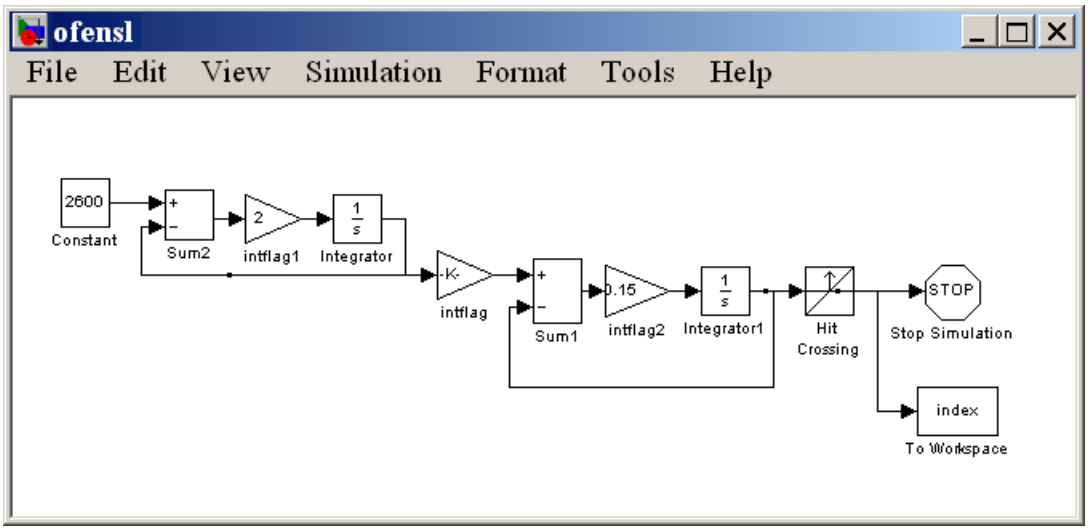
```
% ofen2.gpss & ofenode.m | ofensl.mdl
%   Hybrid system example from:
%   C.D. Pedgen, R.E. Shannon, R.P. Sadowski "Introduction
%   to Simulation Using SIMAN", p.455
%   Ingots arrive at an oven. The oven holds 10 ingots max.
%   The oven is heated continuously. An entering ingot has a
%   randomly distributed initial temperature and reduces the
%   oven temperature. The ingot is heated until it reaches a
%   given final temperature. Then it leaves the oven and gives
%   places for succeding ingots.
%   The oven and ingots temperatures, the content and the
%   queue length are plotted. Tend=50.
%
% Usage: >>prepare('ofen2.gpss'), schedule(1,0), printstat

storages ofen(10)
queues   waitreg                                    % Extens.
init   ingotnum=0;
       x=zeros(11,1);       % continuous state vector(always x)
       ODENAME='ofenode';   % activate for using MATLAB's ode23
       % ODENAME='ofensl';  % activate for using SIMULINK engine
       c_hold(1:10)
       queuelen=[];                                 % Extens.
       content=[];                                  % Extens.
       time=[];                                     % Extens.
model
       generate(1.1,1,10,0,0)
       queue(waitreg,1)                             % Extens.
       enter(ofen,1)
       queuelen=[queuelen; Q(waitreg)]; content=[content;ingotnum];
       time=[time; T];                              % Extens.
       selectmin(F(1:10),1)
       seize(P(1))
       depart(waitreg,1)                            % Extens.
       queuelen=[queuelen; Q(waitreg)]; content=[content;ingotnum];
       time=[time; T];                              % Extens.
       ingotnum=ingotnum+1;
       x(P(1))=rand*200+300;
       c_operate(P(1))
       x(11)=x(11)-(x(11)-x(P(1)))/ingotnum;
       logic_r(P(1))
       queuelen=[queuelen; Q(waitreg)]; content=[content;ingotnum];
       time=[time; T];                              % Extens.
       gate_ls(P(1),0)
       c_hold(P(1))
       x(P(1))=0;
       ingotnum=ingotnum-1;
       release(P(1))
       leave(ofen,1)
       queuelen=[queuelen; Q(waitreg)]; content=[content;ingotnum];
       time=[time; T];                              % Extens.
       terminate(0)

       detect(1:10,0,1)
       logic_s(P(1))
       terminate(0)

       generate(50,0,50,0,0)
       close all; plot(tvec,xmat); title('temperatures');
       figure; stairs(time,content); hold on;
       stairs(time,queuelen); title('content, queue length');
       hold off                                     % Extens.
       terminate(1)
```

```
function [dx,eventflg,direction]=ofenode(t,x,flag)

if nargin<3 | isempty(flag)
   dx=zeros(11,1);
   dx(11)=2*(2600-x(11));
   dx(1:10)=.15*(x(11)-x(1:10));
else
   switch(flag)
   case 'events'
     dx(1:10)=x(1:10)-2200;     % reaching the final temperature
     eventflg=ones(1,10);       % stop on each event
     direction=ones(1,10);      % Xing in + direction
   otherwise
     error(['unknown flag ''' flag '''.']);
   end
end
```



MODEL EXECUTION & SIMULATION RESULTS

```
>> prepare('ofen2.gpss'), schedule(1,0), printstat
…
 T = 49.01
Calling continuous model file ofenode.m.
 T = 49.46
Calling continuous model file ofenode.m.
 T = 49.53
Calling continuous model file ofenode.m.
 T = 50.00
Simulation beendet

------------------------------------------------------------------------------
QUEUE-STATISTIK, T = 50.00
Nr.  max.  mittl. Eintritte zeitlose    mittl.   Verweilzeit aktuelle Name
    Laenge Laenge  insges.  Eintritte Verweilzeit    WZ~=0    Laenge  ####
 1    8     1.89     39        10        2.43       3.26         7
waitreg
------------------------------------------------------------------------------
FACILITY-STATISTIK, T = 50.00
Nr.  belegende    mittl.     Anzahl      mittl.     Name
     Transakt.  Auslastung  Eintritte  Verweilzeit  ####
 1       3         0.80           4       10.00
 2       4         0.77           4        9.67
```

```
 3       9         0.75            3       12.55
 4      10         0.72            3       12.00
 5      17         0.69            3       11.51
 6      11         0.68            3       11.31
 7      12         0.66            3       10.95
 8      13         0.64            3       10.67
 9      14         0.63            3       10.51
10       1         0.59            3        9.87
------------------------------------------------------------------------------
STORAGE-STATISTIK, T = 50.00
Nr. Kapaz.  mittl.  Eintritte  Auslastung    mittl.   aktueller  max.
Name
            Inhalt   insges.              Verweilzeit  Inhalt   Inhalt
####
 1   10      6.94      32         0.69      10.84        10       10
ofen
------------------------------------------------------------------------------
keine USER-CHAIN betreten
------------------------------------------------------------------------------
BLOCK-STATISTIK, T = 50.00
    39     generate(1.1,1,10,0,0)
    39     queue(waitreg,1)
    32     enter(ofen,1)
    32     queuelen=[queuelen; Q(waitreg)]; content=[content;ingotnum];
    32     time=[time; T];
    32     selectmin(F(1:10),1)
    32     seize(P(1))
    32     depart(waitreg,1)
    32     queuelen=[queuelen; Q(waitreg)]; content=[content;ingotnum];
    32     time=[time; T];
    32     ingotnum=ingotnum+1;
    32     x(P(1))=rand*200+300;
    32     c_operate(P(1))
    32     x(11)=x(11)-(x(11)-x(P(1)))/ingotnum;
    32     logic_r(P(1))
    32     queuelen=[queuelen; Q(waitreg)]; content=[content;ingotnum];
    32     time=[time; T];
    22     gate_ls(P(1),0)
    22     c_hold(P(1))
    22     x(P(1))=0;
    22     ingotnum=ingotnum-1;
    22     release(P(1))
    22     leave(ofen,1)
    22     queuelen=[queuelen; Q(waitreg)]; content=[content;ingotnum];
    22     time=[time; T];
    22     terminate(0)
    22     detect(1:10,0,1)
    22     logic_s(P(1))
    22     terminate(0)
     1     generate(50,0,50,0,0)
     1     close all; plot(tvec,xmat); title('temperatures');
     1     figure; stairs(time,content); hold on;
     1     stairs(time,queuelen); title('content, queue length');
     1     hold off
     1     terminate(1)
------------------------------------------------------------------------------
```

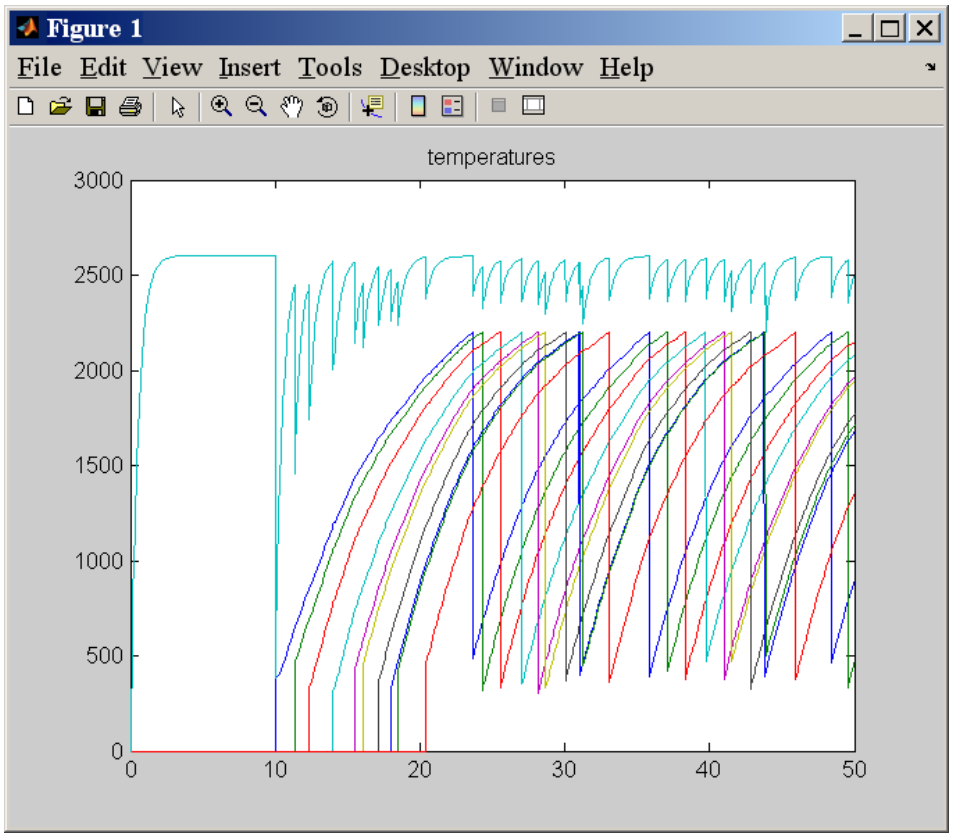


Figure 1
File Edit View Insert Tools Desktop Window Help
temperatures
3000
2500
2000
1500
1000
500
0
0
10
20
30
40
50

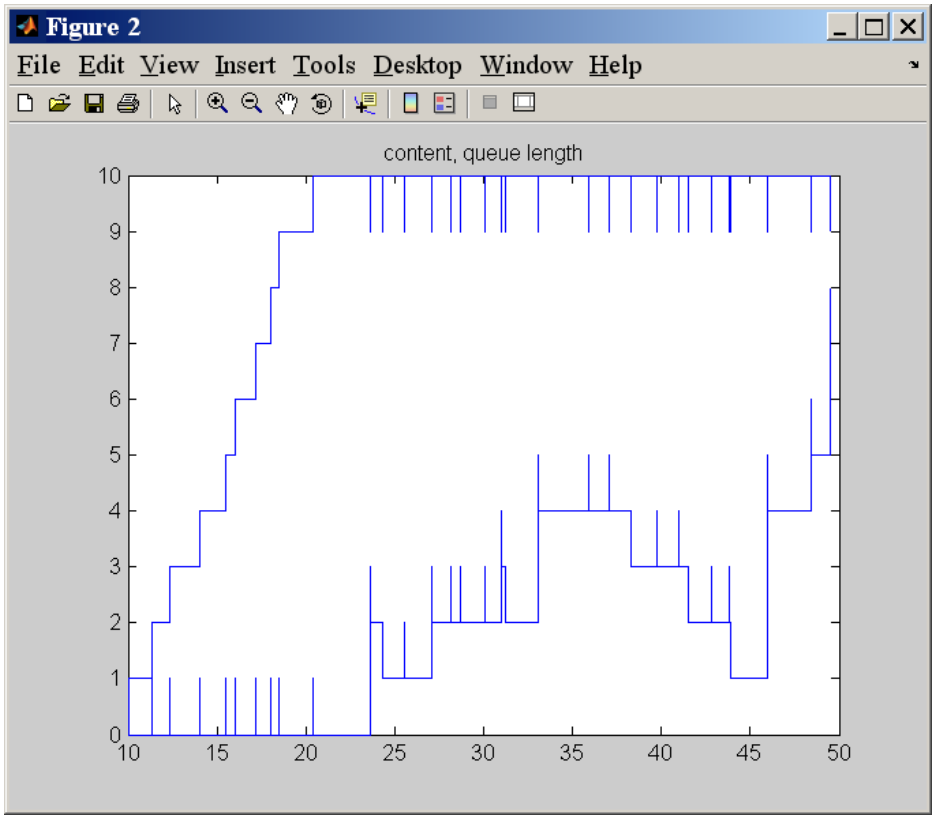


Figure 2
File Edit View Insert Tools Desktop Window Help
content, queue length
10
9
8
7
6
5
4
3
2
1
0
10
15
20
25
30
35
40
45
50