Ministerul Educaţiei al Republicii Moldova

Universitatea Tehnică a Moldovei

Catedra Informatică Aplicată

**RAPORT**

Lucrarea de laborator nr.3

Evaluarea Performatelor

A efectuat:

st. gr. C-171 D. Melniciuc

A verificat:

dr., conf.univ. E.Gutuleac

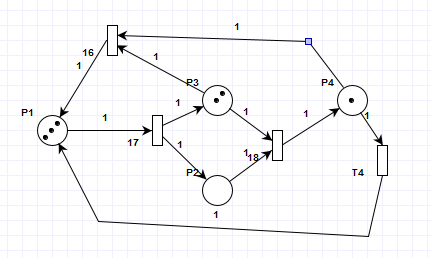
Chişinău 2019

***Scopul lucrării:***

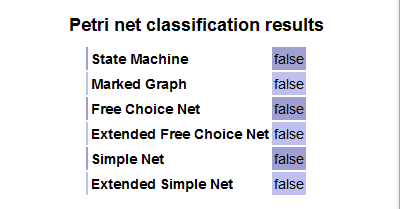
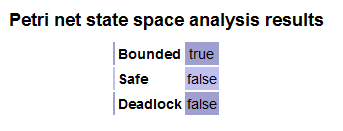
Verificarea si analiza unor indicatori QoS ai protocoalelor reconfigurabile modelate prin retele Petri generalizate stochastice folosind platforma PIPE

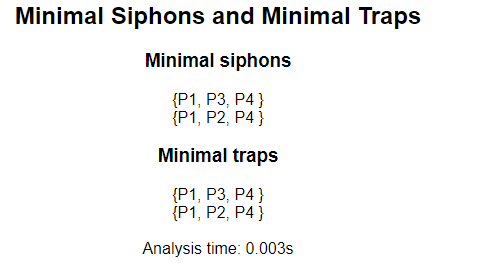
Actualmente, sistemele de calcul (SC) și rețelele de calculatoare (RC) cu arhitecturi orientate pe servicii în timp real cunosc o dezvoltare rapidă, atât sub aspectul complexităţii şi/sau al calității aplicaţiilor serviciilor caracterizate de indicatori QoS (Qualty of Service), cât şi al ariei de răspândir. Acest tip de SC și RC trebuie să aibă o flexibilitate, disponibilitate şi siguranţă în funcţionare (SF) deosebită. RC prezintă vulnerabilităţi în ceea ce priveşte securitatea datelor şi creează dificultăţi în asigurarea serviciilor de securitate în faţa multor tipuri de atacuri cum ar fi: interceptarea pasivă, interferenţa activă, personificarea, blackhole (gaura neagră), manipularea datelor şi refuzul serviciului. În acest context, apare necesitatea de a modela comportamentul atacatorilor şi a evalua unii indicatori SF ai RC, care este capacitatea acestora de aşi indeplini misiunea, într-un interval de timp stabilit, în prezenţa atacurilor intruşilor. Analiza cantitativă a SF a diferitor SC și RC a avut o mare atenţie timp de mai multe decenii. Cu toate acestea cuantificarea securităţii informationnale a RC şi a riscurilor de atac au atras doar recent mai multă atenţie. Lucrări conceptuale bazate pe modele matematice serioase de evaluare a atucurilor și a mecanismelor de securitate au fost publicate doar recent [10, 11, 16, 19]. Metodele uzuale de modelare ale comportării atacatorilor şi a evaluării riscului compromiterii SF al RC sunt arborii de defectare şi de atac teoria jocurilor matematice , lanţurile Markov timp continuu (LMTC) . Abordarea prin LMTC poate fi folosită doar pentru modelarea unei clase restrânse a astfel de procese ce au un spaţiu mic de stări, deoarece el poate fi construit numai în mod manual şi deci, apar probleme cu validarea acestor tipuri de modele. În acest context, apare necesitatea de a automatiza procesul de construire al LMTC, luând în consideraţie astfel de fenomene cum ar fi: competiţia, sincronizarea, situaţii de conflict, excludere mutuală, aşteptare etc.

Metodele tradiţionale de modelare și analiză a indicatorilor QoS la atac folosesc date referitoare la parametrii componentelor (ratele de defectare şi de restabilire ale componentelor, ratele de atac şi apărare etc.) care se presupune că sunt cunoscute cu anumită precizie şi apoi validate prin experienţe reale. Însă, deseori, revenirea la experienţe, cu regret, este insuficientă pentru a valida cu precizia specificată a parametrilor de defectare, vulnerabilitate şi atac. De asemenea, la modelarea şi analiza indicatorilor QoS ai RC una dintre cele mai importante subiecte care trebuie luată în considerare este incertitudinea, legată de motivul pentru care parametrii modelului sunt, de obicei, sub forma unor parametri incerţi.

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***Mersul Lucrarii:***

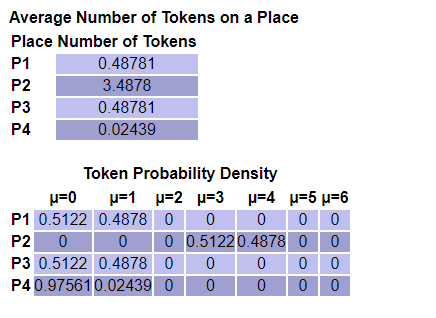
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## GSPN Steady State Analysis Results

|  |
| --- |
| **Set of Tangible States** |

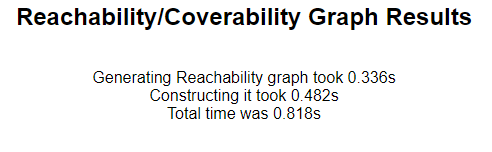
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| |  |  |  |  |  | | --- | --- | --- | --- | --- | |  | **P1** | **P2** | **P3** | **P4** | | **M0** | 3 | 0 | 2 | 1 | | **M1** | 4 | 0 | 2 | 0 | | **M2** | 2 | 1 | 3 | 1 | | **M3** | 4 | 0 | 1 | 0 | | **M4** | 3 | 1 | 3 | 0 | | **M5** | 2 | 0 | 2 | 2 | | **M6** | 1 | 2 | 4 | 1 | | **M7** | 3 | 1 | 2 | 0 | | **M8** | 2 | 2 | 4 | 0 | | **M9** | 1 | 1 | 3 | 2 | | **M10** | 3 | 0 | 1 | 1 | | **M11** | 0 | 3 | 5 | 1 | | **M12** | 2 | 2 | 3 | 0 | | **M13** | 1 | 3 | 5 | 0 | | **M14** | 1 | 0 | 2 | 3 | | **M15** | 0 | 2 | 4 | 2 | | **M16** | 2 | 1 | 2 | 1 | | **M17** | 4 | 0 | 0 | 0 | | **M18** | 1 | 3 | 4 | 0 | | **M19** | 0 | 4 | 6 | 0 | | **M20** | 0 | 1 | 3 | 3 | | **M21** | 2 | 0 | 1 | 2 | | **M22** | 1 | 2 | 3 | 1 | | **M23** | 3 | 1 | 1 | 0 | | **M24** | 0 | 4 | 5 | 0 | | **M25** | 0 | 0 | 2 | 4 | | **M26** | 1 | 1 | 2 | 2 | | **M27** | 3 | 0 | 0 | 1 | | **M28** | 0 | 3 | 4 | 1 | | **M29** | 2 | 2 | 2 | 0 | | **M30** | 1 | 0 | 1 | 3 | | **M31** | 0 | 2 | 3 | 2 | | **M32** | 2 | 1 | 1 | 1 | | **M33** | 1 | 3 | 3 | 0 | | **M34** | 0 | 1 | 2 | 3 | | **M35** | 2 | 0 | 0 | 2 | | **M36** | 1 | 2 | 2 | 1 | | **M37** | 3 | 1 | 0 | 0 | | **M38** | 0 | 4 | 4 | 0 | | **M39** | 0 | 0 | 1 | 4 | | **M40** | 1 | 1 | 1 | 2 | | **M41** | 0 | 3 | 3 | 1 | | **M42** | 2 | 2 | 1 | 0 | | **M43** | 1 | 0 | 0 | 3 | | **M44** | 0 | 2 | 2 | 2 | | **M45** | 2 | 1 | 0 | 1 | | **M46** | 1 | 3 | 2 | 0 | | **M47** | 0 | 1 | 1 | 3 | | **M48** | 1 | 2 | 1 | 1 | | **M49** | 0 | 4 | 3 | 0 | | **M50** | 0 | 0 | 0 | 4 | | **M51** | 1 | 1 | 0 | 2 | | **M52** | 0 | 3 | 2 | 1 | | **M53** | 2 | 2 | 0 | 0 | | **M54** | 0 | 2 | 1 | 2 | | **M55** | 1 | 3 | 1 | 0 | | **M56** | 0 | 1 | 0 | 3 | | **M57** | 1 | 2 | 0 | 1 | | **M58** | 0 | 4 | 2 | 0 | | **M59** | 0 | 3 | 1 | 1 | | **M60** | 0 | 2 | 0 | 2 | | **M61** | 1 | 3 | 0 | 0 | | **M62** | 0 | 4 | 1 | 0 | | **M63** | 0 | 3 | 0 | 1 | |



## **Steady State Analysis Results**

|  |
| --- |
| **Set of Tangible States** |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| |  |  |  |  |  | | --- | --- | --- | --- | --- | |  | **P1** | **P2** | **P3** | **P4** | | **M0** | 3 | 0 | 2 | 1 | | **M1** | 4 | 0 | 2 | 0 | | **M2** | 2 | 1 | 3 | 1 | | **M3** | 4 | 0 | 1 | 0 | | **M4** | 3 | 1 | 3 | 0 | | **M5** | 2 | 0 | 2 | 2 | | **M6** | 1 | 2 | 4 | 1 | | **M7** | 3 | 1 | 2 | 0 | | **M8** | 2 | 2 | 4 | 0 | | **M9** | 1 | 1 | 3 | 2 | | **M10** | 3 | 0 | 1 | 1 | | **M11** | 0 | 3 | 5 | 1 | | **M12** | 2 | 2 | 3 | 0 | | **M13** | 1 | 3 | 5 | 0 | | **M14** | 1 | 0 | 2 | 3 | | **M15** | 0 | 2 | 4 | 2 | | **M16** | 2 | 1 | 2 | 1 | | **M17** | 4 | 0 | 0 | 0 | | **M18** | 1 | 3 | 4 | 0 | | **M19** | 0 | 4 | 6 | 0 | | **M20** | 0 | 1 | 3 | 3 | | **M21** | 2 | 0 | 1 | 2 | | **M22** | 1 | 2 | 3 | 1 | | **M23** | 3 | 1 | 1 | 0 | | **M24** | 0 | 4 | 5 | 0 | | **M25** | 0 | 0 | 2 | 4 | | **M26** | 1 | 1 | 2 | 2 | | **M27** | 3 | 0 | 0 | 1 | | **M28** | 0 | 3 | 4 | 1 | | **M29** | 2 | 2 | 2 | 0 | | **M30** | 1 | 0 | 1 | 3 | | **M31** | 0 | 2 | 3 | 2 | | **M32** | 2 | 1 | 1 | 1 | | **M33** | 1 | 3 | 3 | 0 | | **M34** | 0 | 1 | 2 | 3 | | **M35** | 2 | 0 | 0 | 2 | | **M36** | 1 | 2 | 2 | 1 | | **M37** | 3 | 1 | 0 | 0 | | **M38** | 0 | 4 | 4 | 0 | | **M39** | 0 | 0 | 1 | 4 | | **M40** | 1 | 1 | 1 | 2 | | **M41** | 0 | 3 | 3 | 1 | | **M42** | 2 | 2 | 1 | 0 | | **M43** | 1 | 0 | 0 | 3 | | **M44** | 0 | 2 | 2 | 2 | | **M45** | 2 | 1 | 0 | 1 | | **M46** | 1 | 3 | 2 | 0 | | **M47** | 0 | 1 | 1 | 3 | | **M48** | 1 | 2 | 1 | 1 | | **M49** | 0 | 4 | 3 | 0 | | **M50** | 0 | 0 | 0 | 4 | | **M51** | 1 | 1 | 0 | 2 | | **M52** | 0 | 3 | 2 | 1 | | **M53** | 2 | 2 | 0 | 0 | | **M54** | 0 | 2 | 1 | 2 | | **M55** | 1 | 3 | 1 | 0 | | **M56** | 0 | 1 | 0 | 3 | | **M57** | 1 | 2 | 0 | 1 | | **M58** | 0 | 4 | 2 | 0 | | **M59** | 0 | 3 | 1 | 1 | | **M60** | 0 | 2 | 0 | 2 | | **M61** | 1 | 3 | 0 | 0 | | **M62** | 0 | 4 | 1 | 0 | | **M63** | 0 | 3 | 0 | 1 | |



## **Petri net invariant analysis results**

### **T-Invariants**

|  |  |  |  |
| --- | --- | --- | --- |
| **16** | **17** | **18** | **T4** |
| 0 | 1 | 1 | 1 |

The net is not covered by positive T-Invariants, therefore we do not know if it is bounded and live.

### **P-Invariants**

|  |  |  |  |
| --- | --- | --- | --- |
| **P1** | **P2** | **P3** | **P4** |
| 1 | 1 | 0 | 1 |

The net is not covered by positive P-Invariants, therefore we do not know if it is bounded.

### **P-Invariant equations**

M(P1)+M(P2)+M(P4)=4  
  
Analysis time: 0.0s

## **Petri net incidence and marking**

|  |
| --- |
| **Forwards incidence matrix *I+*** |
| |  |  |  |  |  | | --- | --- | --- | --- | --- | |  | **16** | **17** | **18** | **T4** | | **P1** | 1 | 0 | 0 | 1 | | **P2** | 0 | 1 | 0 | 0 | | **P3** | 0 | 1 | 0 | 0 | | **P4** | 0 | 0 | 1 | 0 | |

|  |
| --- |
| **Backwards incidence matrix *I-*** |
| |  |  |  |  |  | | --- | --- | --- | --- | --- | |  | **16** | **17** | **18** | **T4** | | **P1** | 0 | 1 | 0 | 0 | | **P2** | 0 | 0 | 1 | 0 | | **P3** | 1 | 0 | 1 | 0 | | **P4** | 1 | 0 | 0 | 1 | |

|  |
| --- |
| **Combined incidence matrix *I*** |
| |  |  |  |  |  | | --- | --- | --- | --- | --- | |  | **16** | **17** | **18** | **T4** | | **P1** | 1 | -1 | 0 | 1 | | **P2** | 0 | 1 | -1 | 0 | | **P3** | -1 | 1 | -1 | 0 | | **P4** | -1 | 0 | 1 | -1 | |

|  |
| --- |
| **Inhibition matrix *H*** |
| |  |  |  |  |  | | --- | --- | --- | --- | --- | |  | **16** | **17** | **18** | **T4** | | **P1** | 0 | 0 | 0 | 0 | | **P2** | 0 | 0 | 0 | 0 | | **P3** | 0 | 0 | 0 | 0 | | **P4** | 0 | 0 | 0 | 0 | |

|  |
| --- |
| **Marking** |
| |  |  |  |  |  | | --- | --- | --- | --- | --- | |  | **P1** | **P2** | **P3** | **P4** | | **Initial** | 3 | 0 | 2 | 1 | | **Current** | 3 | 0 | 2 | 1 | |

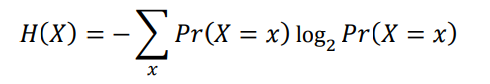
|  |
| --- |
| **Enabled transitions** |
| |  |  |  |  | | --- | --- | --- | --- | | **16** | **17** | **18** | **T4** | | yes | yes | no | yes | |

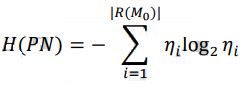
## Petri net simulation results

|  |  |  |
| --- | --- | --- |
| **Place** | **Average number of tokens** | **95% confidence interval (+/-)** |
| **P1** | 1.76238 | 1.00673 |
| **P2** | 1.90099 | 1.02395 |
| **P3** | 3.90099 | 1.81148 |
| **P4** | 0.33663 | 0.04357 |

**Entropia RPGS**

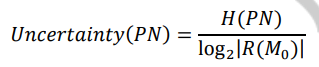
Entropia poate măsura cantitatea de tulburare, care este asociat cu o variabilă aleatorie.



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***Entropia unei RPGS e definita prin relatia:***

***Indicatorul de incetritudine RPGS:***



Acest indicator trebuie sa aiba vaoloare intre 0 si 1

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| M0 | 0.0338 | 4.886833 | 0.16517 | 0.16513 |
| M1 | 0.0336 | 4.895395 | 0.16448 | 0.16538 |
| M2 | 0.00457 | 7.77359 | 0.03552 | 0.03642 |
| M3 | 0.0346 | 4.853084 | 0.16791 | 0.16817 |
| M4 | 0.07247 | 3.786472 | 0.2744 | 0.27466 |
| M5 | 0.07457 | 3.745261 | 0.27928 | 0.28018 |
| M6 | 0.07256 | 3.784682 | 0.27461 | 0.27551 |
| M7 | 0.07436 | 3.749329 | 0.2788 | 0.2797 |
| M8 | 0.02245 | 5.477141 | 0.12296 | 0.12242 |
| M9 | 0.05772 | 4.114785 | 0.2375 | 0.23776 |
| M10 | 0.04736 | 4.400187 | 0.20839 | 0.20785 |
| M11 | 0.03874 | 4.690032 | 0.18169 | 0.18165 |
| M12 | 0.08746 | 3.515233 | 0.30744 | 0.3077 |
| M13 | 0.00731 | 7.095913 | 0.05187 | 0.05277 |
| M14 | 0.01746 | 5.839803 | 0.10196 | 0.10142 |
| M15 | 0.03457 | 4.854336 | 0.16781 | 0.16727 |
| M16 | 0.08171 | 3.613344 | 0.29524 | 0.2952 |
| M17 | 0.0451 | 4.470729 | 0.20162 | 0.20252 |
| M18 | 0.04728 | 4.402626 | 0.20815 | 0.20761 |
| M19 | 0.01135 | 6.461164 | 0.07333 | 0.07329 |
| M20 | 0.01244 | 6.32887 | 0.07873 | 0.07899 |
| M21 | 0.01354 | 6.206628 | 0.08403 | 0.08493 |
| M22 | 0.09153 | 3.449612 | 0.31574 | 0.31664 |
| M23 | 0.00532 | 7.554358 | 0.04018 | 0.04014 |
| M24 | 0.05416 | 4.206628 | 0.22783 | 0.22729 |
| M25 | 0.03442 | 4.860609 | 0.1673 | 0.1682 |
| M26 | 0.00242 | 8.690777 | 0.02103 | 0.02129 |
| M27 | 0.00643 | 7.280966 | 0.04681 | 0.04677 |
| M28 | 0.08432 | 3.567981 | 0.30085 | 0.30081 |
| M29 | 0.04147 | 4.591788 | 0.19042 | 0.19038 |
| M30 | 0.07423 | 3.751854 | 0.2785 | 0.27876 |
| M31 | 0.01343 | 6.218397 | 0.08351 | 0.08297 |
| M32 | 0.06563 | 3.929501 | 0.25789 | 0.25735 |
| M33 | 0.01235 | 6.339345 | 0.07829 | 0.07775 |
| M34 | 0.01324 | 6.238953 | 0.0826 | 0.08256 |
| M35 | 0.00421 | 7.891964 | 0.03322 | 0.03268 |
| M36 | 0.06967 | 3.843319 | 0.26776 | 0.26802 |
| M37 | 0.01535 | 6.025618 | 0.09249 | 0.09339 |
| M38 | 0.06435 | 3.957916 | 0.25469 | 0.25465 |
| M39 | 0.01173 | 6.413653 | 0.07523 | 0.07549 |
| M40 | 0.01452 | 6.105815 | 0.08865 | 0.08811 |
| M41 | 0.03624 | 4.786273 | 0.17345 | 0.17291 |
| M42 | 0.05542 | 4.173449 | 0.23129 | 0.23125 |
| M43 | 0.06234 | 4.003698 | 0.24959 | 0.24985 |
| M44 | 0.02024 | 5.626647 | 0.11388 | 0.11384 |
| M45 | 0.05843 | 4.097147 | 0.23939 | 0.23965 |
| M46 | 0.06834 | 3.871126 | 0.26455 | 0.26451 |
| M47 | 0.00543 | 7.524832 | 0.04085 | 0.04111 |
| M48 | 0.06123 | 4.029618 | 0.24673 | 0.24669 |
| M49 | 0.03289 | 4.926207 | 0.16202 | 0.16292 |
| M50 | 0.03542 | 4.819292 | 0.17069 | 0.17065 |
| M51 | 0.0635 | 3.9771 | 0.25254 | 0.252 |
| M52 | 0.03846 | 4.700497 | 0.18078 | 0.18168 |
| M53 | 0.02123 | 5.557752 | 0.11799 | 0.11889 |
| M54 | 0.02533 | 5.303009 | 0.13432 | 0.13378 |
| M55 | 0.00623 | 7.326552 | 0.04564 | 0.0459 |
| M56 | 0.00323 | 8.27425 | 0.02672 | 0.02618 |
| M57 | 0.07523 | 3.732548 | 0.28079 | 0.28025 |
| M58 | 0.00645 | 7.276485 | 0.04693 | 0.04783 |
| M59 | 0.01263 | 6.307002 | 0.07965 | 0.08055 |
| M60 | 0.0133 | 6.23243 | 0.08289 | 0.08379 |
| M61 | 0.01728 | 5.854753 | 0.10117 | 0.10143 |
| M62 | 0.05478 | 4.190207 | 0.22953 | 0.22979 |
| M63 | 0.67654 | 0.563753 | 0.3814 | 0.3813 |
| **suma** | 3.05397 |  |  |  |
|  |  |  |  |  |

µ1 = 0.508995

µ2 = 0.48235

µ3 = 0.4752

µ4 = 0.446523

***Concluzie:***

Dupa efectuarea laborotorului am dobintid experienta in Evaluarea Perfomantelor verificind si analiaind indicatori QoS folosind platforma PIPE