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LAMPIRAN

Lampiran 1. Dokumentasi penelitian





Lampiran 2. Hasil *running* algoritma genetika

```

>> [RuteTerbaik, jarak]=tspga(xy,50,1000)

t =

    4.2100

RuteTerbaik =

Columns 1 through 22

     1     3     6     5     8     9    11    10     7    15    14    12    13    16     2    17    22    19    24    26    27    25

Columns 23 through 28

    23    21    20    18     4     1

jarak =

    78.7400

>>
    
```

Command Window

```
>> [RuteTerbaik, jarak]=tspga(xy,50,2000)

t =
    5.7900

RuteTerbaik =
Columns 1 through 21
    1    17    16    15    14    13    12     5     6     7     9    10    11     8     2    18    20    22    25    27    26
Columns 22 through 28
    24    19    23    21     4     3     1

jarak =
    71

>> [RuteTerbaik, jarak]=tspga(xy,50,3000)
```

Workspace

Name	Value	Size	Class
RuteTer...	1x28 double	1x28	double
jarak	62.8000	1x1	double
xy	27x27 double	27x27	double

Zoom: 100% UTF-8 CRLF tspga Ln 1 Col 10

Command Window

```
>> [RuteTerbaik, jarak]=tspga(xy,50,3000)

t =
    8.4500

RuteTerbaik =
Columns 1 through 21
    1     2     5     6     7     8     9    10    11    12    13    14    15    16    17    18    23    25    27    26    24
Columns 22 through 28
    19    22    21    20     4     3     1

jarak =
    62.8000

>>
```

Workspace

Name	Value	Size	Class
RuteTer...	1x28 double	1x28	double
jarak	62.8000	1x1	double
xy	27x27 double	27x27	double

Zoom: 100% UTF-8 CRLF tspga Ln 1 Col 10

Command Window

```
>> [RuteTerbaik, jarak]=tspga(xy,50,4000)

t =
    11.2800

RuteTerbaik =
Columns 1 through 21
    1     2     5     6     7     8     9    10    11    12    13    14    15    16    17    18    20    21    22    23    19
Columns 22 through 28
    24    26    27    25     4     3     1

jarak =
    62.7700

>> [RuteTerbaik, jarak]=tspga(xy,50,5000)
```

Workspace

Name	Value	Size	Class
RuteTer...	1x28 double	1x28	double
jarak	62.7000	1x1	double
xy	27x27 double	27x27	double

Zoom: 100% UTF-8 CRLF tspga Ln 1 Col 10

tabusearch.m tspga.m

```

>> [RuteTerbaik, jarak]=tspga(xy,50,5000)

t =
    14.0900

RuteTerbaik =
Columns 1 through 21
     1     2     5     6     7     8     9    10    11    12    13    14    15    16    17    23    25    27    26    24    19
Columns 22 through 28
    22    21    20    18     4     3     1

jarak =
    62.7700

>> [RuteTerbaik, jarak]=tspga(xy,50,6000)
    
```

Workspace:

Name	Value	Size	Class
RuteTer...	1x28 double	1x28	double
jarak	62.7000	1x1	double
xy	27x27 double	27x27	double

Zoom: 100% UTF-8 CRLF tspga Ln 1 Col 10

tabusearch.m tspga.m

```

>> [RuteTerbaik, jarak]=tspga(xy,50,6000)

t =
    16.7000

RuteTerbaik =
Columns 1 through 21
     1     3     4     18    22    25    27    26    24    19    23    21    20    17    16    15    14    13    12    11    10
Columns 22 through 28
     9     8     7     6     5     2     1

jarak =
    62.7000

>> [RuteTerbaik, jarak]=tspga(xy,50,6000)
    
```

Workspace:

Name	Value	Size	Class
RuteTer...	1x28 double	1x28	double
jarak	62.7000	1x1	double
xy	27x27 double	27x27	double

Zoom: 100% UTF-8 CRLF tspga Ln 1 Col 10

tabusearch.m tspga.m

```

>> [RuteTerbaik, jarak]=tspga(xy,50,7000)

t =
    19.5900

RuteTerbaik =
Columns 1 through 21
     1     3     4     18    20    22    23    19    25    24    26    27    21    17    16    15    14    13    12    11    10
Columns 22 through 28
     9     8     7     6     5     2     1

jarak =
    62.8700

>>
    
```

Workspace:

Name	Value	Size	Class
RuteTer...	1x28 double	1x28	double
jarak	62.8700	1x1	double
xy	27x27 double	27x27	double

Zoom: 100% UTF-8 CRLF tspga Ln 1 Col 10

Command Window

```
>> [RuteTerbaik, jarak]=tspga(xy,50,8000)

t =
    22.5300

RuteTerbaik =
Columns 1 through 21
     1     3     4    18    21    23    19    25    27    26    24    22    20    17    16    15    14    13    12    11    10
Columns 22 through 28
     9     8     7     6     5     2     1

jarak =
    62.7500

>>
```

Workspace

Name	Value	Size	Class
RuteTer...	1x28 double	1x28	double
jarak	62.7500	1x1	double
xy	27x27 double	27x27	double

Command Window

```
>> [RuteTerbaik, jarak]=tspga(xy,50,9000)

t =
    25.8500

RuteTerbaik =
Columns 1 through 21
     1     3     4    18    22    25    27    26    24    19    23    21    20    17    16    15    14    13    12    11    10
Columns 22 through 28
     9     8     7     6     5     2     1

jarak =
    62.7000

>>
```

Workspace

Name	Value	Size	Class
RuteTer...	1x28 double	1x28	double
jarak	62.8000	1x1	double
xy	27x27 double	27x27	double

Command Window

```
>> [RuteTerbaik, jarak]=tspga(xy,50,10000)

t =
    27.9600

RuteTerbaik =
Columns 1 through 21
     1     3     4    18    20    22    19    26    27    24    25    23    21    17    16    15    14    13    12    11    10
Columns 22 through 28
     9     8     7     6     5     2     1

jarak =
    62.8000

>>
```

Workspace

Name	Value	Size	Class
RuteTer...	1x28 double	1x28	double
jarak	62.8000	1x1	double
xy	27x27 double	27x27	double

Command Window

```
>> [RuteTerbaik, jarak]=tspga(xy,50,11000)

t =

    31.4500

RuteTerbaik =

Columns 1 through 21

     1     2     5     6     7     8     9    10    11    12    13    14    15    16    17    18    19    20    22    24    26    27    25

Columns 22 through 28

    19    23    21    18     4     3     1

jarak =

    62.7500

>>
```

Name	Value	Size	Class
RuteTer...	1x28 double	1x28	double
jarak	62.7500	1x1	double
xy	27x27 double	27x27	double

Command Window

```
>> [RuteTerbaik, jarak]=tspga(xy,50,12000)

t =

    35.1500

RuteTerbaik =

Columns 1 through 21

     1     2     5     6     7     8     9    10    11    12    13    14    15    16    17    20    23    19    24    26    27

Columns 22 through 28

    25    22    21    18     4     3     1

jarak =

    62.6800

>>
```

Name	Value	Size	Class
RuteTer...	1x28 double	1x28	double
jarak	62.6800	1x1	double
xy	27x27 double	27x27	double

Command Window

```
>> [RuteTerbaik, jarak]=tspga(xy,75,1000)

t =

     5.6000

RuteTerbaik =

Columns 1 through 22

     1     2     5    11    10     9     8     7     6    15    12    14    13    16    17    21    22    25    27    26    24    19

Columns 23 through 28

    23    20    18     4     3     1

jarak =

    69.7000

>>
```

Name	Value	Size	Class
RuteTer...	1x28 double	1x28	double
jarak	69.7000	1x1	double
xy	27x27 double	27x27	double

Command Window

```
>> [RuteTerbaik, jarak]=tspga(xy,75,2000)

t =
    11.2500

RuteTerbaik =

Columns 1 through 21
     1     4    21    22    23    24    26    27    25    19    20    18     2     5     6     7    10     9     8    11    12

Columns 22 through 28
    14    13    15    16    17     3     1

jarak =
    68.2200
```

Workspace

Name	Value	Size	Class
RuteTer...	1x28 double	1x28	double
jarak	68.2200	1x1	double
xy	27x27 double	27x27	double

Command Window

```
>> [RuteTerbaik, jarak]=tspga(xy,75,3000)

t =
    16.8000

RuteTerbaik =

Columns 1 through 21
     1     3     5     9    10    11    12    13    14    15     6     7     8     2    17    16    18    20    21    22    23

Columns 22 through 28
    19    24    26    27    25     4     1

jarak =
    73.0700
```

Workspace

Name	Value	Size	Class
RuteTer...	1x28 double	1x28	double
jarak	73.0700	1x1	double
xy	27x27 double	27x27	double

Command Window

```
>> [RuteTerbaik, jarak]=tspga(xy,75,4000)

t =
    22.3600

RuteTerbaik =

Columns 1 through 21
     1     4    18    19    24    26    27    25    23    22    21    20     2     5     6     7     8     9    10    11    12

Columns 22 through 28
    13    14    15    16    17     3     1

jarak =
    65.1000
```

Workspace

Name	Value	Size	Class
RuteTer...	1x28 double	1x28	double
jarak	65.1000	1x1	double
xy	27x27 double	27x27	double

The screenshot shows the MATLAB environment with the following workspace variables:

Name	Value	Size	Class
RuteTer...	1x28 double	1x28	double
Jarak	66.5000	1x1	double
xy	27x27 double	27x27	double

The Command Window shows the execution of the following code:

```

>> [RuteTerbaik, Jarak]=tspga(xy,75,5000)

t =
    27.9300

RuteTerbaik =
Columns 1 through 21
     1     3     4    20    22    19    25    27    26    24    23    21    18    17    16    6     7     8     9    11
Columns 22 through 28
    12    13    14    15     5     2     1

Jarak =
    68.1000
    
```

The screenshot shows the MATLAB environment with the following workspace variables:

Name	Value	Size	Class
RuteTer...	1x28 double	1x28	double
Jarak	62.8000	1x1	double
xy	27x27 double	27x27	double

The Command Window shows the execution of the following code:

```

>> [RuteTerbaik, Jarak]=tspga(xy,75,6000)

t =
    33.4700

RuteTerbaik =
Columns 1 through 21
     1     2     5     6     7     8     9    10    11    12    13    14    15    16    17    18    19    24    26    27    25
Columns 22 through 28
    23    22    21    20     4     3     1

Jarak =
    62.8000

>> |
    
```

The screenshot shows the MATLAB environment with the following workspace variables:

Name	Value	Size	Class
RuteTer...	1x28 double	1x28	double
Jarak	66.5000	1x1	double
xy	27x27 double	27x27	double

The Command Window shows the execution of the following code:

```

>> [RuteTerbaik, Jarak]=tspga(xy,75,7000)

t =
    39.4200

RuteTerbaik =
Columns 1 through 21
     1     3     4     8    22    25    27    26    24    19    23    21    20    17    16     6     5     7     8     9    10
Columns 22 through 28
    11    12    13    14    15     2     1

Jarak =
    66.5000

>> |
    
```

Workspace:

Name	Value	Size	Class
RuteTer...	1x28 double	1x28	double
jarak	69.5800	1x1	double
xy	27x27 double	27x27	double

```

>> [RuteTerbaik, jarak]=tspga(xy,75,8000)

t =
    44.6800

RuteTerbaik =
Columns 1 through 21
     1     3    17    16     5     7     8     9    10    11    12    13    14    15     6     2    20    23    19    27    26
Columns 22 through 28
    24    25    22    21    18     4     1

jarak =
    69.5800
    
```

Workspace:

Name	Value	Size	Class
RuteTer...	1x28 double	1x28	double
jarak	62.7000	1x1	double
xy	27x27 double	27x27	double

```

>> [RuteTerbaik, jarak]=tspga(xy,75,9000)

t =
    50.3700

RuteTerbaik =
Columns 1 through 21
     1     3     4     18    22    25    27    26    24    19    23    21    20    17    16    15    14    13    12    11    10
Columns 22 through 28
     9     8     7     6     5     2     1

jarak =
    62.7000
    
```

Workspace:

Name	Value	Size	Class
RuteTer...	1x28 double	1x28	double
jarak	62.6800	1x1	double
xy	27x27 double	27x27	double

```

>> [RuteTerbaik, jarak]=tspga(xy,75,10000)

t =
    56.1700

RuteTerbaik =
Columns 1 through 21
     1     3     4     18    21    22    19    24    26    27    25    23    20    17    16    15    14    13    12    11    10
Columns 22 through 28
     9     8     7     6     5     2     1

jarak =
    62.6800
    
```

Command Window

```
>> [RuteTerbaik, jarak]=tspga(xy,75,11000)

t =
    62.6900

RuteTerbaik =
Columns 1 through 21
    1    2    5    6    7    8    9   10   11   12   13   14   15   16   17   20   22   25   27   26   24
Columns 22 through 28
    19   23   21   18    4    3    1

jarak =
    62.6800

>>
```

Workspace

Name	Value	Size	Class
RuteTer...	1x28 double	1x28	double
jarak	62.6800	1x1	double
xy	27x27 double	27x27	double

Zoom: 100% UTF-8 CRLF tspga Ln 1 Col 10

Command Window

```
>> [RuteTerbaik, jarak]=tspga(xy,75,12000)

t =
    67.5600

RuteTerbaik =
Columns 1 through 21
    1    3    4   18   20   21   22   23   19   24   26   27   25   17   16   15   14   13   12   11   10
Columns 22 through 28
    9    8    7    6    5    2    1

jarak =
    62.7700

>>
```

Workspace

Name	Value	Size	Class
RuteTer...	1x28 double	1x28	double
jarak	62.7700	1x1	double
xy	27x27 double	27x27	double

Zoom: 100% UTF-8 CRLF tspga Ln 1 Col 10

Command Window

```
>> [RuteTerbaik, jarak]=tspga(xy,100,1000)

t =
    9.1800

RuteTerbaik =
Columns 1 through 21
    1    3   17   16    6    8    9   12   14   13   15   11   10    7    5    2   21   18   20   22   23
Columns 22 through 28
    19   25   24   27   26    4    1

jarak =
    76.7200

>>
```

Workspace

Name	Value	Size	Class
RuteTer...	1x28 double	1x28	double
jarak	76.7200	1x1	double
xy	27x27 double	27x27	double

Zoom: 100% UTF-8 CRLF tspga Ln 1 Col 10

Command Window

```
>> [RuteTerbaik, jarak]=tspga(xy,100,2000)

t =
    18.2600

RuteTerbaik =
Columns 1 through 21
     1     2     5     6    15    14    13    12    11    10     9     8     7    17    16    18    20    21    22    25    24
Columns 22 through 28
    26    27    19    23     4     3     1

jarak =
    68.6700

>> |
```

Workspace

Name	Value	Size	Class
RuteTer...	1x28 double	1x28	double
jarak	68.6700	1x1	double
xy	27x27 double	27x27	double

Zoom: 100% UTF-8 CRLF tspga Ln 1 Col 10

Command Window

```
>> [RuteTerbaik, jarak]=tspga(xy,100,3000)

t =
    27.1800

RuteTerbaik =
Columns 1 through 21
     1     3     4    18    20    19    24    26    27    25    23    22    21    17    16    15    14    13    12    11     7
Columns 22 through 28
     8     9    10     6     5     2     1

jarak =
    66.2500

>> |
```

Workspace

Name	Value	Size	Class
RuteTer...	1x28 double	1x28	double
jarak	66.2500	1x1	double
xy	27x27 double	27x27	double

Zoom: 100% UTF-8 CRLF tspga Ln 1 Col 10

Command Window

```
>> [RuteTerbaik, jarak]=tspga(xy,100,4000)

t =
    36.6600

RuteTerbaik =
Columns 1 through 21
     1     4    18    20    21    23    25    27    26    24    19    22     2     5     6     7     8     9    10    11    12
Columns 22 through 28
    13    14    15    16    17     3     1

jarak =
    65.0700

>> |
```

Workspace

Name	Value	Size	Class
RuteTer...	1x28 double	1x28	double
jarak	65.0700	1x1	double
xy	27x27 double	27x27	double

Zoom: 100% UTF-8 CRLF tspga Ln 1 Col 10

Command Window

```
>> [RuteTerbaik, jarak]=tspga(xy,100,5000)

t =
    45.8200

RuteTerbaik =
Columns 1 through 21
     1     3     4    18    22    25    27    26    24    19    23    21    20    17    16    15    14    13    12    11    10
Columns 22 through 28
     9     8     7     6     5     2     1

jarak =
    62.7000

>>
```

Name	Value	Size	Class
RuteTer...	1x28 double	1x28	double
jarak	62.7000	1x1	double
xy	27x27 double	27x27	double

Command Window

```
>> [RuteTerbaik, jarak]=tspga(xy,100,6000)

t =
    54.2700

RuteTerbaik =
Columns 1 through 21
     1     2    15    14    13    12    11    10     9     8     7     5     6    16    17    20    21    22    23    25    27
Columns 22 through 28
    26    24    19    18     4     3     1

jarak =
    66.5000

>>
```

Name	Value	Size	Class
RuteTer...	1x28 double	1x28	double
jarak	66.5000	1x1	double
xy	27x27 double	27x27	double

Command Window

```
>> [RuteTerbaik, jarak]=tspga(xy,100,7000)

t =
    63.5600

RuteTerbaik =
Columns 1 through 21
     1     3     4    21    22    25    27    26    24    19    23    18    20    17    16    15    14    13    12    11    10
Columns 22 through 28
     9     8     7     6     5     2     1

jarak =
    62.9000

>>
```

Name	Value	Size	Class
RuteTer...	1x28 double	1x28	double
jarak	62.9000	1x1	double
xy	27x27 double	27x27	double

Command Window

```
>> [RuteTerbaik, jarak]=tspga(xy,100,8000)

t =
    73.0900

RuteTerbaik =
Columns 1 through 21
     1     2     5     6     7     8     9    10    11    12    13    14    15    16    17    20    21    23    19    24    26
Columns 22 through 28
    27    25    22    18     4     3     1

jarak =
    62.7000
```

Workspace

Name	Value	Size	Class
RuteTer...	1x28 double	1x28	double
jarak	62.7000	1x1	double
xy	27x27 double	27x27	double

Command Window

```
>> [RuteTerbaik, jarak]=tspga(xy,100,9000)

t =
    82.0700

RuteTerbaik =
Columns 1 through 21
     1     3    17    16    15    14    13    12     6     5     7    10    11     9     8     2    21    22    23    25    27
Columns 22 through 28
    26    24    19    20    18     4     1

jarak =
    69.1000
```

Workspace

Name	Value	Size	Class
RuteTer...	1x28 double	1x28	double
jarak	69.1000	1x1	double
xy	27x27 double	27x27	double

Command Window

```
>> [RuteTerbaik, jarak]=tspga(xy,100,10000)

t =
    90.6400

RuteTerbaik =
Columns 1 through 21
     1     3     4    18    21    22    19    24    26    27    25    23    20    17    16    15    14    13    11    10
Columns 22 through 28
     9     8     7     6     5     2     1

jarak =
    62.6800
```

Workspace

Name	Value	Size	Class
RuteTer...	1x28 double	1x28	double
jarak	62.6800	1x1	double
xy	27x27 double	27x27	double

Command Window

```
>> [RuteTerbaik, jarak]=tspga(xy,100,11000)

t =
    99.9100

RuteTerbaik =
Columns 1 through 21
     1     2     5     6     7     8     9    10    11    12    13    14    15    16    17    20    21    22    23    25    27
Columns 22 through 28
    26    24    19    18     4     3     1

jarak =
    62.7000

>>
```

Workspace

Name	Value	Size	Class
RuteTer...	1x28 double	1x28	double
jarak	62.7000	1x1	double
xy	27x27 double	27x27	double

Zoom: 100% UTF-8 CRLF tspga Ln 1 Col 10

Command Window

```
>> [RuteTerbaik, jarak]=tspga(xy,100,12000)

t =
    109

RuteTerbaik =
Columns 1 through 21
     1     4    18    19    24    26    27    25    23    22    21    20     2     5     6     7     8     9    10    11    12
Columns 22 through 28
    13    14    15    16    17     3     1

jarak =
    65.1000

>> |
```

Workspace

Name	Value	Size	Class
RuteTer...	1x28 double	1x28	double
jarak	65.1000	1x1	double
xy	27x27 double	27x27	double

Zoom: 100% UTF-8 CRLF tspga Ln 1 Col 10

Command Window

```
>> [RuteTerbaik, jarak]=tspga(xy,125,1000)

t =
    15.6100

RuteTerbaik =
Columns 1 through 21
     1     3     2    20    18    21    23    19    24    26    27    25    22     4    12    13    14    15     5    10     9
Columns 22 through 28
    11     8     7     6    16    17     1

jarak =
    78.4000

>> |
```

Workspace

Name	Value	Size	Class
RuteTer...	1x28 double	1x28	double
jarak	78.4000	1x1	double
xy	27x27 double	27x27	double

Zoom: 100% UTF-8 CRLF tspga Ln 1 Col 10

tabusearch.m tspga.m

Command Window

```
>> [RuteTerbaik, jarak]=tspga(xy,125,2000)
```

t =
28.5900

RuteTerbaik =

Columns 1 through 21

1	3	4	18	20	21	22	23	25	27	26	24	19	17	16	15	13	14	12	11	10
---	---	---	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----

Columns 22 through 28

9	8	7	6	5	2	1
---	---	---	---	---	---	---

jarak =
63.1700

>> |

Workspace

Name	Value	Size	Class
RuteTer...	1x28 double	1x28	double
jarak	63.1700	1x1	double
xy	27x27 double	27x27	double

Zoom: 100% UTF-8 CRLF tspga Ln 1 Col 10

tabusearch.m tspga.m

Command Window

```
>> [RuteTerbaik, jarak]=tspga(xy,125,3000)
```

t =
42.1600

RuteTerbaik =

Columns 1 through 21

1	3	4	20	21	22	24	26	27	25	19	23	18	16	17	5	12	13	14	15	6
---	---	---	----	----	----	----	----	----	----	----	----	----	----	----	---	----	----	----	----	---

Columns 22 through 28

7	11	10	9	8	2	1
---	----	----	---	---	---	---

jarak =
71.5700

>> |

Workspace

Name	Value	Size	Class
RuteTer...	1x28 double	1x28	double
jarak	71.5700	1x1	double
xy	27x27 double	27x27	double

Zoom: 100% UTF-8 CRLF tspga Ln 1 Col 10

tabusearch.m tspga.m

Command Window

```
>> [RuteTerbaik, jarak]=tspga(xy,125,4000)
```

t =
56.2200

RuteTerbaik =

Columns 1 through 21

1	3	4	18	20	24	26	27	25	19	23	22	21	17	16	6	5	7	8	9	10
---	---	---	----	----	----	----	----	----	----	----	----	----	----	----	---	---	---	---	---	----

Columns 22 through 28

11	12	13	14	15	2	1
----	----	----	----	----	---	---

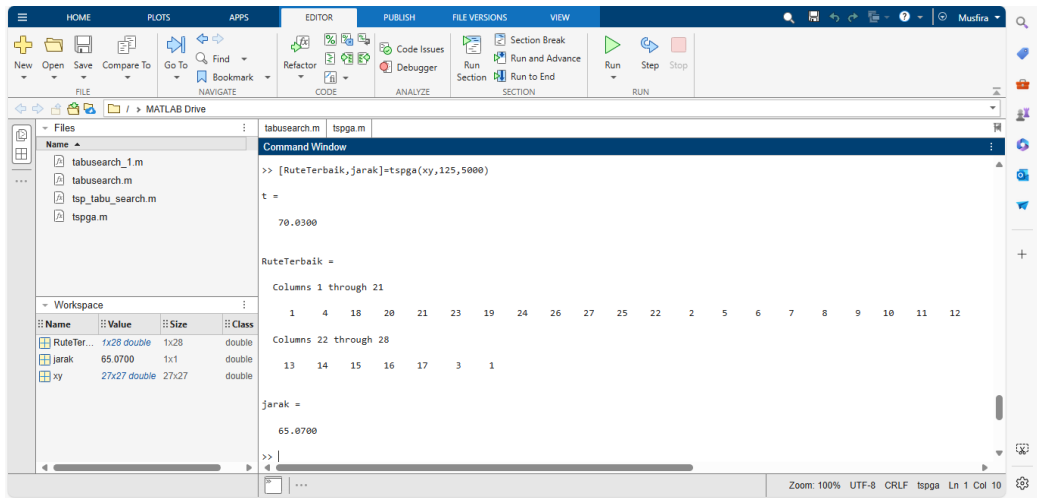
jarak =
66.5700

>> |

Workspace

Name	Value	Size	Class
RuteTer...	1x28 double	1x28	double
jarak	66.5700	1x1	double
xy	27x27 double	27x27	double

Zoom: 100% UTF-8 CRLF tspga Ln 1 Col 10



Command Window

```
>> [RuteTerbaik, jarak]=tspga(xy,125,5000)
```

t =
70.0300

RuteTerbaik =

Columns 1 through 21

1	4	18	20	21	23	19	24	26	27	25	22	2	5	6	7	8	9	10	11	12
---	---	----	----	----	----	----	----	----	----	----	----	---	---	---	---	---	---	----	----	----

Columns 22 through 28

13	14	15	16	17	3	1
----	----	----	----	----	---	---

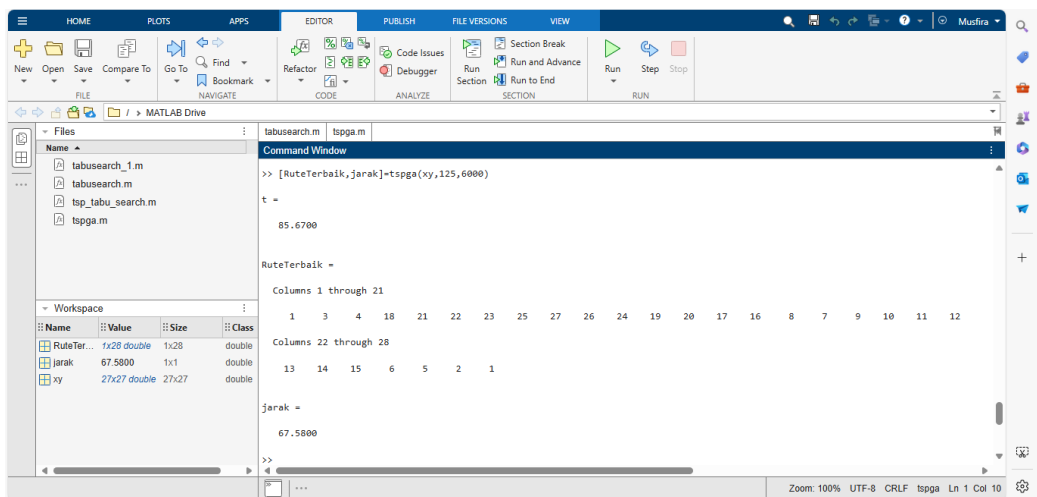
jarak =
65.0700

```
>> |
```

Workspace

Name	Value	Size	Class
RuteTer...	1x28 double	1x28	double
jarak	65.0700	1x1	double
xy	27x27 double	27x27	double

Zoom: 100% UTF-8 CRLF tspga Ln 1 Col 10



Command Window

```
>> [RuteTerbaik, jarak]=tspga(xy,125,6000)
```

t =
85.6700

RuteTerbaik =

Columns 1 through 21

1	3	4	18	21	22	23	25	27	26	24	19	20	17	16	8	7	9	10	11	12
---	---	---	----	----	----	----	----	----	----	----	----	----	----	----	---	---	---	----	----	----

Columns 22 through 28

13	14	15	6	5	2	1
----	----	----	---	---	---	---

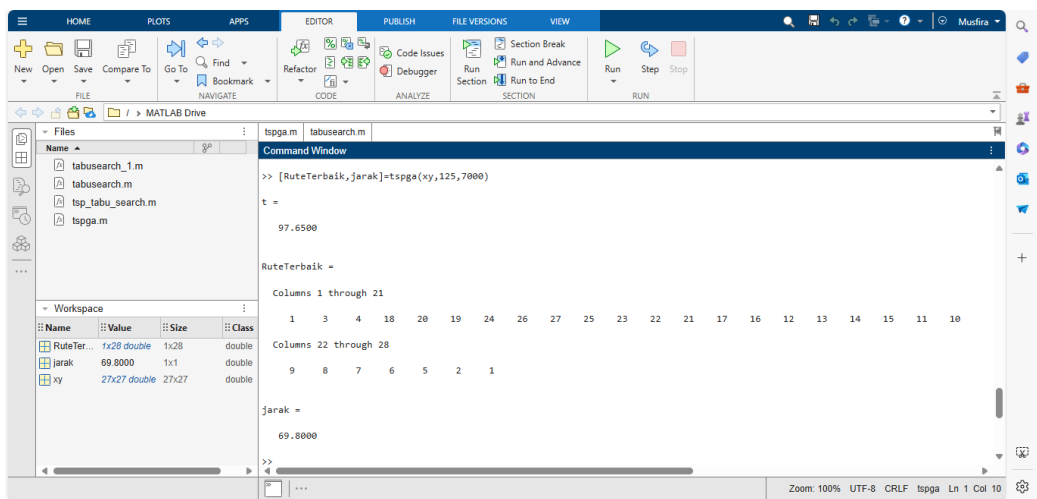
jarak =
67.5800

```
>> |
```

Workspace

Name	Value	Size	Class
RuteTer...	1x28 double	1x28	double
jarak	67.5800	1x1	double
xy	27x27 double	27x27	double

Zoom: 100% UTF-8 CRLF tspga Ln 1 Col 10



Command Window

```
>> [RuteTerbaik, jarak]=tspga(xy,125,7000)
```

t =
97.6500

RuteTerbaik =

Columns 1 through 21

1	3	4	18	20	19	24	26	27	25	23	22	21	17	16	12	13	14	15	11	10
---	---	---	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----

Columns 22 through 28

9	8	7	6	5	2	1
---	---	---	---	---	---	---

jarak =
69.8000

```
>> |
```

Workspace

Name	Value	Size	Class
RuteTer...	1x28 double	1x28	double
jarak	69.8000	1x1	double
xy	27x27 double	27x27	double

Zoom: 100% UTF-8 CRLF tspga Ln 1 Col 10

Command Window

```
>> [RuteTerbaik, jarak]=tspga(xy,125,8000)

t =
    113.0200

RuteTerbaik =
Columns 1 through 21
     1     3     4    18    21    22    25    27    26    24    19    23    20    17    16    15    14    13    12    11    10
Columns 22 through 28
     9     8     7     6     5     2     1

jarak =
    62.6800

>> |
```

Workspace

Name	Value	Size	Class
RuteTer...	1x28 double	1x28	double
jarak	62.6800	1x1	double
xy	27x27 double	27x27	double

Zoom: 100% UTF-8 CRLF tspga Ln 1 Col 10

Command Window

```
>> [RuteTerbaik, jarak]=tspga(xy,125,9000)

t =
    123.6900

RuteTerbaik =
Columns 1 through 21
     1     3     4    18    21    22    19    25    27    26    24    23    20    17    16    15    14    13    12    11    10
Columns 22 through 28
     9     8     7     6     5     2     1

jarak =
    62.7500

>> |
```

Workspace

Name	Value	Size	Class
RuteTer...	1x28 double	1x28	double
jarak	62.7500	1x1	double
xy	27x27 double	27x27	double

Zoom: 100% UTF-8 CRLF tspga Ln 1 Col 10

Command Window

```
>> [RuteTerbaik, jarak]=tspga(xy,125,10000)

t =
    145.7100

RuteTerbaik =
Columns 1 through 21
     1     2     5     6     7     8     9    10    11    12    13    14    15    16    17    19    24    26    27    25    23
Columns 22 through 28
    22    21    20    18     4     3     1

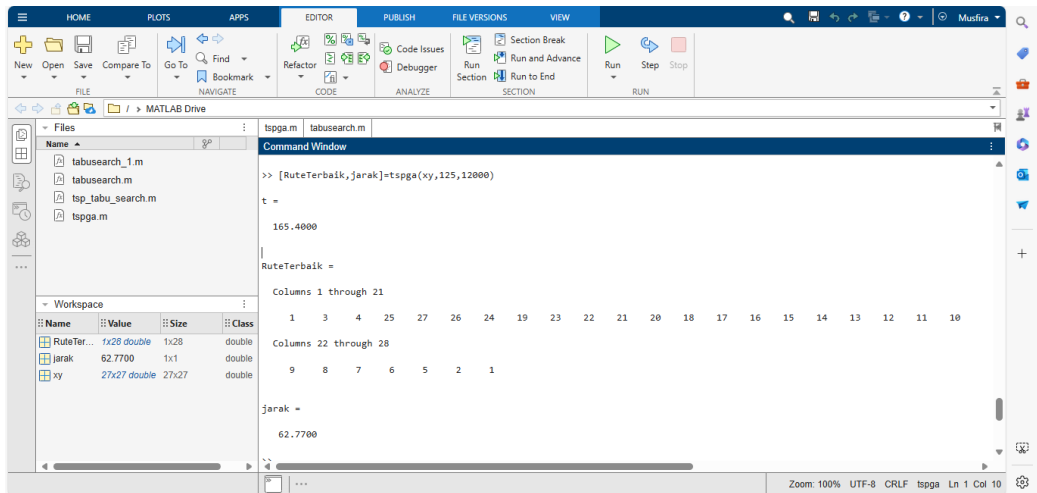
jarak =
    62.7700

>> |
```

Workspace

Name	Value	Size	Class
RuteTer...	1x28 double	1x28	double
jarak	62.7700	1x1	double
xy	27x27 double	27x27	double

Zoom: 100% UTF-8 CRLF tspga Ln 1 Col 10



Command Window

```
>> [RuteTerbaik, jarak]=tspga(xy,125,12000)
```

```
t =
    165.4000
```

```
RuteTerbaik =
```

```
Columns 1 through 21
```

```
    1    3    4    25    27    26    24    19    23    22    21    20    18    17    16    15    14    13    12    11    10
```

```
Columns 22 through 28
```

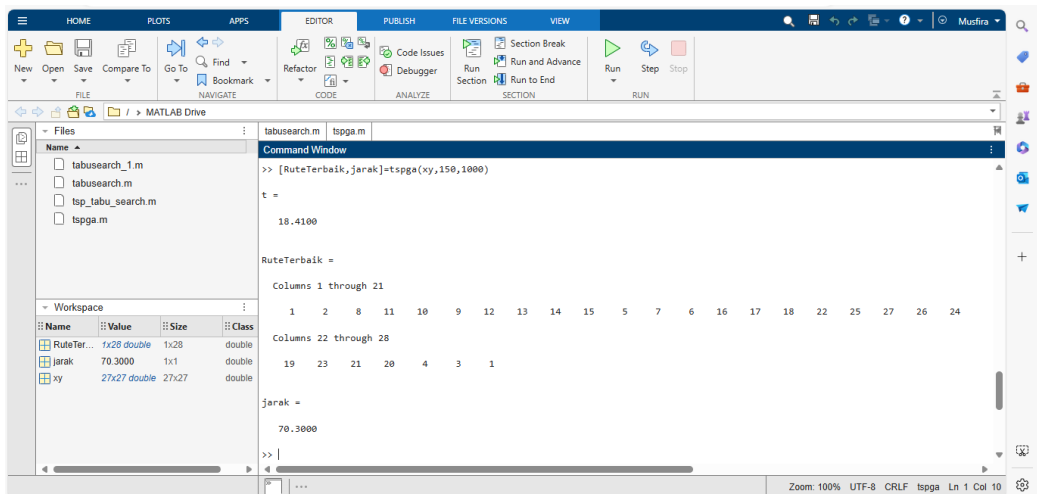
```
    9    8    7    6    5    2    1
```

```
jarak =
    62.7700
```

Workspace

Name	Value	Size	Class
RuteTer...	1x28 double	1x28	double
jarak	62.7700	1x1	double
xy	27x27 double	27x27	double

Zoom: 100% UTF-8 CRLF tspga Ln 1 Col 10



Command Window

```
>> [RuteTerbaik, jarak]=tspga(xy,150,1000)
```

```
t =
    18.4100
```

```
RuteTerbaik =
```

```
Columns 1 through 21
```

```
    1    2    8    11    10    9    12    13    14    15    5    7    6    16    17    18    22    25    27    26    24
```

```
Columns 22 through 28
```

```
   19   23   21   20    4    3    1
```

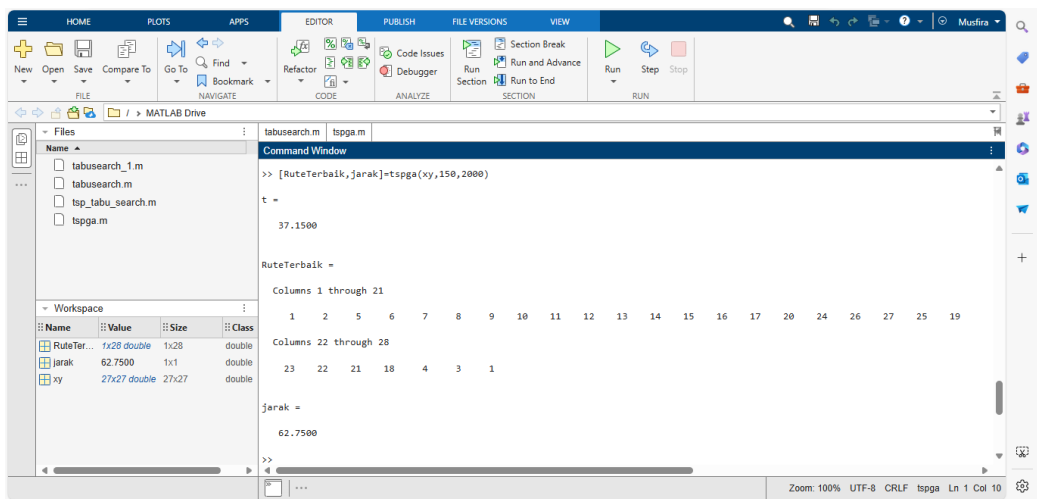
```
jarak =
    70.3000
```

```
>> |
```

Workspace

Name	Value	Size	Class
RuteTer...	1x28 double	1x28	double
jarak	70.3000	1x1	double
xy	27x27 double	27x27	double

Zoom: 100% UTF-8 CRLF tspga Ln 1 Col 10



Command Window

```
>> [RuteTerbaik, jarak]=tspga(xy,150,2000)
```

```
t =
    37.1500
```

```
RuteTerbaik =
```

```
Columns 1 through 21
```

```
    1    2    5    6    7    8    9    10    11    12    13    14    15    16    17    20    24    26    27    25    19
```

```
Columns 22 through 28
```

```
   23   22   21   18    4    3    1
```

```
jarak =
    62.7500
```

```
>>
```

Workspace

Name	Value	Size	Class
RuteTer...	1x28 double	1x28	double
jarak	62.7500	1x1	double
xy	27x27 double	27x27	double

Zoom: 100% UTF-8 CRLF tspga Ln 1 Col 10

Command Window

```
>> [RuteTerbaik, jarak]=tspga(xy,150,3000)

t =
    55.9900

RuteTerbaik =
Columns 1 through 21
     1     2    15    14    13    12    11    10     9     8     7     5     6    16    17    20    21    23    25    27    26
Columns 22 through 28
    24    19    22    18     4     3     1

jarak =
    66.5000
```

Workspace

Name	Value	Size	Class
RuteTer...	1x28 double	1x28	double
jarak	66.5000	1x1	double
xy	27x27 double	27x27	double

Zoom: 100% UTF-8 CRLF tspga Ln 1 Col 10

Command Window

```
>> [RuteTerbaik, jarak]=tspga(xy,150,4000)

t =
    74.2100

RuteTerbaik =
Columns 1 through 21
     1     3     4    18    20    21    22    23    19    25    27    26    24    17    16    15    14    13    12     6     5
Columns 22 through 28
     7    10    11     9     8     2     1

jarak =
    66.8400
```

Workspace

Name	Value	Size	Class
RuteTer...	1x28 double	1x28	double
jarak	66.8400	1x1	double
xy	27x27 double	27x27	double

Zoom: 100% UTF-8 CRLF tspga Ln 1 Col 10

Command Window

```
>> [RuteTerbaik, jarak]=tspga(xy,150,5000)

t =
    93.6100

RuteTerbaik =
Columns 1 through 21
     1     2     5     7     8     9    10    11    12    13    14    15     6    16    17    18    20    21    22    25    27
Columns 22 through 28
    26    24    19    23     4     3     1

jarak =
    64.9700
```

Workspace

Name	Value	Size	Class
RuteTer...	1x28 double	1x28	double
jarak	64.9700	1x1	double
xy	27x27 double	27x27	double

Zoom: 100% UTF-8 CRLF tspga Ln 1 Col 10

Command Window

```
>> [RuteTerbaik, jarak]=tspga(xy,150,6000)
```

t =
111.6300

RuteTerbaik =

Columns 1 through 21

1	2	5	6	7	8	9	10	11	12	13	14	15	16	17	18	20	21	23	25	27
---	---	---	---	---	---	---	----	----	----	----	----	----	----	----	----	----	----	----	----	----

Columns 22 through 28

26	24	19	22	4	3	1
----	----	----	----	---	---	---

jarak =
62.7700

Workspace

Name	Value	Size	Class
RuteTer...	1x28 double	1x28	double
jarak	62.7700	1x1	double
xy	27x27 double	27x27	double

Command Window

```
>> [RuteTerbaik, jarak]=tspga(xy,150,7000)
```

t =
132.8300

RuteTerbaik =

Columns 1 through 21

1	3	4	18	21	23	19	24	26	27	25	22	20	17	16	6	7	8	9	10	11
---	---	---	----	----	----	----	----	----	----	----	----	----	----	----	---	---	---	---	----	----

Columns 22 through 28

12	13	14	15	5	2	1
----	----	----	----	---	---	---

jarak =
66.0800

Workspace

Name	Value	Size	Class
RuteTer...	1x28 double	1x28	double
jarak	66.0800	1x1	double
xy	27x27 double	27x27	double

Command Window

```
>> [RuteTerbaik, jarak]=tspga(xy,150,8000)
```

t =
150.1700

RuteTerbaik =

Columns 1 through 21

1	2	5	6	7	8	9	10	11	12	13	14	15	16	17	20	23	19	25	27	26
---	---	---	---	---	---	---	----	----	----	----	----	----	----	----	----	----	----	----	----	----

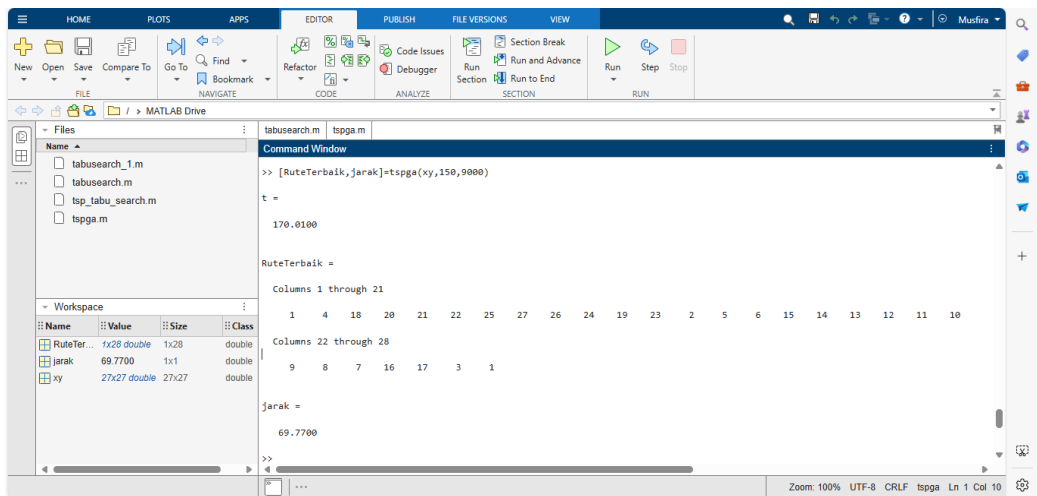
Columns 22 through 28

24	22	21	18	4	3	1
----	----	----	----	---	---	---

jarak =
62.7500

Workspace

Name	Value	Size	Class
RuteTer...	1x28 double	1x28	double
jarak	62.7500	1x1	double
xy	27x27 double	27x27	double



Command Window

```
>> [RuteTerbaik, jarak]=tspga(xy,150,9000)

t =

170.0100

RuteTerbaik =

Columns 1 through 21

1 4 18 20 21 22 25 27 26 24 19 23 2 5 6 15 14 13 12 11 10

Columns 22 through 28

9 8 7 16 17 3 1

jarak =

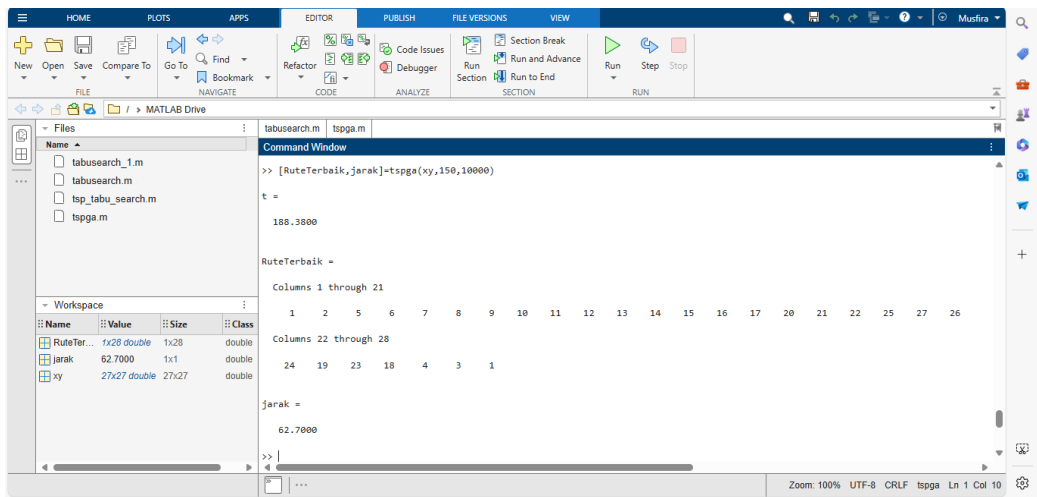
69.7700

>>
```

Workspace

Name	Value	Size	Class
RuteTer...	1x28 double	1x28	double
jarak	69.7700	1x1	double
xy	27x27 double	27x27	double

Zoom: 100% UTF-8 CRLF tspga Ln 1 Col 10



Command Window

```
>> [RuteTerbaik, jarak]=tspga(xy,150,10000)

t =

188.3800

RuteTerbaik =

Columns 1 through 21

1 2 5 6 7 8 9 10 11 12 13 14 15 16 17 20 21 22 25 27 26

Columns 22 through 28

24 19 23 18 4 3 1

jarak =

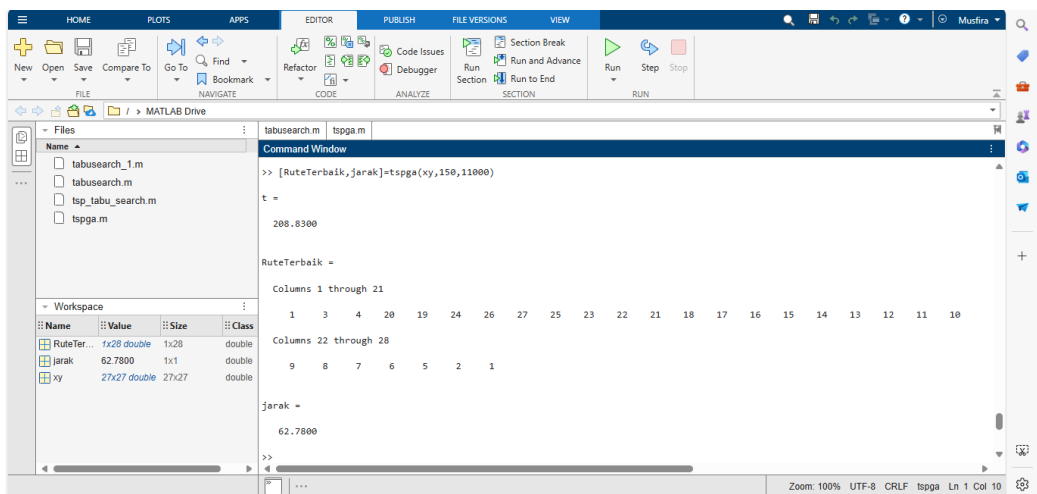
62.7000

>> |
```

Workspace

Name	Value	Size	Class
RuteTer...	1x28 double	1x28	double
jarak	62.7000	1x1	double
xy	27x27 double	27x27	double

Zoom: 100% UTF-8 CRLF tspga Ln 1 Col 10



Command Window

```
>> [RuteTerbaik, jarak]=tspga(xy,150,11000)

t =

208.8300

RuteTerbaik =

Columns 1 through 21

1 3 4 20 19 24 26 27 25 23 22 21 18 17 16 15 14 13 12 11 10

Columns 22 through 28

9 8 7 6 5 2 1

jarak =

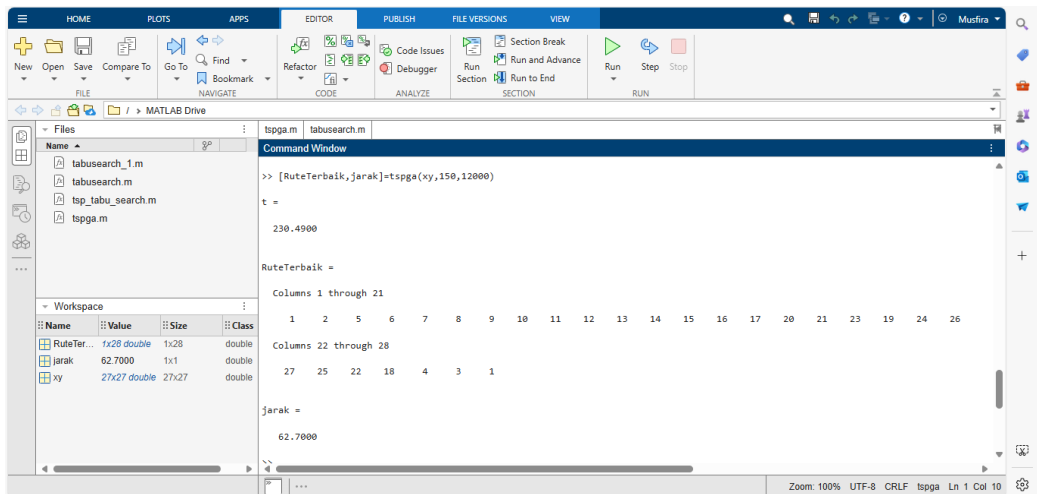
62.7800

>>
```

Workspace

Name	Value	Size	Class
RuteTer...	1x28 double	1x28	double
jarak	62.7800	1x1	double
xy	27x27 double	27x27	double

Zoom: 100% UTF-8 CRLF tspga Ln 1 Col 10



Lampiran 3. Kodings *software* MATLAB untuk algoritma *tabu search*

```
function [BestSol,BestBiaya]=tabusearch(d,Maxit)
```

```
clc
```

```
n=length(d);
```

```
ActionList= permaction(n) % daftar aksi
```

```
nAction= numel(ActionList); % jumlah aksi
```

```
TL= round(0.5*nAction); % Tabu Length
```

```
%% Initialization
```

```
% Create Empty Individual Structure
```

```
empty_individual.Rute= [];
```

```
empty_individual.Biaya= [];
```

```
% Bangkitkan solusi awal
```

```
sol= empty_individual;
```

```
sol.Rute= randperm(n);
```

```
sol.Rute(sol.Rute==1) = []; % kembali ke rute awal
```

```
sol.Rute = [1,sol.Rute,1];
```

```
sol.Biaya= jartsp([sol.Rute sol.Rute(1)],d);
```

```
% jarak total
```

```
BestSol= sol;
```

```
% Array untuk menyimpan biaya terkecil
```

```
Bestbiaya= zeros(Maxit,1);
```

```
% vektor untuk menyimpan jumlah tabu
```

```
TC= zeros(nAction,1);
```

```

%% Tabu Search Main Loop
for it=1:Maxit;
    ts=tic;
    rand(10);
    bestnewsol.Biaya=inf;
    % Terapkan aksi
    for i=1:nAction
        if TC(i)==0
            newsol.Rute=DoAction(sol.Rute,ActionList{i}); % ubah solusi
            newsol.Biaya= jartsp([newsol.Rute newsol.Rute(1)],d); % hitung jarak solusi
baru
            newsol.ActionIndex=i;
            if newsol.Biaya<= bestnewsol.Biaya
                bestnewsol= newsol;
            end
        end
    end
end

% Update solusi sekarang
sol= bestnewsol;

% Update tabu list
for i=1:nAction
    if i== bestnewsol.ActionIndex
        TC(i)= TL; % Add to tabu list
        TC(i)= max(TC(i)-1,0); % Reduce tabu counter
    end
end
disp(' ')
texty = sprintf('% .0f',TC);
disp(texty)
disp(' ')

% Update best solution ever found
if sol.Biaya<BestSol.Biaya
    BestSol=sol;
    Tit=it;
    Time=toc(ts);
    Solusi=BestSol.Rute;
    Action=BestSol.ActionIndex;
end

% Save best biaya ever found
BestBiaya(it)= BestSol.Biaya;

```

```

% Show Iteration Information
textt = sprintf('% .0f',Solusi);
disp(['Iteration ' num2str(it) ': Best Cost = ' num2str(BestBiaya(it)) ' : Best Sol = ' textt '
: Total Moves = ' num2str(Action) ' : Time = ' num2str(Time)']);

% If Global Minimum is Reached
if BestBiaya(it)==0
    break;
end
end
disp(' ');
disp(['Best Cost terdapat pada iterasi ke ' num2str(Tit) ' sebesar = '
num2str(BestBiaya(it)) ' dengan langkah sebanyak ' num2str(Action) ' dan lama waktu '
num2str(Time) ' detik']);
disp(' ');
disp(['Beserta Best Solnya yaitu = ' textt]);
BestBiaya= BestBiaya(1:it);

figure;
plot(BestBiaya,'LineWidth',2);
xlabel('Iteration');
ylabel('Best Cost');
grid on;

function ActionList= permaction(n)
    nSwap= n*(n-1)/2;
    nFlip= n*(n-1)/2;
    nSlide= n^2;
    nActionList= nSwap+nFlip+nSlide;
    % ActionList= cell(nAction,1);
    c=0;

    % Add swap
    for i=2:n
        for j=i+1:n

            c=c+1;
            ActionList{c}= [1 i j];
        end
    end

    % Add Flip

```

```

for i=2:n
  for j=i+1:n
    if abs(i-j)>2
      c=c+1;
      ActionList{c}= [2 i j];
    end
  end
end
end

```

```

for i=2:n
  for j=2:n

    if abs(i-j)>1
      c=c+1;
      ActionList{c}=[3 i j];
    end
  end
end
end
ActionList= ActionList(1:c);

```

```

function q= DoAction(p,a)
switch a(1)
case 1
% swap
  q=DoSwap(p,a(2),a(3));
case 2
% Flip
  q= DoFlip(p,a(2),a(3));
case 3
% slide
  q= DoSlide(p,a(2),a(3));
end

```

```

function q= DoSwap(p,i1,i2)
  q=p;
  q([i1 i2])= p([i2,i1]);

```

```

function q=DoSlide(p,i1,i2)
  if i1<i2
    q=p([1:i1-1 i1+1:i2 i1 i2+1:end]);
  else

```

```

    q=p([1:i2 i1 i2+1:i1-1 i1+1:end]);
end

```

```

function q=DoFlip(p,i1,i2)
    q=p;
    if i1<i2
        q(i1:i2)=p(i2:-1:i1);
    else
        q(i1:-1:i2)=p(i2:i1);
    end
end

```

```

function jarak=jartsp(x1,dx)
[r,c]=size(x1);
k=c-1; %jumlah kota dalam rute tsp
s=0; %jarak awal di kota pertama
for j=1:k
    s=s+dx(x1(j),x1(j+1)); %pengakumulasian jarak rute tsp
end
jarak=s;

```

Lampiran 4. Kodingan *software* MATLAB untuk algoritma genetika

```
function [RuteTerbaik,jarak]=tspga(xy,N,Maxit)
```

```
%Input:
```

```

% xy= [0.00    3.50    2.70    3.00    6.70    7.70    8.10    7.80    9.00    9.70
       10.10   14.00   14.20   14.40   10.20   7.40    5.70    5.70    9.70    5.80
       5.90    7.00    7.20   11.30    9.90   14.90   15.50;
% 3.50 0.00    1.50    1.30    3.20    4.30    4.70    4.30    5.60    6.20    6.60
       10.50   10.20   10.60    6.80    3.80    2.90    3.80    7.80    3.80    4.00
       5.00    5.20    9.40    8.00   13.00   13.60;
% 2.70 1.50    0.00    0.60    4.20    5.20    5.60    5.30    6.60    7.20    7.60
       11.50   11.20   11.20    7.80    4.90    3.00    3.00    7.00    3.10    3.30
       4.30    4.50    8.60    7.30   12.20   12.90;
% 3.00 1.30    0.60    0.00    4.60    5.60    6.00    5.70    6.90    7.50    8.00
       11.80   12.20   12.20    8.10    5.20    3.50    2.60    6.60    2.70    2.90
       3.90    4.10    8.20    6.80   11.80   12.50;
% 6.70 3.20    4.20    4.60    0.00    0.90    2.00    3.10    4.30    3.60    4.00
       7.90    7.00    7.10    3.90    5.10    4.40    6.70   10.70    6.70    6.90
       7.90    8.10   12.30   10.90   15.90   16.50;
% 7.70 4.30    5.20    5.60    0.90    0.00    2.20    3.70    4.60    3.70    4.10
       8.00    6.00    6.10    2.90    4.00    4.90    7.40   11.40    7.50    7.70
       8.70    8.90   13.00   11.70   16.60   17.30;

```

% 8.10	4.70	5.60	6.00	2.00	2.20	0.00	1.50	2.70	2.00	2.50
	7.80	8.40	8.50	6.50	7.60	6.90	9.00	13.10	9.10	9.30
	10.60	10.50	14.90	13.50	18.50	19.10;				
% 7.80	4.30	5.30	5.70	3.10	3.70	1.50	0.00	1.30	2.10	2.50
	7.80	10.20	10.30	7.10	6.40	5.60	7.90	11.90	8.00	8.20
	9.20	9.40	13.50	12.20	17.10	17.80;				
% 9.00	5.60	6.60	6.90	4.30	4.60	2.70	1.30	0.00	1.00	1.50
	7.20	9.50	9.60	7.60	7.70	6.90	9.20	13.20	9.30	9.50
	10.50	10.70	14.80	13.40	18.40	19.10;				
% 9.70	6.20	7.20	7.50	3.60	3.70	2.00	2.10	1.00	0.00	0.45
	6.10	8.40	8.50	6.40	8.10	7.70	10.00	14.10	10.10	10.30
	11.30	11.50	15.60	14.30	19.20	19.90;				
% 10.10		6.60	7.60	8.00	4.00	4.10	2.50	2.50	1.50	0.45
	0.00	5.90	8.30	8.40	6.70	8.60	8.20	10.50	14.50	10.60
	10.70	11.80	12.00	16.10	14.70	19.70	20.40;			
% 14.00		10.50	11.50	11.80	7.90	8.00	7.80	7.80	7.20	6.10
	5.90	0.00	4.20	4.30	7.20	9.90	11.20	14.50	18.30	14.40
	14.50	15.60	15.80	19.90	18.50	23.50	24.10;			
% 14.20		10.20	11.20	12.20	7.00	6.00	8.40	10.20	9.50	8.40
	8.30	4.20	0.00	0.23	4.40	7.30	8.60	11.80	15.90	11.90
	12.10	13.20	13.40	17.40	16.10	21.10	21.80;			
% 14.40		10.60	11.20	12.20	7.10	6.10	8.50	10.30	9.60	8.50
	8.40	4.30	0.23	0.00	4.10	7.00	8.40	11.60	15.70	11.70
	11.90	13.00	13.20	17.20	15.80	20.90	21.50;			
% 10.20		6.80	7.80	8.10	3.90	2.90	6.50	7.10	7.60	6.40
	6.70	7.20	4.40	4.10	0.00	3.60	4.90	8.10	12.10	8.20
	8.40	9.40	9.70	13.70	12.40	17.40	18.10;			
% 7.40	3.80	4.90	5.20	5.10	4.00	7.60	6.40	7.70	8.10	8.60
	9.90	7.30	7.00	3.60	0.00	1.90	5.10	9.10	5.20	5.30
	6.40	6.60	10.70	9.40	14.30	15.00;				
% 5.70	2.90	3.00	3.50	4.40	4.90	6.90	5.60	6.90	7.70	8.20
	11.20	8.60	8.40	4.90	1.90	0.00	3.30	7.30	3.30	3.50
	4.60	4.80	8.90	7.50	12.50	13.10;				
% 5.70	3.80	3.00	2.60	6.70	7.40	9.00	7.90	9.20	10.00	10.50
	14.50	11.80	11.60	8.10	5.10	3.30	0.00	4.00	0.07	0.25
	1.30	1.50	5.60	4.20	9.20	9.90;				
% 9.70	7.80	7.00	6.60	10.70	11.40	13.10	11.90	13.20	14.10	14.50
	18.30	15.90	15.70	12.10	9.10	7.30	4.00	0.00	3.90	3.80
	2.70	2.50	1.60	0.27	5.20	5.90;				
% 5.80	3.80	3.10	2.70	6.70	7.50	9.10	8.00	9.30	10.10	10.60
	14.40	11.90	11.70	8.20	5.20	3.30	0.07	3.90	0.00	0.17
	1.20	1.40	5.50	4.20	9.10	9.80;				
% 5.90	4.00	3.30	2.90	6.90	7.70	9.30	8.20	9.50	10.30	10.70
	14.50	12.10	11.90	8.40	5.30	3.50	0.25	3.80	0.17	0.00
	1.00	1.20	5.40	4.00	9.00	9.60;				

% 7.00	5.00	4.30	3.90	7.90	8.70	10.30	9.20	10.50	11.30	11.80
	15.60	13.20	13.00	9.40	6.40	4.60	1.30	2.70	1.20	1.00
	0.00	0.20	4.30	2.90	7.90	8.60;				
% 7.20	5.20	4.50	4.10	8.10	8.90	10.50	9.40	10.70	11.50	12.00
	15.80	13.40	13.20	9.70	6.60	4.80	1.50	2.50	1.40	1.20
	0.20	0.00	4.10	2.70	7.70	8.40;				
% 11.30		9.40	8.60	8.20	12.30	13.00	14.90	13.50	14.80	15.60
	16.10	19.90	17.40	17.20	13.70	10.70	8.90	5.60	1.60	5.50
	5.40	4.30	4.10	0.00	1.40	3.60	4.30;			
% 9.90	8.00	7.30	6.80	10.90	11.70	13.50	12.20	13.40	14.30	14.70
	18.50	16.10	15.80	12.40	9.40	7.50	4.20	0.27	4.20	4.00
	2.90	2.70	1.40	0.00	5.00	5.60;				
% 14.90		13.00	12.20	11.80	15.90	16.60	18.50	17.10	18.40	19.20
	19.70	23.50	21.10	20.90	17.40	14.30	12.50	9.20	5.20	9.10
	9.00	7.90	7.70	3.60	5.00	0.00	0.65;			
% 15.50		13.60	12.90	12.50	16.50	17.30	19.10	17.80	19.10	19.90
	20.40	24.10	21.80	21.50	18.10	15.00	13.10	9.90	5.90	9.80
	9.60	8.60	8.40	4.30	5.60	0.65	0.00]			

% N= Jumlah kromosom dalam populasi

% Maxit= Jumlah iterasi maksimum

t= cputime; %awal waktu komputasi

jgen= length(xy); % Jumlah Gen (jumlah kota)

Psilang= 0.8; % Probabilitas Pindah silang

Pmutasi= 0.01; % Probabilitas mutasi

Fthreshold= 0.0001;% Threshold untuk fitness

%% menghitung matrik jarak antar kota

for i=1:jgen

for j=1:jgen

cost(i,j)=sqrt((xy(i,1)-xy(j,1))^2+(xy(i,2)-xy(j,2))^2);

end

```
end

dx=cost;

%% Inisialisasi populasi

Populasi= tspinialisasi(N,jgen);

d=size(xy);

if d(2)>2

    dx=xy;

end

for generasi=1:Maxit

    for i=1:N

        Fitness(i)=1/jartsp(Populasi(i,:),dx);

    end

    [MaxF,idk]= max(Fitness);

    RuteTerbaik= Populasi(idk,:);

    MinF= min(Fitness);

    if MinF < Fthreshold

        break;

    end

    Populasi_s= Populasi;

    % Elitisme:
```

```
% Buat 4 kopi dari kromosom terbaik jika ukuran populasi genap
```

```
% Buat 3 kopi dari kromosom terbaik jika ukuran populasi ganjil
```

```
if mod(N,2)==0; % ukuran populasi genap
```

```
    IterasiMulai= 5;
```

```
    Populasi_s(1,:)= Populasi(idk,:);
```

```
    Populasi_s(2,:)= Populasi(idk,:);
```

```
    Populasi_s(3,:)= Populasi(idk,:);
```

```
    Populasi_s(4,:)= Populasi(idk,:);
```

```
else % ukuran populasi ganji
```

```
    IterasiMulai= 4;
```

```
    Populasi_s(1,:)= Populasi(idk,:);
```

```
    Populasi_s(2,:)= Populasi(idk,:);
```

```
    Populasi_s(3,:)= Populasi(idk,:);
```

```
end
```

```
%% Roulette-Wheel selection dan pindah silang
```

```
for j= IterasiMulai:2:N
```

```
    [Bapak,Ibu]= lotere(N,Fitness,jgen);
```

```
    r= rand;
```

```
    if r < Psilang
```

```
        for i= 1:N
```

```
            P1=Populasi(i,:);
```

```
            P1(P1==1)=[];
```

```

    Pop1(i,:)=P1; %Populasi tanpa kota 1

end

%% crossover

Anak= TSPPindahSilang(Pop1(Bapak,:),Pop1(Ibu,:),jgen);

anak1=[1 Anak(1,:) 1];

anak2=[1 Anak(2,:) 1];

Populasi_s(j,:)= anak1;

Populasi_s(j+1,:)= anak2;

else

    Populasi_s(j,:)= Populasi(Bapak,:);

    Populasi_s(j+1,:)= Populasi(Ibu,:);

end

end

end

%% Mutasi dilakukan pada seperempat kromosom

for kk= IterasiMulai:(0.25*N)

    for i= 1:N

        P1=Populasi_s(i,:);

        P1(P1==1)=[];

        Pop1(i,:)=P1; %Populasi tanpa kota 1

    end

    Mutcrom= TSPMutasi(Pop1(kk,:),jgen,Pmutasi);

    Populasi_s(kk,:)= [1 Mutcrom 1];

```

```

end

Populasi= Populasi_s;

end

jater= RuteTerbaik;

jarak= jartsp(jater,dx);

t=cputime-t % total waktu komputasi (detik)

%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%% inialisasi populasi

function Populasi= tspinialisasi(N,jgen)

for i=1:N

    Pop(i,:)= randperm(jgen);

    pop= Pop(i,:);

    pop(pop==1)=[];

    Populasi(i,:)= [1 pop 1];

end

%% menghitung jarak

function jarak=jartsp(x1,dx)

[r,c]=size(x1);

k=c-1; %jumlah kota dalam rute tsp

s=0; %jarak awal di kota pertama

for j=1:k

    s=s+dx(x1(j),x1(j+1)); %pengakumulasian jarak rute tsp

end

```

```
jarak=s;
```

```
%% selection
```

```
function [Bapak,Ibu]= lotere(N,Fitness,jgen)
```

```
    rtf=zeros(1,N);
```

```
    pnt=zeros(1,2);
```

```
    for i=1:N
```

```
        rtf(i)=Fitness(i);
```

```
    end
```

```
    rtf=rtf/sum(rtf);
```

```
    rtf=cumsum(rtf);
```

```
    while pnt(1)==pnt(2)
```

```
        rn1=rand(); rn2=rand();
```

```
        pnt(1)=find(rtf>rn1,1,'first');
```

```
        pnt(2)=find(rtf>rn2,1,'first');
```

```
        Bapak= pnt(1);
```

```
        Ibu= pnt(2);
```

```
    end
```

```
%% mutasi kromosom
```

```
function MutKrom= TSPMutasi(Kromosom,JumGen,Pmutasi)
```

```
MutKrom= Kromosom;
```

```

G=JumGen-1;

for i=1:G

    r= rand;

    if r < Pmutasi

        TM2= 1+fix(rand*G);

        while TM2==i

            TM2= 1+ fix(rand*G);

        end

        temp= MutKrom(i);

        MutKrom(i)= MutKrom(TM2);

        MutKrom(TM2)= temp;

    end

end

%% crossover

function Anak= TSPPindahSilang(Bapak,Ibu,JumGen)

% Dari lampiran buku Suyanto Algoritma Genetika dalam Matlab

% Andi offet 2005

cp1= 1+fix(rand*(JumGen-1));

cp2= 1+fix(rand*(JumGen-1));

while cp2==cp1

    cp2= 1+fix(rand*(JumGen-1));

end

```

```
if cp1 < cp2
    cps= cp1;
    cpd= cp2;
else
    cps= cp2;
    cpd= cp1;
end

Anak(1,cps+1:cpd)= Ibu(cps+1:cpd);
Anak(2,cps+1:cpd)= Bapak(cps+1:cpd);

SisaGenbapak= [];
SisaGenIbu= [];

G= JumGen-1 ;

for i= 1:G
    if ~ismember(Bapak(i),Anak(1,:));
        SisaGenbapak= [SisaGenbapak Bapak(i)];
    end
    if ~ismember(Ibu(i),Anak(2,:));
        SisaGenIbu= [SisaGenIbu Ibu(i)];
    end
end

Anak(1,cpd+1:G)= SisaGenbapak(1:G-cpd);
```


Anak(1,1:cps)= SisaGenbapak(1+G-cpd:length(SisaGenbapak));

Anak(2,cpd+1:G)= SisaGenIbu(1:G-cpd);

Anak(2,1:cps)=