

# ACTIVITATE PARCARE

## Enunt

O parcare are  $N$  locuri; la inceputul simulării sunt deja ocupate  $N_{OCUP}$  locuri. Masinile sosesc la intervale distribuite exponential, cu media  $MED$ . Masinile care nu gasesc loc in parcare pleaca. Cele care gasesc loc parasesc parcare dupa 20 - 180 minute, achitand o taxa de  $VAL$  lei pentru fiecare interval de 1- $IT$  minute.

Se urmareste sa se determine ce suma se incaseaza intr-un anumit interval de timp (16 ore) si, respectiv, in cat timp se incaseaza o anumita suma (100 lei)

Alte statistici colectate:

- incasarile obtinute in fiecare ora;
- distributii:
  - rata sosirilor in intervale de cate 10 minute (0, 1, 2,...,10, >10)
  - intervale intre sosiri si, respectiv, plecari (limite multipli de 2)
  - durate de stationare (limite multipli de  $IT$ )

Sa se realizeze modelul GPSSH.

## Rezolvare

### Analiza

Masinile, modelate prin tranzactii, se impart in doua categorii: cele care se gasesc in parcare la inceputul experimentului de simulare si, respectiv, cele care sosesc pe parcursul experimentului. Pentru fiecare categorie este utilizat un alt bloc GENERATE.

Problema modelarii plecării celor care nu gasesc loc in parcare poate fi rezolvata in mai multe moduri, testand conditii echivalente:

a) resursa multipla LOCURI nu este complet ocupata (Storage Not Full)

GATE SNF	LOCURI , PLEACA
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b) numarul de locuri ramase este mai mare ca 0

TEST G	R(LOCURI) , 0 , PLEACA
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c) este acceptata ocuparea unui loc din parcare

TRANSFER	BOTH , OCUPA , PLEACA
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Timpul de stationare este definit ca entitate de calcul cu valoare de tip real (FVARIABLE), iar taxa de stationare platita la plecare este definita ca entitate de calcul cu valoare de tip intreg (VARIABLE).

Pentru a determina suma incasata trebuie utilizata o variabila de acumulare. Aceasta poate fi o variabila sau o entitate de referinta (SAVEVALUE). Cea de-a doua solutie are avantajul ca valoarea este furnizata in fisierul de iesire standard (.lis). Din acelasi motiv incasarile orare vor fi inregistrate intr-o matrice (entitate de referinta multipla) cu o singura coloana. Elementele acesteia pot fi actualizate ori de cate ori se actualizeaza suma incasata sau la fiecare ora. Cea de-a doua solutie implica mai putine prelucrari, dar trebuie modelata printr-un segment separat, care genereaza cate o tranzactie "ceas" la fiecare 60 minute. De asemenea este necesara o variabila auxiliara, care sa memoreze suma incasata pana la inceputul intervalului curent (&SP).

Pentru a determina intervalul de timp in care se incaseaza o anumita suma (definita de &SI), se utilizeaza un segment separat. Acesta genereaza o singura tranzactie, care asteapta ca suma incasata sa devina mai mare sau egala cu suma de interes &SI. La producerea acestui eveniment se converteste valoarea "timp" in ore si minute.

In varianta 2 timpul de stationare e modelat printr-o functie si se va scrie intr-un fisier numarul de masini sosite la feicare interval de 10 minute, interval care e controlat tot ptrintr-o tranzactie "ceas".

# Modelul GPSS, varianta 1

```

SIMULATE
*-- Parcare cu &NL locuri si taxa de &VAL lei pentru fiecare interval <= &IT minute

REAL          &MED
LET           &MED=2.5          Interval mediu intre sosiri (minute)
INTEGER      &NL,&NROCUP,&VAL,&IT,&IOBS
LET          &NL=30             Numar Locuri in parcare
LET          &NROCUP=10         Numar locuri ocupate initial
LET          &VAL=2             lei
LET          &IT=30             / minute taxate
LET          &IOBS=16          Interval de observare (ore)
INTEGER      &SI
LET          &SI=100           Suma de Interes

STORAGE      S(LOCURI),&NL      Spatiul de parcare
TSTAT       FVARIABLE          FRN(2)*160+20      Timpul de stationare
TAXA        VARIABLE          ((M1-1)/&IT+1)*&VAL  Valoarea taxei de stationare

* --- se colecteaza statistici referitoare la:
SUMORA      MATRIX            MX,&IOBS,1          - incasarile orare
            INTEGER          &SP              variabila auxiliara Suma Partiala
NRM10M      TABLE           RT,0,1,12,10       - nr.masini sosite la fiecare 10 min.
INTS        TABLE           IA,0,2,10         - intervale intre sosiri
IPLEC       TABLE           IA,0,2,10         - intervale intre plecari
TIMPST      TABLE           M1,&IT,&IT,6       - timpi de stationare

*-- masini care se gasesc deja in parcare
GENERATE    ,,,&NROCUP
TRANSFER    ,OCUPA

*-- masini care sosesc pe parcurs
GENERATE    RVEXPO(3,&MED)
SOSIRE      TABULATE         NRM10M           Actualizeaza tabelele
            TABULATE         INTS             referitoare la sosiri
            TRANSFER         BOTH,OCUPA,PLEACA Cei care nu gasesc loc pleaca

*-- masini care au loc in parcare
OCUPA      ENTER            LOCURI             Ocupa un loc
            ADVANCE          V(TSTAT)         Stationeaza
            LEAVE            LOCURI           Elibereaza locul
            SAVEVALUE        SUMA+,V(TAXA),XF Achita taxa
            TABULATE         TIMPST          Actualizeaza statistici
            TABULATE         IPLEC           referitoare la plecari
PLEACA     TERMINATE

*-- determina intervalul de timp necesar pentru a obtine &SI lei
GENERATE    ,,,1            Genereaza o singura tranzactie
TEST GE     XF(SUMA),&SI    care asteapta acumularea sumei
SAVEVALUE   ORE,C1/60,XB   Memoreaza cate ore
SAVEVALUE   MINUTE,C1@60,XB si minute au trecut
TERMINATE

*-- control timp, cu determinarea sumei incasate in fiecare ora
GENERATE    60,,,,1
MSAVEVALUE  SUMORA+,C1/60,1,XF(SUMA)-&SP,MX
BLET       &SP=XF(SUMA)
TERMINATE  1

*-- executie simulare
START      &IOBS
END

```

# Extras din fisierul de iesire standard (.lis)

. . . . .									
BLOCK	CURRENT	TOTAL	BLOCK	CURRENT	TOTAL	BLOCK	CURRENT	TOTAL	
1		10	11		260	21		16	
2		10	12		260	22		16	
3		366	PLEACA		351				
SOSIRE		366	14		1				
5		366	15		1				
6		366	16		1				
OCUPA		285	17		1				
8	25	285	18		1				
9		260	19		16				
10		260	20		16				
--AVG-UTIL-DURING--									
STORAGE	TOTAL	AVAIL	UNAVL	ENTRIES	AVERAGE	CURRENT	PERCENT	CAPACITY	AVERAGE
CURRENT	MAXIMUM				TIME/UNIT	STATUS	AVAIL		CONTENTS
CONTENTS	CONTENTS								
LOCURI	0.916			285	92.540	AVAIL	100.0	30	27.473
25	30								
TABLE NRM10M									
ENTRIES	IN TABLE	MEAN ARGUMENT	STANDARD DEVIATION	SUM OF ARGUMENTS					
96.0000		3.8125		2.0016	366.0000	NON-WEIGHTED			
UPPER	OBSERVED	PERCENT	CUMULATIVE	CUMULATIVE	MULTIPLE	DEVIATION			
LIMIT	FREQUENCY	OF TOTAL	PERCENTAGE	REMAINDER	OF MEAN	FROM MEAN			
0.	3.0000	3.1250	3.12	96.88	0.	-1.9047			
1.0000	9.0000	9.3750	12.50	87.50	0.2623	-1.4051			
2.0000	16.0000	16.6667	29.17	70.83	0.5246	-0.9055			
3.0000	19.0000	19.7917	48.96	51.04	0.7869	-0.4059			
4.0000	9.0000	9.3750	58.33	41.67	1.0492	0.0937			
5.0000	20.0000	20.8333	79.17	20.83	1.3115	0.5933			
6.0000	13.0000	13.5417	92.71	7.29	1.5738	1.0929			
7.0000	3.0000	3.1250	95.83	4.17	1.8361	1.5924			
8.0000	3.0000	3.1250	98.96	1.04	2.0984	2.0920			
9.0000	1.0000	1.0417	100.00	-0.00	2.3607	2.5916			
TABLE INTS									
ENTRIES	IN TABLE	MEAN ARGUMENT	STANDARD DEVIATION	SUM OF ARGUMENTS					
365.0000		2.6073		2.5053	951.6731	NON-WEIGHTED			
UPPER	OBSERVED	PERCENT	CUMULATIVE	CUMULATIVE	MULTIPLE	DEVIATION			
LIMIT	FREQUENCY	OF TOTAL	PERCENTAGE	REMAINDER	OF MEAN	FROM MEAN			
...									
2.0000	187.0000	51.2329	51.23	48.77	0.7671	-0.2424			
4.0000	103.0000	28.2192	79.45	20.55	1.5341	0.5559			
6.0000	42.0000	11.5068	90.96	9.04	2.3012	1.3542			
8.0000	16.0000	4.3836	95.34	4.66	3.0683	2.1525			
10.0000	9.0000	2.4658	97.81	2.19	3.8354	2.9508			
12.0000	7.0000	1.9178	99.73	0.27	4.6024	3.7491			
...									
OVERFLOW	1.0000	0.27	100.00	0.00					
AVERAGE VALUE OF OVERFLOW IS				19.0583					
TABLE IPLEC									
ENTRIES	IN TABLE	MEAN ARGUMENT	STANDARD DEVIATION	SUM OF ARGUMENTS					

259.0000	3.5522	3.6332	920.0269	NON-		
WEIGHTED						
UPPER LIMIT	OBSERVED FREQUENCY	PERCENT OF TOTAL	CUMULATIVE PERCENTAGE	CUMULATIVE REMAINDER	MULTIPLE OF MEAN	DEVIATION FROM MEAN
...						
2.0000	114.0000	44.0154	44.02	55.98	0.5630	-0.4272
4.0000	62.0000	23.9382	67.95	32.05	1.1261	0.1232
6.0000	36.0000	13.8996	81.85	18.15	1.6891	0.6737
8.0000	17.0000	6.5637	88.42	11.58	2.2521	1.2242
10.0000	13.0000	5.0193	93.44	6.56	2.8151	1.7747
12.0000	6.0000	2.3166	95.75	4.25	3.3782	2.3252
14.0000	5.0000	1.9305	97.68	2.32	3.9412	2.8757
16.0000	2.0000	0.7722	98.46	1.54	4.5042	3.4261
OVERFLOW	4.0000	1.54	100.00	0.00		
AVERAGE VALUE OF OVERFLOW IS		18.3001				
TABLE TIMPST						
ENTRIES IN TABLE	MEAN ARGUMENT	STANDARD DEVIATION	SUM OF ARGUMENTS			
260.0000	94.6748	46.9451	24615.4414		NON-	
WEIGHTED						
UPPER LIMIT	OBSERVED FREQUENCY	PERCENT OF TOTAL	CUMULATIVE PERCENTAGE	CUMULATIVE REMAINDER	MULTIPLE OF MEAN	DEVIATION FROM MEAN
30.0000	21.0000	8.0769	8.08	91.92	0.3169	-1.3777
60.0000	54.0000	20.7692	28.85	71.15	0.6337	-0.7386
90.0000	55.0000	21.1538	50.00	50.00	0.9506	-0.0996
120.0000	39.0000	15.0000	65.00	35.00	1.2675	0.5395
150.0000	48.0000	18.4615	83.46	16.54	1.5844	1.1785
OVERFLOW	43.0000	16.54	100.00	0.00		
AVERAGE VALUE OF OVERFLOW IS		166.1975				
NON-ZERO FULLWORD SAVEVALUES: (NAME : VALUE)						
SUMA:		1880				
NON-ZERO BYTE SAVEVALUES: (NAME : VALUE)						
ORE:		3,		MINUTE: 12		
FULLWORD MATRIX SAVEVALUE SUMORA						
ROW/COL	1					
1	3000					
2	33750					
3	59250					
4	27750					
5	64500					
6	42000					
7	47250					
8	54750					
9	42000					
10	59250					
11	30000					
12	52500					
13	45000					
14	56250					
15	45000					
16	42750					
. . . . .						

## Observatie

Din totalul de 376 masini (10 existente la inceputul simularii + 366 sosite pe parcurs) doar 285 au parcat efectiv. Restul de 91 au plecat, deoarece nu au gasit loc.

## Modelul GPSS, varianta 2

```

SIMULATE
*-- Parcare cu &NL locuri si taxa de &VAL lei pentru fiecare interval <= &IT minute
    REAL          &MED
    LET           &MED=2.5                Interval mediu intre sosiri (minute)
    INTEGER       &NL,&NROCUP,&VAL,&IT,&IOBS
    LET           &NL=30                  Numar locuri in parcare
    LET           &NROCUP=10              Numar locuri ocupate initial
    LET           &VAL=2                   lei
    LET           &IT=30                   / minute taxate
    LET           &IOBS=16                Interval de observare (ore)
    STORAGE       S(LOCURI),&NL          Spatiul de parcare
TAXA  VARIABLE   (M1+&IT-1)/&IT*&VAL  Valoarea taxei de stationare
TSTAT FUNCTION   RN(2),C2                Durata de stationare
0,20/1,180

* --- se colecteaza statistici referitoare la :
SUMORA  MATRIX   MX,&IOBS,1              - incasarile orare
INTS    TABLE   IA,0,2,7                - intervale intre sosiri
NRM10M  TABLE   RT,0,1,12,10           - nr.masini sosite la fiecare 10 min.
TIMPST  TABLE   M1,60,30,6             - durate de stationare
IPLEC   TABLE   IA,0,2,7                - intervale intre plecari

        PUTPIC          FILE=SOSIPARC
Nr.crt. | Moment | Sosiri in interval | Sosiri

*-- masini care se gasesc deja in parcare
    GENERATE      ,,,&NROCUP
    TRANSFER      ,OCUPA

*-- masini care sosesc pe parcurs
    GENERATE      RVEXPO(3,&MED)
SOSIRE  TABULATE  NRM10M                  Actualizeaza tabelele
        TABULATE    INTS                    referitoare la sosiri
        TRANSFER    BOTH,OCUPA,PLEACA      Cei care nu gasesc loc pleaca

*-- masini care au loc in parcare
OCUPA   ENTER     LOCURI                    Ocupa un loc
        ADVANCE     FN(TSTAT)                Stationeaza
        LEAVE       LOCURI                    Elibereaza locul
        SAVEVALUE   SUMA+,V(TAXA),XF        Achita taxa
        MSAVEVALUE  SUMORA+,(C1+59)/60,1,V(TAXA),MX Actualiz.incasari orare
        TABULATE    TIMPST                    Actualizeaza statistici
        TABULATE    IPLEC                      referitoare la plecari
PLEACA  TERMINATE

*-- determina intervalul de timp necesar pentru a obtine 100 lei
    GENERATE      ,,,1
    TEST GE       XF(SUMA),100
    SAVEVALUE     ORE,C1/60,XB
    SAVEVALUE     MINUTE,(C1-XB(ORE)*60),XB
    TERMINATE

*-- scrie in fisierul SOSIPARC cate masini au sosit la fiecare 10 minute
    GENERATE      10,,,,1
NNN     BPUTPIC   FILE=SOSIPARC,N(NNN)+1,C1,N(SOSIRE)-XH(NUMAR),N(SOSIRE)
**      | ****   |                **** | ****
        SAVEVALUE  NUMAR,N(SOSIRE),XH
        TERMINATE

*-- control timp
    GENERATE      &IOBS*60    Oprete dupa &IOBS ore
    TERMINATE     1

*-- executie simulare
START   1
END

```

## Extras din fisierul SOSIPARC

Nr.crt.	Moment	Sosiri in interval	Sosiri
1	10	5	5
2	20	3	8
3	30	4	12
4	40	5	17
5	50	3	20
6	60	2	22
7	70	1	23
8	80	2	25
9	90	6	31
10	100	5	36
11	110	8	44
12	120	3	47
...			
92	920	3	358
93	930	5	363
94	940	1	364
95	950	0	364
96	960	2	366

## Extras din fisierul de iesire standard (.lis)

```
Entity Dictionary (in ascending order by entity number; "*" => value conflict.)
  Storages: 1=LOCURI
  Tables: 1=INTS          2=NRM10M          3=TIMPST          4=IPLEC
  Functions: 1=TSTAT
  (F)variables: 1=TAXA
  Fullword Savexes: 1=SUMA
  Halfword Savexes: 1=NUMAR
  Fullword Msavexes: 1=SUMORA
  Byte Savexes: 1=ORE          2=MINUTE
  Random Numbers: 2          3
  Integer &Vars: 1=IOBS          2=IT          3=NL          4=NROCUP          5=VAL
  Real &Vars: 1=MED
  Files: 1=SOSIPARC
```

SYMBOL	VALUE	EQU	DEFNS	CONTEXT	REFERENCES BY STATEMENT NUMBER					
LOCURI	1			Absolute					12	
NNN	21		62	Block					62	
OCUPA	7		42	Block				31	38	
PLEACA	14		49	Block				38		
SOSIRE	4		36	Block				62	62	64
LOCURI	1		12	Storage				42	44	
INTS	1		20	Table				37		
IPLEC	4		23	Table				48		
NRM10M	2		21	Table				36		
TIMPST	3		22	Table				47		
TSTAT	1		14	Function				43		
TAXA	1		13	(F)variable				45	46	
SUMA	1			Fullword Svz				45	54	
NUMAR	1			Halfword Svz				62	64	
SUMORA	1		19	Fullword Msv				46		
MINUTE	2			Byte Svz				56		
ORE	1			Byte Svz				55	56	
2	2			Random Nmbr				14		
3	3			Random Nmbr				35		

```

IOBS      1          5 Integer      10   19   68
IT        2          5 Integer      9    13   13
NL        3          5 Integer      6    12
NROCUP    4          5 Integer      7    30
VAL       5          5 Integer      8    13

```

```

MED       1          3 Real         4    35

```

```

SOSIPARC  1          File          25   62

```

\*\*\* IN STATEMENT 13 - WARNING 343 - Clock value (floating point) will be truncated to an integer value.

Storage Requirements (Bytes)

```

Compiled Code:    2026
Compiled Data:    268
Miscellaneous:    95
Entities:        1319
Common:          10000
-----
Total:           13708

```

GPSS/H Model Size:

```

Control Statements  18
Blocks              25

```

Simulation begins.

Relative Clock: 960.0000 Absolute Clock: 960.0000

Block	Current	Total	Block	Current	Total	Block	Current	Total
1		10	11		260	NNN		96
2		10	12		260	22		96
3		366	13		260	23		96
SOSIRE		366	PLEACA		351	24		1
5		366	15		1	25		1
6		366	16		1			
OCUPA		285	17		1			
8	25	285	18		1			
9		260	19		1			
10		260	20		96			

--Avg-Util-During--

Storage	Total	Avail	Unavl	Entries	Average	Current	Percent	Capacity
Average	Current	Time	Time	Time	Time/Unit	Status	Avail	
Contents	Contents	Contents	Contents					
LOCURI	0.916			285	92.540	AVAIL	100.0	30
	27.473	25	30					

TABLE INTS

ENTRIES IN TABLE 365.0000 MEAN ARGUMENT 2.6073 STANDARD DEVIATION 2.5053 SUM OF ARGUMENTS 951.6731 NON-WEIGHTED

UPPER LIMIT	OBSERVED FREQUENCY	PERCENT OF TOTAL	CUMULATIVE PERCENTAGE	CUMULATIVE REMAINDER	MULTIPLE OF MEAN	DEVIATION FROM MEAN
...						
2.0000	187.0000	51.2329	51.23	48.77	0.7671	-0.2424
4.0000	103.0000	28.2192	79.45	20.55	1.5341	0.5559
6.0000	42.0000	11.5068	90.96	9.04	2.3012	1.3542
8.0000	16.0000	4.3836	95.34	4.66	3.0683	2.1525
10.0000	9.0000	2.4658	97.81	2.19	3.8354	2.9508
OVERFLOW	8.0000	2.19	100.00	0.00		

AVERAGE VALUE OF OVERFLOW IS 12.3241



TABLE NRM10M

ENTRIES IN TABLE MEAN ARGUMENT STANDARD DEVIATION SUM OF ARGUMENTS  
 96.0000 3.8125 2.0016 366.0000 NON-WEIGHTED

UPPER LIMIT	OBSERVED FREQUENCY	PERCENT OF TOTAL	CUMULATIVE PERCENTAGE	CUMULATIVE REMAINDER	MULTIPLE OF MEAN	DEVIATION FROM MEAN
0.	3.0000	3.1250	3.12	96.88	0.	-1.9047
1.0000	9.0000	9.3750	12.50	87.50	0.2623	-1.4051
2.0000	16.0000	16.6667	29.17	70.83	0.5246	-0.9055
3.0000	19.0000	19.7917	48.96	51.04	0.7869	-0.4059
4.0000	9.0000	9.3750	58.33	41.67	1.0492	0.0937
5.0000	20.0000	20.8333	79.17	20.83	1.3115	0.5933
6.0000	13.0000	13.5417	92.71	7.29	1.5738	1.0929
7.0000	3.0000	3.1250	95.83	4.17	1.8361	1.5924
8.0000	3.0000	3.1250	98.96	1.04	2.0984	2.0920
9.0000	1.0000	1.0417	100.00	-0.00	2.3607	2.5916

TABLE TIMPST

ENTRIES IN TABLE MEAN ARGUMENT STANDARD DEVIATION SUM OF ARGUMENTS  
 260.0000 94.6748 46.9451 24615.4414 NON-WEIGHTED

UPPER LIMIT	OBSERVED FREQUENCY	PERCENT OF TOTAL	CUMULATIVE PERCENTAGE	CUMULATIVE REMAINDER	MULTIPLE OF MEAN	DEVIATION FROM MEAN
60.0000	75.0000	28.8462	28.85	71.15	0.6337	-0.7386
90.0000	55.0000	21.1538	50.00	50.00	0.9506	-0.0996
120.0000	39.0000	15.0000	65.00	35.00	1.2675	0.5395
150.0000	48.0000	18.4615	83.46	16.54	1.5844	1.1785
180.0000	43.0000	16.5385	100.00	0.00	1.9012	1.8176

TABLE IPLEC

ENTRIES IN TABLE MEAN ARGUMENT STANDARD DEVIATION SUM OF ARGUMENTS  
 259.0000 3.5522 3.6332 920.0269 NON-WEIGHTED

UPPER LIMIT	OBSERVED FREQUENCY	PERCENT OF TOTAL	CUMULATIVE PERCENTAGE	CUMULATIVE REMAINDER	MULTIPLE OF MEAN	DEVIATION FROM MEAN
...						
2.0000	114.0000	44.0154	44.02	55.98	0.5630	-0.4272
4.0000	62.0000	23.9382	67.95	32.05	1.1261	0.1232
6.0000	36.0000	13.8996	81.85	18.15	1.6891	0.6737
8.0000	17.0000	6.5637	88.42	11.58	2.2521	1.2242
10.0000	13.0000	5.0193	93.44	6.56	2.8151	1.7747
OVERFLOW	17.0000	6.56	100.00	0.00		

AVERAGE VALUE OF OVERFLOW IS 13.6991

Non-zero Fullword Savevalues: (NAME : VALUE)  
 SUMA: 376000

Non-zero Halfword Savevalues: (NAME : VALUE)  
 NUMAR: 366

Non-zero Byte Savevalues: (NAME : VALUE)  
 ORE: 4, MINUTE: 47

Fullword Matrix Savevalue SUMORA

ROW/COL	1
1	2400
2	17200
3	31600
4	16400
5	32800
6	24800

```

7          23600
8          28400
9          22400
10         31600
11         18400
12         25600
13         27200
14         26800
15         24000
16         22800

```

Random Stream	Antithetic Variates	Initial Position	Current Position	Sample Count	Chi-Square Uniformity
2	OFF	200000	200285	285	0.53
3	OFF	300000	300367	367	0.49

Status of Common Storage

```

5936 bytes available
4064 in use
4848 used (max)

```

Simulation complete. Absolute Clock: 960.0000

Total Block Executions: 4096

Blocks / second: 1156842

Microseconds / Block: 0.86

Elapsed Time Used (Sec)

```

Pass1:          0.00
Sym/Xref       0.00
Pass2:          0.00
Load/Ctrl:     0.00
Execution:     0.00
Output:        0.00
-----
Total:         0.01

```