

# **Binary Search**

## **For and While Looping**

if, elseif, else

switch, case, otherwise

for

while

try, catch

break

return

continue

pause

parfor

end

Execute statements if condition is true

Execute one of several groups of statements

for loop to repeat specified number of times

while loop to repeat when condition is true

Execute statements and catch resulting errors

Terminate execution of for or while loop

Return control to invoking script or function

Pass control to next iteration of for or while loop

Stop MATLAB execution temporarily

Parallel for loop

Terminate block of code or indicate last array index

```
x = ones(1,10);  
for n = 2:6  
    x(n) = 2 * x(n - 1);  
end
```

$$x_n = 2x_{n-1}$$
$$x_1 = 1$$

iteration



n	x(1)	x(2)	x(3)	x(4)	x(5)	x(6)	x(7)	x(8)	x(9)
初始值	1	1	1	1	1	1	1	1	1
2	1	2	1	1	1	1	1	1	1
3	1	2	4	1	1	1	1	1	1
4	1	2	4	8	1	1	1	1	1
5	1	2	4	8	16	1	1	1	1
6	1	2	4	8	16	32	1	1	1

Table in memory

進入條件

累積乘法

```
n = 1;
nFactorial = 1;
while nFactorial < 100
    n = n + 1;
    nFactorial = nFactorial * n;
    fprintf('n=%d n!=%f',n,nFactorial)
end
fprintf('n=%d n!=%f',n,nFactorial)
```

```
>> demo_factorial
n=2 n!=2
n=3 n!=6
n=4 n!=24
n=5 n!=120
n=5 n!=120
```

$$f_n = (n - 1) * f_{n-1}, \quad n > 1$$

迴圈	n	nFactorial
初始值	1	1
1	2	2
2	3	6
3	4	24
4	5	120
5	6	

```
>> ss = fprintf('%f',nFactorial)
11978571669969890269925854460558840225267029209529303278944419871214396524861374498691473966836482048.000000
ss =
```

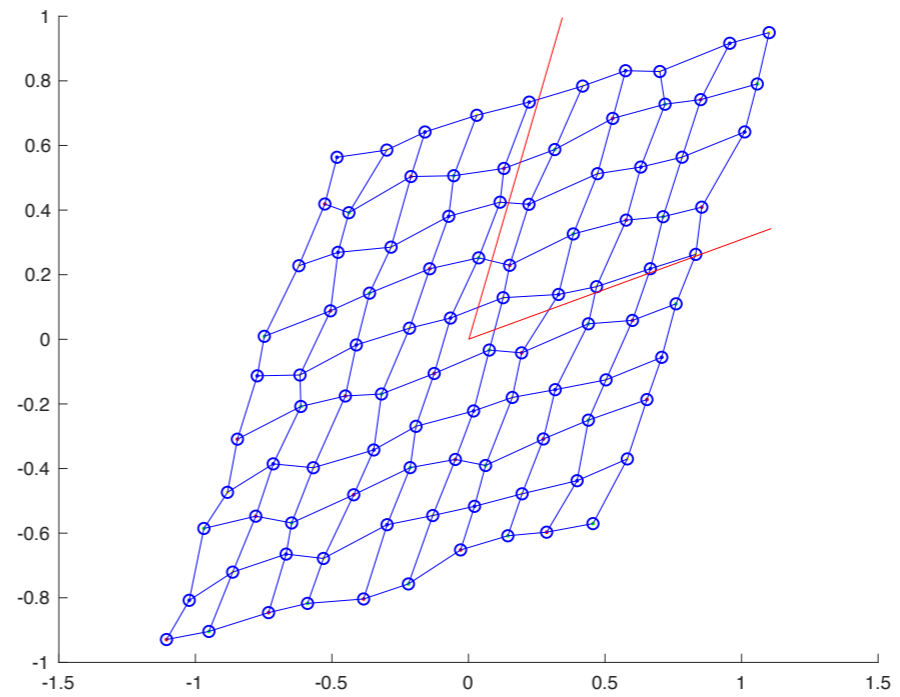
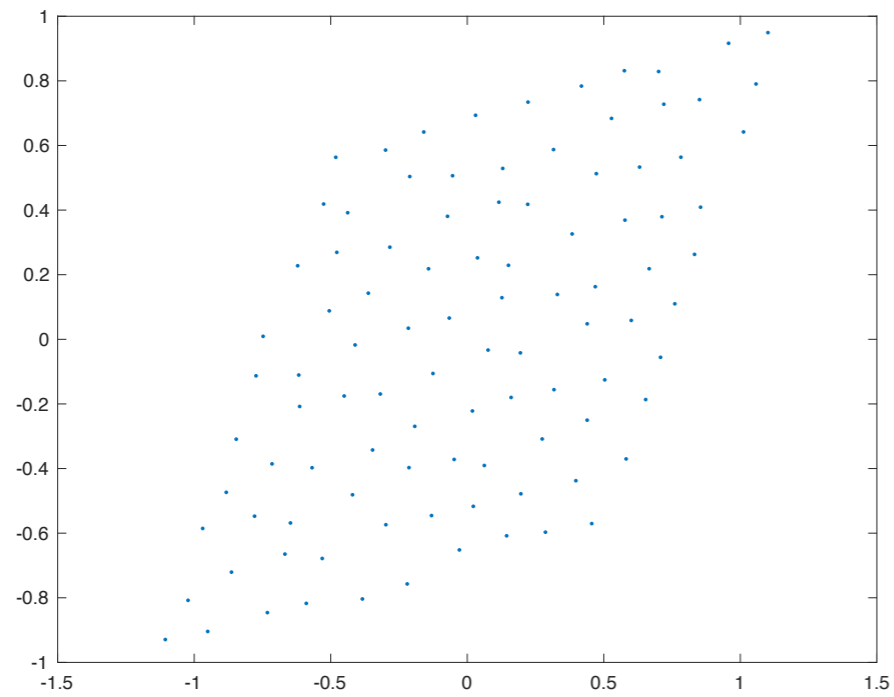
$$f_n = (n - 1) * f_{n-1}, \quad n > 1$$

$$f_{77} = ?$$

```
A = zeros(5,100);  
for m = 1:5  
    for n = 1:100  
        A(m, n) = 1/(m + n - 1);  
    end  
end
```

A 矩陣的元素值不同，使用  
巢狀雙迴圈設定元素值

# 資料的網格結構建構



```
 / ▶ Users ▶ apple ▶ Desktop ▶ Jiann-Ming Wu ▶ code2019_2020_2021 ▶ code2006 ▶ Apps ▶ NEN ▶
Editor - /Users/apple/Desktop/Jiann-Ming Wu/code2019_2020_2021/code2006/Apps/NEN/demo_ex_nen_GTSP.m
demo_LS_TSP2.m x pdp_MFA_TSP.m x MFA_TSP.m x update_v_tsp3.m x demo_ex_nen_GTSP.m x bsearch.m x +
2 -      addpath('../..../methods/common');
3 -      ch = ['nen'; 'som'; 'rdm'; 'fea'];
4 -      select = 4; no=1; exe_time =1;
5 -      method = ch(no,:);
6 -      switch select
7 -          case 1
8 -              eval([sprintf('load data/test200.mat;')]);
9 -              R=2;C=2;
10 -             Map = Make_Para('Row',2,'Col',2,'InitlizeT',2.5,'Constant',1,'ShrinkT',0.9995,'Conver
11 -             case 2
--
Command Window
0.2000005.4:rate = 0.971421 upY = 0.000321 upW=0.010744 0.073514 9.338072 0.185656
0.2000005.4:rate = 0.974326 upY = 0.000295 upW=0.009615 0.070720 9.340200 0.181071
0.2000005.4:rate = 0.976963 upY = 0.000271 upW=0.008595 0.068208 9.342090 0.176599
0.2000005.4:rate = 0.979354 upY = 0.000249 upW=0.007672 0.065952 9.343765 0.172238
0.2000005.4:rate = 0.981520 upY = 0.000228 upW=0.006840 0.063927 9.345249 0.167984
0.2000005.4:rate = 0.983481 upY = 0.000209 upW=0.006089 0.062112 9.346561 0.163836
0.2000005.4:rate = 0.985253 upY = 0.000191 upW=0.005413 0.060487 9.347720 0.159790
0.2000005.4:rate = 0.986852 upY = 0.000174 upW=0.004805 0.059034 9.348741 0.155843
0.2000005.4:rate = 0.988294 upY = 0.000159 upW=0.004259 0.057736 9.349640 0.151995
0.2000005.4:rate = 0.989592 upY = 0.000145 upW=0.003770 0.056577 9.350430 0.148241

Waiting for calculation B=sqrtm(W) ..|....Mean distance bewteen a data point and its center 0.020826
Total distances bewteen two neighboring knots 31.526845
Mean distance bewteen a data point and its center 0.000000
Total distances bewteen two neighboring knots 33.044458
```

HOME

PLOTS

APPS

EDITOR

PUBLISH

VIEW

Q Search Documentation

Jiann-Ming



Find Files

Compare

Print



Go To

Find

Insert



Comment



Indent



Breakpoints



Run

Run and  
Advance

Run Section



Advance

Run and  
Time

FILE

NAVIGATE

EDIT

BREAKPOINTS

RUN

/ Users apple Desktop Jiann-Ming Wu code2019\_2020\_2021 code2006 Apps NEN

Editor - /Users/apple/Desktop/Jiann-Ming Wu/code2019\_2020\_2021/code2006/Apps/NEN/demo\_ex\_nen\_GTSP.m

demo\_ex\_nen\_GTSP.m

```
1 - addpath('../..../methods/NEN');  
2 - addpath('../..../methods/common');  
3 - ch = ['nen';'som';'rdm';'fea'];  
4 - select = 4; no=1; exe_time =1;  
5 - method = ch(no:).
```

Command Window

*fx* >> |

I

Name ▲

# Binary Search

num\_A儲存介於1到1000  
之間100個隨機產生的整數

- **Let num\_A be an array that stores n randomly generated integers, ranging from 1 to  $10 \cdot n$**
- **Set x to num\_A(randi(n))**
- **Sort these integers and store them by num\_B**
- **Use binary search to find index k such that num\_B(k) equals x**

x儲存100個數字  
中任意一個數字

使用二分搜尋法，找索引i  
使得num\_B(i)等於x

排序後儲存在  
num\_B

# 二元搜尋法範例 A

x is 588

num\_B =

L = 1

20 21 47 64 66 84 89 90 92 95 98

101 103 112 134 152 162 170 173 200 212 222

224 267 269 274 285 286 307 315 319 323 325

331 357 368 369 381 382 387 392 397 400 401

405 413 415 417 429 441 450 452 474 485 489

500 502 504 538 544 552 577 579 588 597 599

601 606 609 615 618 648 661 662 671 674 678

683 694 711 742 770 781 788 791 794 795 801

812 816 821 822 853 863 869 919 934 941 943

947

R = 100

x is 588

num\_B =

迴圈數	M	L	R
初始值		1	100
1	51	52	100

20 21 47 64 66 84 89 90 92 95 98

101 103 112 134 152 162 170 173 200 212 222

224 267 269 274 285 286 307 315 319 323 325

331 357 368 369 381 382 387 392 397 400 401

405 413 415 417 429 441 450 452 474 485 489

500 502 504 538 544 552 577 579 588 597 599

601 606 609 615 618 648 661 662 671 674 678

683 694 711 742 770 781 788 791 794 795 801

812 816 821 822 853 863 869 919 934 941 943

947

x大於450，L設定為M+1

$$M = \text{ceil}((L + R)/2)$$

## 改變下界

因為  $x$  大於  $\text{num\_B}(M)$  ，  
將  $L$  設定為  $M+1$

x is 588

num\_B =

20 21 47 64 66 84 89 90 92 95 98

101 103 112 134 152 162 170 173 200 212 222

224 267 269 274 285 286 307 315 319 323 325

331 357 368 369 381 382 387 392 397 400 401

L = 52

405 413 415 417 429 441 450 452 474 485 489

500 502 504 538 544 552 577 579 588 597 599

601 606 609 615 618 648 661 662 671 674 678

683 694 711 742 770 781 788 791 794 795 801

812 816 821 822 853 863 869 919 934 941 943

947

R = 100

迴圈數	M	L	R
		1	100
1	51	52	100
2	76	52	75

x is 588

num\_B =

20 21 47 64 66 84 89 90 92 95 98

101 103 112 134 152 162 170 173 200 212 222

224 267 269 274 285 286 307 315 319 323 325

331 357 368 369 381 382 387 392 397 400 401

405 413 415 417 429 441 450 452 474 485 489

500 502 504 538 544 552 577 579 588 597 599

601 606 609 615 618 648 661 662 671 674 678

683 694 711 742 770 781 788 791 794 795 801

812 816 821 822 853 863 869 919 934 941 943

947

x小於674，R設定  
為M-1

$$M = \text{ceil}((L + R)/2)$$

## 改變上界

因為  $x$  小於  $\text{num\_B}(M)$  ，  
將  $R$  設定為  $M-1$

x is 588

num\_B =

20 21 47 64 66 84 89 90 92 95 98

101 103 112 134 152 162 170 173 200 212 222

224 267 269 274 285 286 307 315 319 323 325

331 357 368 369 381 382 387 392 397 400 401

L = 52

405 413 415 417 429 441 450 452 474 485 489

500 502 504 538 544 552 577 579 588 597 599

601 606 609 615 618 648 661 662 671 674 678

R = 75

683 694 711 742 770 781 788 791 794 795 801

812 816 821 822 853 863 869 919 934 941 943

947

迴圈數	M	L	R
		1	100
1	51	52	100
2	76	52	75
3	64		

x is 588

num\_B =

20 21 47 64 66 84 89 90 92 95 98

101 103 112 134 152 162 170 173 200 212 222

224 267 269 274 285 286 307 315 319 323 325

331 357 368 369 381 382 387 392 397 400 401

405 413 415 417 429 441 450 452 474 485 489

500 502 504 538 544 552 577 579 588 597 599

601 606 609 615 618 648 661 662 671 674 678

683 694 711 742 770 781 788 791 794 795 801

812 816 821 822 853 863 869 919 934 941 943

947

x等於588，k設定為  
num\_B(M)，中斷迴圈

$$M = \text{ceil}((L + R)/2)$$

因為 $x$ 等於 $\text{num\_B}(M)$ ，  
將 $k$ 設定為 $x$ ，迴圈結束

init:        L : 1, R : 100

loop:1, M : 51, num\_B(M) : 450, L : 52, R : 100,

loop:2, M : 76, num\_B(M) : 674, L : 52, R : 75,

The number at 64 is 588

```
>> bsearch2023
x is 204
```

```
num_B =
```

$$M = \text{ceil}((L + R)/2)$$

2	12	18	L = 21	27	42	102	106	111	115	125	143	146	152	157	159	161	191	199	
204	210	227	260	267	306	307	308	318	328	329	357	362	370	375	379	392	398	416	418
421	426	434	441	449	456	460	475	479	491	539	546	557	558	577	581	584	588	595	609
622	625	631	632	647	654	658	663	694	699	702	704	709	720	722	733	765	766	777	783
787	789	792	796	802	808	816	825	842	845	900	908	909	926	934	952	961	968	989	998

$$R = 21$$

```
init:          L : 1, R : 100
loop:1, M : 51, num_B(M) : 539, L : 1, R : 50,
loop:2, M : 26, num_B(M) : 306, L : 1, R : 25,
loop:3, M : 13, num_B(M) : 143, L : 14, R : 25,
loop:4, M : 20, num_B(M) : 199, L : 21, R : 25,
loop:5, M : 23, num_B(M) : 227, L : 21, R : 22,
loop:6, M : 22, num_B(M) : 210, L : 21, R : 21,
Elapsed time is 0.002715 seconds.
The number at 21 is 204
```

# 使用while迴圈，實作二分搜尋法

迴圈將持續執行直到進入條件不成立

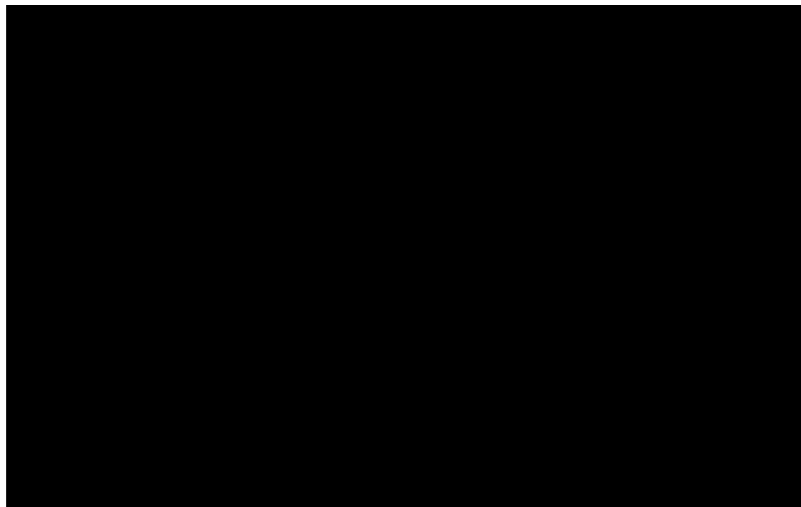
初始設定：  
將L設為1，k設為0  
將R設為陣列長度

```
M = ceil()  
if  
elseif  
else  
end
```

while L <= R

- 將M設為比(L+R)/2大的最小整數
- 如果 x 大於陣列中第M個數，將L設為M+1  
否則如果，x 小於陣列中第M個數將R設為M-1  
否則，將k設定為M，離開迴圈

陣列中第k個數為x

```
1 - n = 100;
2 - S = randperm(10*n);
3 - num_A = S(1:n);
4 - x = num_A(randi(n));
5 - fprintf("x is %d\n",x)
6 - num_B = sort(num_A);
7 - L = 1;
8 - R = length(num_B);
9 - count = 1;
10 - display(num_B);
11 - fprintf("init:           L : %2d, R : %2d\n",L,R)
12 - k = 0;
13 - tic
14 - while L <= R
15 - 
16 -
17 -
18 -
19 -
20 -
21 -
22 -
23 -
24 -     fprintf("loop:%d, M : %2d, num_B(M) : %d, L : %2d, R : %2d, \n",count,M,num_B(M),L,R)
25 -     count = count + 1;
26 - end
27 - toc
28 - fprintf("The number at %2d is %2d\n",k,num_B(k))
```

num\_A儲存介於1到999之間100個隨機產生的整數

- Let num\_A be an array that stores  $n$  randomly generated integers, ranging from 1 to  $10 \cdot n$
- Set  $x$  to num\_A(randi(n))
- Sort these integers and store them by num\_B
- Use binary search to find index  $k$  such that num\_B( $k$ ) equals  $x$

$x$ 儲存100個數字中任意一個數字

使用二分搜尋法，找索引 $i$ 使得num\_B( $i$ )等於 $x$

排序後儲存在num\_B

# **A study on triple search and matlab implementation**

```
>> help magic
magic Magic square.
magic(N) is an N-by-N matrix constructed from the integers
1 through N^2 with equal row, column, and diagonal sums.
Produces valid magic squares for all N > 0 except N = 2.
```

```
fid = fopen('magic.m','r');
count = 0;
while ~feof(fid)
    line = fgetl(fid);
    if isempty(line)
        break
    elseif ~strncmp(line, '%', 1)
        continue
    end
    count = count + 1;
end
fprintf('%d lines in MAGIC help\n', count);
fclose(fid);
```

```
4 lines in MAGIC help
```

```
fid = fopen('magic.m','r');
count = 0;
while ~feof(fid)
    line = fgetl(fid);
    if isempty(line)
        break
    elseif ~strncmp(line,'% ',1)
        continue
    end
    count = count + 1;
end
fprintf('%d lines in MAGIC help\n',count);
fclose(fid);
```

以唯讀模式開啟檔案，將  
檔案id存在變數fid中

```
4 lines in MAGIC help
```

```
fid = fopen('magic.m','r');
count = 0;
while ~feof(fid)
    line = fgetl(fid);
    if isempty(line)
        break
    elseif ~strncmp(line, '%', 1)
        continue
    end
    count = count + 1;
end
fprintf('%d lines in MAGIC help\n', count);
fclose(fid);
```

執行while迴圈  
進入條件為檔案未結束  
eof (end of file)

```
4 lines in MAGIC help
```

```
fid = fopen('magic.m','r');
count = 0;
while ~feof(fid)
    line = fgetl(fid);
    if isempty(line)
        break
    elseif ~strncmp(line,'% ',1)
        continue
    end
    count = count + 1;
end
fprintf('%d lines in MAGIC help\n',count);
fclose(fid);
```

從檔案中讀進一列  
儲存在line變數中

如line為空字串  
離開迴圈  
否則如果line的  
第一個字元不  
是'%'  
跳過以下指令，  
繼續執行迴圈

```
4 lines in MAGIC help
```

```
fid = fopen('magic.m','r');
count = 0;
while ~feof(fid)
    line = fgetl(fid);
    if isempty(line)
        break
    elseif ~strncmp(line, '%', 1)
        continue
    end
    count = count + 1;
end
fprintf('%d lines in MAGIC help\n', count);
fclose(fid);
```

計算行數

關閉檔案

4 lines in MAGIC help