DJILLALI LIABES UNIVERSITY OF SIDI BEL ABBES
FACULTY OF EXACT SCIENCES
DEPARTMENT OF COMPUTER SCIENCES

Module : Intelligence Artificielle II
1ST YEAR OF MASTER'S DEGEREE IN
NETWORKS,INFORMATION SYSTEMS & SECURITY(RSSI)
2021/2022

Réseaux de Neurones
TP-05

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A paper submitted in fulfilment of the requirements for the
TP-05

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Contents

Chapter 1

Réseaux de Neurones.

1.1 Digit Detection with Neural Networks

- Working Environment
  - **Machine :** LENOVO IdeaPad S210, Intel Celeron 1037U, 2GB DDR3L
  - **OS :** Linux Mint 20.3 Una
  - **Kernel :** 5.4.0-100-generic x86_64 bits
  - **MATLAB :** R2015 v8.5.0.197613

1.1.1 Creation of dataset.

Here we used matrices to generate numbers from 0 to 9.

```
%Creation of matrices for the following numbers 0 1 2 3 4 5 6 7 8 9





  x1 = [0 ; 0 ; 1 ; 0 ; 0 ;
        0 ; 1 ; 1 ; 0 ; 0 ;
        0 ; 0 ; 1 ; 0 ; 0 ;
        0 ; 0 ; 1 ; 0 ; 0 ;
        0 ; 0 ; 1 ; 0 ; 0 ;
        0 ; 0 ; 1 ; 0 ; 0 ;
        0 ; 0 ; 1 ; 0 ; 0 ;
        ];



   x2 = [0 ; 1 ; 1 ; 1 ; 0 ;
         0 ; 1 ; 0 ; 1 ; 0 ;
         0 ; 0 ; 0 ; 1 ; 0 ;
         0 ; 1 ; 1 ; 1 ; 0 ;
         0 ; 1 ; 0 ; 0 ; 0 ;
         0 ; 1 ; 0 ; 1 ; 0 ;
         0 ; 1 ; 1 ; 1 ; 0 ;
         ];

```

```


    x3 = [0 ; 1 ; 1 ; 1 ; 0 ;
          0 ; 1 ; 0 ; 1 ; 0 ;
          0 ; 0 ; 0 ; 1 ; 0 ;
          0 ; 1 ; 1 ; 1 ; 0 ;
          0 ; 0 ; 0 ; 1 ; 0 ;
          0 ; 1 ; 0 ; 1 ; 0 ;
          0 ; 1 ; 1 ; 1 ; 0 ;
          ];



      x4 = [0 ; 1 ; 0 ; 1 ; 0 ;
            0 ; 1 ; 0 ; 1 ; 0 ;
            0 ; 1 ; 0 ; 1 ; 0 ;
            0 ; 1 ; 1 ; 1 ; 0 ;
            0 ; 0 ; 0 ; 1 ; 0 ;
            0 ; 0 ; 0 ; 1 ; 0 ;
            0 ; 0 ; 0 ; 1 ; 0 ;
            ];


      x5 = [0 ; 1 ; 1 ; 1 ; 0 ;
            0 ; 1 ; 0 ; 0 ; 0 ;
            0 ; 1 ; 0 ; 0 ; 0 ;
            0 ; 1 ; 1 ; 1 ; 0 ;
            0 ; 0 ; 0 ; 1 ; 0 ;
            0 ; 0 ; 0 ; 1 ; 0 ;
            0 ; 1 ; 1 ; 1 ; 0 ;
            ];

      x6 = [0 ; 0 ; 1 ; 0 ; 0 ;
            0 ; 1 ; 0 ; 1 ; 0 ;
            0 ; 1 ; 0 ; 0 ; 0 ;
            0 ; 1 ; 1 ; 0 ; 0 ;
            0 ; 1 ; 0 ; 1 ; 0 ;
            0 ; 1 ; 0 ; 1 ; 0 ;
            0 ; 0 ; 1 ; 0 ; 0 ;
            ];




      x7 = [0 ; 1 ; 1 ; 1 ; 0 ;
            0 ; 0 ; 0 ; 1 ; 0 ;
            0 ; 0 ; 1 ; 0 ; 0 ;
            0 ; 0 ; 1 ; 0 ; 0 ;
            0 ; 0 ; 1 ; 0 ; 0 ;
            0 ; 1; 0 ; 0 ; 0 ;
            0 ; 1 ; 0 ; 0 ; 0 ;
```

```
           ];



    x8 = [0 ; 0 ; 1 ; 0 ; 0 ;
          0 ; 1 ; 0 ; 1 ; 0 ;
          0 ; 1 ; 0 ; 1 ; 0 ;
          0 ; 0 ; 1; 0 ; 0 ;
          0 ; 1 ; 0 ; 1 ; 0 ;
          0 ; 1 ; 0 ; 1 ; 0 ;
          0 ; 0 ; 1 ; 0 ; 0 ;
          ];




    x9 = [0 ; 0 ; 1 ; 0 ; 0 ;
          0 ; 1 ; 0 ; 1 ; 0 ;
          0 ; 1 ; 0 ; 1 ; 0 ;
          0 ; 0 ; 1 ; 1 ; 0 ;
          0 ; 0 ; 0 ; 1 ; 0 ;
          0 ; 1 ; 0 ; 1 ; 0 ;
          0 ; 0 ; 1 ; 0 ; 0 ;
          ];


        x10 = [0 ; 0 ; 1 ; 0 ; 0 ;
        0 ; 1 ; 0 ; 1 ; 0 ;
        0 ; 1 ; 0 ; 1 ; 0 ;
        0 ; 1 ; 0 ; 1 ; 0 ;
        0 ; 1 ; 0 ; 1 ; 0 ;
        0 ; 1 ; 0 ; 1 ; 0 ;
        0 ; 0 ; 1 ; 0 ; 0 ;
        ];
```

The resulted pictures look like this :

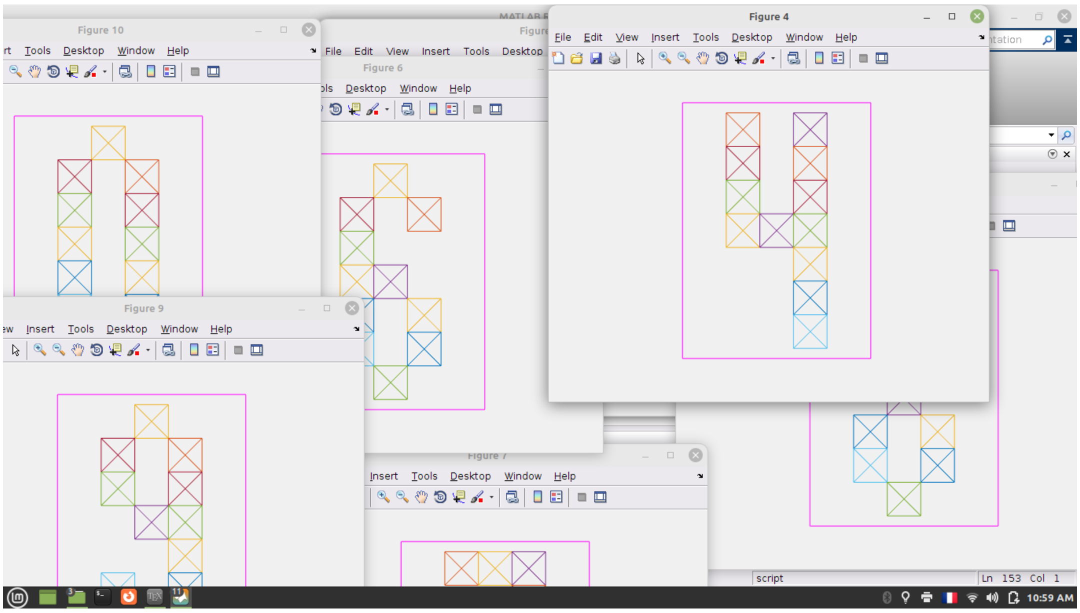
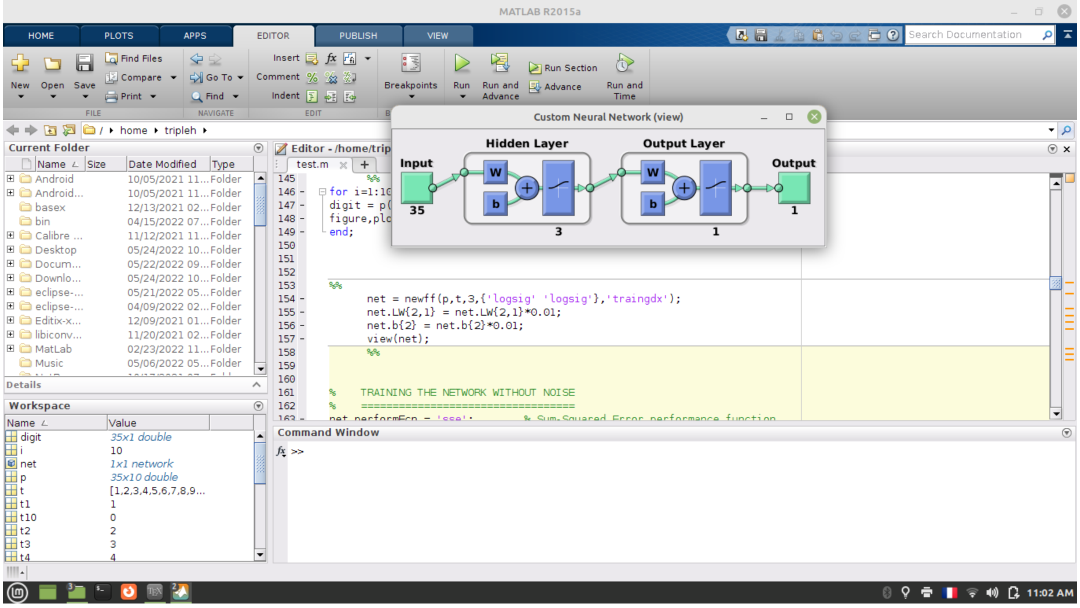


FIGURE 1.1: numbers

1.1.2 Creation on the Neural network

Now we create our Neural Network with 3 hidden layers and 35 inputs and 1 output while using **logsig** in hidden and output layers.

```
    net = newff(p,t,3,{'logsig' 'logsig'},'traingdx');
    net.LW{2,1} = net.LW{2,1}*0.01;
    net.b{2} = net.b{2}*0.01;
    view(net);
```



Current Folder

Name	Size	Date Modified	Type
Android		10/05/2021 11...	Folder
Android...		10/05/2021 11...	Folder
basex		12/13/2021 02...	Folder
bin		04/15/2022 07...	Folder
Calibre ...		11/12/2021 11...	Folder
Desktop		05/24/2022 10...	Folder
Docum...		05/22/2022 09...	Folder
Downlo...		05/24/2022 10...	Folder
eclipse-...		05/21/2022 05...	Folder
eclipse-...		04/09/2022 02...	Folder
Editix-x...		12/09/2021 01...	Folder
libiconv...		11/20/2021 02...	Folder
MatLab		02/23/2022 11...	Folder
Music		05/06/2022 05...	Folder

Workspace

Name	Value
digit	35x1 double
i	10
net	1x1 network
p	35x10 double
t	[1,2,3,4,5,6,7,8,9...
t1	1
t10	0
t2	2
t3	3
t4	4

```
    %%
for i=1:1(
digit = p(
figure,plo
end;



%%
      net = newff(p,t,3,{'logsig' 'logsig'},'traingdx');
      net.LW{2,1} = net.LW{2,1}*0.01;
      net.b{2} = net.b{2}*0.01;
      view(net);
      %%


%    TRAINING THE NETWORK WITHOUT NOISE
%    ==================================
net.performFcn = 'sse';        % Sum-Squared Error performance function
```

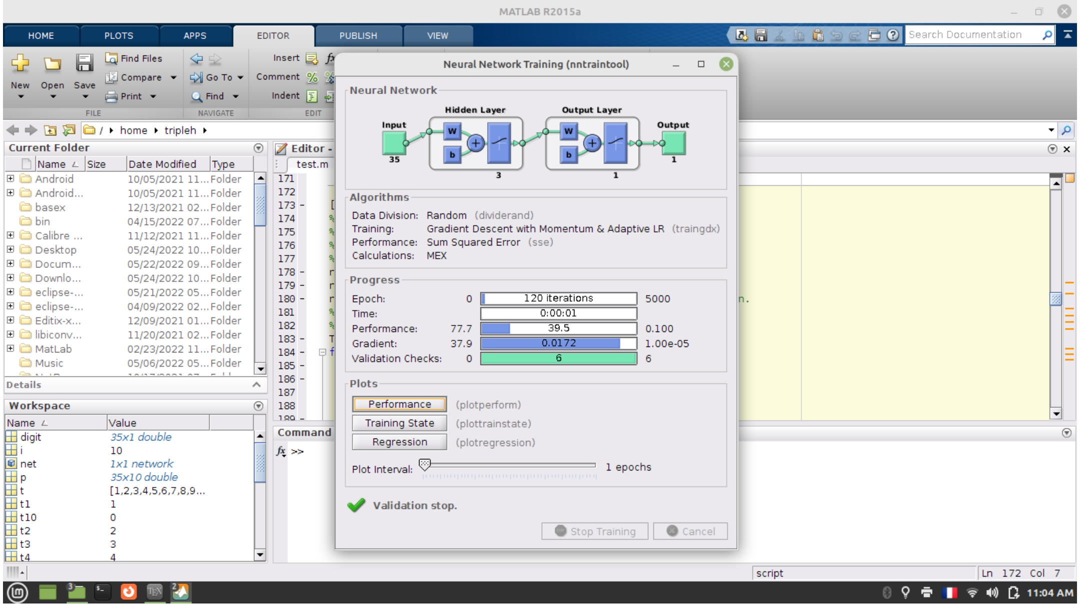
```
>>
```

FIGURE 1.2: NN

1.1.3 Training our network with no noise

Here we are training our network with no noise.

```
%     TRAINING THE NETWORK WITHOUT NOISE
%     ==================================
net.performFcn = 'sse';          % Sum-Squared Error performance function
net.trainParam.goal = 0.1;       % Sum-squared error goal.
net.trainParam.show = 20;        % Frequency of progress displays (in epochs).
net.trainParam.epochs = 5000;    % Maximum number of epochs to train.
net.trainParam.mc = 0.95;        % Momentum constant.
%     Training begins...please wait...
[net,tr] = train(net,p,t);
%     ...and finally finishes.
```



Current Folder

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Desktop		05/24/2022 10...	Folder
Docum...		05/22/2022 09...	Folder
Downlo...		05/24/2022 10...	Folder
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libiconv...		11/20/2021 02...	Folder
MatLab		02/23/2022 11...	Folder
Music		05/06/2022 05...	Folder

Workspace

Name	Value
digit	35x1 double
i	10
net	1x1 network
p	35x10 double
t	[1,2,3,4,5,6,7,8,9...
t1	1
t10	0
t2	2
t3	3
t4	4

Neural Network Training (nntraintool)

Neural Network

Algorithms

Data Division: Random (dividerand)
Training: Gradient Descent with Momentum & Adaptive LR (traingdx)
Performance: Sum Squared Error (sse)
Calculations: MEX

Progress

Epoch:	0	120 iterations	5000
Time:		0:00:01	
Performance:	77.7	39.5	0.100
Gradient:	37.9	0.0172	1.00e-05
Validation Checks:	0	6	6

Plots

Performance (plotperform)
Training State (plottrainstate)
Regression (plotregression)
Plot Interval: 1 epochs

✓ Validation stop.

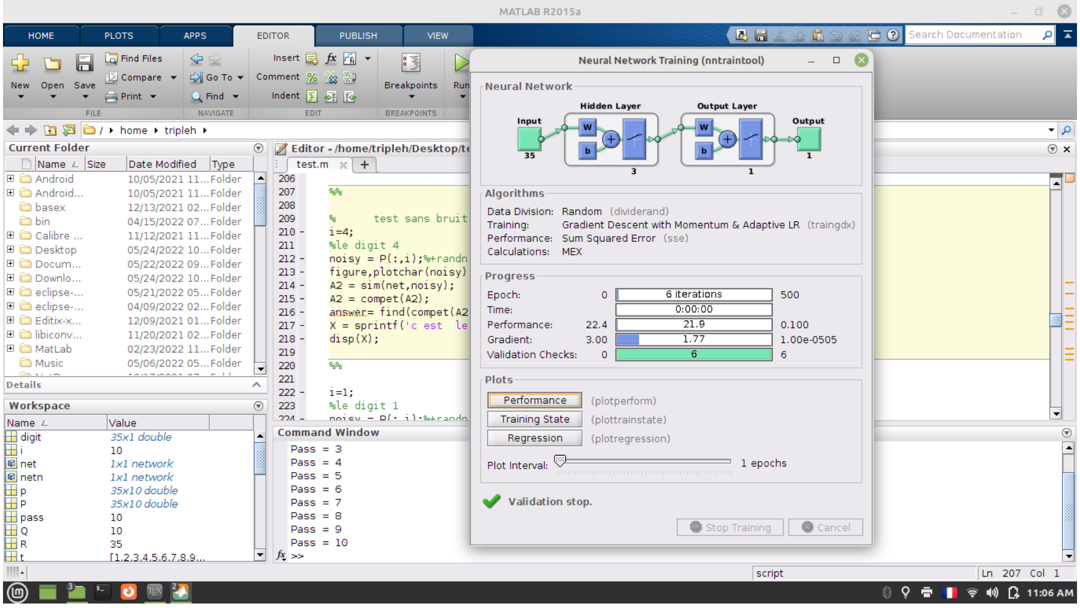
Stop Training
Cancel

FIGURE 1.3: train no noise

1.1.4 Training our network with noise twice

```
[R,Q] = size(p);
%     TRAINING THE NETWORK WITH NOISE
%     ===============================
%     A copy of the network will now be made.  This copy will
%     be trained with noisy examples of letters of the alphabet.
netn = net;
netn.trainParam.goal = 0.6;      % Mean-squared error goal.
netn.trainParam.epochs = 300;    % Maximum number of epochs to train.
%     The network will be trained on 10 sets of noisy data.
%     Training begins...please wait...
T = [t t t t];
for pass = 1:10
```

```
  fprintf('Pass = %.0f\n',pass);
  P = [p, p, ...
       (p + randn(R,Q)*0.1), ...
       (p + randn(R,Q)*0.2)];
  [netn,tr] = train(netn,P,T);
  echo off
end
echo on
%    ...and finally finishes.
%    TRAINING THE SECOND NETWORK WITHOUT NOISE
%    ==========================================
%    The second network is now retrained without noise to
%    insure that it correctly categorizes non-noizy letters.
netn.trainParam.goal = 0.1;     % Mean-squared error goal.
netn.trainParam.epochs = 500;  % Maximum number of epochs to train.
netn.trainParam.show = 5;        % Frequency of progress displays (in epochs).
%    Training begins...please wait...
P = p;
T = t;
[netn,tr] = train(netn,P,T);
%    ...and finally finishes
```



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basex		12/13/2021 02...	Folder
bin		04/15/2022 07...	Folder
Calibre ...		11/12/2021 11...	Folder
Desktop		05/24/2022 10...	Folder
Docum...		05/22/2022 09...	Folder
Downlo...		05/24/2022 10...	Folder
eclipse-...		05/21/2022 05...	Folder
eclipse-...		04/09/2022 02...	Folder
Editix-x...		12/09/2021 01...	Folder
libiconv...		11/20/2021 02...	Folder
MatLab		02/23/2022 11...	Folder
Music		05/06/2022 05...	Folder

Name	Value
digit	35x1 double
i	10
net	1x1 network
netn	1x1 network
p	35x10 double
P	35x10 double
pass	10
Q	10
R	35
t	[1,2,3,4,5,6,7,8,9...

```

%%

%       test sans bruit
i=4;
%le digit 4
noisy = P(:,i);%+randn
figure,plotchar(noisy)
A2 = sim(net,noisy);
A2 = compet(A2);
answer= find(compet(A2
X = sprintf('c est  le
disp(X);

%%

i=1;
%le digit 1
noisy = P(:,i);%+randn
```

```
Pass = 3
Pass = 4
Pass = 5
Pass = 6
Pass = 7
Pass = 8
Pass = 9
Pass = 10
>>
```

Data Division: Random (dividerand)
Training: Gradient Descent with Momentum & Adaptive LR (traingdx)
Performance: Sum Squared Error (sse)
Calculations: MEX

Epoch: 0 | 6 iterations | 500
Time: | 0:00:00 |
Performance: 22.4 | 21.9 | 0.100
Gradient: 3.00 | 1.77 | 1.00e-0505
Validation Checks: 0 | 6 | 6

Performance (plotperform)
Training State (plottrainstate)
Regression (plotregression)

Plot Interval: 1 epochs

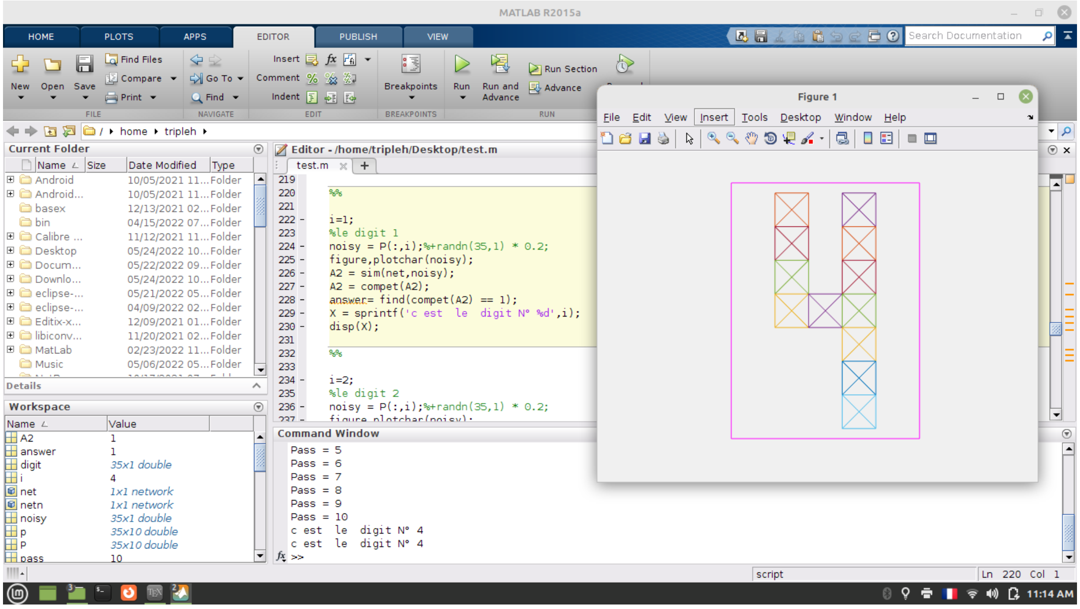
✓ Validation stop.

FIGURE 1.4: train with noise

1.1.5 Testing with no noise

```
%      test sans bruit          %%%%%%%%%%%%%%%%%%
i=4;
%le digit 4
noisy = P(:,i);%+randn(35,1) * 0.2;
figure,plotchar(noisy);
```

```
A2 = sim(net,noisy);
A2 = compet(A2);
answer= find(compet(A2) == 1);
X = sprintf('c est  le  digit N %d',i);
disp(X);
```



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Android...		10/05/2021 11...	Folder
basex		12/13/2021 02...	Folder
bin		04/15/2022 07...	Folder
Calibre ...		11/12/2021 11...	Folder
Desktop		05/24/2022 10...	Folder
Docum...		05/22/2022 09...	Folder
Downlo...		05/24/2022 10...	Folder
eclipse-...		05/21/2022 05...	Folder
eclipse-...		04/09/2022 02...	Folder
Editix-x...		12/09/2021 01...	Folder
libiconv...		11/20/2021 02...	Folder
MatLab		02/23/2022 11...	Folder
Music		05/06/2022 05...	Folder

Name	Value
A2	1
answer	1
digit	35x1 double
i	4
net	1x1 network
netn	1x1 network
noisy	35x1 double
p	35x10 double
P	35x10 double
pass	10

Editor - /home/tripleh/Desktop/test.m

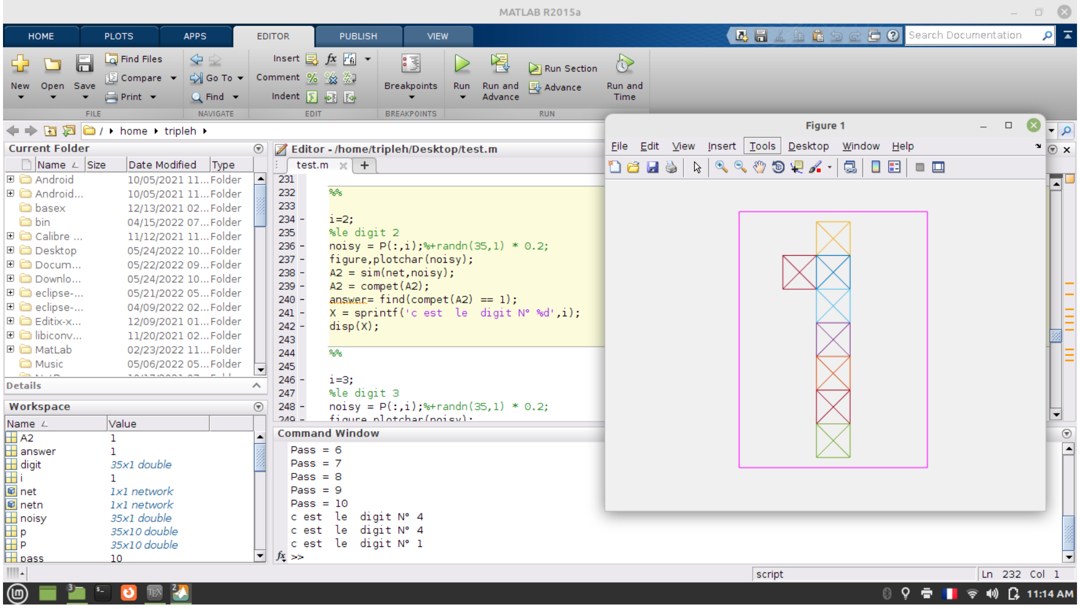
test.m

```
%%

i=1;
%le digit 1
noisy = P(:,i);%+randn(35,1) * 0.2;
figure,plotchar(noisy);
A2 = sim(net,noisy);
A2 = compet(A2);
answer= find(compet(A2) == 1);
X = sprintf('c est  le  digit N° %d',i);
disp(X);

%%

i=2;
%le digit 2
noisy = P(:,i);%+randn(35,1) * 0.2;
figure,plotchar(noisy);
```

Command Window

```
Pass = 5
Pass = 6
Pass = 7
Pass = 8
Pass = 9
Pass = 10
c est  le  digit N° 4
c est  le  digit N° 4
fx >>
```

FIGURE 1.5: test no noise



Name	Size	Date Modified	Type
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Android...		10/05/2021 11...	Folder
basex		12/13/2021 02...	Folder
bin		04/15/2022 07...	Folder
Calibre ...		11/12/2021 11...	Folder
Desktop		05/24/2022 10...	Folder
Docum...		05/22/2022 09...	Folder
Downlo...		05/24/2022 10...	Folder
eclipse-...		05/21/2022 05...	Folder
eclipse-...		04/09/2022 02...	Folder
Editix-x...		12/09/2021 01...	Folder
libiconv...		11/20/2021 02...	Folder
MatLab		02/23/2022 11...	Folder
Music		05/06/2022 05...	Folder

Name	Value
A2	1
answer	1
digit	35x1 double
i	1
net	1x1 network
netn	1x1 network
noisy	35x1 double
p	35x10 double
P	35x10 double
pass	10

Editor - /home/tripleh/Desktop/test.m

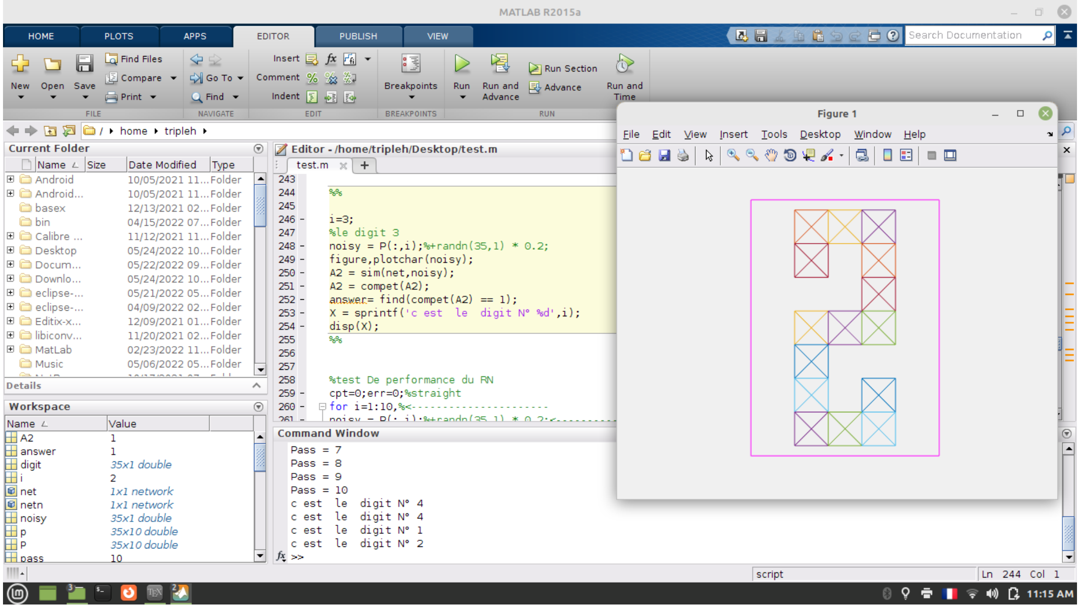
test.m

```
%%

i=2;
%le digit 2
noisy = P(:,i);%+randn(35,1) * 0.2;
figure,plotchar(noisy);
A2 = sim(net,noisy);
A2 = compet(A2);
answer= find(compet(A2) == 1);
X = sprintf('c est  le  digit N° %d',i);
disp(X);

%%

i=3;
%le digit 3
noisy = P(:,i);%+randn(35,1) * 0.2;
figure,plotchar(noisy);
```

Command Window

```
Pass = 6
Pass = 7
Pass = 8
Pass = 9
Pass = 10
c est  le  digit N° 4
c est  le  digit N° 4
c est  le  digit N° 1
fx >>
```

FIGURE 1.6: test no noise



Name	Size	Date Modified	Type
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basex		12/13/2021 02...	Folder
bin		04/15/2022 07...	Folder
Calibre ...		11/12/2021 11...	Folder
Desktop		05/24/2022 10...	Folder
Docum...		05/22/2022 09...	Folder
Downlo...		05/24/2022 10...	Folder
eclipse-...		05/21/2022 05...	Folder
eclipse-...		04/09/2022 02...	Folder
Editix-x...		12/09/2021 01...	Folder
libiconv...		11/20/2021 02...	Folder
MatLab		02/23/2022 11...	Folder
Music		05/06/2022 05...	Folder

Name	Value
A2	1
answer	1
digit	35x1 double
i	2
net	1x1 network
netn	1x1 network
noisy	35x1 double
p	35x10 double
P	35x10 double
pass	10

Editor - /home/tripleh/Desktop/test.m

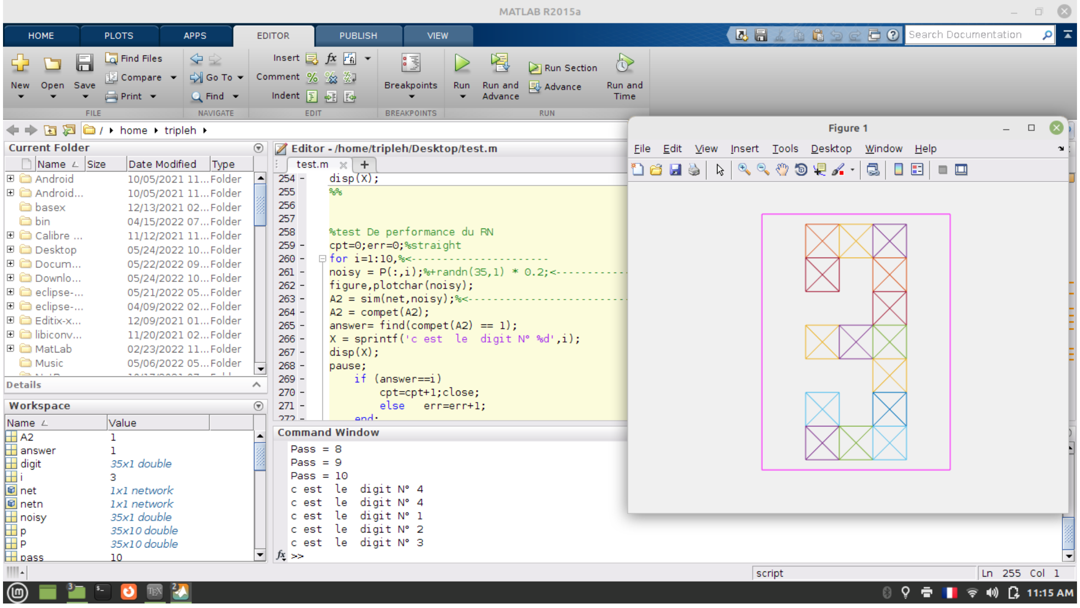
test.m

```
%%

i=3;
%le digit 3
noisy = P(:,i);%+randn(35,1) * 0.2;
figure,plotchar(noisy);
A2 = sim(net,noisy);
A2 = compet(A2);
answer= find(compet(A2) == 1);
X = sprintf('c est  le  digit N° %d',i);
disp(X);
%%


%test De performance du RN
cpt=0;err=0;%straight
for i=1:10,%<----------------------
```

Command Window

```
Pass = 7
Pass = 8
Pass = 9
Pass = 10
c est  le  digit N° 4
c est  le  digit N° 4
c est  le  digit N° 1
c est  le  digit N° 2
>>
```

FIGURE 1.7: test no noise



Name	Size	Date Modified	Type
Android		10/05/2021 11...	Folder
Android...		10/05/2021 11...	Folder
basex		12/13/2021 02...	Folder
bin		04/15/2022 07...	Folder
Calibre ...		11/12/2021 11...	Folder
Desktop		05/24/2022 10...	Folder
Docum...		05/22/2022 09...	Folder
Downlo...		05/24/2022 10...	Folder
eclipse-...		05/21/2022 05...	Folder
eclipse-...		04/09/2022 02...	Folder
Editix-x...		12/09/2021 01...	Folder
libiconv...		11/20/2021 02...	Folder
MatLab		02/23/2022 11...	Folder
Music		05/06/2022 05...	Folder

Name	Value
A2	1
answer	1
digit	35x1 double
i	3
net	1x1 network
netn	1x1 network
noisy	35x1 double
p	35x10 double
P	35x10 double
pass	10

Editor - /home/tripleh/Desktop/test.m

test.m

```
disp(X);
%%


%test De performance du RN
cpt=0;err=0;%straight
for i=1:10,%<----------------------
noisy = P(:,i);%+randn(35,1) * 0.2;<-----------
figure,plotchar(noisy);
A2 = sim(net,noisy);%<-----------------------------
A2 = compet(A2);
answer= find(compet(A2) == 1);
X = sprintf('c est  le  digit N° %d',i);
disp(X);
pause;
    if (answer==i)
        cpt=cpt+1;close;
        else   err=err+1;
    end;
```

Command Window

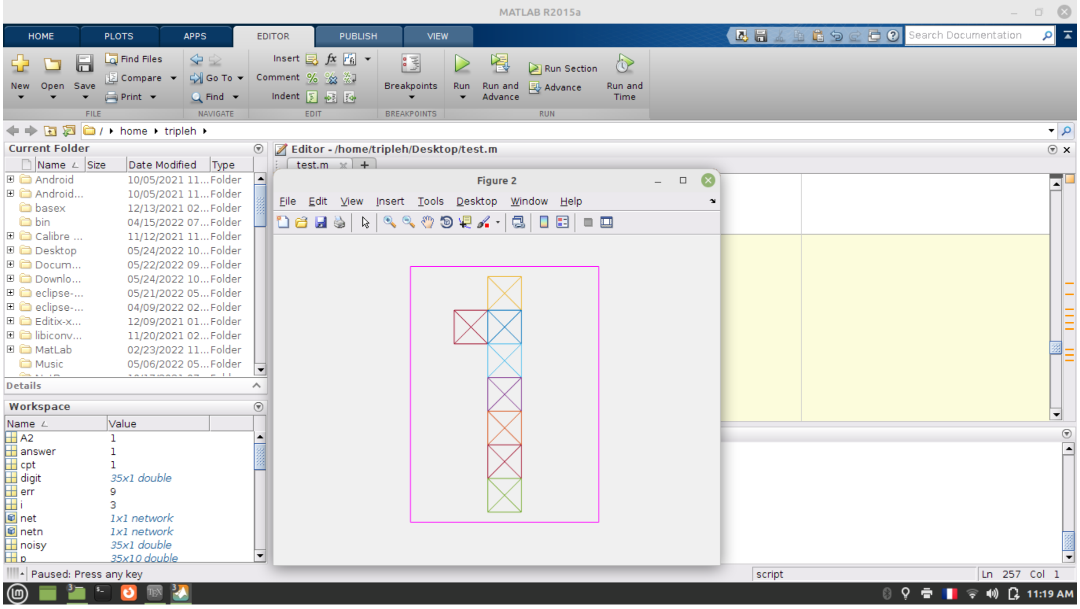
```
Pass = 8
Pass = 9
Pass = 10
c est  le  digit N° 4
c est  le  digit N° 4
c est  le  digit N° 1
c est  le  digit N° 2
c est  le  digit N° 3
>>
```

FIGURE 1.8: test no noise

1.1.6 Test Performance of Neural Network

```
%test De performance du RN
cpt=0;err=0;%straight
for i=1:10,%<-----------------------
noisy = P(:,i);%+randn(35,1) * 0.2;<-------------------
figure,plotchar(noisy);
A2 = sim(net,noisy);%<---------------------------
A2 = compet(A2);
answer= find(compet(A2) == 1);
X = sprintf(’c est  le  digit N %d’,i);
```

```
disp(X);
pause;
    if (answer==i)
        cpt=cpt+1;close;
        else    err=err+1;
    end;
end;
X = sprintf('nombre de reconnaissance correcte est : %d',cpt);
disp(X);
X = sprintf('nombre d erreur de reconnaissance est : %d',err);
disp(X);
```



Current Folder

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Downlo...		05/24/2022 10...	Folder
eclipse-...		05/21/2022 05...	Folder
eclipse-...		04/09/2022 02...	Folder
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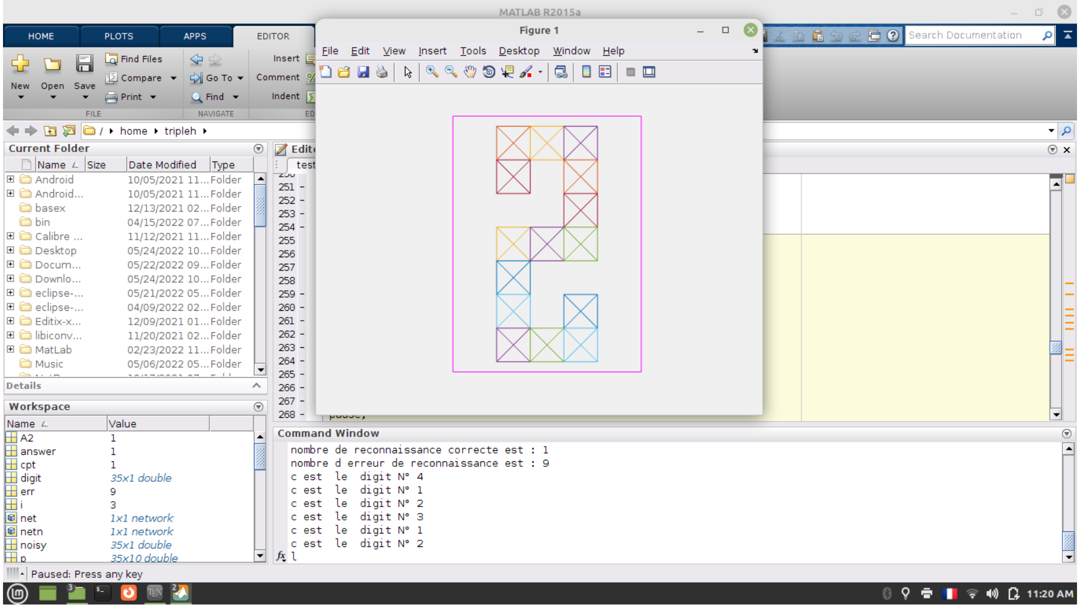
libiconv...		11/20/2021 02...	Folder
MatLab		02/23/2022 11...	Folder
Music		05/06/2022 05...	Folder

Workspace

Name	Value
A2	1
answer	1
cpt	1
digit	35x1 double
err	9
i	3
net	1x1 network
netn	1x1 network
noisy	35x1 double
p	35x10 double

Paused: Press any key

FIGURE 1.9: testing



Current Folder

Name	Size	Date Modified	Type
Android		10/05/2021 11...	Folder
Android...		10/05/2021 11...	Folder
basex		12/13/2021 02...	Folder
bin		04/15/2022 07...	Folder
Calibre ...		11/12/2021 11...	Folder
Desktop		05/24/2022 10...	Folder
Docum...		05/22/2022 09...	Folder
Downlo...		05/24/2022 10...	Folder
eclipse-...		05/21/2022 05...	Folder
eclipse-...		04/09/2022 02...	Folder
Editix-x...		12/09/2021 01...	Folder
libiconv...		11/20/2021 02...	Folder
MatLab		02/23/2022 11...	Folder
Music		05/06/2022 05...	Folder

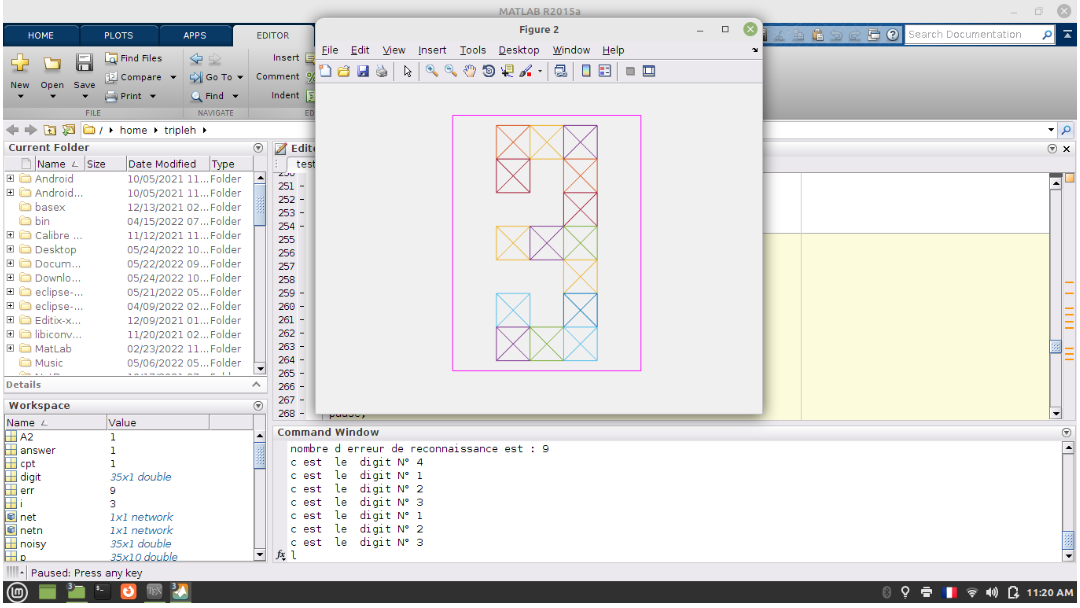
Workspace

Name	Value
A2	1
answer	1
cpt	1
digit	35x1 double
err	9
i	3
net	1x1 network
netn	1x1 network
noisy	35x1 double
p	35x10 double

Command Window

```
nombre de reconnaissance correcte est : 1
nombre d erreur de reconnaissance est : 9
c est  le  digit N° 4
c est  le  digit N° 1
c est  le  digit N° 2
c est  le  digit N° 3
c est  le  digit N° 1
c est  le  digit N° 2
```

FIGURE 1.10: testing



Current Folder

Name	Size	Date Modified	Type
Android		10/05/2021 11...	Folder
Android...		10/05/2021 11...	Folder
basex		12/13/2021 02...	Folder
bin		04/15/2022 07...	Folder
Calibre ...		11/12/2021 11...	Folder
Desktop		05/24/2022 10...	Folder
Docum...		05/22/2022 09...	Folder
Downlo...		05/24/2022 10...	Folder
eclipse-...		05/21/2022 05...	Folder
eclipse-...		04/09/2022 02...	Folder
Editix-x...		12/09/2021 01...	Folder
libiconv...		11/20/2021 02...	Folder
MatLab		02/23/2022 11...	Folder
Music		05/06/2022 05...	Folder

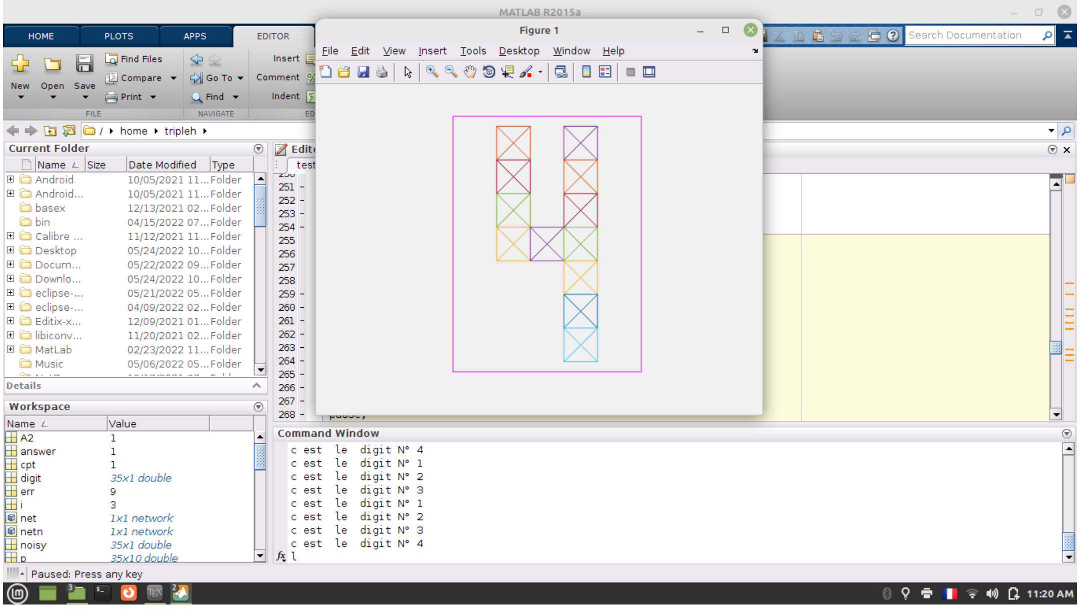
Workspace

Name	Value
A2	1
answer	1
cpt	1
digit	35x1 double
err	9
i	3
net	1x1 network
netn	1x1 network
noisy	35x1 double
p	35x10 double

Command Window

```
nombre d erreur de reconnaissance est : 9
c est  le  digit N° 4
c est  le  digit N° 1
c est  le  digit N° 2
c est  le  digit N° 3
c est  le  digit N° 1
c est  le  digit N° 2
c est  le  digit N° 3
```

FIGURE 1.11: testing



Current Folder

Name	Size	Date Modified	Type
Android		10/05/2021 11...	Folder
Android...		10/05/2021 11...	Folder
basex		12/13/2021 02...	Folder
bin		04/15/2022 07...	Folder
Calibre ...		11/12/2021 11...	Folder
Desktop		05/24/2022 10...	Folder
Docum...		05/22/2022 09...	Folder
Downlo...		05/24/2022 10...	Folder
eclipse-...		05/21/2022 05...	Folder
eclipse-...		04/09/2022 02...	Folder
Editix-x...		12/09/2021 01...	Folder
libiconv...		11/20/2021 02...	Folder
MatLab		02/23/2022 11...	Folder
Music		05/06/2022 05...	Folder

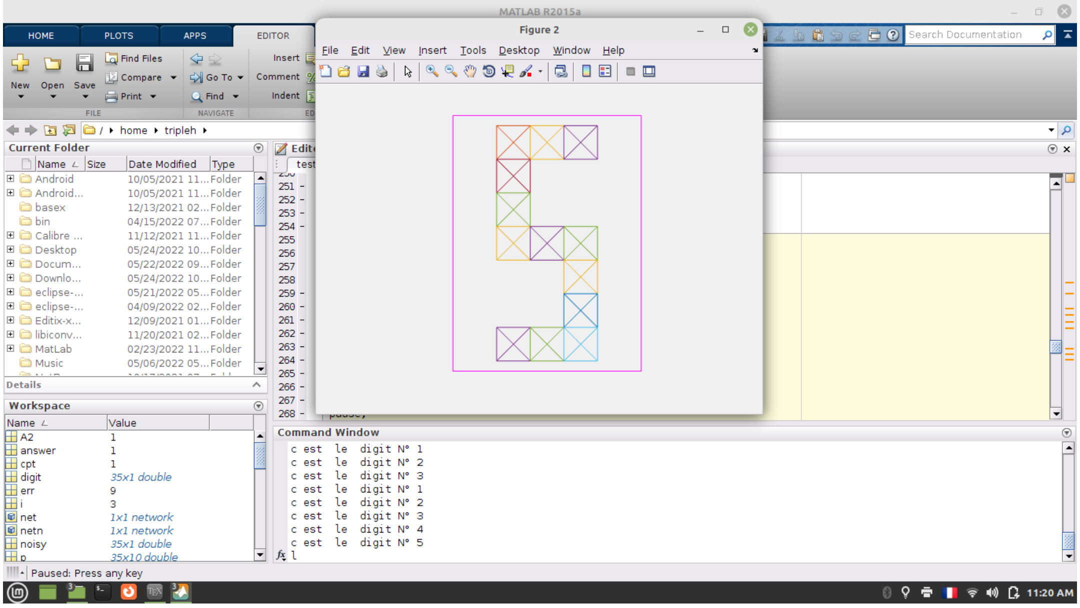
Workspace

Name	Value
A2	1
answer	1
cpt	1
digit	35x1 double
err	9
i	3
net	1x1 network
netn	1x1 network
noisy	35x1 double
p	35x10 double

Command Window

```
c est  le  digit N° 4
c est  le  digit N° 1
c est  le  digit N° 2
c est  le  digit N° 3
c est  le  digit N° 1
c est  le  digit N° 2
c est  le  digit N° 3
c est  le  digit N° 4
fx l
```

FIGURE 1.12: testing



Current Folder

Name	Size	Date Modified	Type
Android		10/05/2021 11...	Folder
Android...		10/05/2021 11...	Folder
basex		12/13/2021 02...	Folder
bin		04/15/2022 07...	Folder
Calibre ...		11/12/2021 11...	Folder
Desktop		05/24/2022 10...	Folder
Docum...		05/22/2022 09...	Folder
Downlo...		05/24/2022 10...	Folder
eclipse-...		05/21/2022 05...	Folder
eclipse-...		04/09/2022 02...	Folder
Editix-x...		12/09/2021 01...	Folder
libiconv...		11/20/2021 02...	Folder
MatLab		02/23/2022 11...	Folder
Music		05/06/2022 05...	Folder

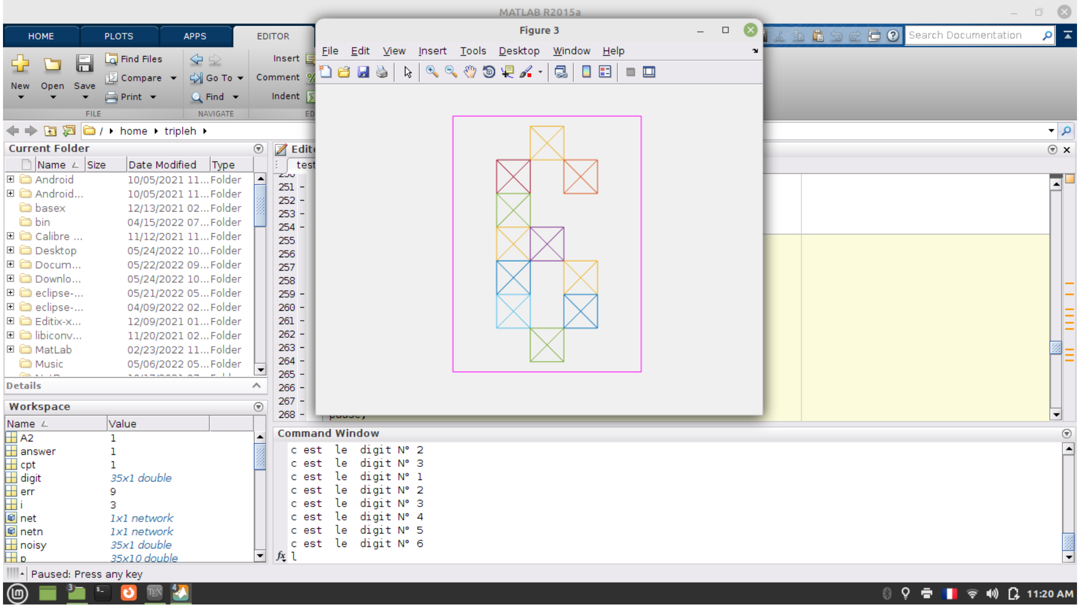
Workspace

Name	Value
A2	1
answer	1
cpt	1
digit	35x1 double
err	9
i	3
net	1x1 network
netn	1x1 network
noisy	35x1 double
p	35x10 double

Command Window

```
c est  le  digit N° 1
c est  le  digit N° 2
c est  le  digit N° 3
c est  le  digit N° 1
c est  le  digit N° 2
c est  le  digit N° 3
c est  le  digit N° 4
c est  le  digit N° 5
fx l
```

FIGURE 1.13: testing

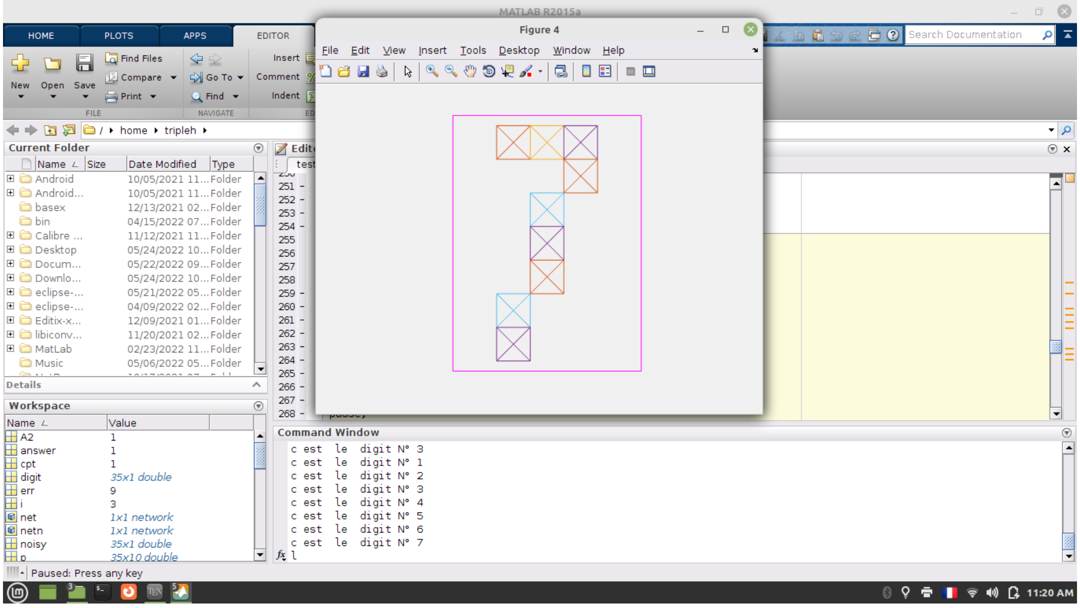


Name	Size	Date Modified	Type
Android		10/05/2021 11...	Folder
Android...		10/05/2021 11...	Folder
basex		12/13/2021 02...	Folder
bin		04/15/2022 07...	Folder
Calibre ...		11/12/2021 11...	Folder
Desktop		05/24/2022 10...	Folder
Docum...		05/22/2022 09...	Folder
Downlo...		05/24/2022 10...	Folder
eclipse-...		05/21/2022 05...	Folder
eclipse-...		04/09/2022 02...	Folder
Editix-x...		12/09/2021 01...	Folder
libiconv...		11/20/2021 02...	Folder
MatLab		02/23/2022 11...	Folder
Music		05/06/2022 05...	Folder

Name	Value
A2	1
answer	1
cpt	1
digit	35x1 double
err	9
i	3
net	1x1 network
netn	1x1 network
noisy	35x1 double
p	35x10 double

```
c est  le  digit N° 2
c est  le  digit N° 3
c est  le  digit N° 1
c est  le  digit N° 2
c est  le  digit N° 3
c est  le  digit N° 4
c est  le  digit N° 5
c est  le  digit N° 6
fx l
```

FIGURE 1.14: testing

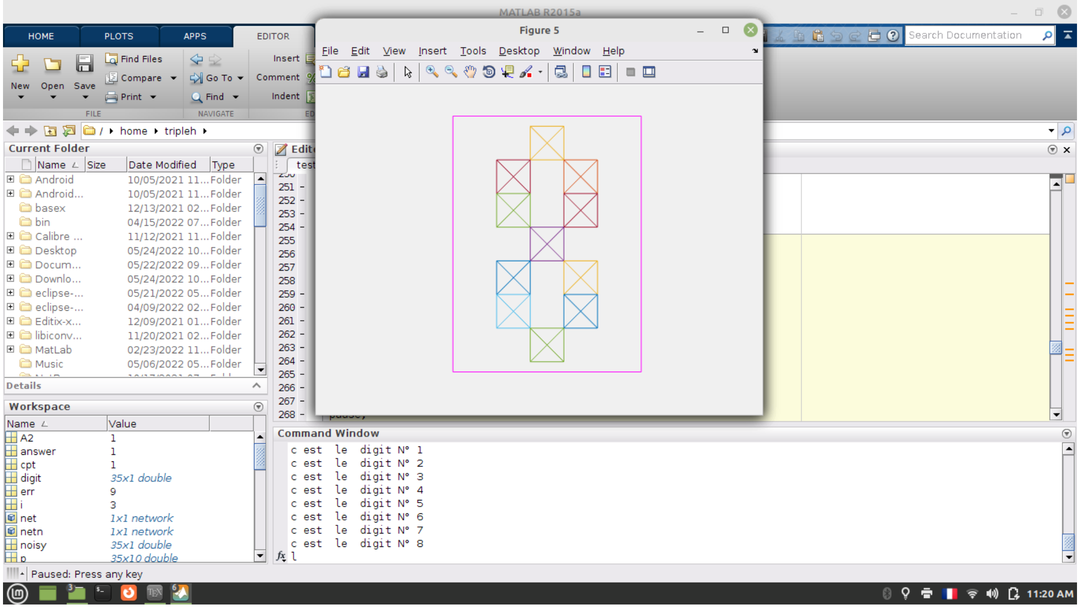


Name	Size	Date Modified	Type
Android		10/05/2021 11...	Folder
Android...		10/05/2021 11...	Folder
basex		12/13/2021 02...	Folder
bin		04/15/2022 07...	Folder
Calibre ...		11/12/2021 11...	Folder
Desktop		05/24/2022 10...	Folder
Docum...		05/22/2022 09...	Folder
Downlo...		05/24/2022 10...	Folder
eclipse-...		05/21/2022 05...	Folder
eclipse-...		04/09/2022 02...	Folder
Editix-x...		12/09/2021 01...	Folder
libiconv...		11/20/2021 02...	Folder
MatLab		02/23/2022 11...	Folder
Music		05/06/2022 05...	Folder

Name	Value
A2	1
answer	1
cpt	1
digit	35x1 double
err	9
i	3
net	1x1 network
netn	1x1 network
noisy	35x1 double
p	35x10 double

```
c est  le  digit N° 3
c est  le  digit N° 1
c est  le  digit N° 2
c est  le  digit N° 3
c est  le  digit N° 4
c est  le  digit N° 5
c est  le  digit N° 6
c est  le  digit N° 7
fx l
```

FIGURE 1.15: testing

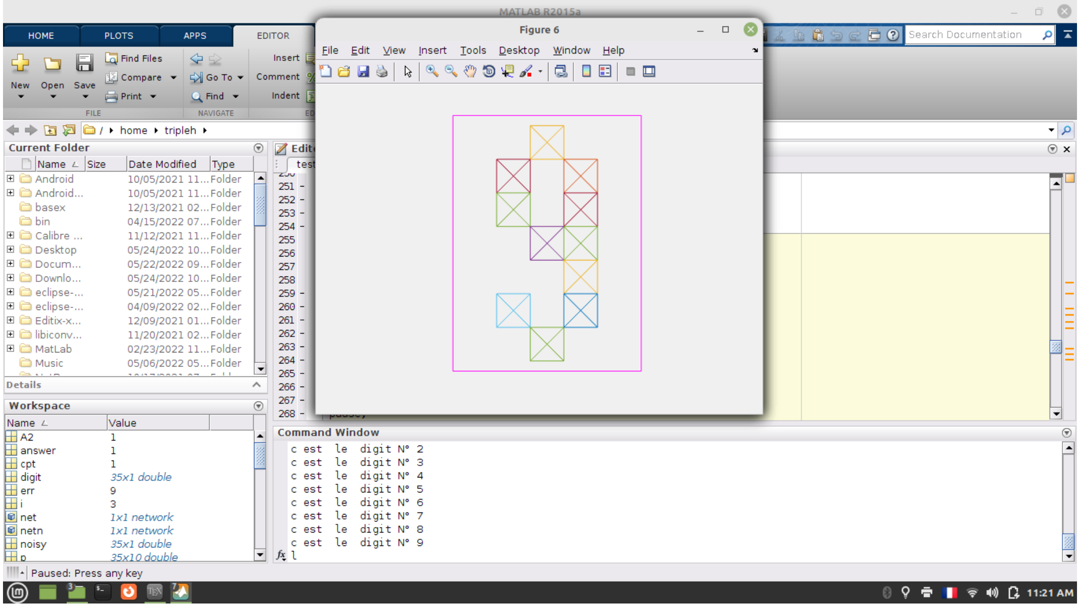


Name	Size	Date Modified	Type
Android		10/05/2021 11...	Folder
Android...		10/05/2021 11...	Folder
basex		12/13/2021 02...	Folder
bin		04/15/2022 07...	Folder
Calibre ...		11/12/2021 11...	Folder
Desktop		05/24/2022 10...	Folder
Docum...		05/22/2022 09...	Folder
Downlo...		05/24/2022 10...	Folder
eclipse-...		05/21/2022 05...	Folder
eclipse-...		04/09/2022 02...	Folder
Editix-x...		12/09/2021 01...	Folder
libiconv...		11/20/2021 02...	Folder
MatLab		02/23/2022 11...	Folder
Music		05/06/2022 05...	Folder

Name	Value
A2	1
answer	1
cpt	1
digit	35x1 double
err	9
i	3
net	1x1 network
netn	1x1 network
noisy	35x1 double
p	35x10 double

```
 c est  le  digit N° 1
 c est  le  digit N° 2
 c est  le  digit N° 3
 c est  le  digit N° 4
 c est  le  digit N° 5
 c est  le  digit N° 6
 c est  le  digit N° 7
 c est  le  digit N° 8
fx l
```

FIGURE 1.16: testing

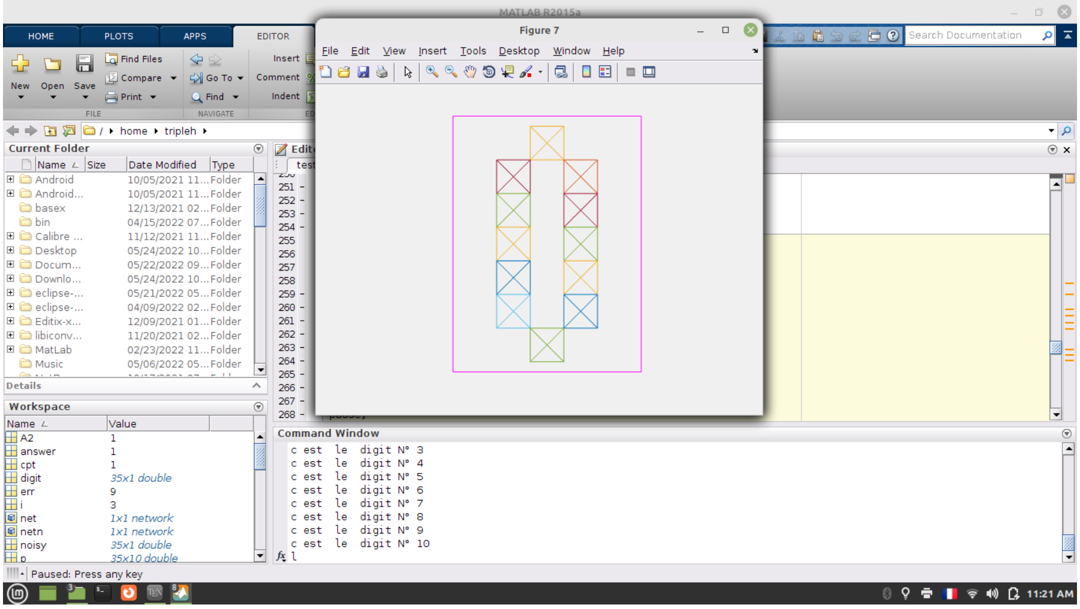


Name	Size	Date Modified	Type
Android		10/05/2021 11...	Folder
Android...		10/05/2021 11...	Folder
basex		12/13/2021 02...	Folder
bin		04/15/2022 07...	Folder
Calibre ...		11/12/2021 11...	Folder
Desktop		05/24/2022 10...	Folder
Docum...		05/22/2022 09...	Folder
Downlo...		05/24/2022 10...	Folder
eclipse-...		05/21/2022 05...	Folder
eclipse-...		04/09/2022 02...	Folder
Editix-x...		12/09/2021 01...	Folder
libiconv...		11/20/2021 02...	Folder
MatLab		02/23/2022 11...	Folder
Music		05/06/2022 05...	Folder

Name	Value
A2	1
answer	1
cpt	1
digit	35x1 double
err	9
i	3
net	1x1 network
netn	1x1 network
noisy	35x1 double
p	35x10 double

```
 c est  le  digit N° 2
 c est  le  digit N° 3
 c est  le  digit N° 4
 c est  le  digit N° 5
 c est  le  digit N° 6
 c est  le  digit N° 7
 c est  le  digit N° 8
 c est  le  digit N° 9
fx l
```

FIGURE 1.17: testing

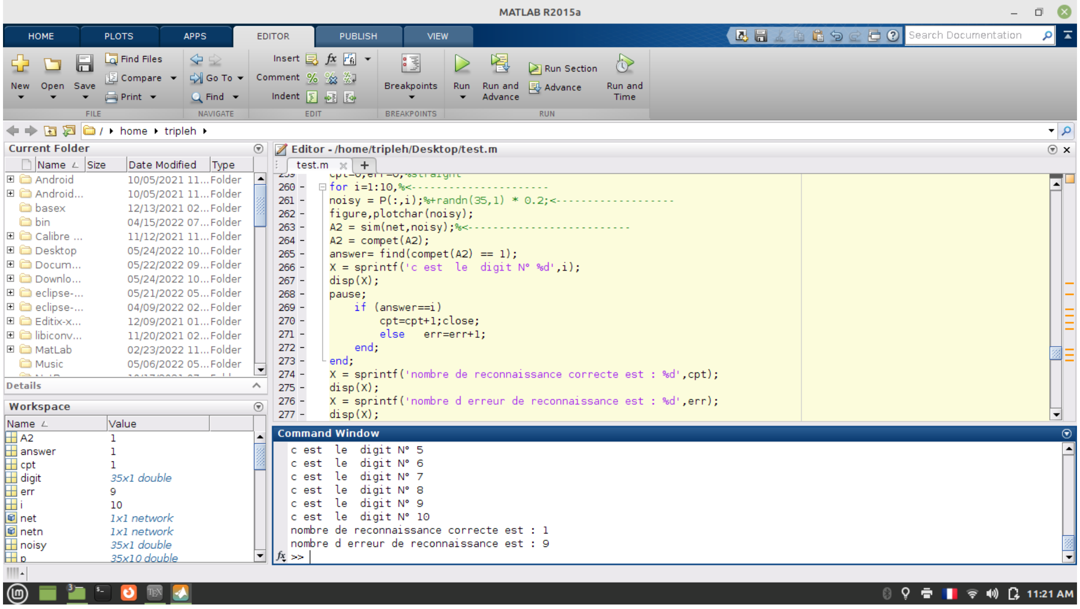


Name	Value
A2	1
answer	1
cpt	1
digit	35x1 double
err	9
i	3
net	1x1 network
netn	1x1 network
noisy	35x1 double
p	35x10 double

```
c est  le  digit N° 3
c est  le  digit N° 4
c est  le  digit N° 5
c est  le  digit N° 6
c est  le  digit N° 7
c est  le  digit N° 8
c est  le  digit N° 9
c est  le  digit N° 10
```

Paused: Press any key

FIGURE 1.18: testing



```
for i=1:10,%<--------------------
noisy = P(:,i);%+randn(35,1) * 0.2;<------------------
figure,plotchar(noisy);
A2 = sim(net,noisy);%<------------------------
A2 = compet(A2);
answer= find(compet(A2) == 1);
X = sprintf('c est  le  digit N° %d',i);
disp(X);
pause;
    if (answer==i)
        cpt=cpt+1;close;
        else   err=err+1;
    end;
end;
X = sprintf('nombre de reconnaissance correcte est : %d',cpt);
disp(X);
X = sprintf('nombre d erreur de reconnaissance est : %d',err);
disp(X);
```

Name	Value
A2	1
answer	1
cpt	1
digit	35x1 double
err	9
i	10
net	1x1 network
netn	1x1 network
noisy	35x1 double
p	35x10 double

```
c est  le  digit N° 5
c est  le  digit N° 6
c est  le  digit N° 7
c est  le  digit N° 8
c est  le  digit N° 9
c est  le  digit N° 10
nombre de reconnaissance correcte est : 1
nombre d erreur de reconnaissance est : 9
>>
```

FIGURE 1.19: testing

1.1.7 Test with noise

```
%       test Avec bruit            %%%%%%%%%%%%%%%%%%
i=4;
%le caractere 4
noisy = P(:,i)+randn(35,1) * 0.2;
figure,plotchar(noisy);
A2 = sim(netn,noisy);
A2 = compet(A2);
answer= find(compet(A2) == 1);
X = sprintf(’c est  le  digit N %d’,i);
```

```
disp(X);

i=1;
%le digit 1
noisy = P(:,i)+randn(35,1) * 0.2;
figure,plotchar(noisy);
A2 = sim(netn,noisy);
A2 = compet(A2);
answer= find(compet(A2) == 1);
X = sprintf('c est  le  digit N %d',i);
disp(X);

i=2;
%le digit 2
noisy = P(:,i)+randn(35,1) * 0.2;
figure,plotchar(noisy);
A2 = sim(netn,noisy);
A2 = compet(A2);
answer= find(compet(A2) == 1);
X = sprintf('c est  le  digit N %d',i);
disp(X);

i=3;
%le digit 3
noisy = P(:,i)+randn(35,1) * 0.2;
figure,plotchar(noisy);
A2 = sim(netn,noisy);
A2 = compet(A2);
answer= find(compet(A2) == 1);
X = sprintf('c est  le  digit N %d',i);
disp(X);
```

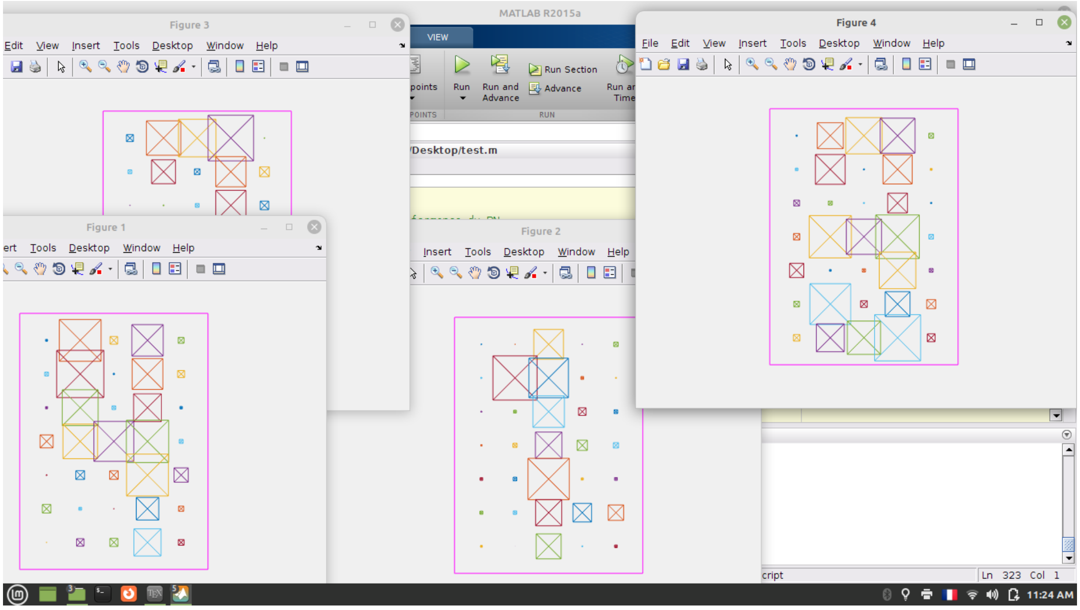
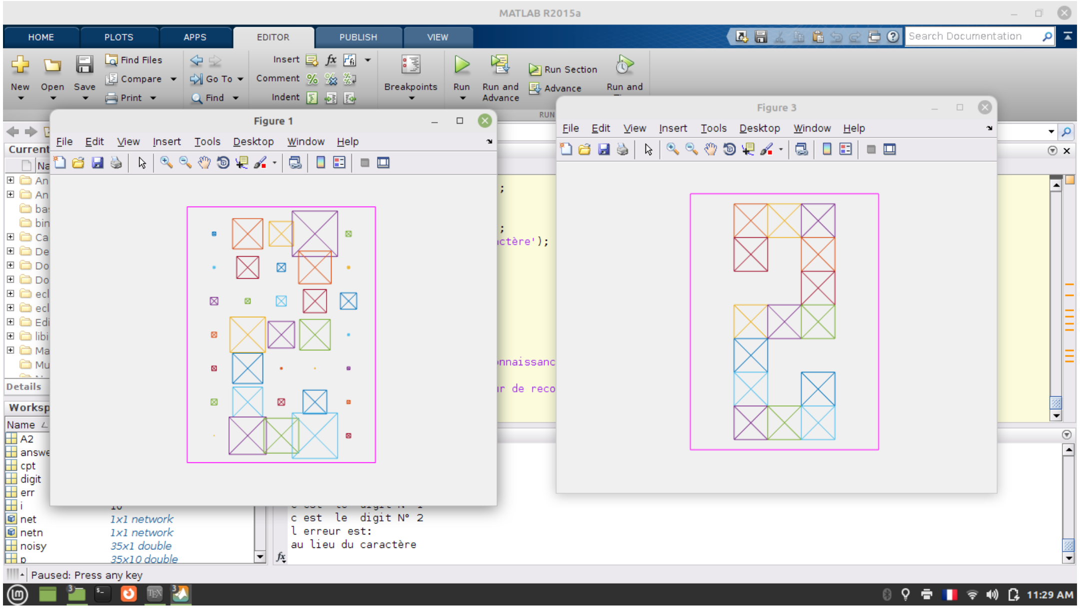


FIGURE 1.20: test with noise

1.1.8 Test the performance of our neural network

```
%test Des performance du RN
cpt=0;err=0;%straight
for i=1:10,%<----------------------
%les digit 1,2,3 to 0
noisy = P(:,i)+randn(35,1) * 0.2;%<-------------------
figure,plotchar(noisy);
A2 = sim(netn,noisy);%<--------------------------
A2 = compet(A2);
answer= find(compet(A2) == 1);
X = sprintf('c est  le  digit N %d',i);
disp(X);
pause;
  if (answer==i)
    cpt=cpt+1;close;
  else
      err=err+1;
      disp('l erreur est:');
      answer;
      figure;
      plotchar(P(:,answer));
      disp('au lieu du caractere');
      i;
      figure;
      plotchar(P(:,i));
      pause;
  end;

end;

X = sprintf('nombre de reconnaissance correcte est : %d',cpt);
disp(X);
X = sprintf('nombre d erreur de reconnaissance est : %d',err);
disp(X);
```

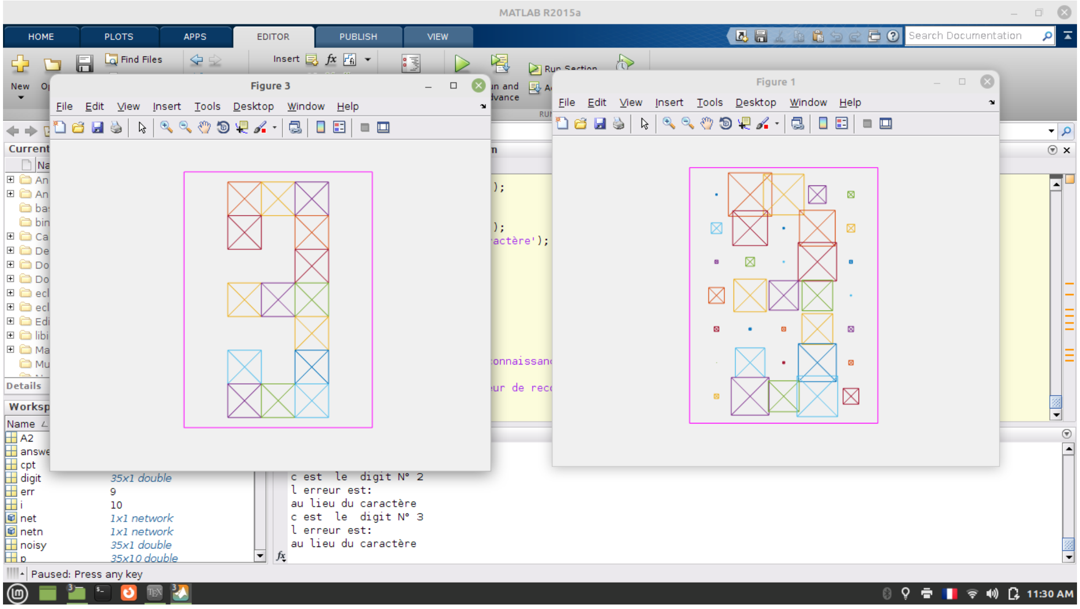


Name	
A2	
answe	
cpt	
digit	
err	
i	10
net	1x1 network
netn	1x1 network
noisy	35x1 double
p	35x10 double

```
c est  le  digit N° 2
l erreur est:
au lieu du caractère
```

Paused: Press any key

FIGURE 1.21: test with noise

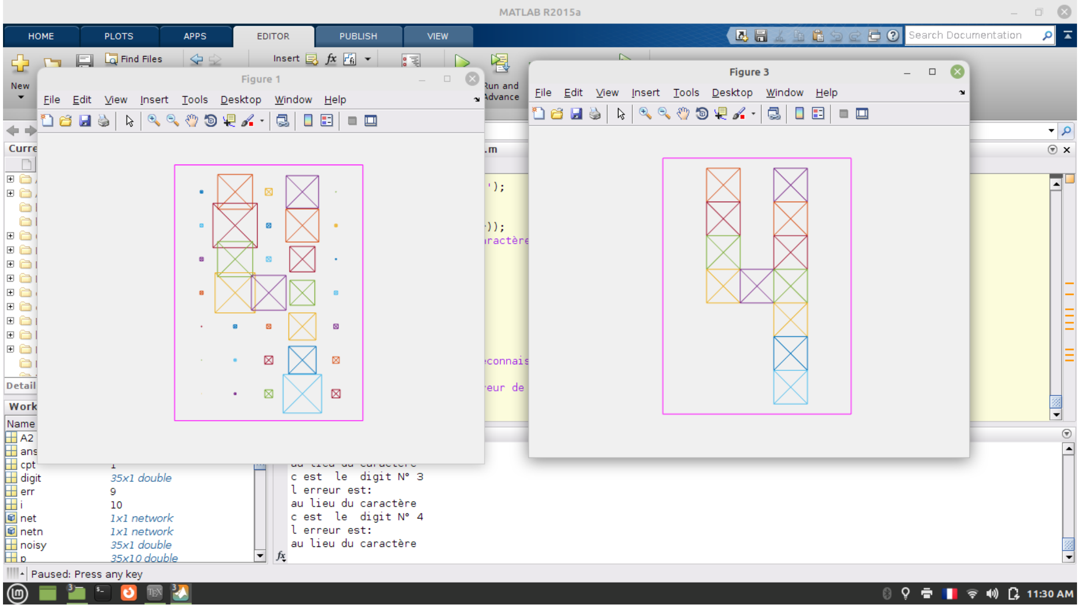


Name	
A2	
answe	
cpt	
digit	35x1 double
err	9
i	10
net	1x1 network
netn	1x1 network
noisy	35x1 double
p	35x10 double

```
c est  le  digit N° 2
l erreur est:
au lieu du caractère
c est  le  digit N° 3
l erreur est:
au lieu du caractère
```

Paused: Press any key

FIGURE 1.22: test with noise

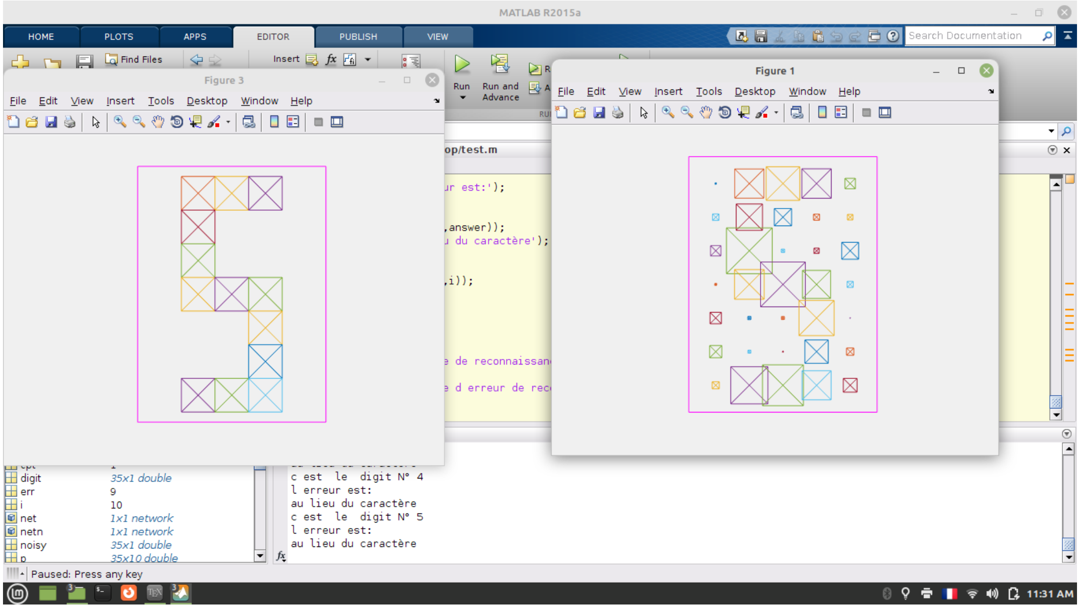


Name	
A2	
ans	
cpt	1
digit	35x1 double
err	9
i	10
net	1x1 network
netn	1x1 network
noisy	35x1 double
p	35x10 double

```
c est  le  digit N° 3
l erreur est:
au lieu du caractère
c est  le  digit N° 4
l erreur est:
au lieu du caractère
```

Paused: Press any key

FIGURE 1.23: test with noise

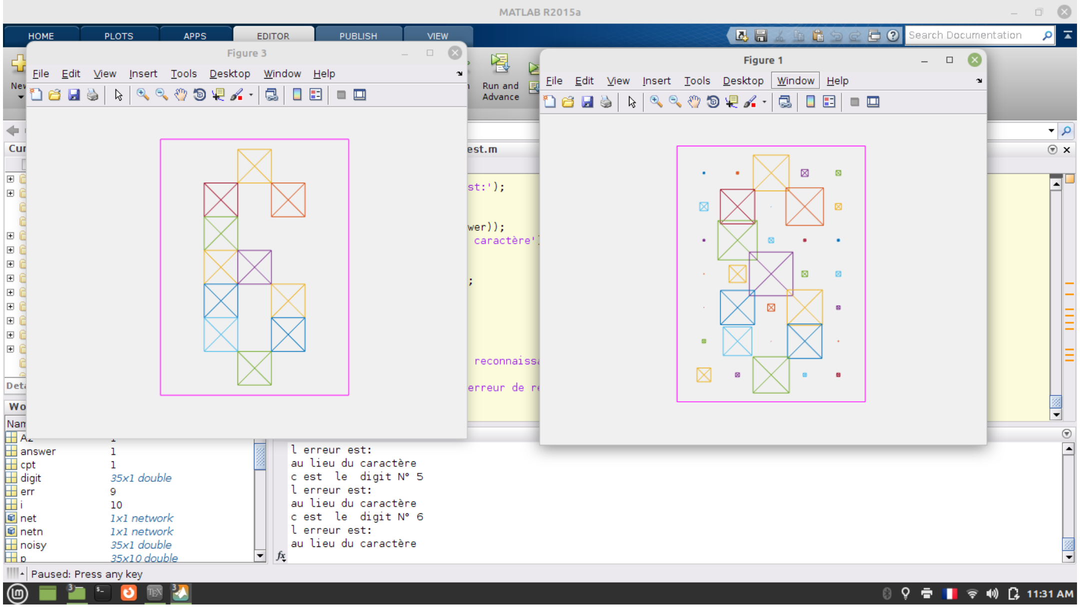


Name	
cpt	1
digit	35x1 double
err	9
i	10
net	1x1 network
netn	1x1 network
noisy	35x1 double
p	35x10 double

```
c est  le  digit N° 4
l erreur est:
au lieu du caractère
c est  le  digit N° 5
l erreur est:
au lieu du caractère
```

Paused: Press any key

FIGURE 1.24: test with noise

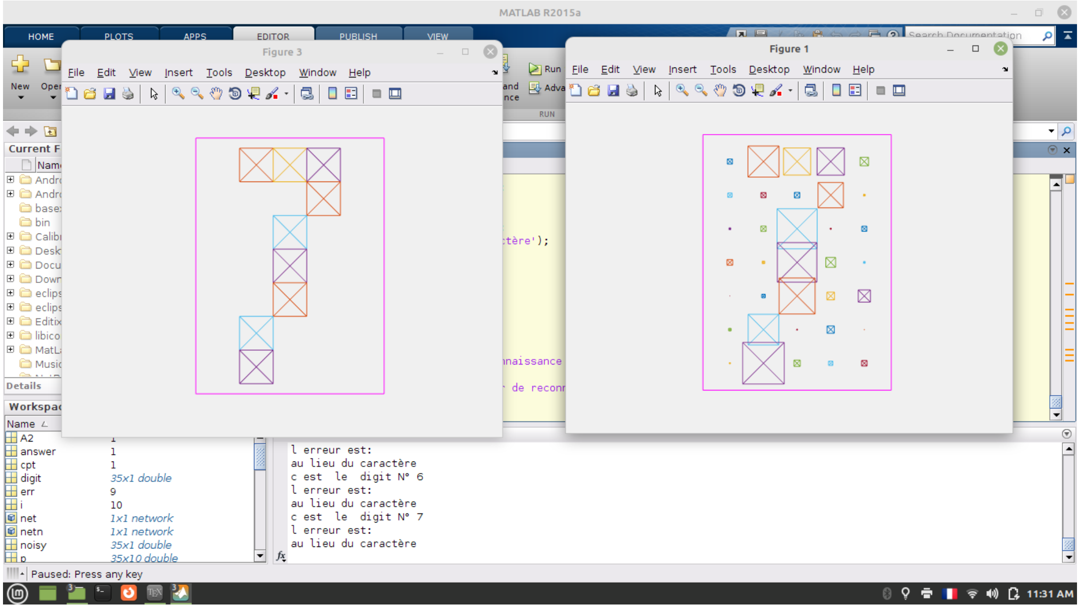


Name	Value
A2	1
answer	1
cpt	1
digit	35x1 double
err	9
i	10
net	1x1 network
netn	1x1 network
noisy	35x1 double
p	35x10 double

```
l erreur est:
au lieu du caractère
c est  le  digit N° 5
l erreur est:
au lieu du caractère
c est  le  digit N° 6
l erreur est:
au lieu du caractère
```

Paused: Press any key

FIGURE 1.25: test with noise

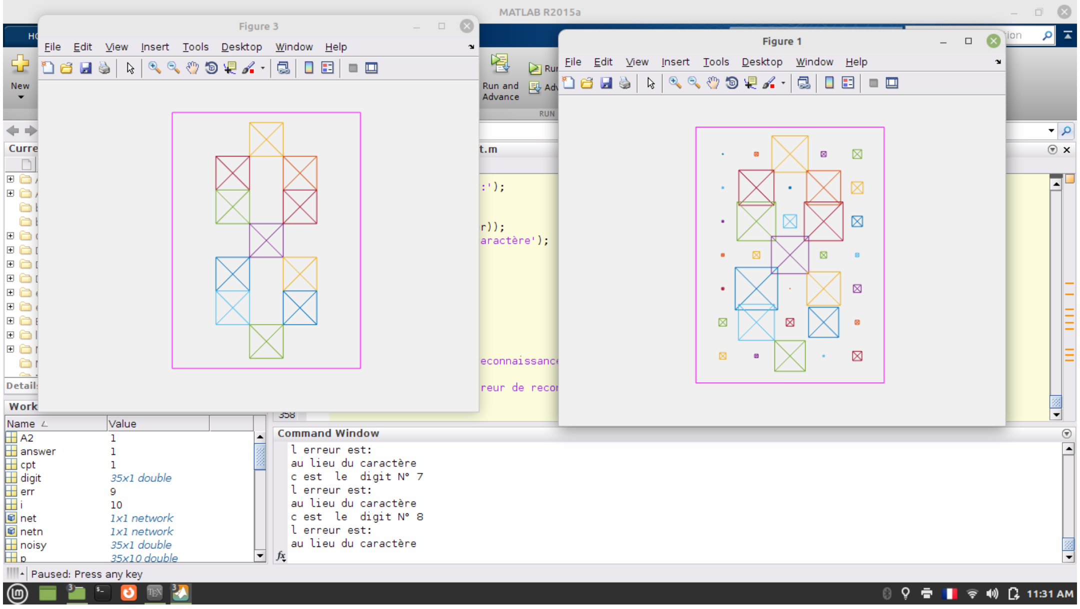


Name	Value
A2	1
answer	1
cpt	1
digit	35x1 double
err	9
i	10
net	1x1 network
netn	1x1 network
noisy	35x1 double
p	35x10 double

```
l erreur est:
au lieu du caractère
c est  le  digit N° 6
l erreur est:
au lieu du caractère
c est  le  digit N° 7
l erreur est:
au lieu du caractère
```

Paused: Press any key

FIGURE 1.26: test with noise

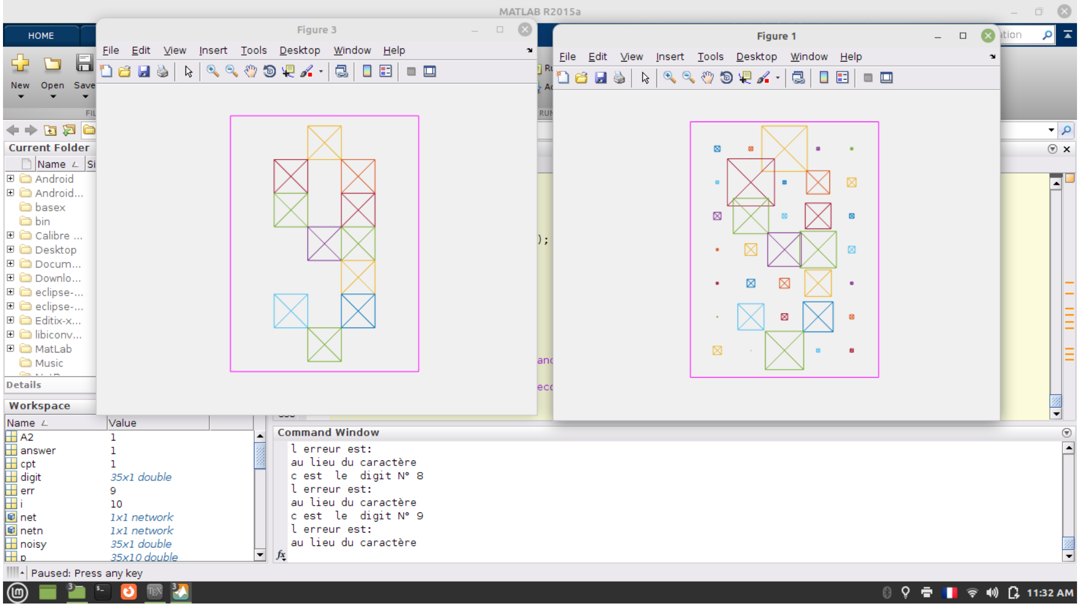


Name	Value
A2	1
answer	1
cpt	1
digit	35x1 double
err	9
i	10
net	1x1 network
netn	1x1 network
noisy	35x1 double
p	35x10 double

```
l erreur est:
au lieu du caractère
c est  le  digit N° 7
l erreur est:
au lieu du caractère
c est  le  digit N° 8
l erreur est:
au lieu du caractère
```

Paused: Press any key

FIGURE 1.27: test with noise

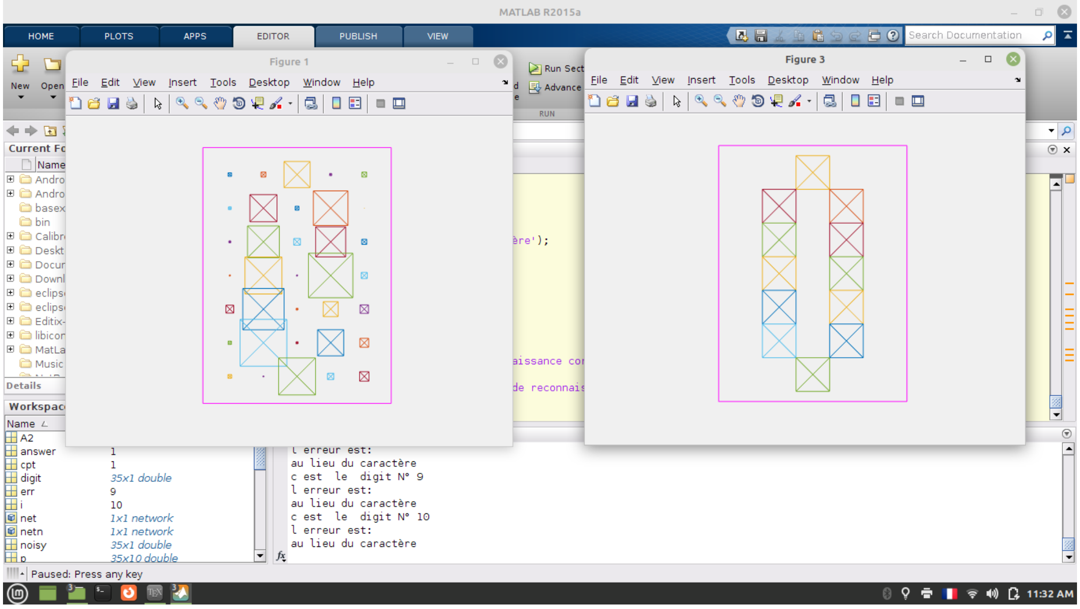


Name	Value
A2	1
answer	1
cpt	1
digit	35x1 double
err	9
i	10
net	1x1 network
netn	1x1 network
noisy	35x1 double
p	35x10 double

```
l erreur est:
au lieu du caractère
c est  le  digit N° 8
l erreur est:
au lieu du caractère
c est  le  digit N° 9
l erreur est:
au lieu du caractère
```

Paused: Press any key

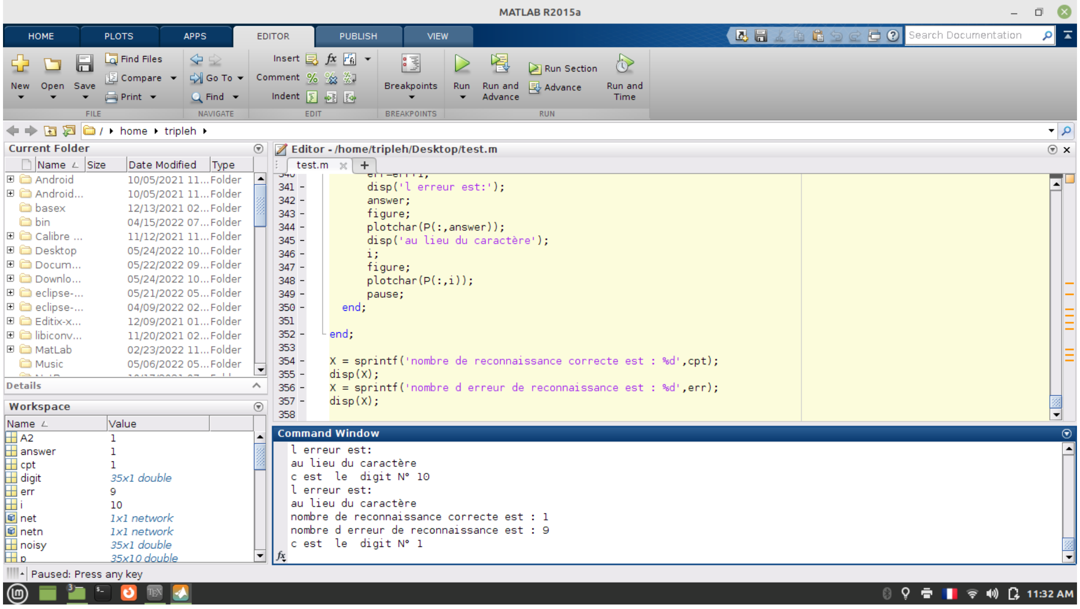
FIGURE 1.28: test with noise



```
Name    Value
A2
answer  1
cpt     1
digit   35x1 double
err     9
i       10
net     1x1 network
netn    1x1 network
noisy   35x1 double
p       35x10 double
```

```
l erreur est:
au lieu du caractère
c est  le  digit N° 9
l erreur est:
au lieu du caractère
c est  le  digit N° 10
l erreur est:
au lieu du caractère
```

FIGURE 1.29: test with noise



Editor - /home/tripleh/Desktop/test.m

```
        disp('l erreur est:');
        answer;
        figure;
        plotchar(P(:,answer));
        disp('au lieu du caractère');
        i;
        figure;
        plotchar(P(:,i));
        pause;
    end;

end;

X = sprintf('nombre de reconnaissance correcte est : %d',cpt);
disp(X);
X = sprintf('nombre d erreur de reconnaissance est : %d',err);
disp(X);
```

Command Window

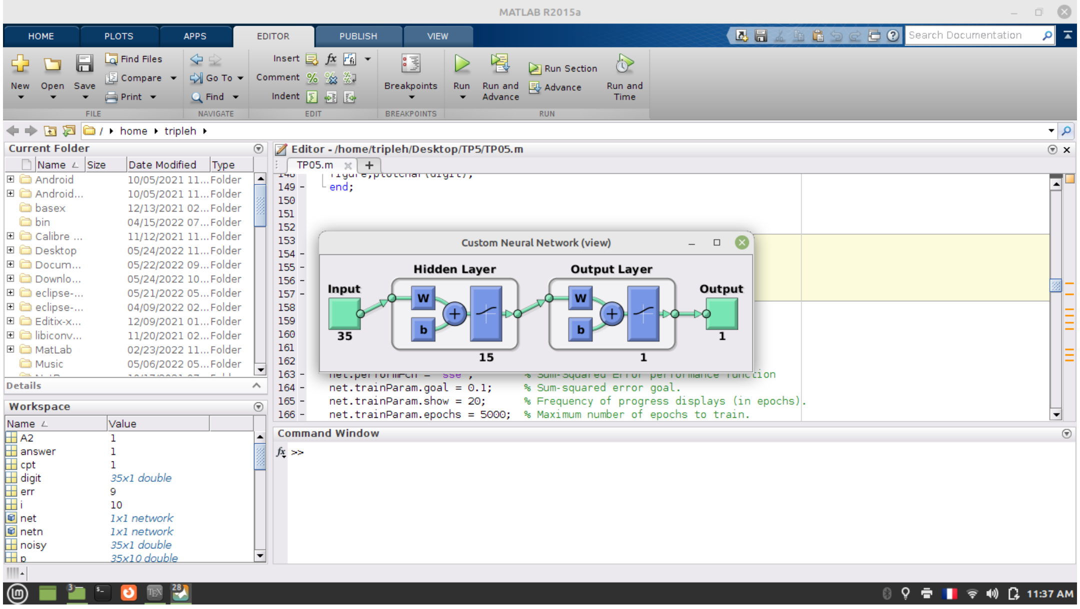
```
l erreur est:
au lieu du caractère
c est  le  digit N° 10
l erreur est:
au lieu du caractère
nombre de reconnaissance correcte est : 1
nombre d erreur de reconnaissance est : 9
c est  le  digit N° 1
```

FIGURE 1.30: test with noise

1.2 Improvments on our neural network

1.2.1 Increase number of hidden layers

```
    net  = newff(p,t,15,{'logsig' 'logsig'},'traingdx');
    net.LW{2,1} = net.LW{2,1}*0.01;
    net.b{2} = net.b{2}*0.01;
    view(net);
```



Name	Size	Date Modified	Type
Android		10/05/2021 11...	Folder
Android...		10/05/2021 11...	Folder
basex		12/13/2021 02...	Folder
bin		04/15/2022 07...	Folder
Calibre ...		11/12/2021 11...	Folder
Desktop		05/24/2022 11...	Folder
Docum...		05/22/2022 09...	Folder
Downlo...		05/24/2022 10...	Folder
eclipse-...		05/21/2022 05...	Folder
eclipse-...		04/09/2022 02...	Folder
Editix-x...		12/09/2021 01...	Folder
libiconv...		11/20/2021 02...	Folder
MatLab		02/23/2022 11...	Folder
Music		05/06/2022 05...	Folder

Name	Value
A2	1
answer	1
cpt	1
digit	35x1 double
err	9
i	10
net	1x1 network
netn	1x1 network
noisy	35x1 double
p	35x10 double

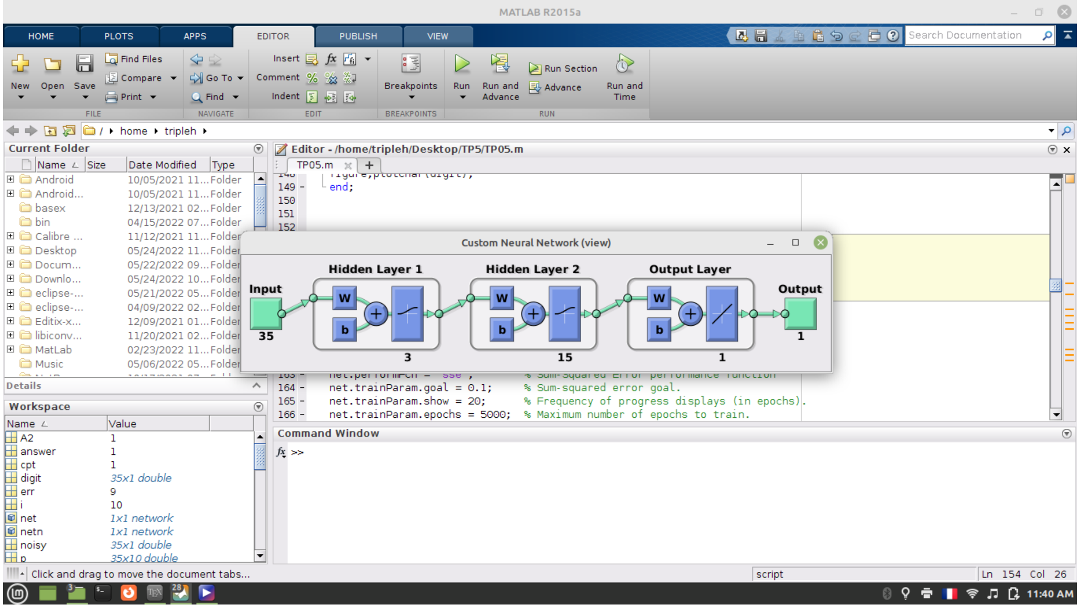
```
    end;

    net.performFcn = 'sse';        % Sum-Squared Error performance function
    net.trainParam.goal = 0.1;     % Sum-squared error goal.
    net.trainParam.show = 20;      % Frequency of progress displays (in epochs).
    net.trainParam.epochs = 5000;  % Maximum number of epochs to train.
```

```
>>
```

FIGURE 1.31: improve

1.2.2 Increse number of networks

```
        net = newff(p,t,[3,15],{'logsig' 'logsig'},'traingdx');
        net.LW{2,1} = net.LW{2,1}*0.01;
        net.b{2} = net.b{2}*0.01;
        view(net);
```



Name	Size	Date Modified	Type
Android		10/05/2021 11...	Folder
Android...		10/05/2021 11...	Folder
basex		12/13/2021 02...	Folder
bin		04/15/2022 07...	Folder
Calibre ...		11/12/2021 11...	Folder
Desktop		05/24/2022 11...	Folder
Docum...		05/22/2022 09...	Folder
Downlo...		05/24/2022 10...	Folder
eclipse-...		05/21/2022 05...	Folder
eclipse-...		04/09/2022 02...	Folder
Editix-x...		12/09/2021 01...	Folder
libiconv...		11/20/2021 02...	Folder
MatLab		02/23/2022 11...	Folder
Music		05/06/2022 05...	Folder

Name	Value
A2	1
answer	1
cpt	1
digit	35x1 double
err	9
i	10
net	1x1 network
netn	1x1 network
noisy	35x1 double
p	35x10 double

```
    end;

    net.performFcn = 'sse';        % Sum-Squared Error performance function
    net.trainParam.goal = 0.1;     % Sum-squared error goal.
    net.trainParam.show = 20;      % Frequency of progress displays (in epochs).
    net.trainParam.epochs = 5000;  % Maximum number of epochs to train.
```

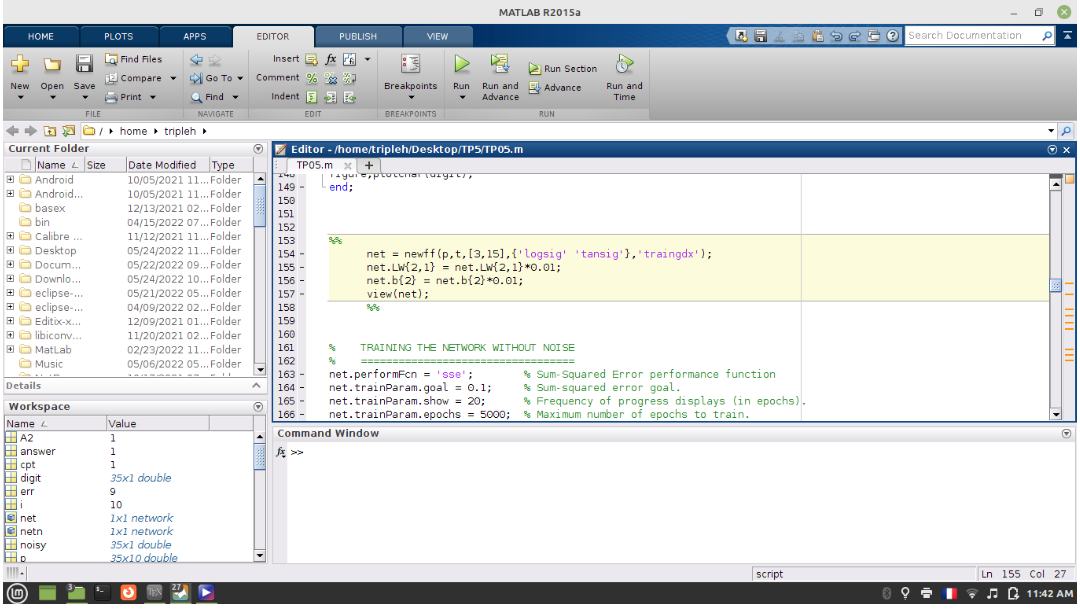
```
>>
```

FIGURE 1.32: improve

1.2.3 change algorithms used in networks

we try **tansig** instead of **logsig**.

```
        net = newff(p,t,[3,15],{'logsig' 'tansig'},'traingdx');
        net.LW{2,1} = net.LW{2,1}*0.01;
        net.b{2} = net.b{2}*0.01;
        view(net);
```



Name	Size	Date Modified	Type
Android		10/05/2021 11...	Folder
Android...		10/05/2021 11...	Folder
basex		12/13/2021 02...	Folder
bin		04/15/2022 07...	Folder
Calibre ...		11/12/2021 11...	Folder
Desktop		05/24/2022 11...	Folder
Docum...		05/22/2022 09...	Folder
Downlo...		05/24/2022 10...	Folder
eclipse-...		05/21/2022 05...	Folder
eclipse-...		04/09/2022 02...	Folder
Editix-x...		12/09/2021 01...	Folder
libiconv...		11/20/2021 02...	Folder
MatLab		02/23/2022 11...	Folder
Music		05/06/2022 05...	Folder

Name	Value
A2	1
answer	1
cpt	1
digit	35x1 double
err	9
i	10
net	1x1 network
netn	1x1 network
noisy	35x1 double
p	35x10 double

```
end;



%%
     net = newff(p,t,[3,15],{'logsig' 'tansig'},'traingdx');
     net.LW{2,1} = net.LW{2,1}*0.01;
     net.b{2} = net.b{2}*0.01;
     view(net);
     %%


%    TRAINING THE NETWORK WITHOUT NOISE
%    ================================
net.performFcn = 'sse';        % Sum-Squared Error performance function
net.trainParam.goal = 0.1;     % Sum-squared error goal.
net.trainParam.show = 20;      % Frequency of progress displays (in epochs).
net.trainParam.epochs = 5000;  % Maximum number of epochs to train.
```

```
>>
```

FIGURE 1.33: improve