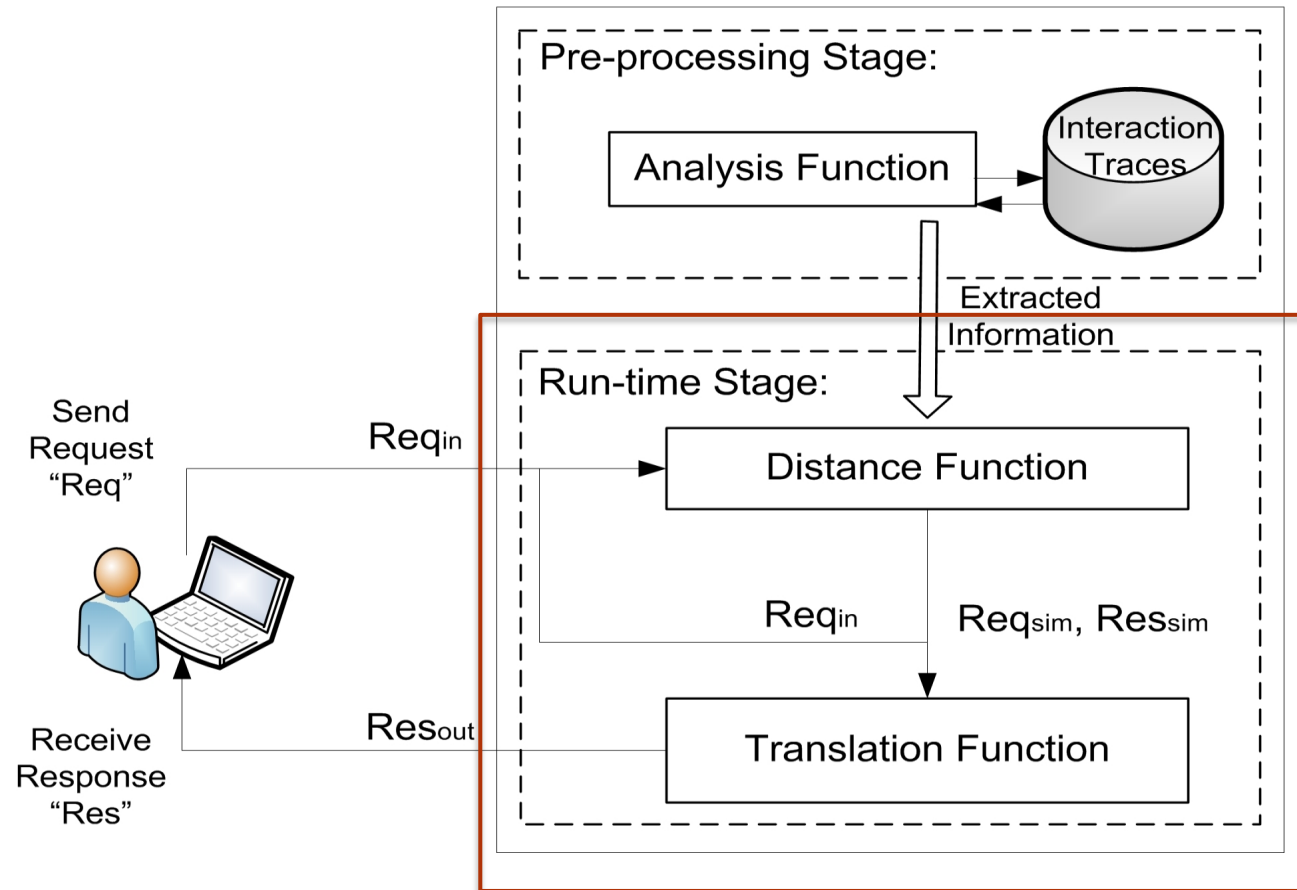


Background & Motivation

- Executable interaction models
 - Objective:
 - Efficiently generate required responses for the SUT
 - Common approaches:
 - Manual
 - Automatic
 - Prior work
 - An automatic method
 - Iterate the entire interaction trace collection



Proposed Framework





Scenario Example

- Incoming request

Message ID: 18
ProtocolOp: searchRequest
ObjectName: cn=Mal BAIL, ou=Administration,
ou=Corporate, o=DEMOCORP, c=AU

- Synthesized response

Message ID: 18
ProtocolOp: searchResEntry
ObjectName: cn=Mal BAIL, ou=Administration,
ou=Corporate, o=DEMOCORP, c=AU

Message ID: 18
ProtocolOp: searchResDone
resultCode: success

- Recorded request

Message ID: 37
ProtocolOp: searchRequest
ObjectName: cn=Miao DU, ou=Research,
ou=Project, o=DEMOCORP, c=AU

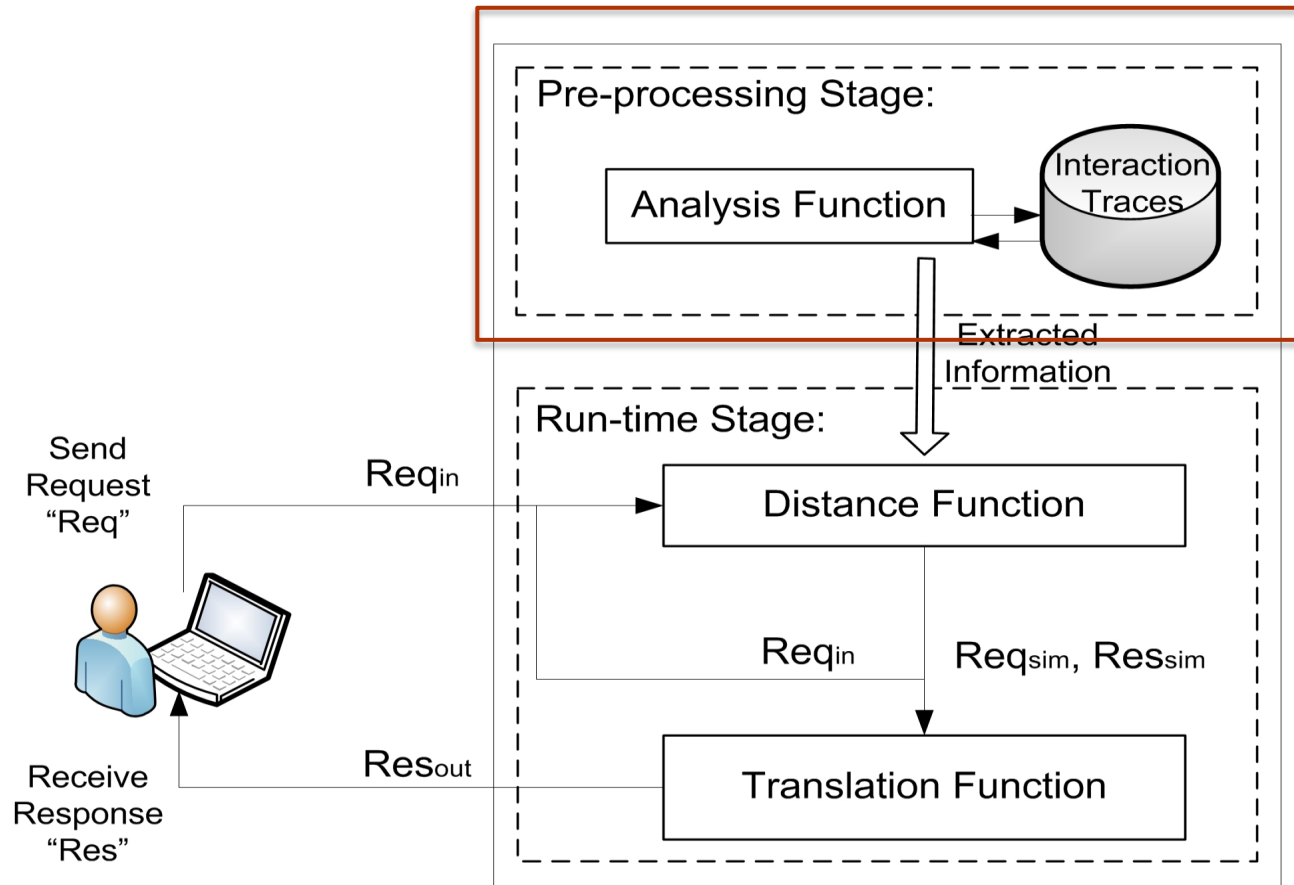
- Recorded response

Message ID: 37
ProtocolOp: searchResEntry
ObjectName: cn=Miao DU, ou=Research,
ou=Project, o=DEMOCORP, c=AU

Message ID: 37
ProtocolOp: searchResDone
resultCode: success



Proposed Framework





Design of Analysis Function

Step 1:

Transforming Network Data

Index

1: addRequest(36) "cn=Miao DU, ou=administration, ou=Corporate, o=DEMOCORP, c=AU"

2: searchRequest(147) "cn=Alfred FITZGERALD, ou=Legal, ou=Corporate, o=DEMOCORP, c=AU" baseObject

...

5: addRequest(171) "cn=Debbie DALLY, ou=Finance, ou=Corporate, o=DEMOCORP, c=AU"

...

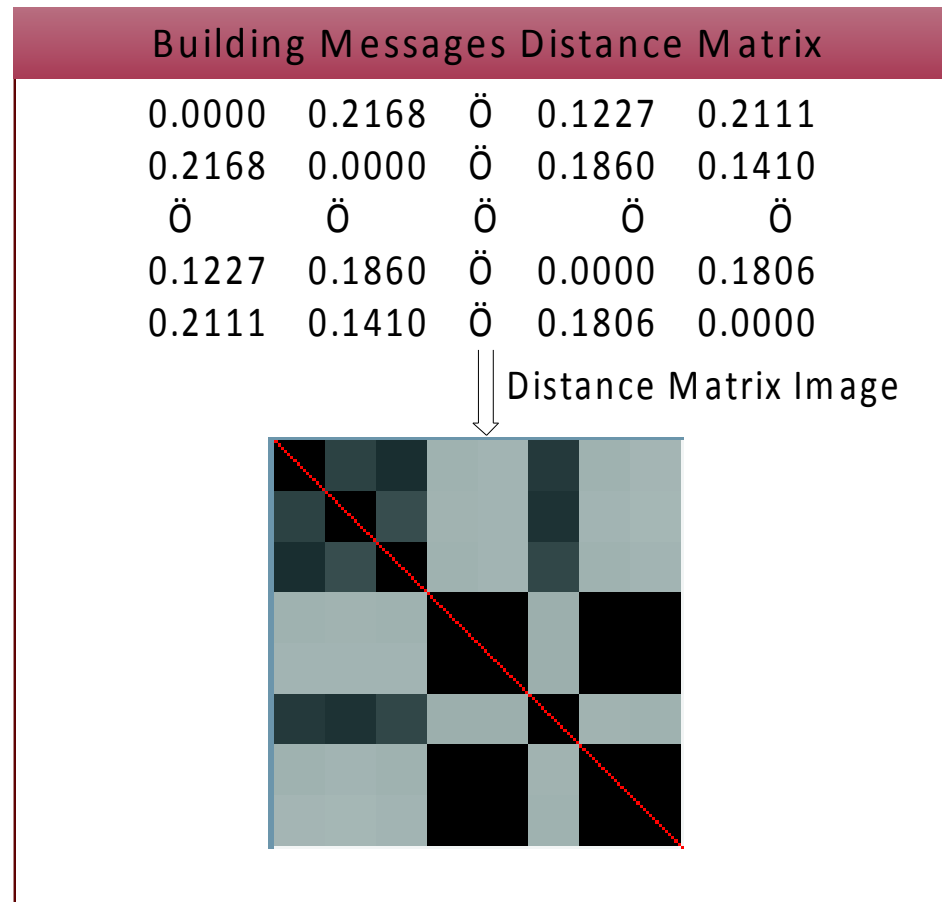
8: searchRequest(159) "cn=Barbara HARTLEY, ou=Management, ou=Corporate, o=DEMOCORP, c=AU" baseObject

Translate raw network data to corresponding text format



Design of Analysis Function

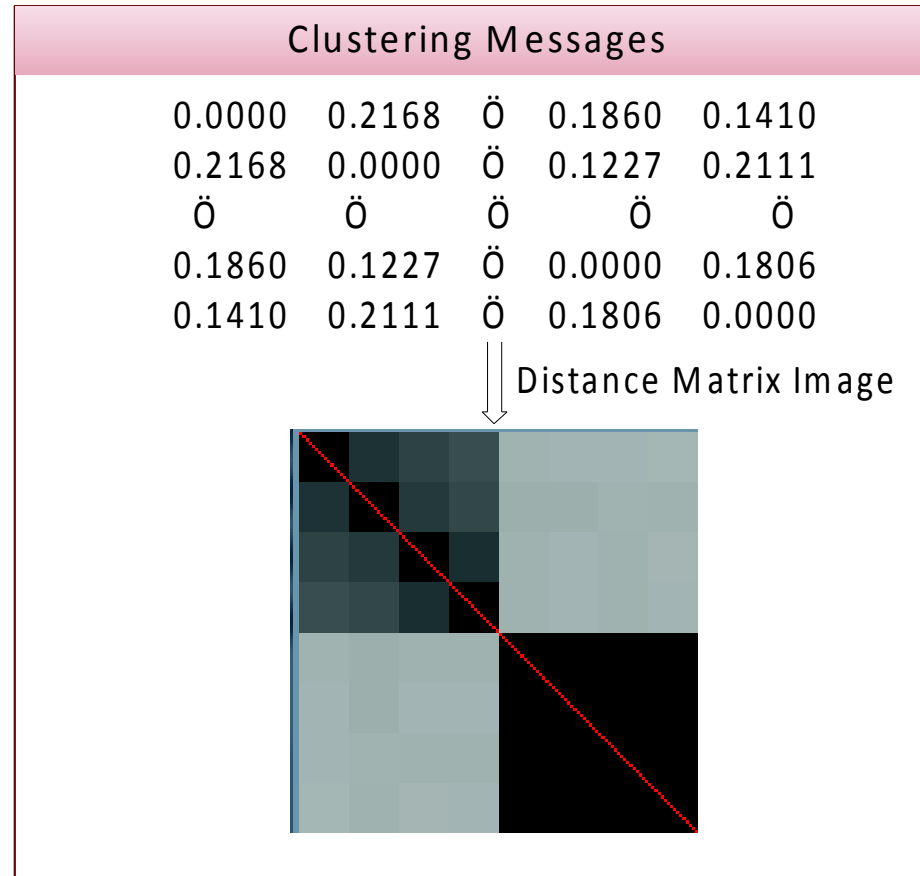
Step 2:





Design of Analysis Function

Step 3:





Design of Analysis Function

Step 4:

Exporting Clusters

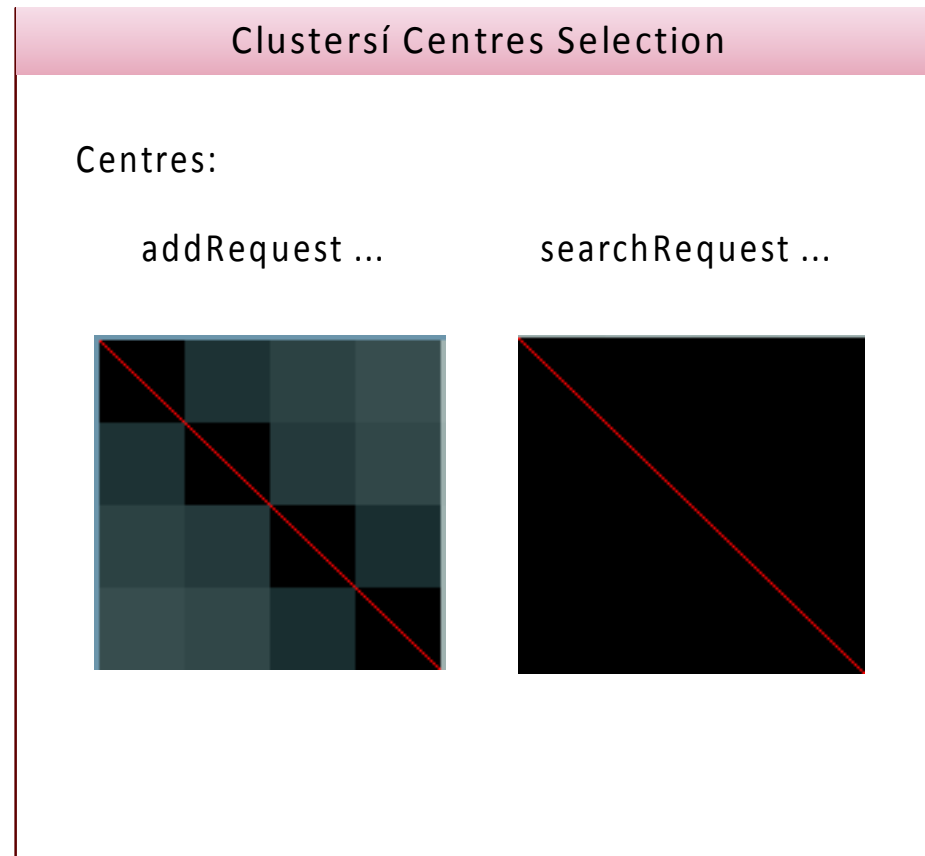
0.0000	0.2168	Ö	Ö	Ö	Ö
0.2168	0.0000	Ö	Ö	0.0000	0.1806
Ö	...	Ö	Ö	0.1806	0.0000

Manually select clusters to export



Design of Analysis Function

Step 5:





Evaluation

- Test Cases
 - Simple Object Access Protocol (SOAP)
 - Lightweight Directory Access Protocol (LDAP)
- Trace size: 1000 interactions for each test case
- Experiment
 - No Cluster – Not use analysis function
 - Whole Cluster – Require further searching in the selected cluster
 - Cluster Only – No further searching in the selected cluster



Evaluation

- Selected Clustering Methods
 - VAT : Visual Assessment of (cluster) Tendency
 - BEA : Bond Energy Algorithm
- Criteria for evaluating the effectiveness of our proposed approach
 - Identical
 - Protocol Conformant } Valid
 - Well-Formed (Well formed message, but out of sequence)
 - Ill-Formed } Invalid



Effectiveness Evaluation Results

- SOAP

Experiment	Cluster Method	No.	Valid	Ident.	Conf. ¹	Well-form. ²	Ill-form.
No Cluster	None	1,000	1,000	85	915	0	0
Whole Cluster	VAT	1,000	1,000	90	910	0	0
	BEA	1,000	1,000	82	918	0	0
Center Only	VAT	1,000	1,000	87	913	0	0
	BEA	1,000	1,000	92	908	0	0

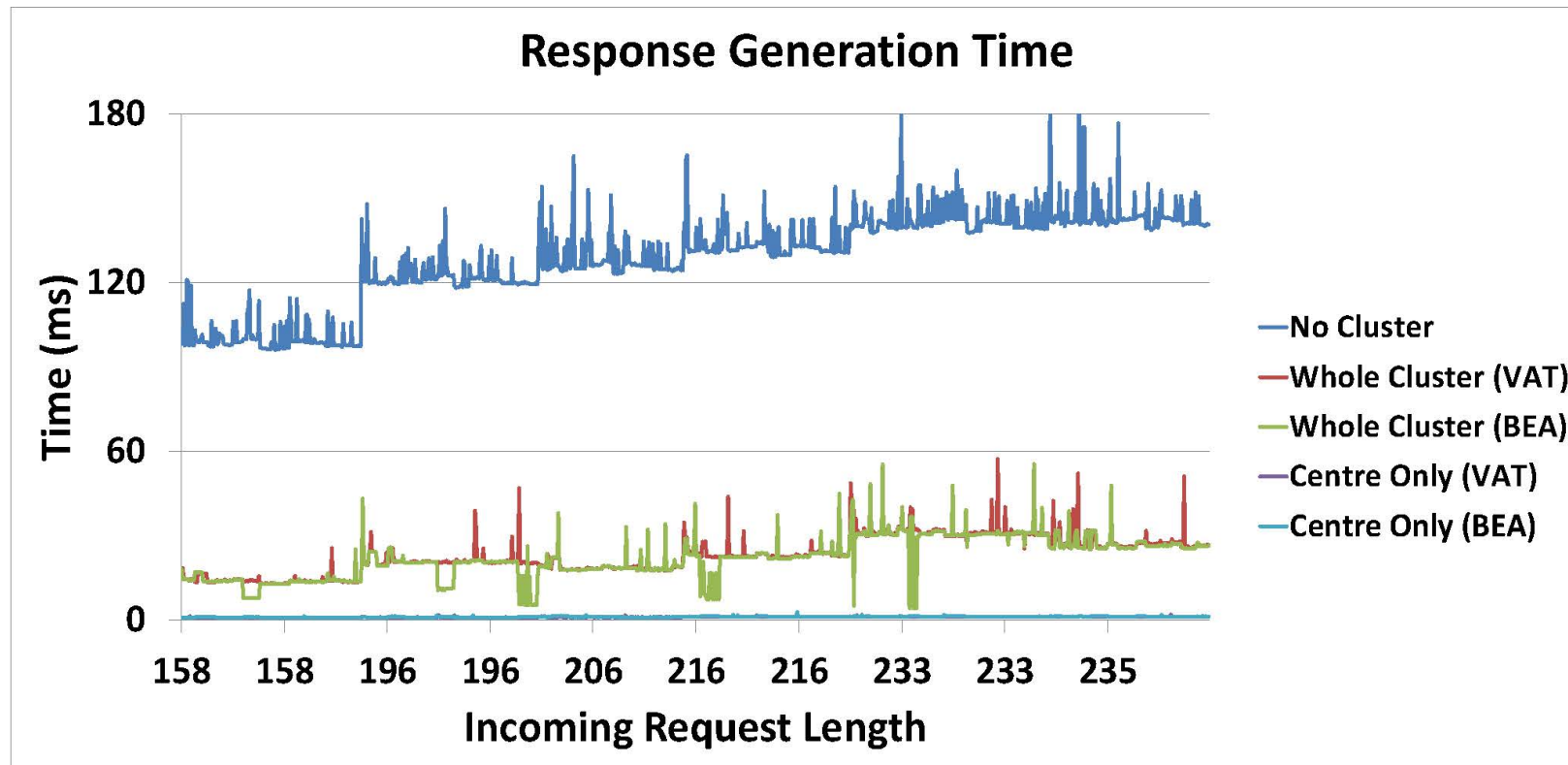
- LDAP

Experiment	Cluster Method	No.	Valid	Ident.	Conf. ²	Well-form. ³	Ill-form.
No Cluster	None	1,000	908	451	457	89	3
Whole Cluster	VAT	1,000	751	360	391	246	3
	BEA	1,000	753	383	370	241	6
Center Only	VAT	1,000	751	296	455	235	14
	BEA	1,000	761	330	431	232	7



Efficiency Evaluation Results

- SOAP

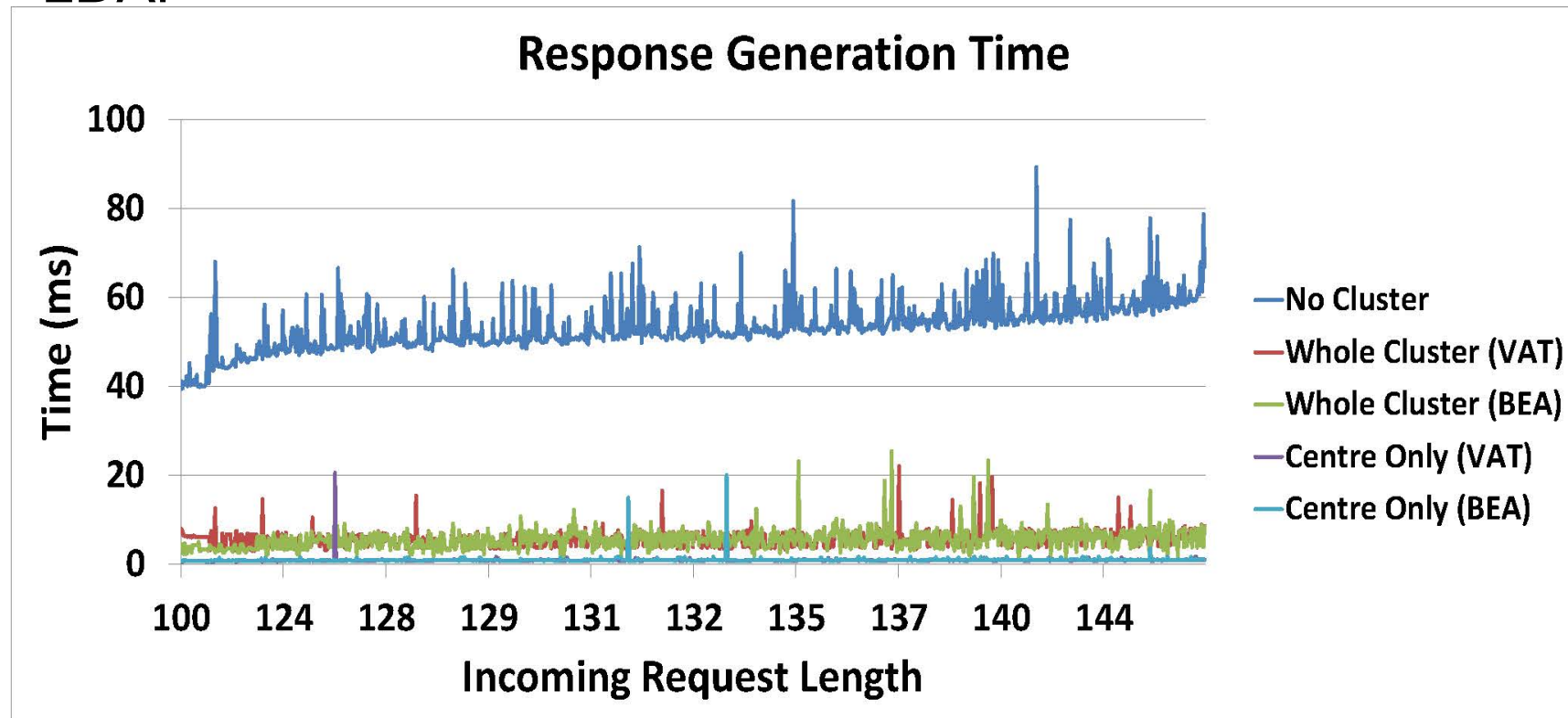


Generation Time for SOAP



Evaluation Results

- LDAP



Summary of Evaluation Results for LDAP



Result Summary

Experiment	Cluster Method(VAT)	Response Time(ms)	Dist. Calcs.	Accuracy
SOAP	No Cluster	128.6	899	100%
	Whole	22.92	156	100%
	Center	0.90	6	100%
LDAP	No Cluster	53.28	899	90.8%
	Whole	5.46	96	75.1%
	Center	0.79	11	75.1%



Future Work

- Relief the reliance on formation translation function of the network traffic capture tool
- Devise better cluster centre selection method
- Further improve the efficiency of distance calculation approach



Conclusion

- Using mining techniques before runtime
 - Greatly improve response generation time
 - Facilitate the mimicking of software interaction behaviours
 - Eliminate the required human effort

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Many thanks!

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