DOCUMENTATIE

TEMA 2

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CUPRINS

1. Obiectivul temei

Proiectarea si implementarea o aplicatie care sa analizeze sistemele bazate pe cozi de asteptare prin (1) simularea unei serii de N clienti care sosesc pentru servicii, intrand in Q cozi, asteptand, fiind serviti si in cele din urma parasind cozile si (2) calcularea timpului mediu de asteptare, timpului mediu de servire si a orei de varf.

Obiectivele secundare sunt:

- Analiza problemei si identificarea cerintelor
- Proiectarea aplicatiei de simulare
- Implementarea aplicatiei de simulare
- Testarea aplicatiei

2. Analiza problemei, modelare, scenarii, cazuri de utilizare

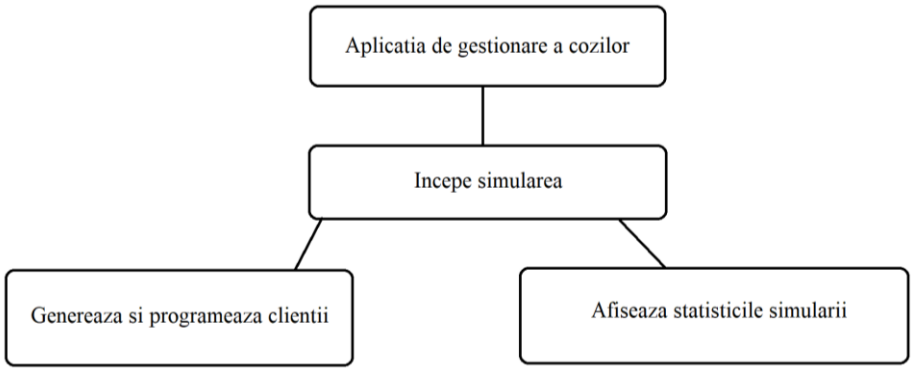
Cerinte functionale:

- Aplicatia de simulare ar trebui sa permita utilizatorilor să configureze simularea
- Aplicatia de simulare ar trebui sa permita utilizatorilor sa porneasca simularea
- Aplicatia de simulare ar trebui sa afiseze evolutia cozilor în timp real

Cerinte non-functionale:

- Aplicatia de simulare ar trebui să fie intuitiva si usor de utilizat de catre utilizator
- Eficacitatea: Aplicatia de simulare ar trebui sa fie eficienta in ceea ce priveste utilizarea resurselor sistemului
- Scalabilitate: Aplicatia de simulare ar trebui sa poata gestiona un numar mare de clienti si cozi fara a compromite performanta

Diagrama cazurilor de utilizare pentru o aplicatie de gestionare a cozilor care atribuie clientii la cozi:



Descrierea use-case-urilor sub forma unei liste:

1. Incepe Simularea:
    - utilizatorul introduce parametrii de simulare (numarul de clienti, numarul de cozi, durata limita, timpul de sosire minim/maxim si timpul de procesare minim/maxim).
    - utilizatorul porneste simularea.
    - aplicatia genereaza clientii si atribuie timpul de sosire si timpul de procesare in functie de parametrii specificati.
    - aplicatia programeaza si adauga clientii la cozile in functie de strategia de minimizare a timpului de asteptare.

2. Genereaza si Programeaza Clientii:
    - aplicatia genereaza un numar specificat de clienti.
    - aplicatia atribuie fiecarui client un timp de sosire si un timp de procesare aleatoriu in functie de parametrii specificati.
    - aplicatia sorteaza clientii in functie de timpul de sosire.
    - pe masura ce clientii sosesc, aplicatia le atribuie cozilor, astfel incat sa minimizeze timpul de asteptare.
    -
3. Afiseaza si Inregistreaza Statisticile Simularii:
    - aplicatia monitorizeaza statisticile simularii, cum ar fi timpul de asteptare mediu, timpul de servire mediu si numarul de clienti aflati in asteptare in timpul de varf.
    - la fiecare unitate de timp, aplicatia actualizeaza si afiseaza statisticile in timp real.
    - aplicatia inregistreaza statisticile intr-un fisier de log pentru analiza ulterioara.

3. Proiectare

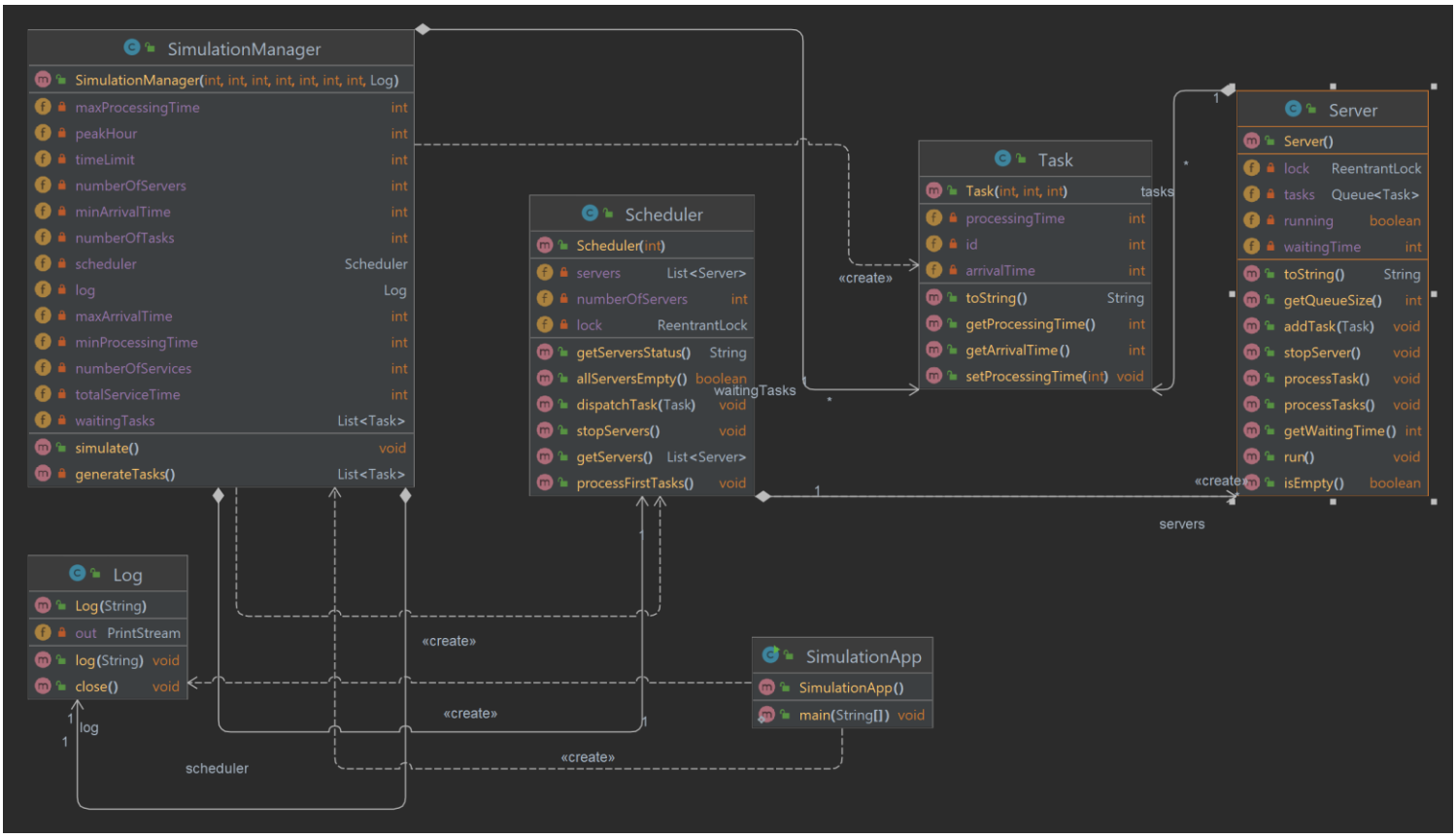
Structuri de date folosite: Cozi: Folositi cozi pentru a reprezenta cozile de clienti care asteapta la casele de marcat. Aceasta structura de date este potrivita, deoarece coada este o structura de date First-In-First-Out (FIFO), ceea ce inseamna ca primul client care intra in coada va fi si primul care va fi servit.

Algoritmii folositi sunt:

Algoritmul de distribuire a task-urilor (clientilor) catre servere (casele de marcat): Scheduler distribuie task-urile catre serverul cu cele mai putine task-uri in coada.

Algoritmul de simulare: SimulationManager ruleaza simularea, procesand task-urile in functie de timpul lor de sosire si de procesare, si calculeaza statisticile, cum ar fi timpul mediu de asteptare si timpul mediu de servire.

Diagrama UML a aplicatiei de gestionare a cozilor care atribuie clienții la cozi:



4. Implementare

Clasa Task

Reprezinta un task (client) care are un timp de sosire si un timp de procesare. Un task este creat cu un ID unic, timpul sau de sosire si timpul sau de procesare.

Campuri:

- id: ID-ul unic al task-ului (clientului).
- arrivalTime: Timpul de sosire al task-ului (clientului) în sistem.
- processingTime: Timpul necesar pentru a procesa task-ul (clientului) de catre un server (casa de marcat).

Metode:

- getArrivalTime(): Returneaza timpul de sosire al task-ului.
- getProcessingTime(): Returneaza timpul de procesare al task-ului.
- setProcessingTime(int processingTime): Seteaza timpul de procesare al task-ului.

Clasa Server

Reprezinta un server (coada, casa de marcat) care proceseaza task-uri (clienti). Serverul are o coada de task-uri, un timp de asteptare si un obiect de blocare (ReentrantLock). Cand serverul este pornit, proceseaza task-urile din coada sa.

Campuri:

- tasks: O coada de task-uri (clienti) care asteapta sa fie procesati.
- waitingTime: Timpul total de asteptare pentru toate task-urile din coada.
- lock: Un obiect de tip ReentrantLock pentru a asigura sincronizarea intre firele de executie.
- running: Un camp boolean care indica daca serverul este in executie sau oprit.

Metode:

- run(): Implementarea metodei Runnable care permite serverului sa fie executat intr-un fir de executie separat.
- stopServer(): Opreste serverul.
- isEmpty(): Verifica daca coada de task-uri este goala.
- getQueueSize(): Returneaza dimensiunea cozii de task-uri.
- addTask(Task task): Adauga un task in coada si actualizeaza timpul de asteptare.
- processTask(): Proceseaza primul task din coada (daca exista) si ii scade timpul de procesare.
- processTasks(): Proceseaza toate task-urile din coada, reducand timpul de procesare pentru fiecare si eliminand task-urile completate.
- getWaitingTime(): Returneaza timpul total de asteptare pentru task-urile din coada.

Clasa SimulationManager

Gestioneaza simularea si contine parametrii si metodele necesare pentru a rula simularea. Creeaza task-uri, le distribuie catre servere si calculeaza statisticile, cum ar fi timpul mediu de asteptare si timpul mediu de servire.

Campuri:

- timeLimit, maxProcessingTime, maxArrivalTime, minArrivalTime, minProcessingTime, numberOfServers, numberOfTasks: Parametrii de intrare pentru simulare.
- waitingTasks: O lista de task-uri care asteapta sa fie distribuite catre servere.
- scheduler: O instanta a clasei Scheduler care gestioneaza serverele.
- log: O instanta a clasei Log pentru a inregistra rezultatele simularii.

Metode:

- generateTasks(): Genereaza task-urile (clientii) ale simularii în functie de parametrii de intrare.
- simulate(): Ruleaza simularea, distribuie task-urile catre servere, proceseaza task-urile si calculeaza statisticile.

Clasa Scheduler

Gestioneaza serverele si distribuie task-uri (clienti) catre acestea in functie de dimensiunea cozilor. Schedulerul are o lista de servere, un numar de servere si un obiect de blocare (ReentrantLock).

Campuri:

- servers: O lista de servere (case de marcat).
- numberOfServers: Numarul de servere din simulare.
- lock: Un obiect de tip ReentrantLock pentru a asigura sincronizarea intre firele de executie.

Metode:

- dispatchTask(Task task): Distribuie un task (client) catre cel mai potrivit server (casa de marcat) in functie de dimensiunea cozii.
- processFirstTasks(): Proceseaza primul task din coada fiecarui server.
- getServersStatus(): Returneaza starea tuturor serverelor sub forma unui sir de caractere.
- allServersEmpty(): Verifica daca toate serverele au coada goala.
- stopServers(): Opreste toate serverele din lista.
- getServers(): Returneaza lista de servere.

Clasa Log

Responsabila pentru a scrie in fisierul de log. Contine un obiect de tip PrintStream pentru a scrie in fisier si metode pentru a inregistra mesaje si a inchide fluxul de iesire.

Campuri: out: Un obiect de tip PrintStream pentru a scrie in fisierul de log.

Metode:

- log(String message): Scrie un mesaj in fisierul de log.
- close(): Inchide fluxul de iesire si elibereaza resursele alocate.

Clasa SimulationApp

Aceasta este clasa principala a aplicatiei care contine metoda main. Initializeaza parametrii de simulare, creeaza instanta SimulationManager si ruleaza simularea. De asemenea, creeaza o instanta a clasei Log pentru a inregistra rezultatele simularii.

Metode: main(String[] args): Punctul de intrare al aplicatiei. Initializeaza parametrii de simulare si instantiaza clasele necesare pentru a rula simularea.

5. Rezultate

Pentru a testa aplicatia, am folosit trei seturi de date de intrare diferite, prezentate in tabelul de mai jos. Aceste seturi de date au fost utilizate pentru a evalua comportamentul si performanta aplicatiei in diferite scenarii.

Test 1
N = 4
Q = 2
$tsimulation\ MAX$ = 60 secunde
[$tarrival\ MIN, tarrival\ MAX$] = [2, 30]
[$tservice\ MIN, tservice\ MAX$] = [2, 4]

Rezultatele testului:

Time 0
Waiting clients: (1,17,2); (2,24,3); (3,16,4); (4,28,2);
Queue 1: closed
Queue 2: closed

Time 1
Waiting clients: (1,17,2); (2,24,3); (3,16,4); (4,28,2);
Queue 1: closed
Queue 2: closed

Time 2
Waiting clients: (1,17,2); (2,24,3); (3,16,4); (4,28,2);
Queue 1: closed
Queue 2: closed

…

…

Time 16
Waiting clients: (1,17,2); (2,24,3); (4,28,2);
Queue 1: (3,16,4);
Queue 2: closed

Time 17
Waiting clients: (2,24,3); (4,28,2);
Queue 1: (3,16,3);
Queue 2: (1,17,2);

Time 18
Waiting clients: (2,24,3); (4,28,2);
Queue 1: (3,16,2);
Queue 2: (1,17,1);

Time 19
Waiting clients: (2,24,3); (4,28,2);
Queue 1: (3,16,1);
Queue 2: closed

Time 20
Waiting clients: (2,24,3); (4,28,2);
Queue 1: closed
Queue 2: closed

Time 21
Waiting clients: (2,24,3); (4,28,2);
Queue 1: closed
Queue 2: closed

Time 22
Waiting clients: (2,24,3); (4,28,2);
Queue 1: closed
Queue 2: closed

Time 23
Waiting clients: (2,24,3); (4,28,2);
Queue 1: closed
Queue 2: closed

Time 24
Waiting clients: (4,28,2);
Queue 1: (2,24,3);
Queue 2: closed

```
169
170     Time 17
171     Waiting clients:
172     (2,24,3);
173     (4,28,2);
174
175     Queue 1: (3,16,3);
176     Queue 2: (1,17,2);
177
178     Time 18
179     Waiting clients:
180     (2,24,3);
181     (4,28,2);
182
183     Queue 1: (3,16,2);
184     Queue 2: (1,17,1);
185
186     Time 19
187     Waiting clients:
188     (2,24,3);
189     (4,28,2);
190
191     Queue 1: (3,16,1);
192     Queue 2: closed
```

Aceleasi rezultate in fisierul text – Test 1

Time 25
Waiting clients: (4,28,2);
Queue 1: (2,24,2);
Queue 2: closed

Time 26
Waiting clients: (4,28,2);
Queue 1: (2,24,1);
Queue 2: closed

Time 27
Waiting clients: (4,28,2);
Queue 1: closed
Queue 2: closed

Time 28
Waiting clients:
Queue 1: (4,28,2);
Queue 2: closed

Time 29
Waiting clients:
Queue 1: (4,28,1);
Queue 2: closed

Time 30
Waiting clients:
Queue 1: closed
Queue 2: closed

…
Time 59
Waiting clients:
Queue 1: closed
Queue 2: closed

Average waiting time: 21.25
Average service time: 2.75

Process finished with exit code 0

Rezultatele din consola vor fi de asemenea incluse intr-un fisier text, in acelasi proiect

Test 2
N = 50
Q = 5
$tsimulation\ MAX$ = 60 secunde
[$tarrival\ MIN$, $tarrival\ MAX$] = [2, 40]
[$tservice\ MIN$, $tservice\ MAX$] = [1, 7]

Rezultatele testului:

Time 0

Waiting clients: (1,29,7); (2,33,6); (3,19,4); (4,26,3); (5,17,5); (6,39,4); (7,14,6); (8,24,7); (9,14,4); (10,27,5); (11,22,2); (12,31,5); (13,15,1); (14,39,6); (15,31,7); (16,32,7); (17,36,5); (18,24,5); (19,34,2); (20,6,4); (21,30,1); (22,33,1); (23,10,5); (24,37,6); (25,28,1); (26,12,2); (27,7,7); (28,31,6); (29,14,5); (30,36,3); (31,9,5); (32,6,7); (33,36,3); (34,12,3); (35,6,4); (36,33,5); (37,25,7); (38,17,2); (39,32,5); (40,26,6); (41,24,6); (42,26,2); (43,2,4); (44,27,4); (45,4,4); (46,36,4); (47,27,4); (48,20,7); (49,14,4); (50,12,5);

Queue 1: closed

Queue 2: closed

Queue 3: closed

Queue 4: closed

Queue 5: closed

Time 1

Waiting clients: (1,29,7); (2,33,6); (3,19,4); (4,26,3); (5,17,5); (6,39,4); (7,14,6); (8,24,7); (9,14,4); (10,27,5); (11,22,2); (12,31,5); (13,15,1); (14,39,6); (15,31,7); (16,32,7); (17,36,5); (18,24,5); (19,34,2); (20,6,4); (21,30,1); (22,33,1); (23,10,5); (24,37,6); (25,28,1); (26,12,2); (27,7,7); (28,31,6); (29,14,5); (30,36,3); (31,9,5); (32,6,7); (33,36,3); (34,12,3); (35,6,4); (36,33,5); (37,25,7); (38,17,2); (39,32,5); (40,26,6); (41,24,6); (42,26,2); (43,2,4); (44,27,4); (45,4,4); (46,36,4); (47,27,4); (48,20,7); (49,14,4); (50,12,5);

Queue 1: closed

Queue 2: closed

Queue 3: closed

Queue 4: closed

Queue 5: closed

Time 2

Waiting clients: (1,29,7); (2,33,6); (3,19,4); (4,26,3); (5,17,5); (6,39,4); (7,14,6); (8,24,7); (9,14,4); (10,27,5); (11,22,2); (12,31,5); (13,15,1); (14,39,6); (15,31,7); (16,32,7); (17,36,5); (18,24,5); (19,34,2); (20,6,4); (21,30,1); (22,33,1); (23,10,5); (24,37,6); (25,28,1); (26,12,2); (27,7,7); (28,31,6); (29,14,5); (30,36,3); (31,9,5); (32,6,7); (33,36,3); (34,12,3); (35,6,4); (36,33,5); (37,25,7); (38,17,2); (39,32,5); (40,26,6); (41,24,6); (42,26,2); (44,27,4); (45,4,4); (46,36,4); (47,27,4); (48,20,7); (49,14,4); (50,12,5);

Queue 1: (43,2,4);

Queue 2: closed

Queue 3: closed

Queue 4: closed

Queue 5: closed

Time 3

Waiting clients: (1,29,7); (2,33,6); (3,19,4); (4,26,3); (5,17,5); (6,39,4); (7,14,6); (8,24,7); (9,14,4); (10,27,5); (11,22,2); (12,31,5); (13,15,1); (14,39,6); (15,31,7); (16,32,7); (17,36,5); (18,24,5); (19,34,2); (20,6,4); (21,30,1); (22,33,1); (23,10,5); (24,37,6); (25,28,1); (26,12,2); (27,7,7); (28,31,6); (29,14,5); (30,36,3); (31,9,5); (32,6,7); (33,36,3); (34,12,3); (35,6,4); (36,33,5); (37,25,7); (38,17,2); (39,32,5); (40,26,6); (41,24,6); (42,26,2); (44,27,4); (45,4,4); (46,36,4); (47,27,4); (48,20,7); (49,14,4); (50,12,5);

Queue 1: (43,2,3);

Queue 2: closed

Queue 3: closed

Queue 4: closed

Queue 5: closed

Time 4

Waiting clients: (1,29,7); (2,33,6); (3,19,4); (4,26,3); (5,17,5); (6,39,4); (7,14,6); (8,24,7); (9,14,4); (10,27,5); (11,22,2); (12,31,5); (13,15,1); (14,39,6); (15,31,7); (16,32,7); (17,36,5); (18,24,5); (19,34,2); (20,6,4); (21,30,1); (22,33,1); (23,10,5); (24,37,6); (25,28,1); (26,12,2); (27,7,7); (28,31,6); (29,14,5); (30,36,3); (31,9,5); (32,6,7); (33,36,3); (34,12,3); (35,6,4); (36,33,5); (37,25,7); (38,17,2); (39,32,5); (40,26,6); (41,24,6); (42,26,2); (44,27,4); (46,36,4); (47,27,4); (48,20,7); (49,14,4); (50,12,5);

Queue 1: (43,2,2);

Queue 2: (45,4,4);

Queue 3: closed

Queue 4: closed

Queue 5: closed

Time 5

Waiting clients: (1,29,7); (2,33,6); (3,19,4); (4,26,3); (5,17,5); (6,39,4); (7,14,6); (8,24,7); (9,14,4); (10,27,5); (11,22,2); (12,31,5); (13,15,1); (14,39,6); (15,31,7); (16,32,7); (17,36,5); (18,24,5); (19,34,2); (20,6,4); (21,30,1); (22,33,1); (23,10,5); (24,37,6); (25,28,1); (26,12,2); (27,7,7); (28,31,6); (29,14,5); (30,36,3); (31,9,5); (32,6,7); (33,36,3); (34,12,3); (35,6,4); (36,33,5); (37,25,7); (38,17,2); (39,32,5); (40,26,6); (41,24,6); (42,26,2); (44,27,4); (46,36,4); (47,27,4); (48,20,7); (49,14,4); (50,12,5);

Queue 1: (43,2,1);

Queue 2: (45,4,3);

Queue 3: closed

Queue 4: closed

Queue 5: closed

Time 6

Waiting clients: (1,29,7); (2,33,6); (3,19,4); (4,26,3); (5,17,5); (6,39,4); (7,14,6); (8,24,7); (9,14,4); (10,27,5); (11,22,2); (12,31,5); (13,15,1); (14,39,6); (15,31,7); (16,32,7); (17,36,5); (18,24,5); (19,34,2); (21,30,1); (22,33,1); (23,10,5); (24,37,6); (25,28,1); (26,12,2); (27,7,7); (28,31,6); (29,14,5); (30,36,3); (31,9,5); (33,36,3); (34,12,3); (36,33,5); (37,25,7); (38,17,2); (39,32,5); (40,26,6); (41,24,6); (42,26,2); (44,27,4); (46,36,4); (47,27,4); (48,20,7); (49,14,4); (50,12,5);

Queue 1: (20,6,4);

Queue 2: (45,4,2);

Queue 3: (32,6,7);

Queue 4: (35,6,4);

Queue 5: closed

Time 7

Waiting clients: (1,29,7); (2,33,6); (3,19,4); (4,26,3); (5,17,5); (6,39,4); (7,14,6); (8,24,7); (9,14,4); (10,27,5); (11,22,2); (12,31,5); (13,15,1); (14,39,6); (15,31,7); (16,32,7); (17,36,5); (18,24,5); (19,34,2); (21,30,1); (22,33,1); (23,10,5); (24,37,6); (25,28,1); (26,12,2); (28,31,6); (29,14,5); (30,36,3); (31,9,5); (33,36,3); (34,12,3); (36,33,5); (37,25,7); (38,17,2); (39,32,5); (40,26,6); (41,24,6); (42,26,2); (44,27,4); (46,36,4); (47,27,4); (48,20,7); (49,14,4); (50,12,5);

Queue 1: (20,6,3);

Queue 2: (45,4,1);

Queue 3: (32,6,6);

Queue 4: (35,6,3);

Queue 5: (27,7,7);

Time 8

Waiting clients: (1,29,7); (2,33,6); (3,19,4); (4,26,3); (5,17,5); (6,39,4); (7,14,6); (8,24,7); (9,14,4); (10,27,5); (11,22,2); (12,31,5); (13,15,1); (14,39,6); (15,31,7); (16,32,7); (17,36,5); (18,24,5); (19,34,2); (21,30,1); (22,33,1); (23,10,5); (24,37,6); (25,28,1); (26,12,2); (28,31,6); (29,14,5); (30,36,3); (31,9,5); (33,36,3); (34,12,3); (36,33,5); (37,25,7); (38,17,2); (39,32,5); (40,26,6); (41,24,6); (42,26,2); (44,27,4); (46,36,4); (47,27,4); (48,20,7); (49,14,4); (50,12,5);

Queue 1: (20,6,2);

Queue 2: closed

Queue 3: (32,6,5);

Queue 4: (35,6,2);

Queue 5: (27,7,6);

Time 9

Waiting clients: (1,29,7); (2,33,6); (3,19,4); (4,26,3); (5,17,5); (6,39,4); (7,14,6); (8,24,7); (9,14,4); (10,27,5); (11,22,2); (12,31,5); (13,15,1); (14,39,6); (15,31,7); (16,32,7); (17,36,5); (18,24,5); (19,34,2); (21,30,1); (22,33,1); (23,10,5); (24,37,6); (25,28,1); (26,12,2); (28,31,6); (29,14,5); (30,36,3); (33,36,3); (34,12,3); (36,33,5); (37,25,7); (38,17,2); (39,32,5); (40,26,6); (41,24,6); (42,26,2); (44,27,4); (46,36,4); (47,27,4); (48,20,7); (49,14,4); (50,12,5);

Queue 1: (20,6,1);

Queue 2: (31,9,5);

Queue 3: (32,6,4);

Queue 4: (35,6,1);

Queue 5: (27,7,5);

Time 10

Waiting clients: (1,29,7); (2,33,6); (3,19,4); (4,26,3); (5,17,5); (6,39,4); (7,14,6); (8,24,7); (9,14,4); (10,27,5); (11,22,2); (12,31,5); (13,15,1); (14,39,6); (15,31,7); (16,32,7); (17,36,5); (18,24,5); (19,34,2); (21,30,1); (22,33,1); (24,37,6); (25,28,1); (26,12,2); (28,31,6); (29,14,5); (30,36,3); (33,36,3); (34,12,3); (36,33,5); (37,25,7); (38,17,2); (39,32,5); (40,26,6); (41,24,6); (42,26,2); (44,27,4); (46,36,4); (47,27,4); (48,20,7); (49,14,4); (50,12,5);

Queue 1: (23,10,5);

Queue 2: (31,9,4);

Queue 3: (32,6,3);

Queue 4: closed

Queue 5: (27,7,4);

Time 11

Waiting clients: (1,29,7); (2,33,6); (3,19,4); (4,26,3); (5,17,5); (6,39,4); (7,14,6); (8,24,7); (9,14,4); (10,27,5); (11,22,2); (12,31,5); (13,15,1); (14,39,6); (15,31,7); (16,32,7); (17,36,5); (18,24,5); (19,34,2); (21,30,1); (22,33,1); (24,37,6); (25,28,1); (26,12,2); (28,31,6); (29,14,5); (30,36,3); (33,36,3); (34,12,3); (36,33,5); (37,25,7); (38,17,2); (39,32,5); (40,26,6); (41,24,6); (42,26,2); (44,27,4); (46,36,4); (47,27,4); (48,20,7); (49,14,4); (50,12,5);

Queue 1: (23,10,4);

Queue 2: (31,9,3);

Queue 3: (32,6,2);

Queue 4: closed

Queue 5: (27,7,3);

Time 12

Waiting clients: (1,29,7); (2,33,6); (3,19,4); (4,26,3); (5,17,5); (6,39,4); (7,14,6); (8,24,7); (9,14,4); (10,27,5); (11,22,2); (12,31,5); (13,15,1); (14,39,6); (15,31,7); (16,32,7); (17,36,5); (18,24,5); (19,34,2); (21,30,1); (22,33,1); (24,37,6); (25,28,1); (28,31,6); (29,14,5); (30,36,3); (33,36,3); (36,33,5); (37,25,7); (38,17,2); (39,32,5); (40,26,6); (41,24,6); (42,26,2); (44,27,4); (46,36,4); (47,27,4); (48,20,7); (49,14,4);

Queue 1: (23,10,3); (34,12,3);

Queue 2: (31,9,2); (50,12,5);

Queue 3: (32,6,1);

Queue 4: (26,12,2);

Queue 5: (27,7,2);

Time 13

Waiting clients: (1,29,7); (2,33,6); (3,19,4); (4,26,3); (5,17,5); (6,39,4); (7,14,6); (8,24,7); (9,14,4); (10,27,5); (11,22,2); (12,31,5); (13,15,1); (14,39,6); (15,31,7); (16,32,7); (17,36,5); (18,24,5); (19,34,2); (21,30,1); (22,33,1); (24,37,6); (25,28,1); (28,31,6); (29,14,5); (30,36,3); (33,36,3); (36,33,5); (37,25,7); (38,17,2); (39,32,5); (40,26,6); (41,24,6); (42,26,2); (44,27,4); (46,36,4); (47,27,4); (48,20,7); (49,14,4);

Queue 1: (23,10,2); (34,12,3);

Queue 2: (31,9,1); (50,12,5);

Queue 3: closed

Queue 4: (26,12,1);

Queue 5: (27,7,1);

...

...

Time 45

Waiting clients:

Queue 1: (33,36,3); (14,39,6);

Queue 2: (15,31,4); (46,36,4);

Queue 3: (19,34,2);

Queue 4: (2,33,4); (24,37,6);

Queue 5: (6,39,3);

Time 46

Waiting clients:

Queue 1: (33,36,2); (14,39,6);

Queue 2: (15,31,3); (46,36,4);

Queue 3: (19,34,1);

Queue 4: (2,33,3); (24,37,6);

Queue 5: (6,39,2);

Time 47

Waiting clients:

Queue 1: (33,36,1); (14,39,6);

Queue 2: (15,31,2); (46,36,4);

Queue 3: closed

Queue 4: (2,33,2); (24,37,6);

Queue 5: (6,39,1);

Time 48

Waiting clients:

Queue 1: (14,39,6);

Queue 2: (15,31,1); (46,36,4);

Queue 3: closed

Queue 4: (2,33,1); (24,37,6);

Queue 5: closed

Time 49

Waiting clients:

Queue 1: (14,39,5);

Queue 2: (46,36,4);

Queue 3: closed

Queue 4: (24,37,6);

Queue 5: closed

Time 50

Waiting clients:

Queue 1: (14,39,4);

Queue 2: (46,36,3);

```
1577  Time 48
1578  Waiting clients:
1579
1580  Queue 1: (14,39,6);
1581  Queue 2: (15,31,1); (46,36,4);
1582  Queue 3: closed
1583  Queue 4: (2,33,1); (24,37,6);
1584  Queue 5: closed
1585
1586  Time 49
1587  Waiting clients:
1588
1589  Queue 1: (14,39,5);
1590  Queue 2: (46,36,4);
1591  Queue 3: closed
1592  Queue 4: (24,37,6);
1593  Queue 5: closed
1594
1595  Time 50
1596  Waiting clients:
1597
1598  Queue 1: (14,39,4);
1599  Queue 2: (46,36,3);
1600  Queue 3: closed
1601  Queue 4: (24,37,5);
1602  Queue 5: closed
```

Aceleasi rezultate in fisierul text – Test 2

Queue 3: closed

Queue 4: (24,37,5);

Queue 5: closed

Time 51

Waiting clients:

Queue 1: (14,39,3);

Queue 2: (46,36,2);

Queue 3: closed

Queue 4: (24,37,4);

Queue 5: closed

Time 52

Waiting clients:

Queue 1: (14,39,2);

Queue 2: (46,36,1);

Queue 3: closed

Queue 4: (24,37,3);

Queue 5: closed

Time 53

Waiting clients:

Queue 1: (14,39,1);

Queue 2: closed

Queue 3: closed

Queue 4: (24,37,2);

Queue 5: closed

...

...

Average waiting time: 22.88

Average service time: 4.46

Test 3
N = 1000
Q = 20
$tsimulation\ MAX$ = 200 secunde
[$tarrival\ MIN$, $tarrival\ MAX$] = [10, 100]
[$tservice\ MIN$, $tservice\ MAX$] = [3, 9]

Rezultatele testului:

...

Time 99

Waiting clients: (82,100,8); (117,100,9); (130,100,9); (216,100,3); (369,100,4); (390,100,5); (528,100,9); (663,100,8); (702,100,6); (721,100,5); (775,100,8); (820,100,4); (941,100,5);

Queue 1: (590,35,3); (706,37,9); (792,39,8); (624,41,4); (359,42,8); (411,43,4); (302,45,9); (137,46,9); (955,46,5); (641,50,7); (341,53,7); (258,54,3); (228,55,7); (127,58,7); (703,60,8); (961,62,8); (329,63,9); (900,65,3); (280,68,4); (13,71,5); (644,71,5); (419,73,7); (798,75,4); (487,78,5); (126,80,5); (824,81,9); (77,83,7); (844,85,4); (580,86,5); (666,88,9); (846,89,4); (307,92,6); (640,93,6); (2,96,4); (380,96,5); (334,99,4);

Queue 2: (16,37,3); (899,37,8); (805,39,9); (263,41,5); (780,41,4); (441,43,3); (358,45,7); (107,47,3); (514,48,6); (691,50,3); (440,53,5); (288,54,6); (351,55,3); (136,58,9); (255,59,4); (710,60,3); (344,63,6); (925,65,8); (30,68,5); (303,68,9); (760,71,4); (435,73,8); (192,75,9); (847,75,7); (771,78,9); (180,79,6); (102,82,4); (864,85,7); (626,86,7); (765,88,4); (878,89,6); (84,91,4); (843,93,7); (665,94,4); (385,96,4); (466,99,4);

Queue 3: (219,33,2); (729,35,7); (193,38,8); (852,39,7); (394,40,3); (823,41,9); (476,43,6); (373,45,6); (183,47,9); (416,49,7); (737,50,6); (485,53,3); (354,55,5); (311,56,8); (428,58,9); (953,60,7); (589,63,3); (185,65,9); (962,65,8); (304,68,6); (849,71,6); (381,72,6); (448,73,9); (326,76,8); (24,78,8); (984,78,4); (122,82,3); (918,85,5); (96,87,6); (883,88,4); (153,90,7); (120,91,8); (857,93,4); (32,96,9); (543,96,6); (501,99,5);

Queue 4: (294,33,2); (778,35,7); (21,38,6); (196,38,4); (898,39,9); (383,42,6); (664,43,7); (1,45,6); (434,45,6); (282,47,5); (526,49,7); (432,51,7); (822,53,3); (401,55,6); (9,58,3); (455,58,6); (483,61,3); (614,63,6); (279,65,3); (237,66,6); (470,68,6); (859,71,3); (506,72,9); (472,73,9); (389,76,4); (990,78,8); (512,80,6); (234,82,8); (978,85,4); (124,88,7); (905,88,5); (410,90,6); (887,93,7); (154,95,8); (548,96,7); (538,99,4);

Queue 5: (932,35,2); (259,38,3); (26,39,6); (954,39,8); (491,42,9); (688,43,7); (524,45,6); (283,47,6); (576,48,5); (445,51,5); (935,53,5); (573,55,4); (361,56,7); (488,58,9); (378,59,9); (544,61,9); (128,63,6); (658,63,3); (337,66,6); (482,68,5); (885,71,9); (551,72,6); (628,73,4); (319,75,4); (443,76,5); (267,79,3); (542,82,9); (270,83,7); (115,86,8); (773,86,9); (61,89,7); (716,90,6); (948,93,5); (694,94,8); (594,96,7); (612,99,3);

Queue 6: (65,37,7); (272,38,5); (396,40,8); (346,41,7); (525,42,8); (835,43,3); (577,45,5); (468,47,4); (604,48,4); (63,51,3); (680,51,3); (937,53,5); (712,55,3); (29,58,4); (747,58,9); (616,61,8); (796,63,6); (391,66,5); (50,67,5); (739,68,8); (209,71,9); (638,72,6); (672,73,8); (511,76,5); (516,79,5); (554,80,9); (678,82,8); (197,86,3); (784,86,8); (73,89,8); (762,90,9); (134,91,4); (966,93,5); (888,96,3); (97,99,7); (718,99,8);

Queue 7: (274,38,8); (417,40,6); (398,41,7); (629,42,7); (983,43,7); (704,45,9); (233,46,4); (480,47,5); (761,51,8); (372,52,8); (957,53,7); (100,55,9); (799,55,3); (793,58,8); (151,60,8); (902,61,3); (982,63,5); (677,66,3); (60,67,5); (842,68,5); (647,72,5); (717,73,8); (323,75,6); (535,76,3); (533,79,5); (709,80,9); (856,82,4); (897,86,9); (34,89,9); (104,89,3); (987,90,8); (412,92,9); (777,94,8); (920,96,8); (121,99,9); (722,99,8);

Queue 8: (225,36,2); (300,38,5); (273,39,5); (467,40,8); (740,42,3); (245,44,3); (735,45,7); (559,47,4); (738,48,7); (206,51,9); (790,51,4); (125,54,9); (298,54,4); (912,55,7); (810,58,8); (943,61,9); (145,63,8); (313,64,9); (881,66,5); (865,68,7); (215,69,6); (661,72,8); (776,73,7); (129,76,6); (596,76,9); (655,79,8); (734,80,4); (933,82,6); (135,85,8); (949,86,4); (142,89,5); (262,91,6); (160,94,7); (786,94,8); (745,97,3); (803,99,5);

Queue 9: (62,38,2); (310,38,8); (549,40,4); (779,42,4); (276,44,4); (868,45,4); (248,46,6); (855,47,8); (812,51,8); (218,53,5); (342,54,8); (971,55,9); (486,59,8); (18,62,5); (199,62,5); (315,64,9); (35,66,8); (904,66,7); (504,69,9); (686,72,9); (33,73,8); (800,73,5); (169,76,7); (768,76,6); (92,79,3); (731,79,7); (981,82,5); (325,83,5); (17,87,9); (163,87,4); (284,89,6); (585,91,9); (293,94,6); (951,94,8); (795,97,5);

Queue 10: (45,35,4); (454,36,3); (426,38,5); (133,40,7); (574,40,5); (828,42,6); (421,44,7); (870,45,6); (3,47,5); (924,47,9); (886,51,4); (347,54,9); (988,55,6); (395,56,4); (571,59,8); (224,62,3); (85,64,5); (425,64,9); (94,67,6); (674,69,3); (87,70,9); (699,72,4); (832,73,4); (789,76,9); (306,77,7); (797,79,7); (366,83,8); (286,85,6); (213,87,9); (203,88,8); (437,89,5); (727,91,7); (497,94,6); (167,95,4); (913,97,7);

Queue 11: (190,38,6); (502,38,7); (633,40,3); (64,42,3); (869,42,7); (444,44,3); (928,45,5); (40,48,9); (963,48,6); (975,51,9); (357,54,9); (995,55,4); (969,56,3); (152,59,5); (654,59,7); (338,62,8); (149,63,4); (566,64,8); (430,67,9); (782,69,5); (5,72,9); (725,72,9); (873,73,5); (188,76,4); (861,76,8); (838,80,4); (418,83,8); (66,84,3); (275,87,8); (537,89,8); (863,91,7); (436,92,5); (619,95,9); (970,97,9); (222,98,7);

Queue 12: (67,37,1); (527,38,4); (247,40,5); (657,40,3); (889,42,3); (119,43,8); (458,44,3); (944,45,5); (531,49,8); (111,50,9); (555,52,4); (375,54,5); (992,56,8); (157,59,8); (667,59,9); (368,62,8); (618,64,3); (387,65,9); (564,67,8); (923,69,5); (353,71,3); (753,72,5); (877,73,5); (894,76,9); (156,78,7); (956,80,7); (447,83,6); (569,84,6); (492,87,6); (48,89,4); (600,89,9); (980,91,8); (662,95,4); (668,97,4); (295,98,4);

Queue 13: (836,36,2); (752,38,6); (309,40,8); (669,40,5); (901,42,4); (532,44,4); (91,45,3); (518,46,8); (651,49,7); (673,52,5); (214,54,8); (403,54,6); (462,57,8); (809,59,6); (254,60,5); (406,62,7); (630,64,5); (58,66,8); (592,67,4); (972,69,4); (109,70,5); (811,72,7); (409,74,6); (367,77,7); (221,78,5); (28,81,5); (81,82,9); (565,83,7); (220,86,8); (503,87,3); (634,89,4); (986,91,9); (615,94,7); (914,95,6); (413,98,9);

Queue 14: (70,36,1); (880,36,6); (801,38,6); (331,39,3); (695,40,4); (907,42,6); (563,44,8); (72,46,5); (568,46,4); (701,49,4); (707,52,4); (251,54,4); (442,54,4); (570,57,3); (821,59,5); (161,62,4); (474,62,4); (802,64,7); (636,67,9); (4,70,8); (352,70,6); (974,72,5); (461,74,4);

(392,77,5); (132,79,4); (226,81,3); (606,83,9); (715,84,4); (529,87,9); (232,88,8); (646,89,9); (620,92,5); (314,93,9); (931,95,8); (439,98,5);

Queue 15: (179,37,6); (829,38,3); (723,40,5); (550,41,7); (930,42,3); (643,44,3); (591,46,5); (131,48,4); (750,49,5); (89,52,6); (719,52,6); (473,54,6); (178,57,8); (625,57,4); (874,59,6); (523,62,3); (967,64,5); (59,66,9); (769,67,6); (370,70,4); (15,72,6); (200,73,7); (659,74,8); (477,77,7); (223,78,6); (355,81,3); (807,83,4); (561,85,4); (840,87,8); (652,89,3); (47,90,7); (749,92,7); (934,95,8); (51,96,8); (451,98,5);

Queue 16: (895,38,4); (424,39,5); (741,40,4); (88,43,5); (159,43,9); (845,44,9); (599,46,5); (69,47,7); (165,50,9); (866,52,8); (509,54,3); (292,56,7); (746,57,5); (291,60,4); (299,61,6); (602,62,4); (968,64,4); (515,65,7); (815,67,9); (522,70,3); (243,72,3); (202,73,6); (728,74,9); (679,77,8); (110,80,5); (382,81,6); (831,83,3); (266,88,9); (56,89,6); (660,89,4); (103,92,4); (884,92,8); (952,95,4); (8,98,5); (642,98,7);

Queue 17: (959,38,7); (587,39,4); (743,40,5); (175,43,5); (53,44,4); (892,44,8); (649,46,4); (261,50,5); (229,51,5); (960,52,7); (572,54,3); (205,55,5); (806,57,5); (305,60,3); (705,62,6); (242,63,7); (989,64,3); (139,66,3); (818,67,8); (774,70,4); (356,71,8); (327,73,9); (384,75,3); (57,77,3); (882,77,5); (423,81,6); (965,83,6); (720,84,9); (322,88,8); (671,89,5); (244,92,6); (979,92,4); (71,96,4); (690,97,7); (998,98,8);

Queue 18: (138,36,4); (471,37,3); (595,39,6); (321,40,8); (891,40,8); (240,43,7); (112,44,4); (939,44,3); (732,46,5); (339,50,5); (143,52,4); (977,52,4); (693,54,6); (211,55,4); (841,57,7); (335,60,9); (827,62,8); (212,64,9); (597,65,8); (826,67,3); (813,70,4); (540,71,3); (350,73,6); (388,75,9); (141,77,3); (994,77,3); (427,81,5); (724,84,4); (393,86,4); (400,88,3); (763,89,8); (405,93,7); (144,95,6); (101,96,6); (146,99,8);

Queue 19: (20,39,9); (650,39,9); (909,40,7); (95,43,4); (277,43,3); (155,45,3); (908,46,4); (348,50,9); (363,52,6); (317,53,5); (867,54,9); (993,57,3); (648,60,3); (365,61,5); (893,62,6); (756,65,6); (37,68,7); (148,69,5); (985,70,3); (360,73,6); (113,74,3); (431,75,3); (210,77,8); (235,78,6); (457,81,9); (748,84,6); (469,86,4); (558,88,7); (808,89,4); (80,90,4); (505,93,6); (622,94,3); (312,96,4); (23,99,6); (239,99,6);

Queue 20: (593,37,3); (653,39,7); (586,41,7); (377,43,8); (166,44,4); (269,45,8); (947,46,8); (420,50,8); (170,53,6); (332,53,8); (879,54,5); (371,57,8); (999,57,3); (696,60,3); (399,61,7); (921,62,7); (278,64,3); (848,65,5); (43,67,8); (99,68,3); (997,70,7); (386,73,5); (465,75,9); (191,76,7); (343,78,8); (546,81,5); (896,84,6); (825,85,6); (609,88,7); (816,89,4); (260,93,6); (534,93,6); (333,96,4); (42,98,4); (308,99,8);

Time 100

Waiting clients:

Queue 1: (590,35,2); (706,37,9); (792,39,8); (624,41,4); (359,42,8); (411,43,4); (302,45,9); (137,46,9); (955,46,5); (641,50,7); (341,53,7); (258,54,3); (228,55,7); (127,58,7); (703,60,8); (961,62,8); (329,63,9); (900,65,3); (280,68,4); (13,71,5); (644,71,5); (419,73,7); (798,75,4); (487,78,5); (126,80,5); (824,81,9); (77,83,7); (844,85,4); (580,86,5); (666,88,9); (846,89,4); (307,92,6); (640,93,6); (2,96,4); (380,96,5); (334,99,4);

Queue 2: (16,37,2); (899,37,8); (805,39,9); (263,41,5); (780,41,4); (441,43,3); (358,45,7); (107,47,3); (514,48,6); (691,50,3); (440,53,5); (288,54,6); (351,55,3); (136,58,9); (255,59,4);

(710,60,3); (344,63,6); (925,65,8); (30,68,5); (303,68,9); (760,71,4); (435,73,8); (192,75,9); (847,75,7); (771,78,9); (180,79,6); (102,82,4); (864,85,7); (626,86,7); (765,88,4); (878,89,6); (84,91,4); (843,93,7); (665,94,4); (385,96,4); (466,99,4);

Queue 3: (219,33,1); (729,35,7); (193,38,8); (852,39,7); (394,40,3); (823,41,9); (476,43,6); (373,45,6); (183,47,9); (416,49,7); (737,50,6); (485,53,3); (354,55,5); (311,56,8); (428,58,9); (953,60,7); (589,63,3); (185,65,9); (962,65,8); (304,68,6); (849,71,6); (381,72,6); (448,73,9); (326,76,8); (24,78,8); (984,78,4); (122,82,3); (918,85,5); (96,87,6); (883,88,4); (153,90,7); (120,91,8); (857,93,4); (32,96,9); (543,96,6); (501,99,5);

Queue 4: (294,33,1); (778,35,7); (21,38,6); (196,38,4); (898,39,9); (383,42,6); (664,43,7); (1,45,6); (434,45,6); (282,47,5); (526,49,7); (432,51,7); (822,53,3); (401,55,6); (9,58,3); (455,58,6); (483,61,3); (614,63,6); (279,65,3); (237,66,6); (470,68,6); (859,71,3); (506,72,9); (472,73,9); (389,76,4); (990,78,8); (512,80,6); (234,82,8); (978,85,4); (124,88,7); (905,88,5); (410,90,6); (887,93,7); (154,95,8); (548,96,7); (538,99,4);

Queue 5: (932,35,1); (259,38,3); (26,39,6); (954,39,8); (491,42,9); (688,43,7); (524,45,6); (283,47,6); (576,48,5); (445,51,5); (935,53,5); (573,55,4); (361,56,7); (488,58,9); (378,59,9); (544,61,9); (128,63,6); (658,63,3); (337,66,6); (482,68,5); (885,71,9); (551,72,6); (628,73,4); (319,75,4); (443,76,5); (267,79,3); (542,82,9); (270,83,7); (115,86,8); (773,86,9); (61,89,7); (716,90,6); (948,93,5); (694,94,8); (594,96,7); (612,99,3);

Queue 6: (65,37,6); (272,38,5); (396,40,8); (346,41,7); (525,42,8); (835,43,3); (577,45,5); (468,47,4); (604,48,4); (63,51,3); (680,51,3); (937,53,5); (712,55,3); (29,58,4); (747,58,9); (616,61,8); (796,63,6); (391,66,5); (50,67,5); (739,68,8); (209,71,9); (638,72,6); (672,73,8); (511,76,5); (516,79,5); (554,80,9); (678,82,8); (197,86,3); (784,86,8); (73,89,8); (762,90,9); (134,91,4); (966,93,5); (888,96,3); (97,99,7); (718,99,8);

Queue 7: (274,38,7); (417,40,6); (398,41,7); (629,42,7); (983,43,7); (704,45,9); (233,46,4); (480,47,5); (761,51,8); (372,52,8); (957,53,7); (100,55,9); (799,55,3); (793,58,8); (151,60,8); (902,61,3); (982,63,5); (677,66,3); (60,67,5); (842,68,5); (647,72,5); (717,73,8); (323,75,6); (535,76,3); (533,79,5); (709,80,9); (856,82,4); (897,86,9); (34,89,9); (104,89,3); (987,90,8); (412,92,9); (777,94,8); (920,96,8); (121,99,9); (722,99,8);

Queue 8: (225,36,1); (300,38,5); (273,39,5); (467,40,8); (740,42,3); (245,44,3); (735,45,7); (559,47,4); (738,48,7); (206,51,9); (790,51,4); (125,54,9); (298,54,4); (912,55,7); (810,58,8); (943,61,9); (145,63,8); (313,64,9); (881,66,5); (865,68,7); (215,69,6); (661,72,8); (776,73,7); (129,76,6); (596,76,9); (655,79,8); (734,80,4); (933,82,6); (135,85,8); (949,86,4); (142,89,5); (262,91,6); (160,94,7); (786,94,8); (745,97,3); (803,99,5);

Queue 9: (62,38,1); (310,38,8); (549,40,4); (779,42,4); (276,44,4); (868,45,4); (248,46,6); (855,47,8); (812,51,8); (218,53,5); (342,54,8); (971,55,9); (486,59,8); (18,62,5); (199,62,5); (315,64,9); (35,66,8); (904,66,7); (504,69,9); (686,72,9); (33,73,8); (800,73,5); (169,76,7); (768,76,6); (92,79,3); (731,79,7); (981,82,5); (325,83,5); (17,87,9); (163,87,4); (284,89,6); (585,91,9); (293,94,6); (951,94,8); (795,97,5); (130,100,9);

Queue 10: (45,35,3); (454,36,3); (426,38,5); (133,40,7); (574,40,5); (828,42,6); (421,44,7); (870,45,6); (3,47,5); (924,47,9); (886,51,4); (347,54,9); (988,55,6); (395,56,4); (571,59,8); (224,62,3); (85,64,5); (425,64,9); (94,67,6); (674,69,3); (87,70,9); (699,72,4); (832,73,4); (789,76,9); (306,77,7); (797,79,7); (366,83,8); (286,85,6); (213,87,9); (203,88,8); (437,89,5); (727,91,7); (497,94,6); (167,95,4); (913,97,7); (216,100,3);

Queue 11: (190,38,5); (502,38,7); (633,40,3); (64,42,3); (869,42,7); (444,44,3); (928,45,5); (40,48,9); (963,48,6); (975,51,9); (357,54,9); (995,55,4); (969,56,3); (152,59,5); (654,59,7); (338,62,8); (149,63,4); (566,64,8); (430,67,9); (782,69,5); (5,72,9); (725,72,9); (873,73,5); (188,76,4); (861,76,8); (838,80,4); (418,83,8); (66,84,3); (275,87,8); (537,89,8); (863,91,7); (436,92,5); (619,95,9); (970,97,9); (222,98,7); (369,100,4);

Queue 12: (527,38,4); (247,40,5); (657,40,3); (889,42,3); (119,43,8); (458,44,3); (944,45,5); (531,49,8); (111,50,9); (555,52,4); (375,54,5); (992,56,8); (157,59,8); (667,59,9); (368,62,8); (618,64,3); (387,65,9); (564,67,8); (923,69,5); (353,71,3); (753,72,5); (877,73,5); (894,76,9); (156,78,7); (956,80,7); (447,83,6); (569,84,6); (492,87,6); (48,89,4); (600,89,9); (980,91,8); (662,95,4); (668,97,4); (295,98,4); (82,100,8); (390,100,5);

Queue 13: (836,36,1); (752,38,6); (309,40,8); (669,40,5); (901,42,4); (532,44,4); (91,45,3); (518,46,8); (651,49,7); (673,52,5); (214,54,8); (403,54,6); (462,57,8); (809,59,6); (254,60,5); (406,62,7); (630,64,5); (58,66,8); (592,67,4); (972,69,4); (109,70,5); (811,72,7); (409,74,6); (367,77,7); (221,78,5); (28,81,5); (81,82,9); (565,83,7); (220,86,8); (503,87,3); (634,89,4); (986,91,9); (615,94,7); (914,95,6); (413,98,9); (528,100,9);

Queue 14: (880,36,6); (801,38,6); (331,39,3); (695,40,4); (907,42,6); (563,44,8); (72,46,5); (568,46,4); (701,49,4); (707,52,4); (251,54,4); (442,54,4); (570,57,3); (821,59,5); (161,62,4); (474,62,4); (802,64,7); (636,67,9); (4,70,8); (352,70,6); (974,72,5); (461,74,4); (392,77,5); (132,79,4); (226,81,3); (606,83,9); (715,84,4); (529,87,9); (232,88,8); (646,89,9); (620,92,5); (314,93,9); (931,95,8); (439,98,5); (117,100,9); (663,100,8);

Queue 15: (179,37,5); (829,38,3); (723,40,5); (550,41,7); (930,42,3); (643,44,3); (591,46,5); (131,48,4); (750,49,5); (89,52,6); (719,52,6); (473,54,6); (178,57,8); (625,57,4); (874,59,6); (523,62,3); (967,64,5); (59,66,9); (769,67,6); (370,70,4); (15,72,6); (200,73,7); (659,74,8); (477,77,7); (223,78,6); (355,81,3); (807,83,4); (561,85,4); (840,87,8); (652,89,3); (47,90,7); (749,92,7); (934,95,8); (51,96,8); (451,98,5); (702,100,6);

Queue 16: (895,38,3); (424,39,5); (741,40,4); (88,43,5); (159,43,9); (845,44,9); (599,46,5); (69,47,7); (165,50,9); (866,52,8); (509,54,3); (292,56,7); (746,57,5); (291,60,4); (299,61,6); (602,62,4); (968,64,4); (515,65,7); (815,67,9); (522,70,3); (243,72,3); (202,73,6); (728,74,9); (679,77,8); (110,80,5); (382,81,6); (831,83,3); (266,88,9); (56,89,6); (660,89,4); (103,92,4); (884,92,8); (952,95,4); (8,98,5); (642,98,7); (721,100,5);

Queue 17: (959,38,6); (587,39,4); (743,40,5); (175,43,5); (53,44,4); (892,44,8); (649,46,4); (261,50,5); (229,51,5); (960,52,7); (572,54,3); (205,55,5); (806,57,5); (305,60,3); (705,62,6); (242,63,7); (989,64,3); (139,66,3); (818,67,8); (774,70,4); (356,71,8); (327,73,9); (384,75,3); (57,77,3); (882,77,5); (423,81,6); (965,83,6); (720,84,9); (322,88,8); (671,89,5); (244,92,6); (979,92,4); (71,96,4); (690,97,7); (998,98,8); (775,100,8);

Queue 18: (138,36,3); (471,37,3); (595,39,6); (321,40,8); (891,40,8); (240,43,7); (112,44,4); (939,44,3); (732,46,5); (339,50,5); (143,52,4); (977,52,4); (693,54,6); (211,55,4); (841,57,7); (335,60,9); (827,62,8); (212,64,9); (597,65,8); (826,67,3); (813,70,4); (540,71,3); (350,73,6); (388,75,9); (141,77,3); (994,77,3); (427,81,5); (724,84,4); (393,86,4); (400,88,3); (763,89,8); (405,93,7); (144,95,6); (101,96,6); (146,99,8); (820,100,4);

Queue 19: (20,39,8); (650,39,9); (909,40,7); (95,43,4); (277,43,3); (155,45,3); (908,46,4); (348,50,9); (363,52,6); (317,53,5); (867,54,9); (993,57,3); (648,60,3); (365,61,5); (893,62,6); (756,65,6); (37,68,7); (148,69,5); (985,70,3); (360,73,6); (113,74,3); (431,75,3); (210,77,8);

(235,78,6); (457,81,9); (748,84,6); (469,86,4); (558,88,7); (808,89,4); (80,90,4); (505,93,6); (622,94,3); (312,96,4); (23,99,6); (239,99,6); (941,100,5);

Queue 20: (593,37,2); (653,39,7); (586,41,7); (377,43,8); (166,44,4); (269,45,8); (947,46,8); (420,50,8); (170,53,6); (332,53,8); (879,54,5); (371,57,8); (999,57,3); (696,60,3); (399,61,7); (921,62,7); (278,64,3); (848,65,5); (43,67,8); (99,68,3); (997,70,7); (386,73,5); (465,75,9); (191,76,7); (343,78,8); (546,81,5); (896,84,6); (825,85,6); (609,88,7); (816,89,4); (260,93,6); (534,93,6); (333,96,4); (42,98,4); (308,99,8);

Average waiting time: 54.3
Average service time: 6.056

Process finished with exit code 0

6. Concluzii

In concluzie, am invatat sa cream si sa punem in aplicare un program de gestionare a cozilor folosind principiile programarii orientate pe obiect si a programarii in paralel. Am folosit UML pentru a ne da seama cum arata componentele sistemului si pentru a ne ajuta sa construim structura acestuia. Ne-am concentrat pe a face aplicatia eficienta prin folosirea algoritmilor de planificare potriviti si gestionarea resurselor in mod corespunzator.

In viitor, am putea sa dezvoltam si sa imbunatatim proiectul prin adaugarea de noi strategii de planificare si prin optimizarea performantei. De asemenea, am putea crea o interfata grafica care sa ajute utilizatorii sa aiba o experienta mai buna si sa le permita sa configureze si sa urmareasca simularile in timp ce acestea se desfasoara.

7. Bibliografie

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