CSC 470F

Computer System Modelling and Analysis

Learning MAP by Example

Below is an annotated (in { }) simple MAP session in which a MAP model is created and then altered in various ways. See the MAP Reference Guide and MAP User's Manual for more detail about these commands and others.

```
% map

                                MAP VERSION 3.02

                              COMPILED: 27 January 1992

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 MAP>
cen cpu           { define a processor called cpu with the center command }
 DEFINING NEW SERVICE CENTER.
 MAP>
cen disk1  cen disk2               { define two disk centers }
 DEFINING NEW SERVICE CENTER.
 DEFINING NEW SERVICE CENTER.
 MAP>
class query   type transaction   arriv .10
 DEFINING NEW CLASS.               { define a class of database transactions }
                   { with arrival rate one every ten seconds }
 MAP>
class massage   type terminal   online 20   think 30
 DEFINING NEW CLASS.               { define a class of interactive customers }
                   { with a population of 20 and think time of 30 }
 MAP>
class crunch   type batch   avg 3
 DEFINING NEW CLASS.               { define a batch class with }
                   { average multiprogramming level 3 }
 MAP>
class each cen each load          { for each class and center, }
                   { indicate the service demand }
 QUERY:
   CPU:
1
   DISK1:
1
   DISK2:
1
 MASSAGE:
   CPU:
4
   DISK1:
10
   DISK2:
10
```

```
 CRUNCH:
   CPU:
100
   DISK1:
50
   DISK2:
50
 MAP>
list                                { list the model as defined so far }

   3 CLASSES
   3 CENTERS
   0 DOMAINS

                    WRKLOAD          PRI NON-              DOM
        CLASS TYPE  INTENS. THINK    LEV DISP IN DOMAIN    PRI
        ----- ----  ------- -----    --- ---- ---------    ---
        QUERY TRANS   0.100                                 1
      MASSAGE TERM   20.000  30.000                        1
       CRUNCH BATCH   3.000                                 1


       CENTER UNIT SCHED PROCS MODEL
       ------ ---- ----- ----- -----
          CPU       NORM    1
        DISK1       NORM    1
        DISK2       NORM    1

 DEVICE LOADINGS:

                      QUERY      MASSAGE       CRUNCH
          CPU        1.0000       4.0000     100.0000
        DISK1        1.0000      10.0000      50.0000
        DISK2        1.0000      10.0000      50.0000
        TOTAL        3.0000      24.0000     200.0000
 MAP>
perf                                    { evaluate the model to get throughputs }
                                        { and response times (and cpu utilization) }
                     *** SYSTEM PERFORMANCE MEASURES ***

               EXPAN.  RESPONSE   TIME IN   MEMORY   TERM
        CLASS  FACTOR    TIME      SYSTEM    WAIT   DELAY THROUGHPUT %CPU
        QUERY   8.81     26.417    26.417    0.000  0.000     0.1000  10%
      MASSAGE   9.99    239.731   239.731    0.000  0.000     0.0741  30%
       CRUNCH   6.90   1379.414  1379.414    0.000  0.000     0.0022  22%
                                                                     ----
                                                                      61%
 MAP>
cen every  util   { examine the utilization of all centers }

                          *** DEVICE UTILIZATIONS ***

                      QUERY      MASSAGE       CRUNCH        TOTAL
          CPU        0.1000       0.2966       0.2175       0.6141
        DISK1        0.1000       0.7415       0.1087       0.9502
        DISK2        0.1000       0.7415       0.1087       0.9502
 MAP>
qlength           {examine the average queue length at each center }

                          *** DEVICE QUEUE LENGTHS ***

                      QUERY      MASSAGE       CRUNCH        TOTAL
          CPU        0.2462       0.7198       0.4964       1.4625
        DISK1        1.1977       8.5279       1.2518      10.9774
        DISK2        1.1977       8.5279       1.2518      10.9774
```

```
   TERMINALS  -----------       2.2244  -----------  -----------
 MAP>
class each   plevel                  { set priority levels for the classes }
                  { where higher numbers are higher priority }
 QUERY:
9
 MASSAGE:
5
 CRUNCH:
3
 MAP>
cen cpu    schedule priority         { change cpu scheduling to priority }
 MAP>
perf                                 { look for the effect on system performance }
                                     { (not much change is found) }
                    *** SYSTEM PERFORMANCE MEASURES ***

               EXPAN.  RESPONSE   TIME IN   MEMORY   TERM
        CLASS  FACTOR    TIME      SYSTEM    WAIT   DELAY THROUGHPUT %CPU
        QUERY   8.33     24.999    24.999    0.000  0.000     0.1000  10%
      MASSAGE   9.85    236.511   236.511    0.000  0.000     0.0750  30%
       CRUNCH   7.53   1506.529  1506.529    0.000  0.000     0.0020  20%
                                                                     ----
                                                                     60%
 MAP>
cen disk3 cen disk4                  { add two more disk drives to the system }
 DEFINING NEW SERVICE CENTER.
 DEFINING NEW SERVICE CENTER.
 MAP>                                { spread the disk usage of all classes evenly }
                                     { across the four disks }
class each   cen disk1 load  .5  5  25
 MAP>
cen disk2   load   .5  5  25
 MAP>
cen disk3   load   .5  5  25
 MAP>
cen disk4 load   .5  5  25
 MAP>
list                                 { list the revised model with four disks }

   3 CLASSES
   5 CENTERS
   0 DOMAINS

                   WRKLOAD          PRI NON-              DOM
        CLASS TYPE  INTENS. THINK   LEV DISP IN DOMAIN   PRI
        ----- ----  ------- -----   --- ---- ---------   ---
        QUERY TRANS   0.100           9                   1
      MASSAGE TERM   20.000  30.000   5                   1
       CRUNCH BATCH   3.000           3                   1


       CENTER UNIT SCHED PROCS MODEL
       ------ ---- ----- ----- -----
          CPU        PRI    1
        DISK1       NORM    1
        DISK2       NORM    1
        DISK3       NORM    1
        DISK4       NORM    1

 DEVICE LOADINGS:

                    QUERY      MASSAGE       CRUNCH
          CPU      1.0000       4.0000     100.0000
        DISK1      0.5000       5.0000      25.0000
```

```
        DISK2       0.5000       5.0000      25.0000
        DISK3       0.5000       5.0000      25.0000
        DISK4       0.5000       5.0000      25.0000
        TOTAL       3.0000      24.0000     200.0000
 MAP>
perf                                 { look for change in performance }
                    *** SYSTEM PERFORMANCE MEASURES ***

               EXPAN.  RESPONSE   TIME IN   MEMORY   TERM
        CLASS  FACTOR    TIME      SYSTEM    WAIT   DELAY THROUGHPUT %CPU
        QUERY   3.60     10.805    10.805    0.000  0.000     0.1000  10%
      MASSAGE   4.43    106.418   106.418    0.000  0.000     0.1466  59%
       CRUNCH   9.68   1935.278  1935.278    0.000  0.000     0.0016  16%
                                                                     ----
                                                                      84%
 MAP>
cen every   util  { utilizations }

                          *** DEVICE UTILIZATIONS ***

                       QUERY      MASSAGE       CRUNCH        TOTAL
          CPU       0.1000       0.5864       0.1550       0.8415
        DISK1       0.0500       0.7330       0.0388       0.8218
        DISK2       0.0500       0.7330       0.0388       0.8218
        DISK3       0.0500       0.7330       0.0388       0.8218
        DISK4       0.0500       0.7330       0.0388       0.8218
 MAP>
                                     { if the interactive work is modified }
                                     { either by changing memory management }
                                     { or by rewriting software to make it }
                                     { require only half as many physical }
                                     { disks I/O's, ... }
class massage   cen every  load 2.5
 MAP>
cen cpu   load 2  { reset cpu service demand }
 MAP>
list                                 { list latest model }

   3 CLASSES
   5 CENTERS
   0 DOMAINS

                    WRKLOAD          PRI NON-              DOM
        CLASS TYPE  INTENS. THINK    LEV DISP IN DOMAIN    PRI
        ----- ----  ------- -----    --- ---- ---------    ---
        QUERY TRANS   0.100            9                    1
      MASSAGE TERM   20.000  30.000    5                    1
       CRUNCH BATCH   3.000            3                    1


       CENTER UNIT SCHED PROCS MODEL
       ------ ---- ----- ----- -----
          CPU        PRI    1
        DISK1       NORM    1
        DISK2       NORM    1
        DISK3       NORM    1
        DISK4       NORM    1

 DEVICE LOADINGS:

                       QUERY      MASSAGE       CRUNCH
          CPU       1.0000       2.0000     100.0000
        DISK1       0.5000       2.5000      25.0000
        DISK2       0.5000       2.5000      25.0000
        DISK3       0.5000       2.5000      25.0000
```

```
        DISK4       0.5000       2.5000      25.0000
        TOTAL       3.0000      12.0000     200.0000
 MAP>
perf                                { examine its performance }
                    *** SYSTEM PERFORMANCE MEASURES ***

                EXPAN.  RESPONSE   TIME IN   MEMORY   TERM
        CLASS  FACTOR    TIME      SYSTEM    WAIT   DELAY THROUGHPUT %CPU
        QUERY   3.02      9.062     9.062    0.000  0.000     0.1000  10%
      MASSAGE   3.68     44.147    44.147    0.000  0.000     0.2697  54%
       CRUNCH   7.75   1550.129  1550.129    0.000  0.000     0.0019  19%
                                                                     ----
                                                                      83%
 MAP>
cen cpu   sched normal              { remove priority scheduling at the cpu }
 MAP>
perf                                { see effect of higher cpu utilization }
                                    { but worse performance for two classes }
                    *** SYSTEM PERFORMANCE MEASURES ***

                EXPAN.  RESPONSE   TIME IN   MEMORY   TERM
        CLASS  FACTOR    TIME      SYSTEM    WAIT   DELAY THROUGHPUT %CPU
        QUERY   4.82     14.469    14.469    0.000  0.000     0.1000  10%
      MASSAGE   4.14     49.738    49.738    0.000  0.000     0.2508  50%
       CRUNCH   4.96    992.603   992.603    0.000  0.000     0.0030  30%
                                                                     ----
                                                                      90%
 MAP>
save example.3cl  { save the model definition in a file }
                                    { for later reuse with the read command }
 MAP>
class massage   graph resp wi 4 40 4
                                    { try out the graph exec }
          |
   95.635 +                                                 X
          |
          |                                           X
   81.121 +
          |                                     X
          |
   66.606 +                                 X
          |
          |                              X
   52.091 +                        X
          |
          |                  X
   37.576 +
          |            X
          |       X
   23.061 +    X
          +----+-----+-----+-----+-----+-----+-----+-----+-----+----
              4.0000     13.0000     22.0000     31.0000     40.0000

 RESP VS. WI FOR CLASS MASSAGE
```

```
 MAP>
cen cpu  class crunch  graph util wi 1 5 1
                                   { try it again }
          |
    0.241 +                                                     X
          |
          |                                         X
    0.208 +
          |
          |
    0.175 +                            X
          |
          |
    0.142 +
          |                 X
          |
    0.109 +
          |
          |
    0.076 +    X
          +----+-----+-----+-----+-----+-----+-----+-----+-----+----
              1.0000      2.0000      3.0000      4.0000      5.0000

 UTIL VS. WI FOR CLASS CRUNCH
 MAP>
quit                               { exit from MAP }
```