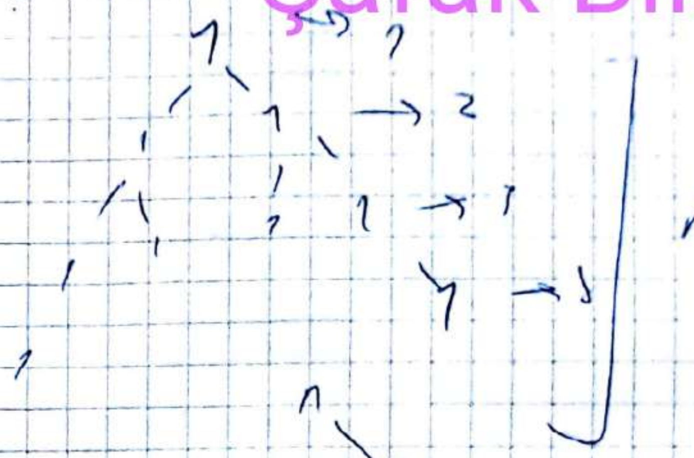
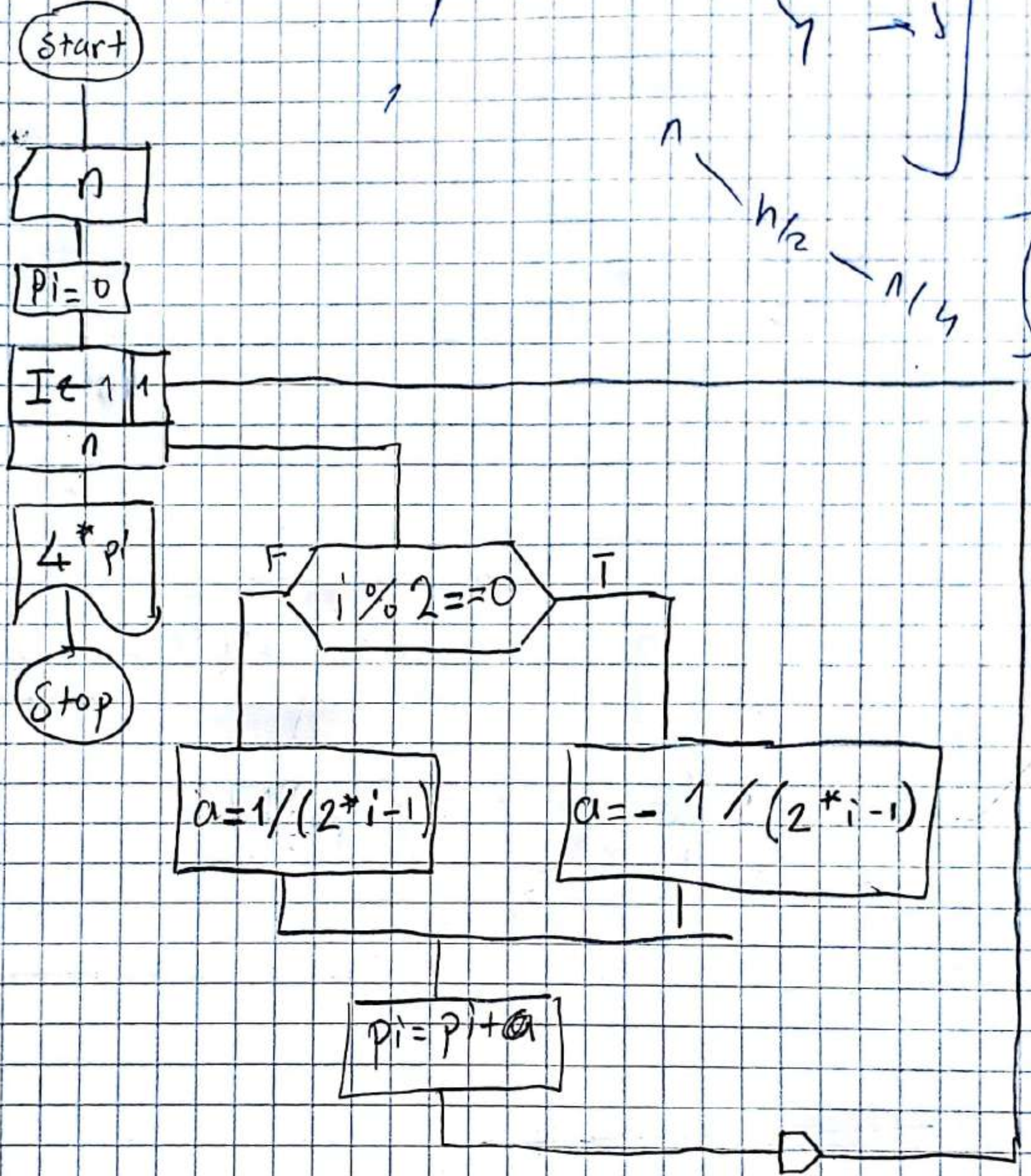
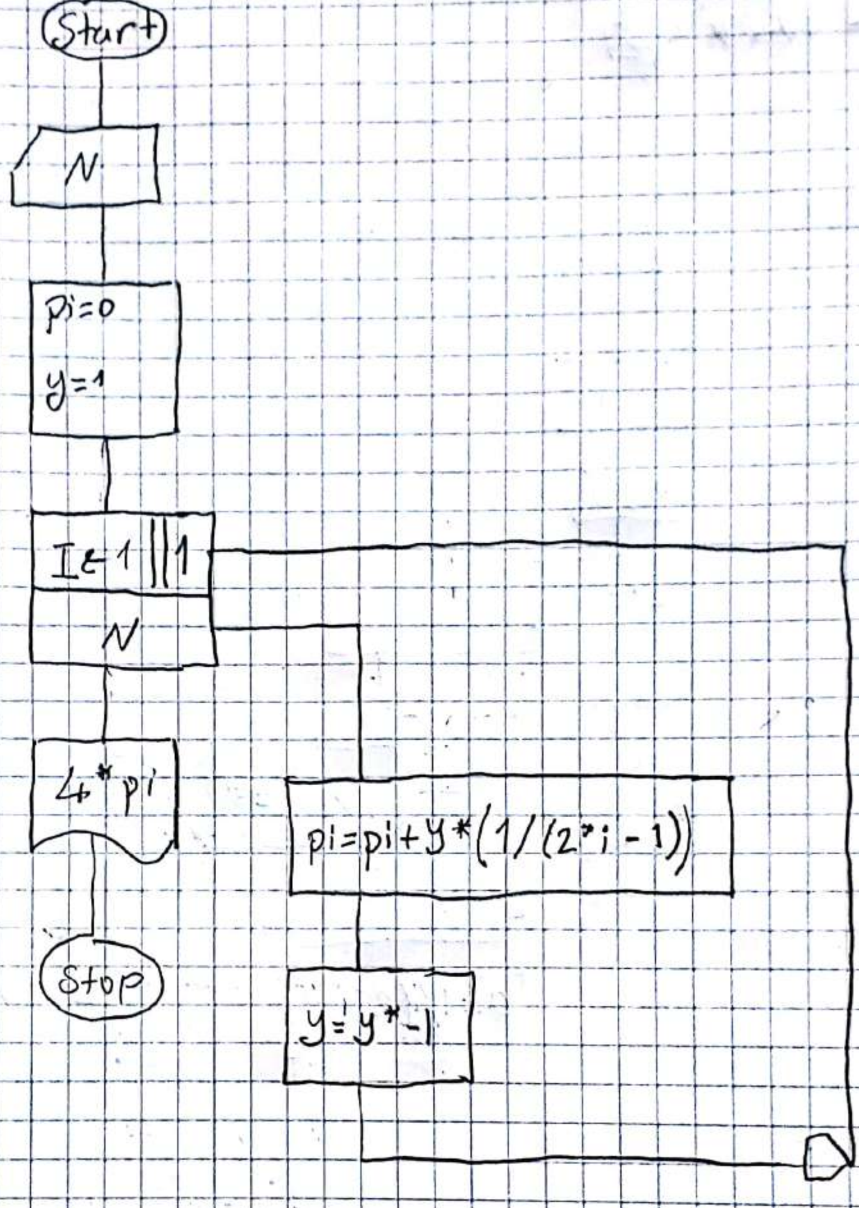
$$n! \cong \sqrt{2\pi n} \cdot \left(\frac{n}{e}\right)^n$$





$$\pi = 4 - \frac{4}{3} + \frac{4}{5} - \frac{4}{7} \cdots = 4\left(1 - \frac{1}{3} + \frac{1}{5} - \right.$$

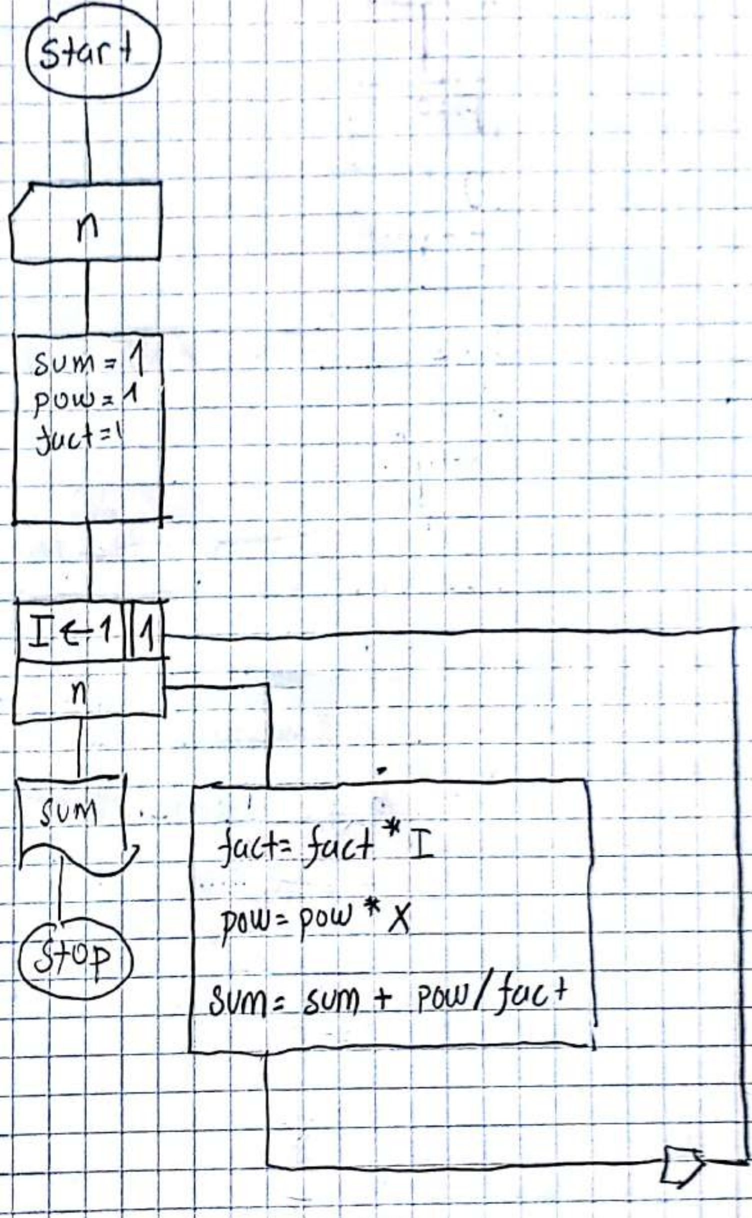
PI 1



PI 2

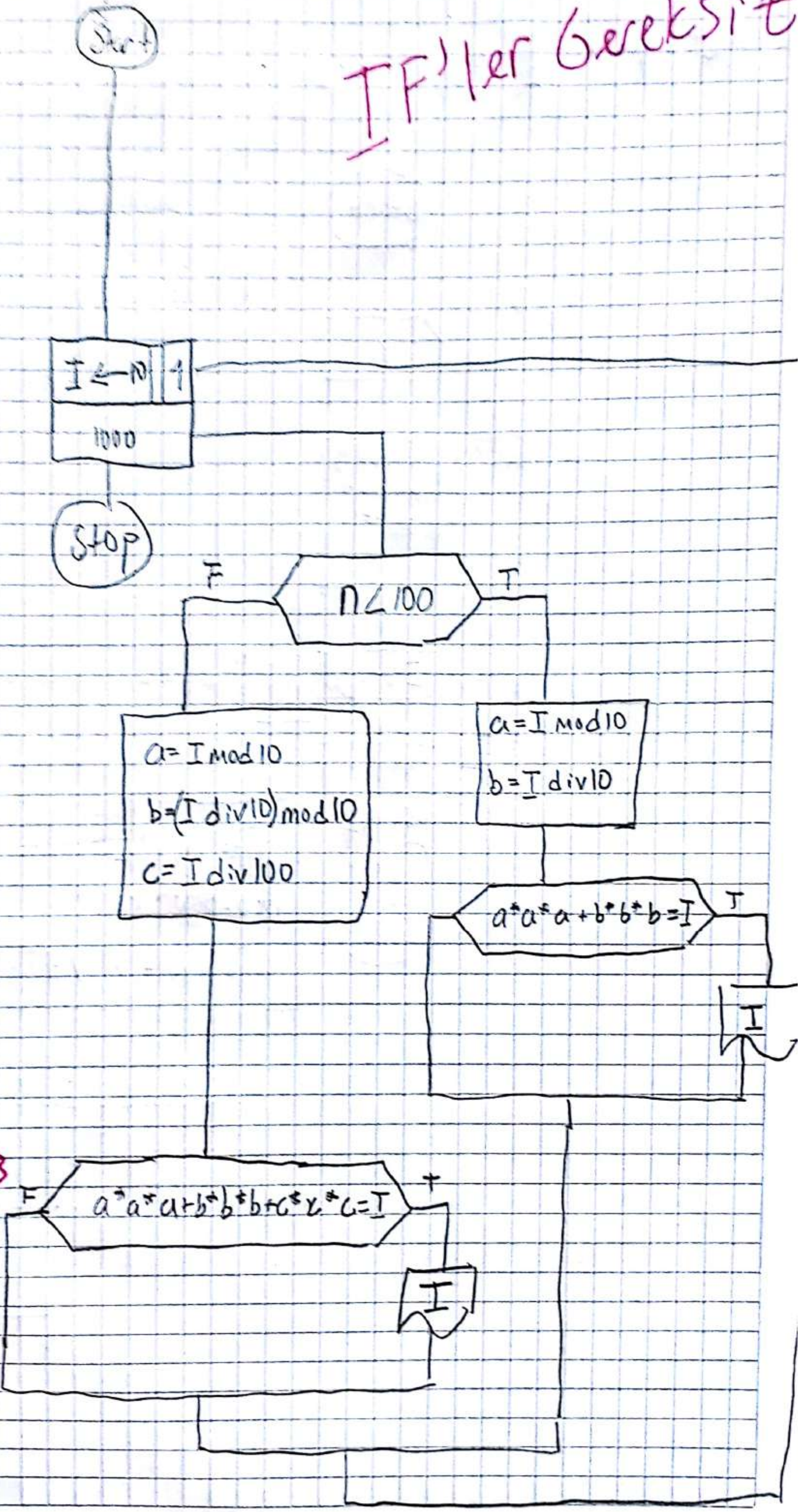
$$e^x = 1 + x + \frac{x^2}{2!} + \frac{x^3}{3!} \cdots$$

1 2 3



exp

IF'ler Gereksiz



$153=1^3+5^3+3^3$

$a^4+b^4+c^4=d^4$

A=2

B=4

2	4	
A	B	
6	4	A = A+B
6	2	B = A-B
4	2	A = A-B

$a+b+c=1000 \qquad a, b, c \in \mathbb{N}^+$

$a^2+b^2=c^2$

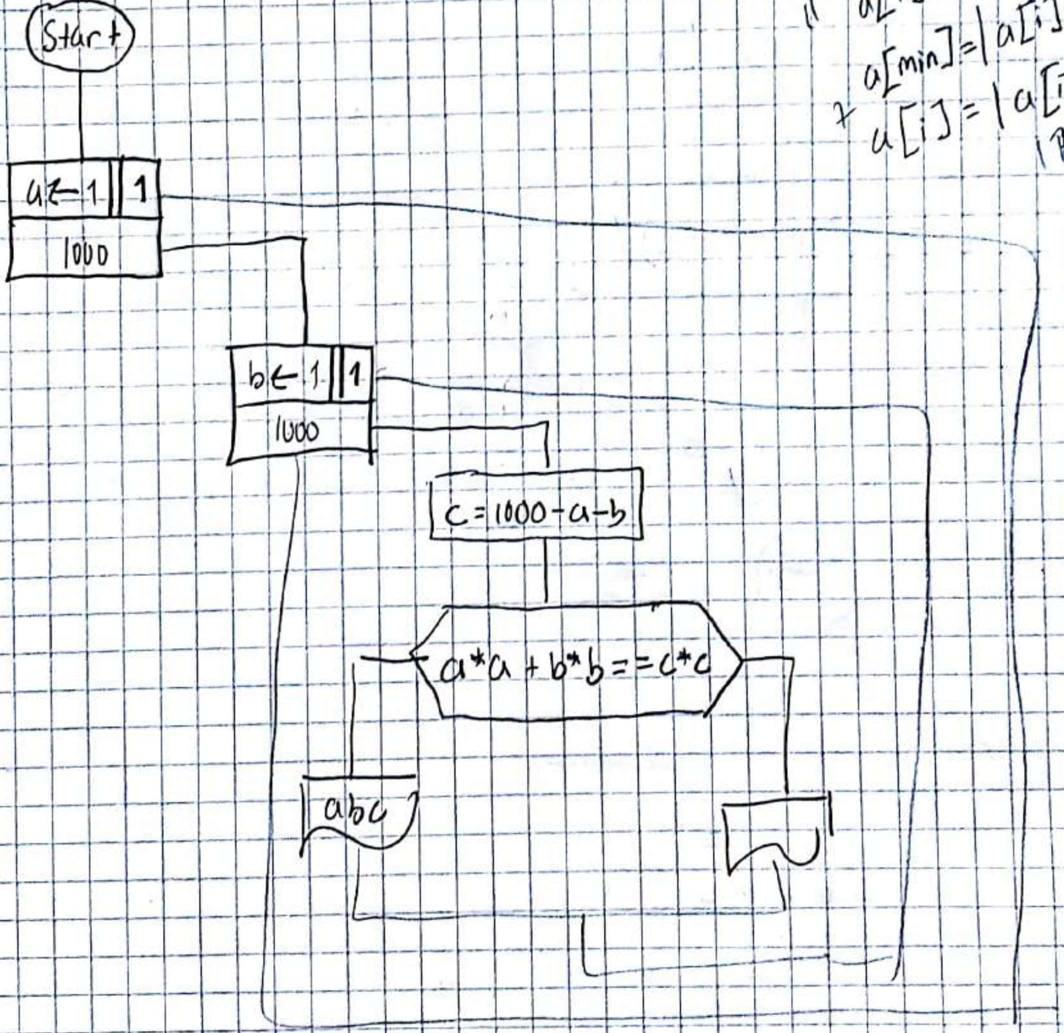
7
4
3
A

a[i] a[min]

a[i] = a[min] + a[i]

a[min] = |a[i] - a[min]|

a[i] = |a[i] - a[min]|

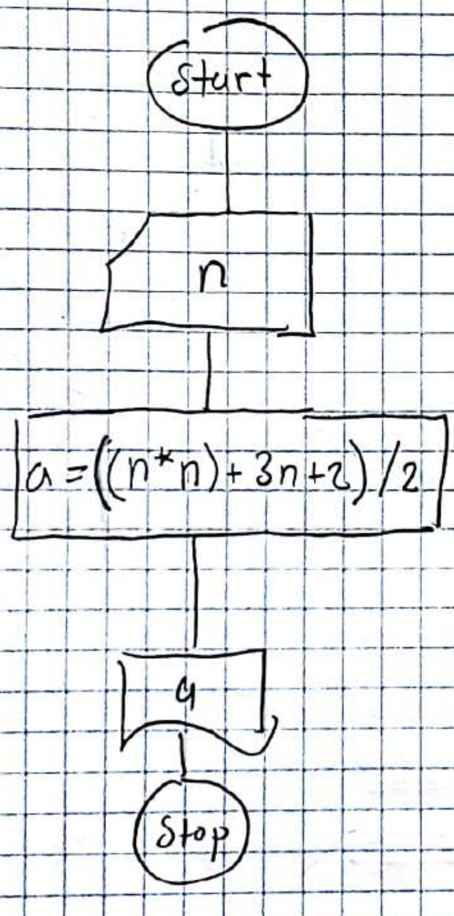


1

2 3

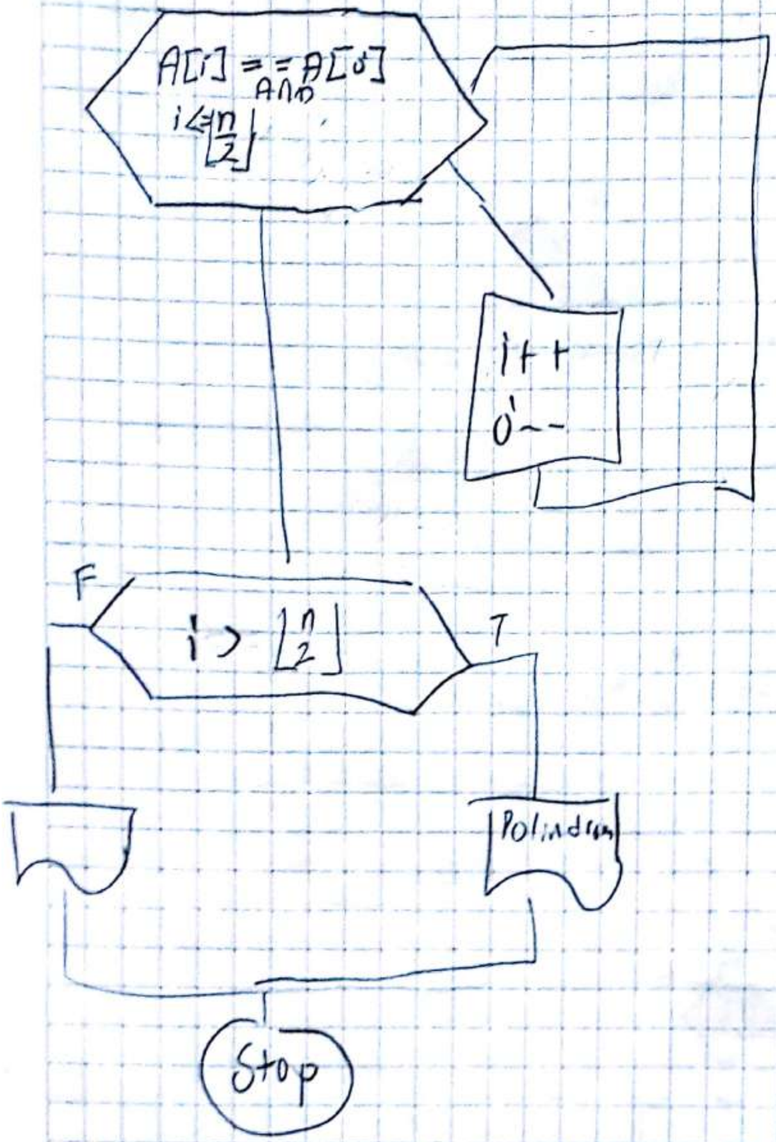
4 5 6

$n \rightarrow ?$

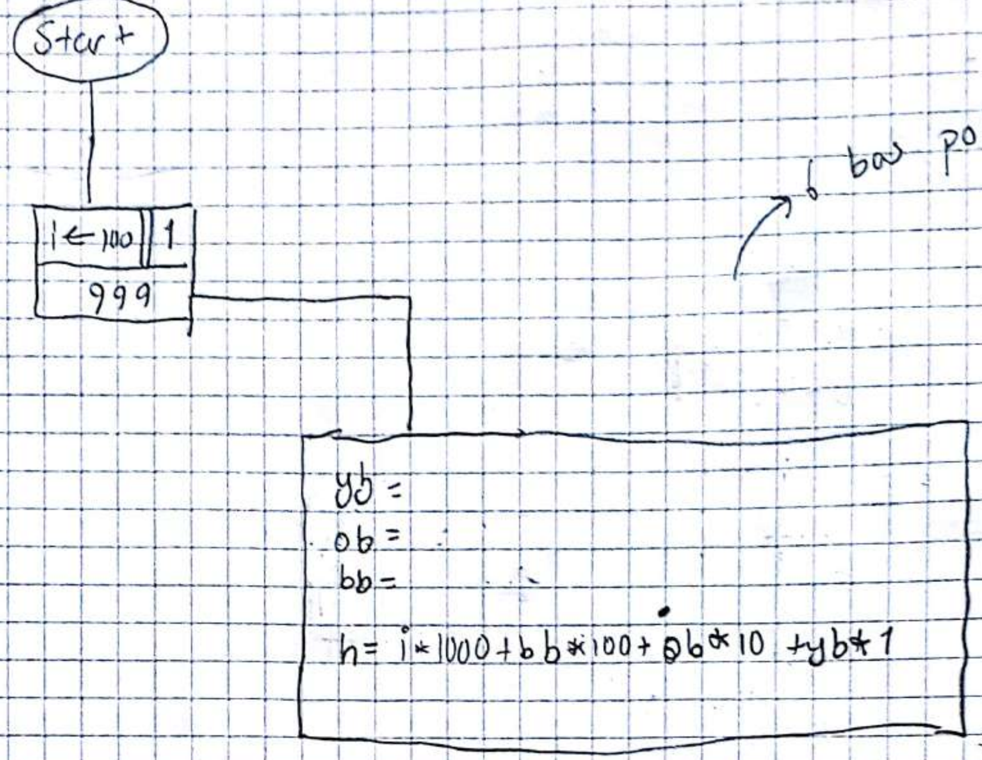


$i=0$

$j=n-1$

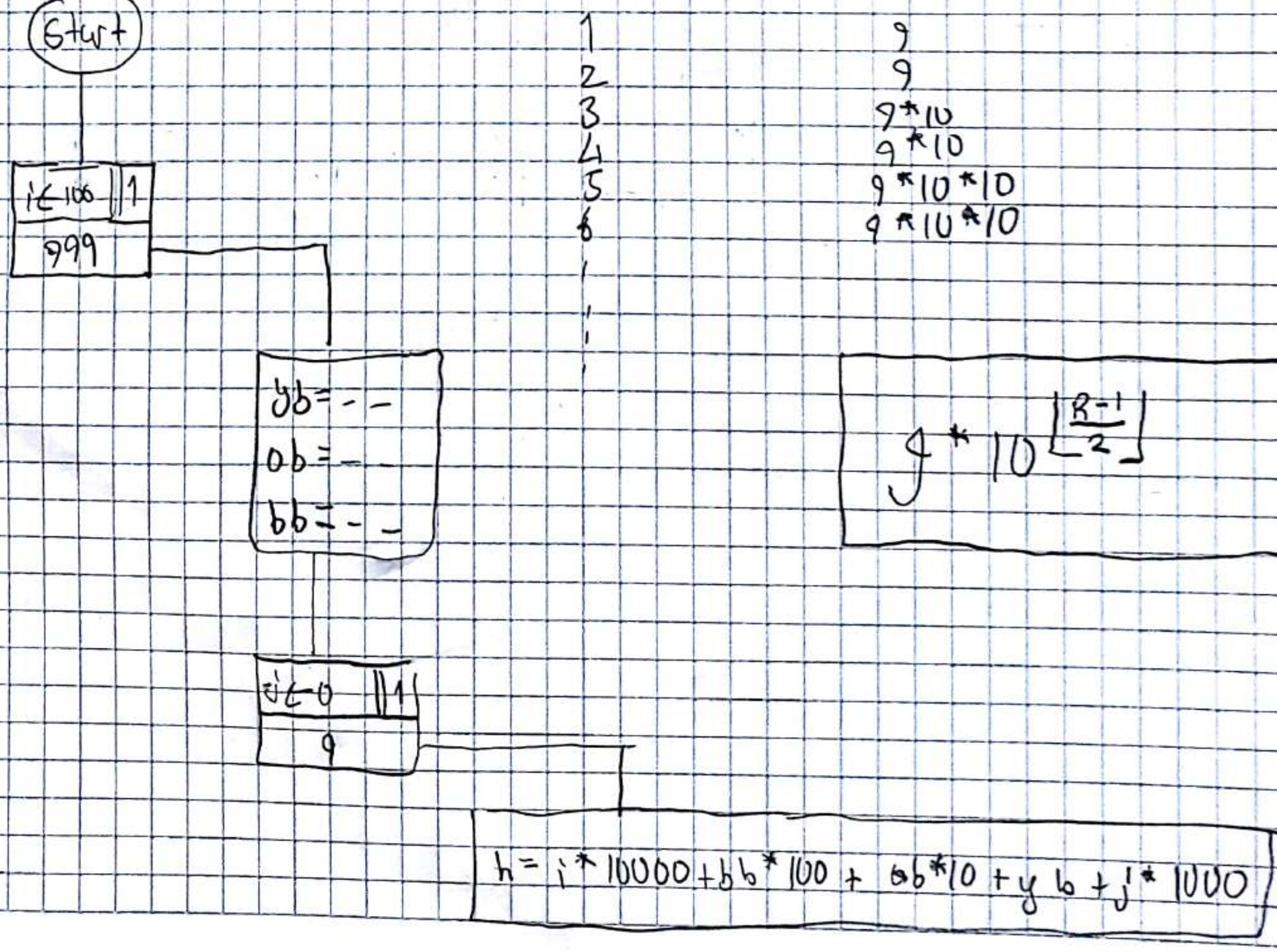


6 bas polindrom



B bas	Sayı
1	9
2	9
3	9*10
4	9*10
5	9*10*10
6	9*10*10

$$9 * 10^{\left\lfloor \frac{B-1}{2} \right\rfloor}$$



$N=2 \quad \{2,2\}$

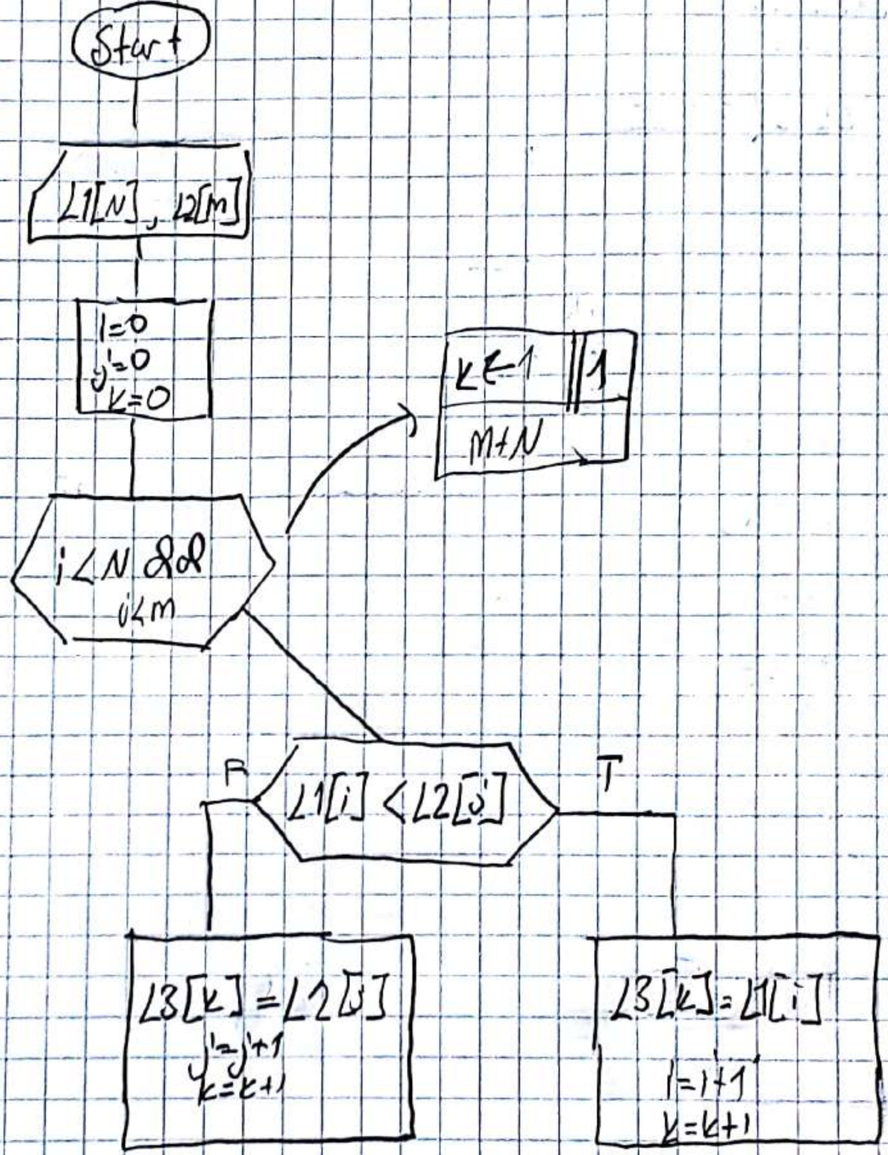
$N=3 \quad \{1,2,3\}$

$N=7 \quad \{7,2,1,1,1,1,1\}$

$L1=\{2,4,6,9\}$

$L2=\{1,3,7,11,18,20\}$

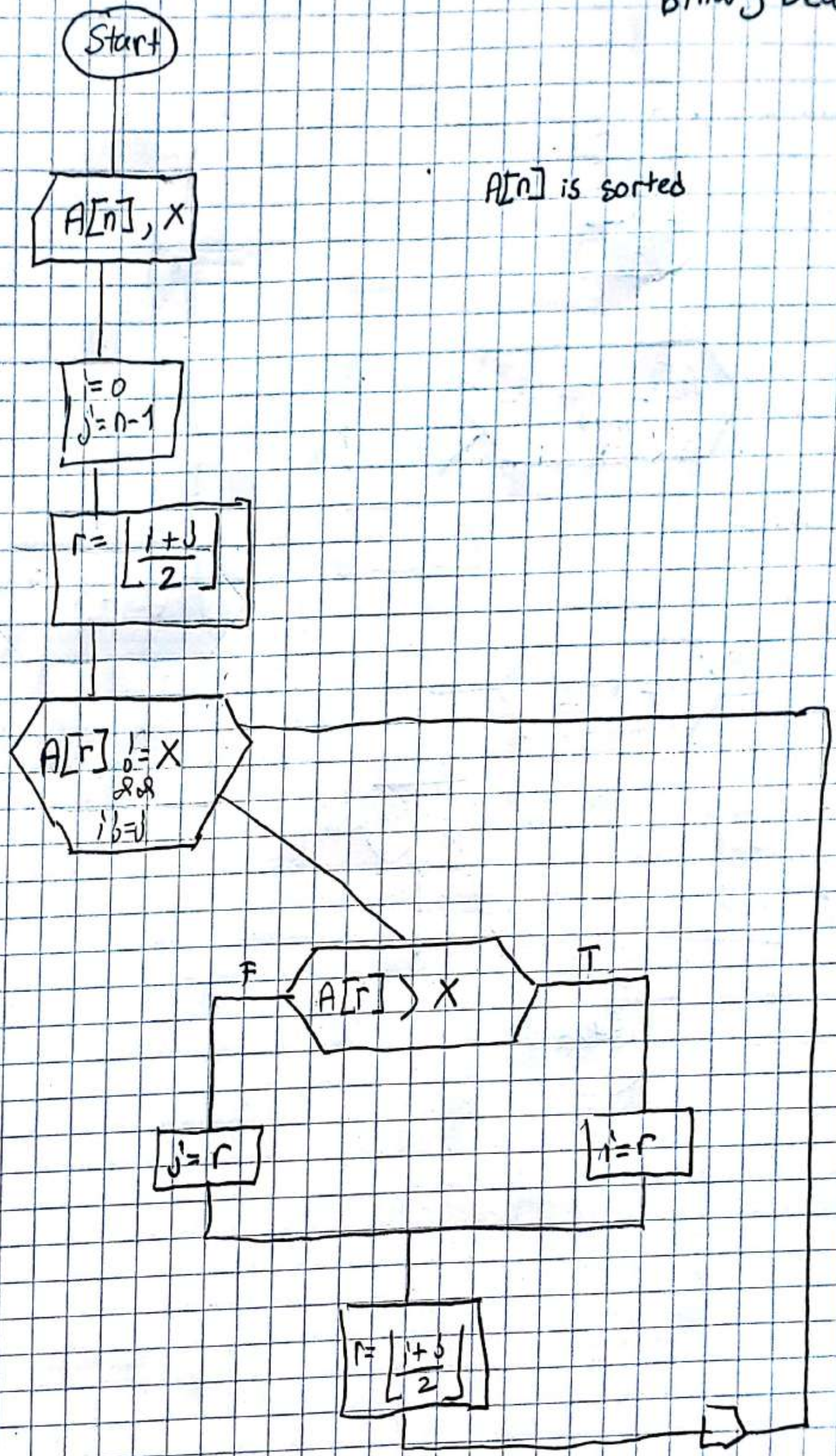
sıralı

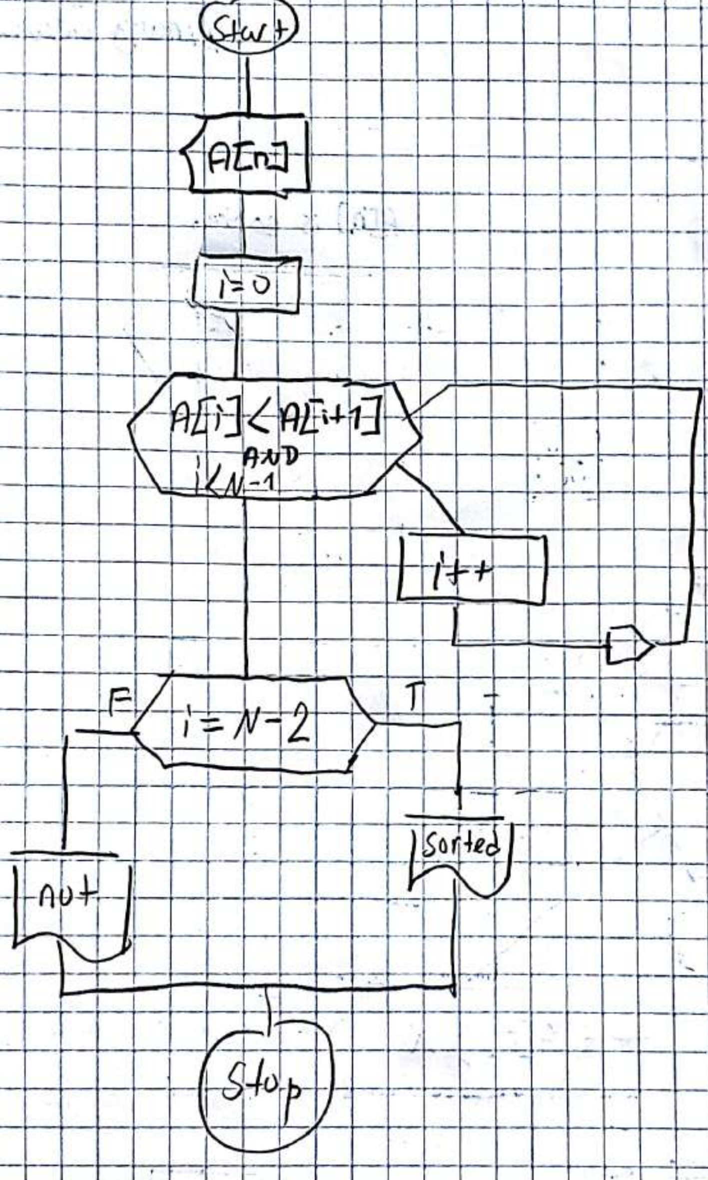


```
void swap (int, int);

main () {

  swap(&x, &y)

}

void swap (int *x, int *y) {
   int t;
   t=*x;
   *x=*y;
   *y=t;
}
```

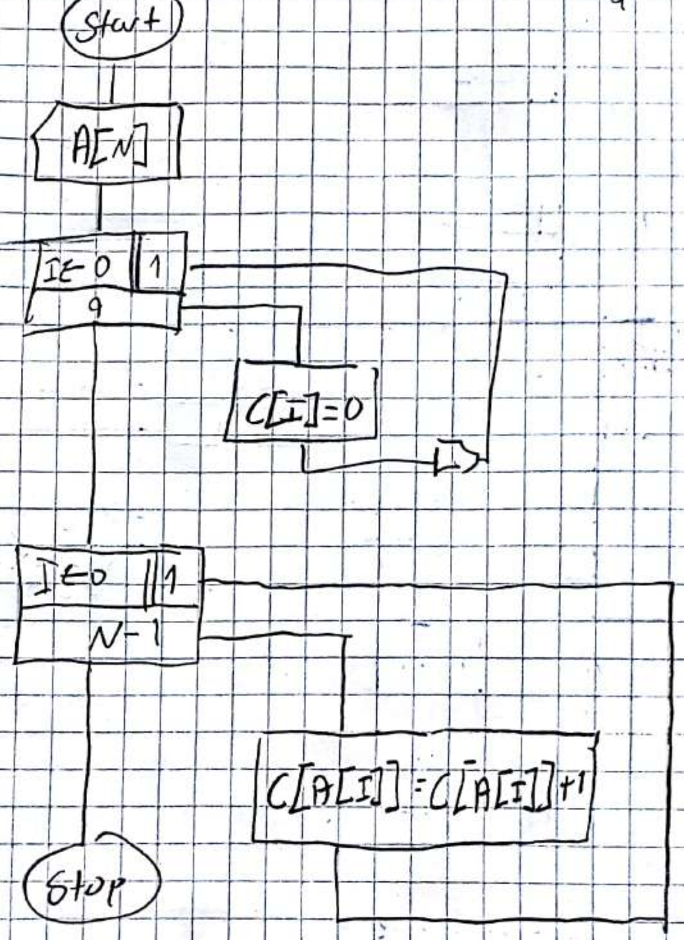
Binary Search

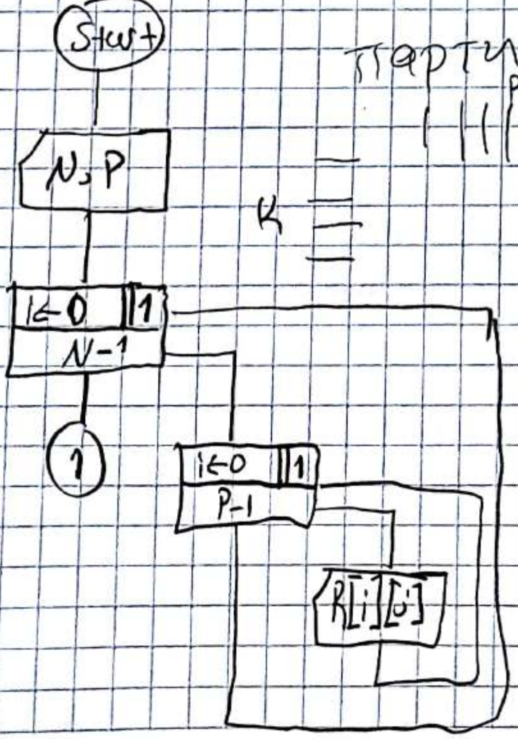
A[n] is sorted




Start
A[n]
i=0
A[i] < A[i+1] AND i<N-1
i++
F
i=N-2
T
sorted
not
Stop

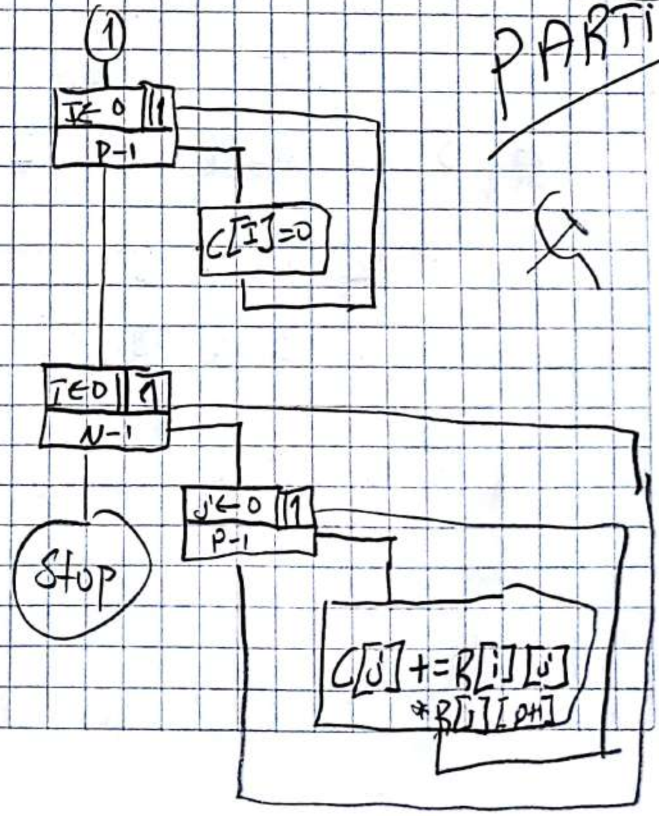
Kümede hangi elemandan
kaç tane





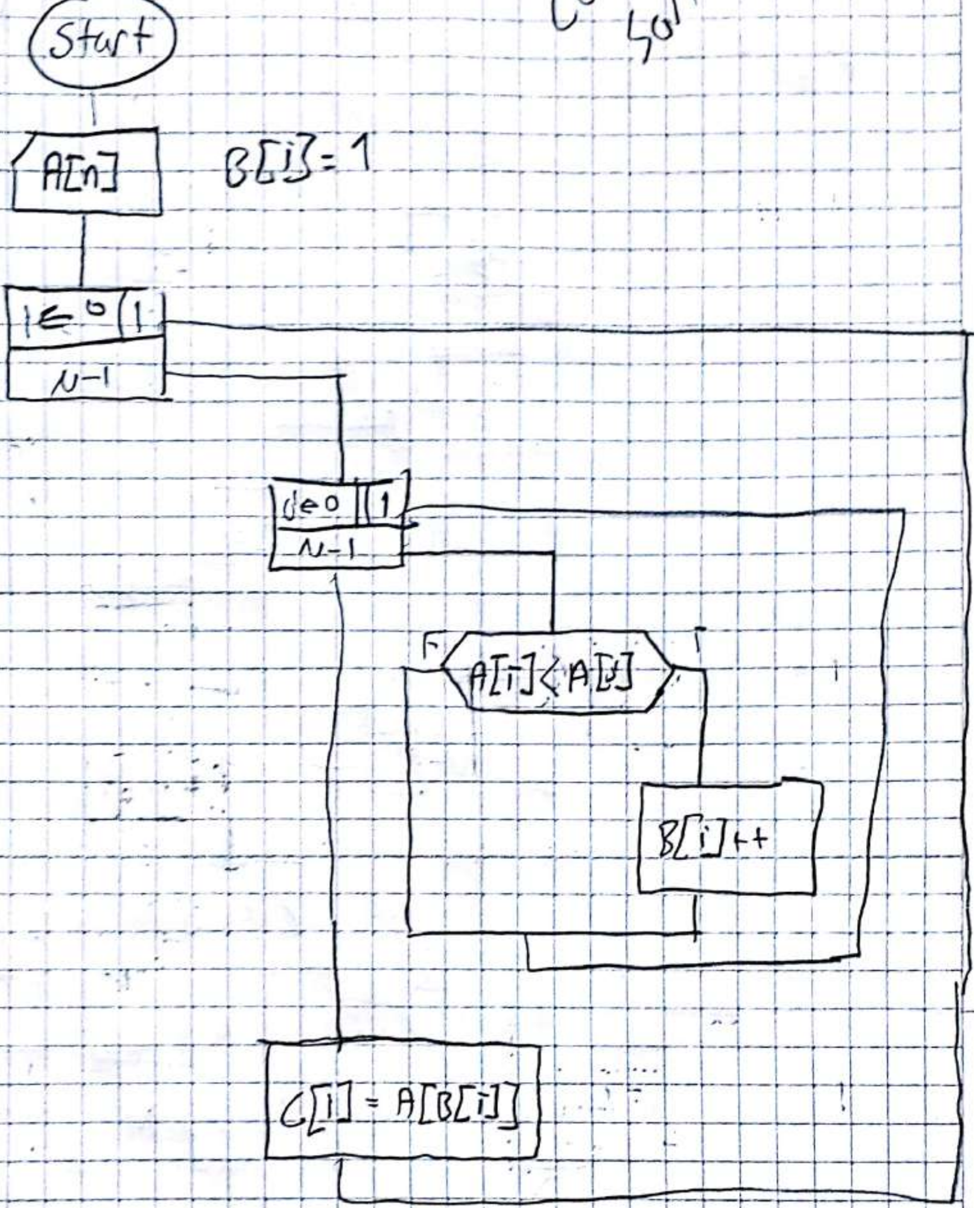
партий

K



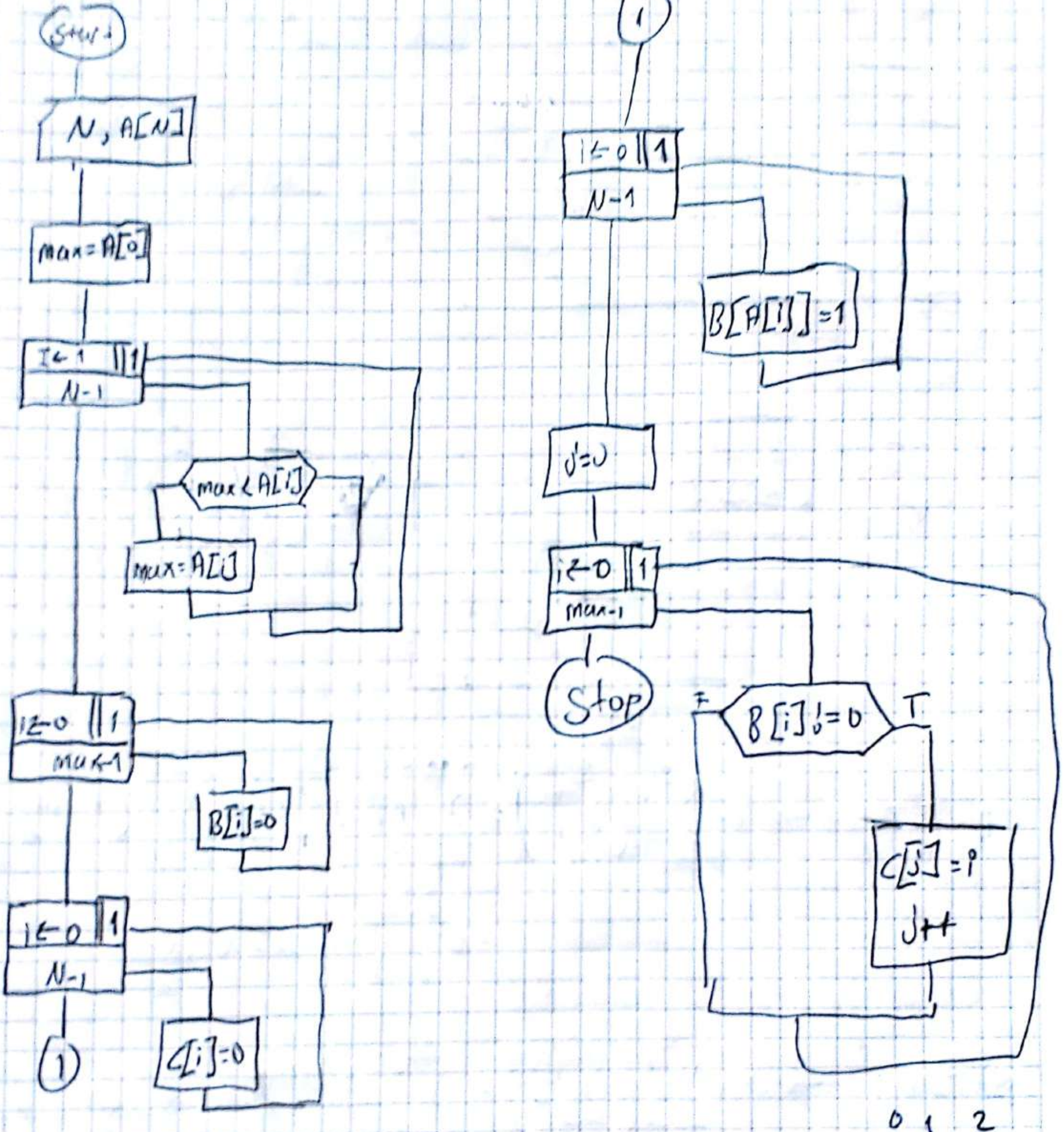
PARTİ

Counting sort



A	5	3	4	1	2
	0	2	1	4	3
B	1	3	2	5	4
C	5	4	3	2	1

Radix Sort



A	5	6	4	1	2	
B	1	1	0	1	1	1
C	1	2	4	5	6	

0 1 2
4 7 9

a[4]=4
a[7]=7
a[9]=9 0 1 2
a[max]
↓
max

$\sum_{i=1}^{N}\left(\prod_{j=1}^{N^2} 2\right)$ $\quad N=3 \quad (2^{N^2}).N$

$\prod_{i=1}^{N}\left(\prod_{j=1}^{N^2} 2\right) \quad \prod_{i=1}^{N} 2^{N^2}. \quad 2^{N^2}$

$N=3$ için

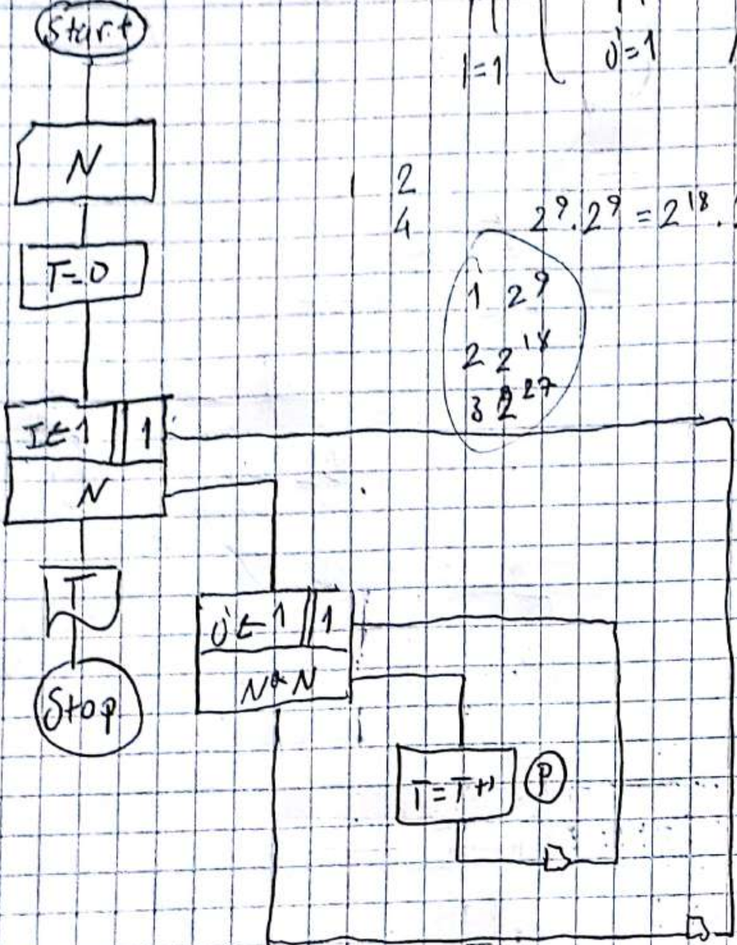
2
4

$2^9.2^9 = 2^{18}.2^9$

1 2^9
2 2^{18}
3 2^{27}

$\prod_{j=1}^{N^2} 2$

2^{N^2}



$$T=\sum_{i=1}^{N}\left(\sum_{j=1}^{N*N} 1\right)=N^3$$

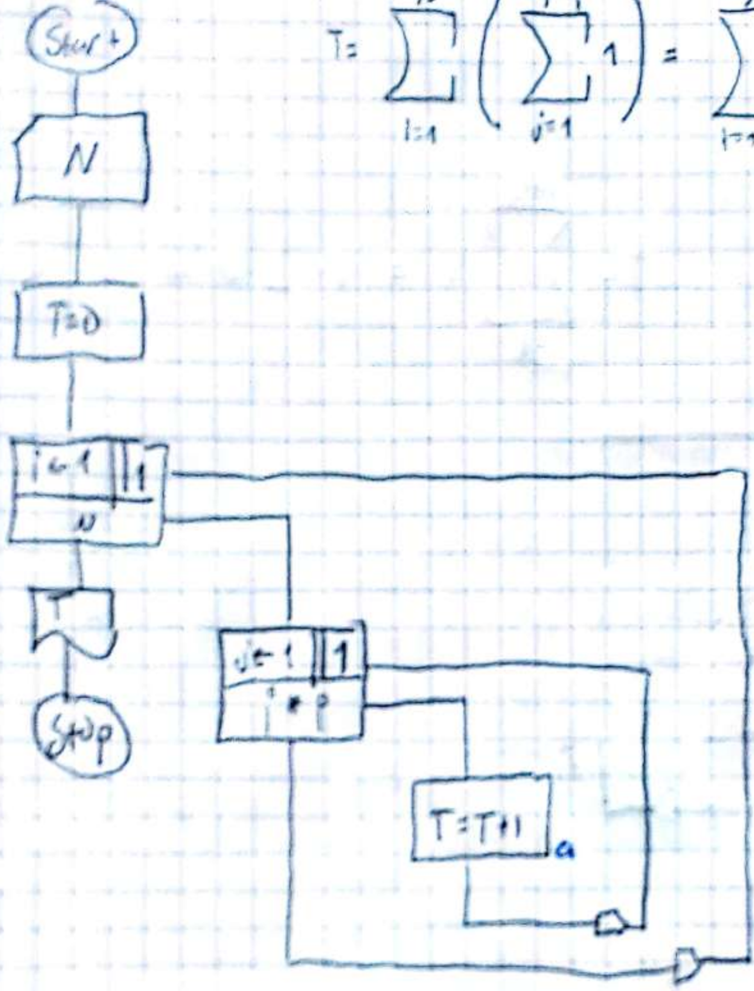
P_1) $T=T+i \longrightarrow T=\sum_{i=1}^{N}\left(\sum_{j=1}^{N*N} i\right)=\sum_{i=1}^{N}\left(i.\sum_{j=1}^{N*N} 1\right)=\sum_{i=1}^{N}(i.N^2)$

$$=N^2\sum_{i=1}^{N} i = N^2.N.\frac{(N+1)}{2}$$

P_2.) $T=T+j \longrightarrow T=\sum_{i=1}^{N}\left(\sum_{j=1}^{N*N} j\right)=\sum_{i=1}^{N}\frac{N^2.(N^2+1)}{2}=\frac{N^3.(N^2+1)}{2}$

$$\prod_{i=1}^{N}\left(2^{N^2}\right)^N$$

$$T=\sum_{i=1}^{N}\left(\sum_{j=1}^{i*i}1\right)=\sum_{i=1}^{N}i^2=\frac{N.(N+1)(2N+1)}{6}$$

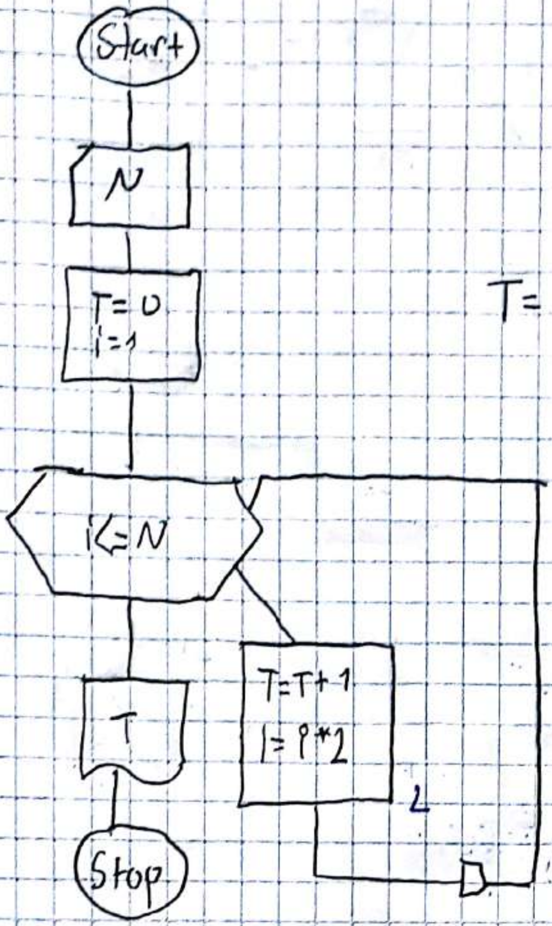


$$a_1)\ T=T+i \longrightarrow \sum_{i=1}^{N}\left(\sum_{j=1}^{i*i}i\right)=\sum_{i=1}^{N}i^2 i=\sum_{i=1}^{N}i^3=\left(\frac{N.(N+1)}{2}\right)^2$$

$$a_2)\ T=T+j \longrightarrow \sum_{i=1}^{N}\left(\sum_{j=1}^{i*i}j\right)=\sum_{j=1}^{N}\frac{i^2.(i^2+1)}{2}=\sum_{i=1}^{N}\frac{i^4+i^2}{2}$$

$$=\ +\sum_{i=1}^{N}i^4+\sum_{i=1}^{N}i^2$$

$$=\frac{1}{2}\left(\frac{N^5}{5}+\frac{N^4}{4}+\frac{N^3}{3}-\frac{N}{30}+\frac{N.(2N+1)(N+1)}{6}\right)$$



$$T=\sum_{i=1}^{1+\lg N} 1 = 1+\lfloor \lg N \rfloor$$

$L_1)$ $T=T+i$, $i=i*2$ $\longrightarrow T=\sum_{i=0}^{\lg N} 2^i = 2^{\lg N+1}-1 = 2N-1$

$T=T+1$

$T=T+2$

$T=T+4$

$$T = \sum_{i=0}^{N} (i \cdot A^i)$$

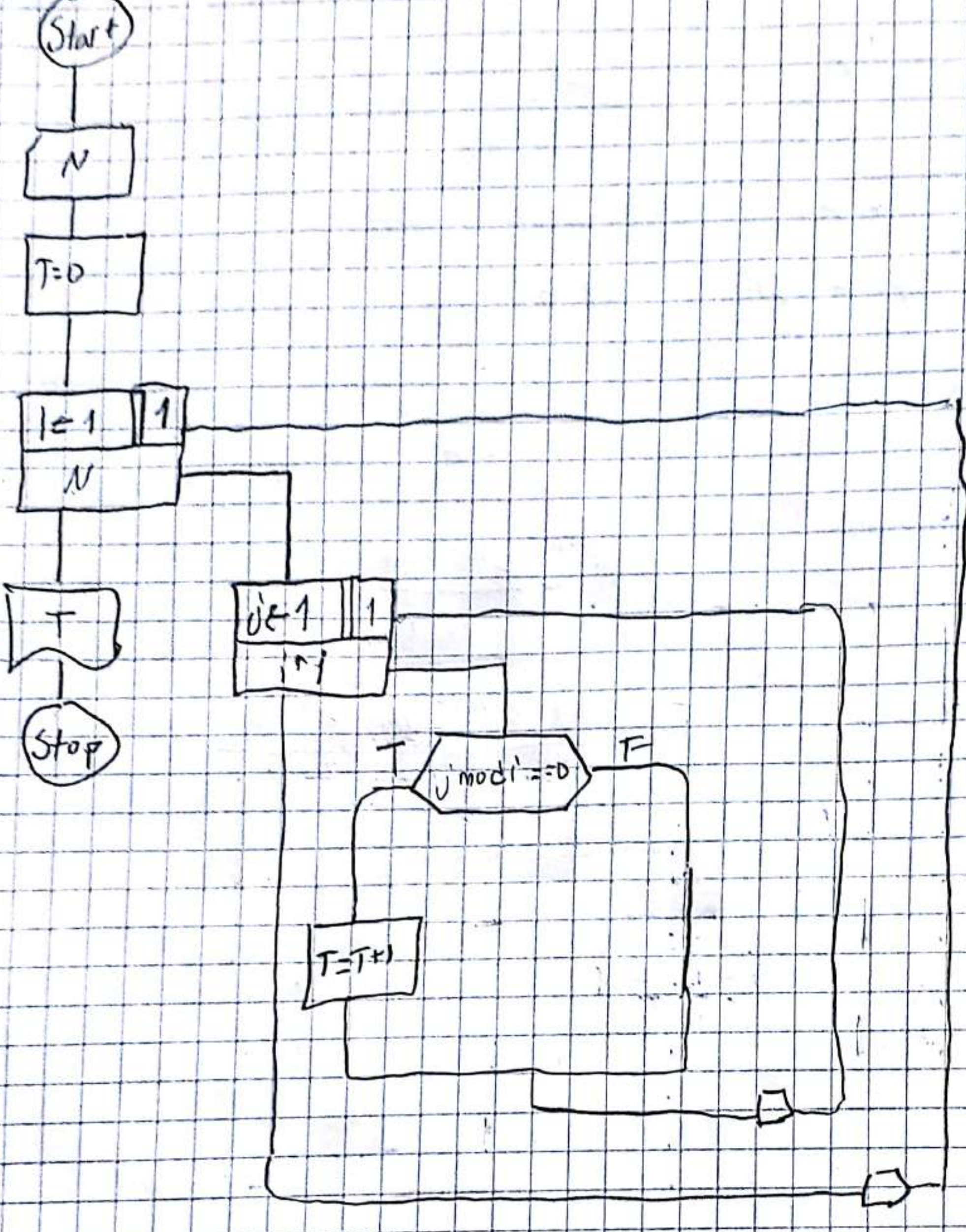
$$T = A + 2A^2 + 3A^3 + 4A^4 + \ldots + NA^N$$

$$T \cdot A = A^2 + 2A^3 + \ldots + N \cdot A^{N+1}$$

$$TA - T = -A - \ldots - A^N + N \cdot A^{N+1}$$

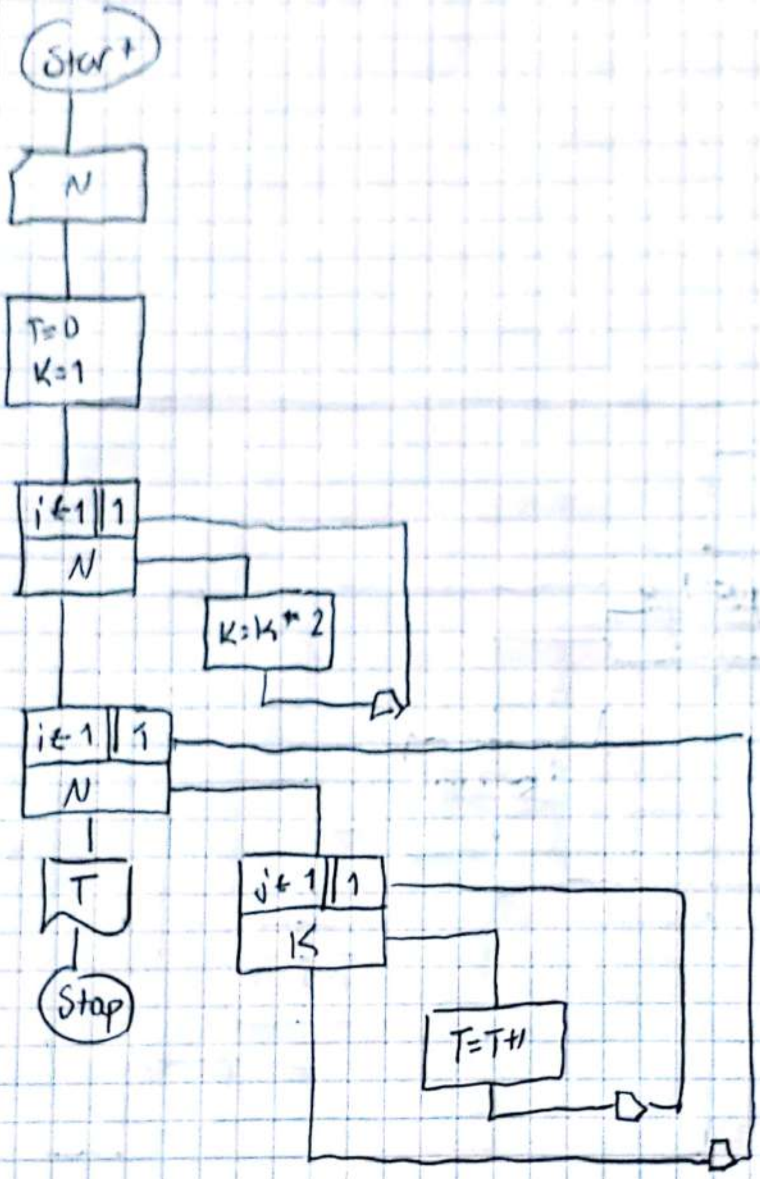
$$N \cdot A^{N+1} - \frac{A^{N+1} - 1}{A - 1}$$

$$T = \frac{N \cdot A^{N+2} - (N+1) A^{N+1} + 1}{(A-1)^2}$$



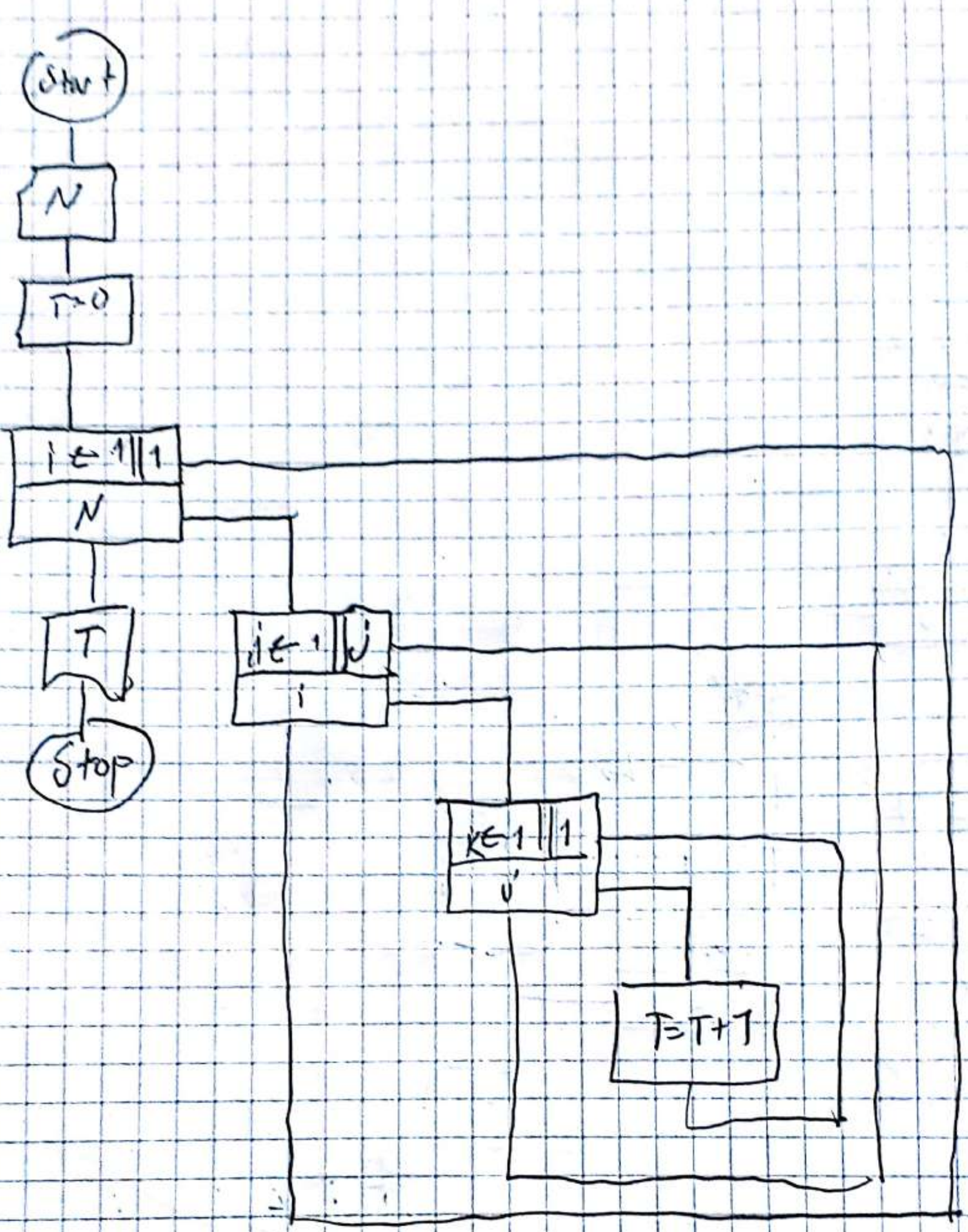
i	j
1	1
2	1 2 3 4
3	1 2 3 4 5 6 7 8 9
4	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16

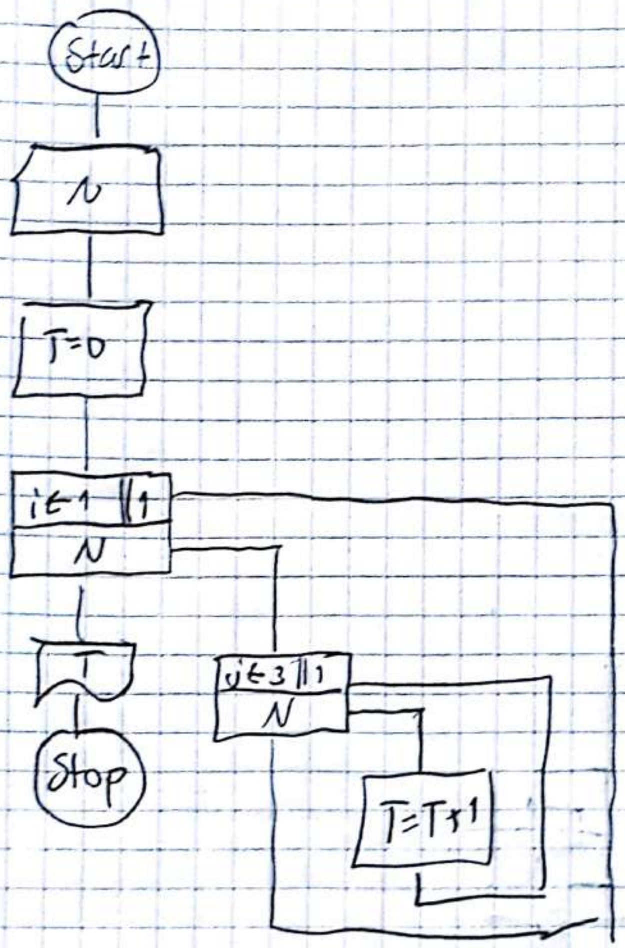
$$T = N \cdot \frac{(N+1)}{2}$$



$$K = \prod_{i=1}^{N} 2 = 2^N$$

$$\sum_{i=1}^{N} \left(\sum_{j=1}^{2^N} 1 \right) = \sum_{i=1}^{N} 2^N = N \cdot 2^N$$

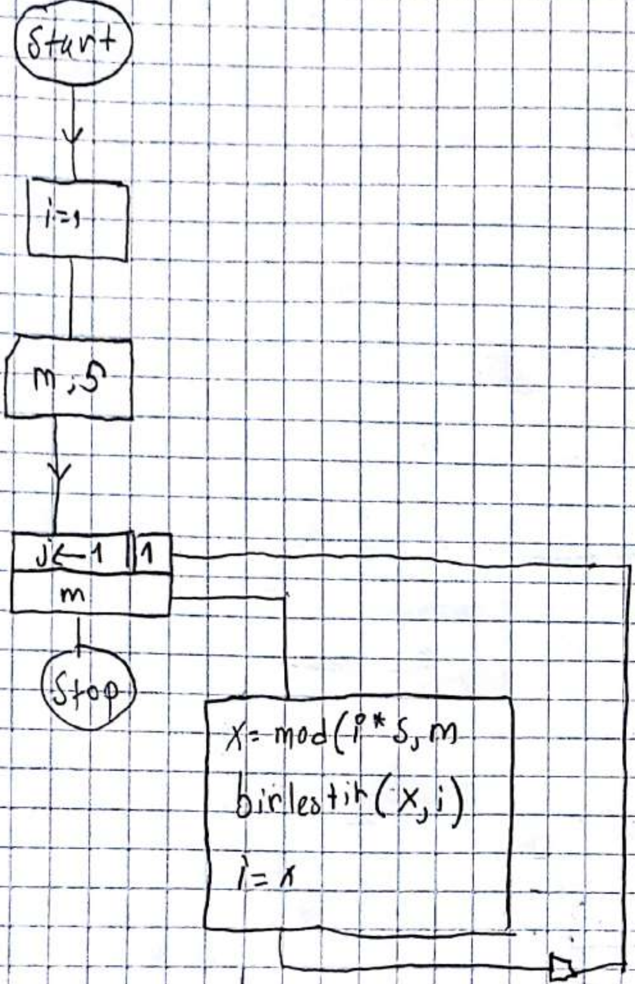

Start
N
T←0
i ← 1 || 1
N
j ← 1 || j
i
k ← 1 || 1
j
T=T+1
T
Stop



$$T = \sum_{i=1}^{N} \left(\sum_{j=3}^{N} 1 \right)$$

$$= \sum_{i=1}^{N} (N-2) = (N-2).N$$

Rastgele Sayı Üretme



Uniform Distribution

$B[n] = mod(a * B[n-1] + c, m)$

$B[0] = 0$

$a = 1366$

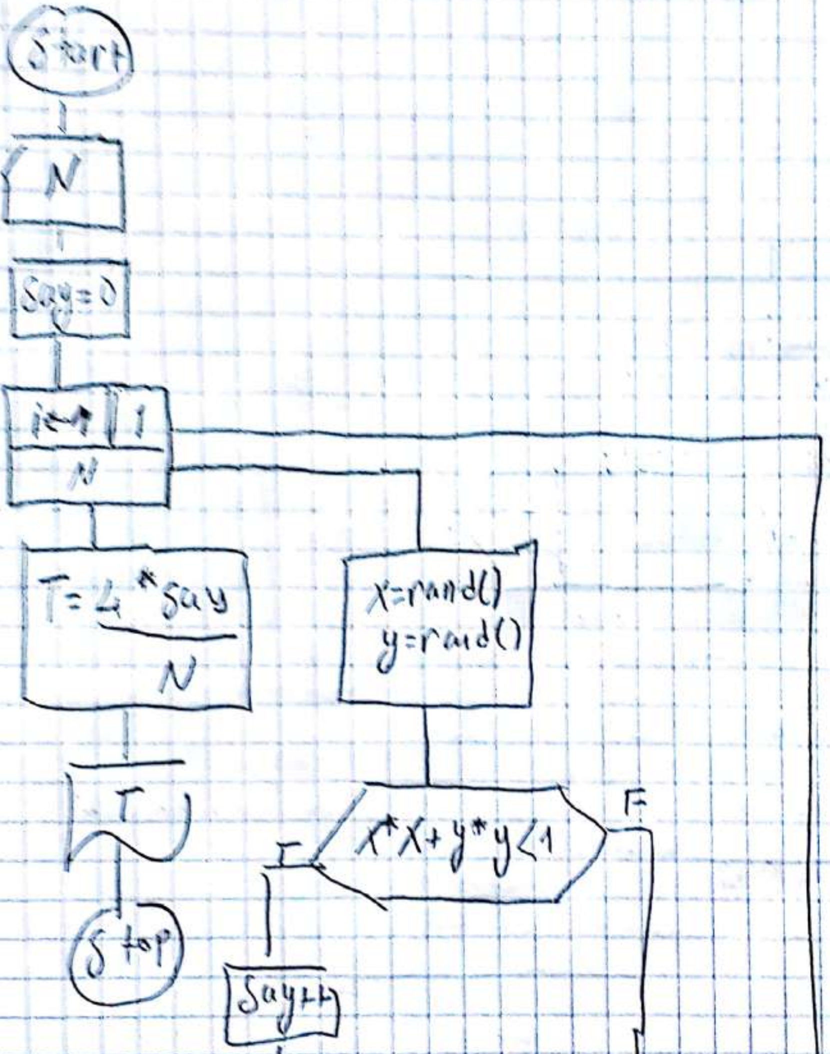
$c = 150889$

$m = 714025$

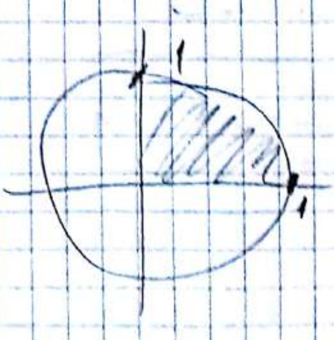
k= rand()

r= rand()

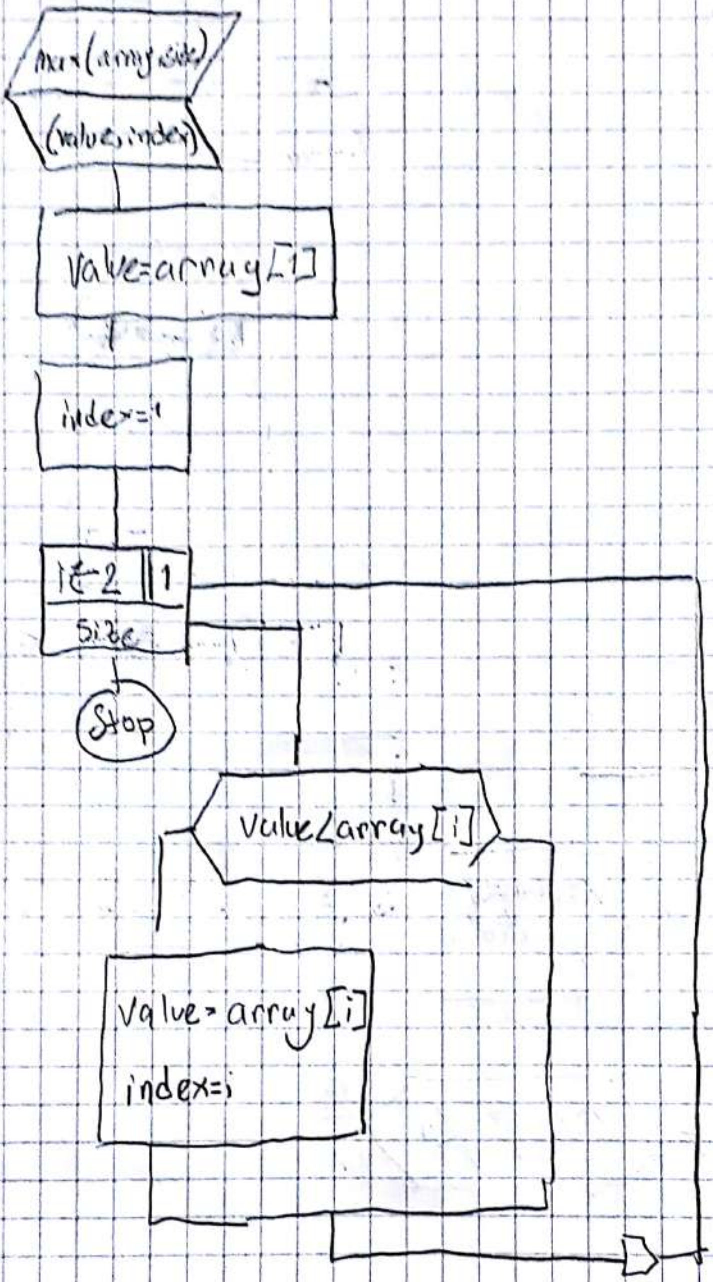
$m = \frac{k+r}{2}$

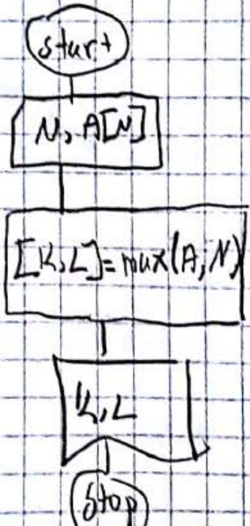


$\lim_{N \to \infty} T = ?$

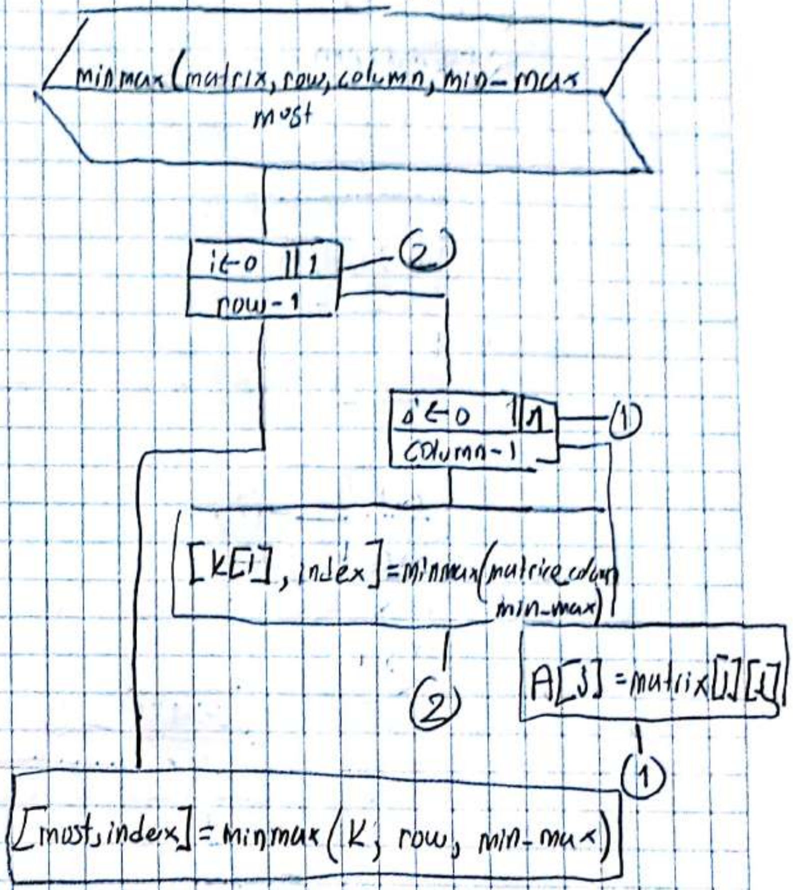


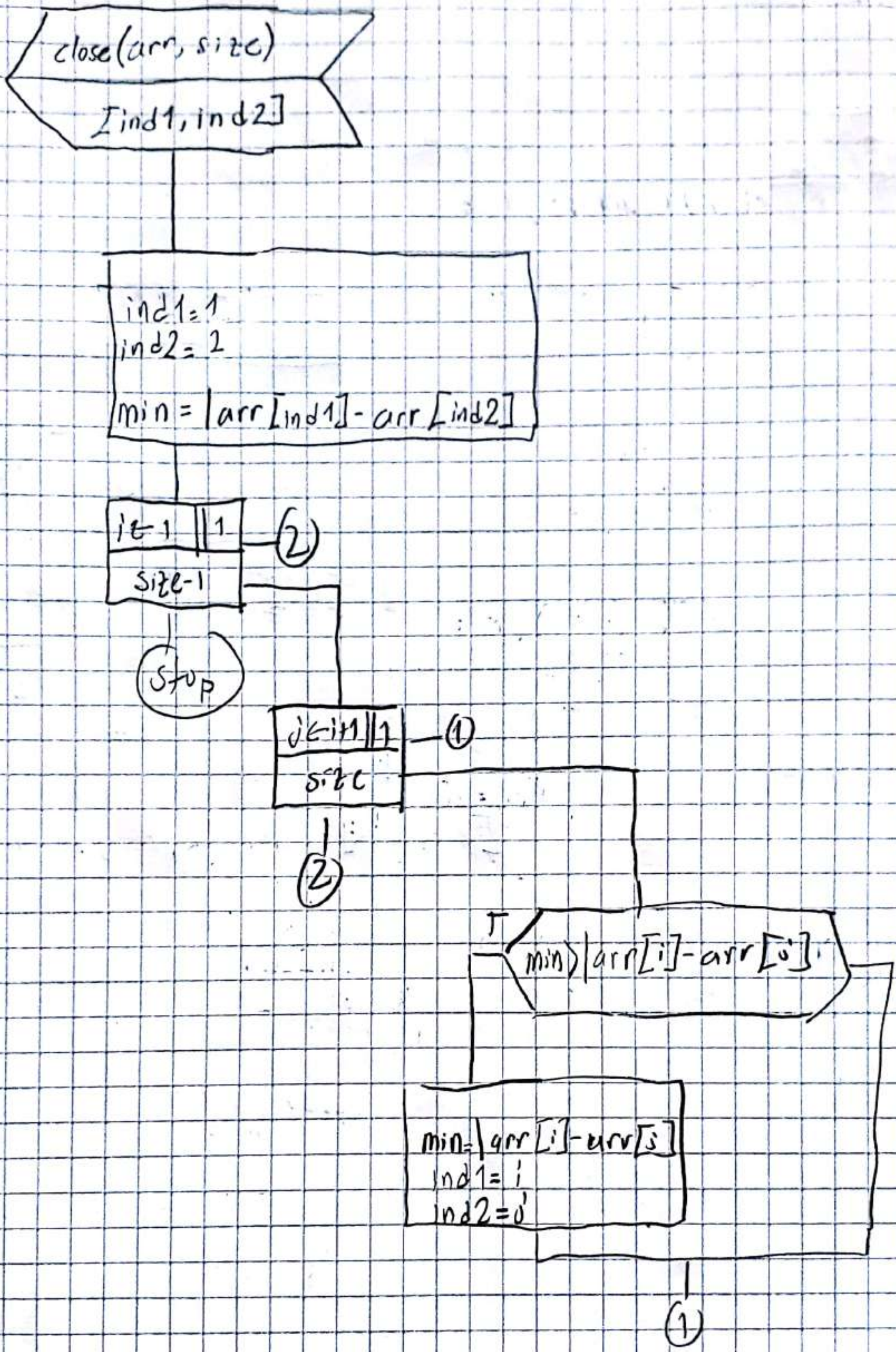
π


max(array,size)
(value,index)
value=array[1]
index=1
i←2
1
size
Stop
value<array[i]
value=array[i]
index=i


start
N, A[N]
[K,L]=max(A,N)
K,L
Stop

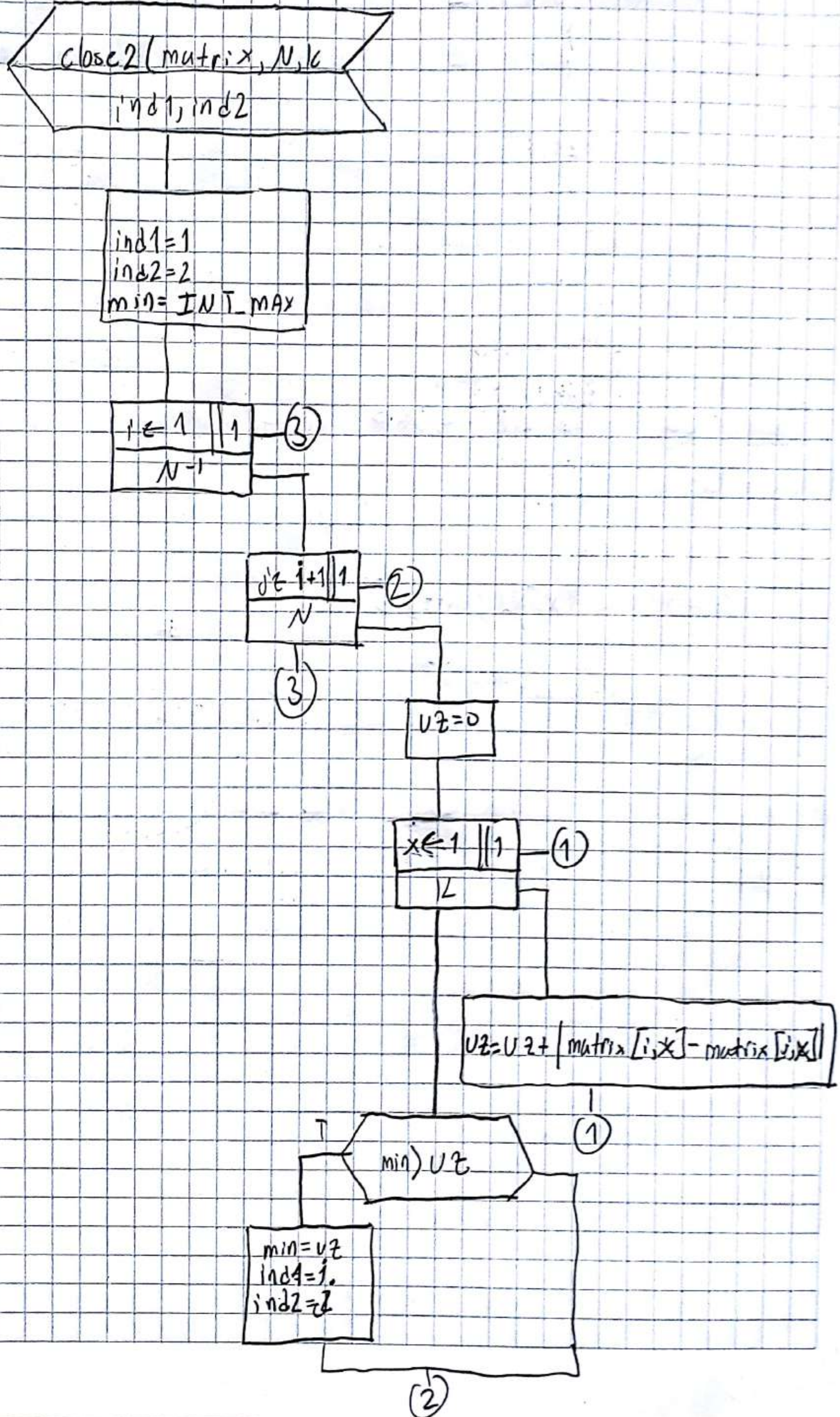

Start
m[a][b]


minmax(matrix, row, column, min_max
most
i←0 || 1
row-1
2
j←0 || 1
column-1
1
[K[i]], index] = minmax(matrice, colum
min_max)
2
A[j] = matrix[i][j]
1
[most, index] = minmax(K, row, min_max)


close(arr, size)
[ind1, ind2]
ind1 = 1
ind2 = 2
min = |arr[ind1] - arr[ind2]|
i = 1
1
2
size-1
stop
j = i+1
1
1
size
2
T
min > |arr[i] - arr[j]|
min = |arr[i] - arr[j]|
ind1 = i
ind2 = j
1

N tane nokta

k boyut



$$\begin{bmatrix} 10 & 50 \\ 1 & 1 \\ 46 & 53 \end{bmatrix}$$

$i \to 1 \quad 1$

$j \to i+1 \quad 2$

$k \to 1 \quad 2$

1,1 – 3,1
1,1 – 3,2

$uz = uz + |m[i,k] - m[j,k]|$ 36

$i=1$
$j=2$

$$|\overset{10}{m[1,1]} - \overset{46}{m[2,1]}|$$
$$\underset{50}{m[1,2]} - \underset{53}{m[2,2]}$$

39 = min
ind1 = 1
ind2 = 2

---

pointer değer yazdırmak ⟶ %p   printf("%p", a)

```
int *a;

for(a=x; a<&x[10]; a++) {

        sum = sum + *a;

}
```

16 0 | 16 12✓
16 2✓ | 16 14✓
16 4✓
16 6✓
16 8✓
16 10✓
16 12✓

```
read(N)
T=0;
D=1;
While (D<N)
    K=1;
    While (K<=N)
        K=K+2
        T=T+1
    END
D=D*2
END
A=T;
D=0;
While(D<N)
    A=A-log2(N);
    D=D+2
    K=K-1
END
```

T✓ $N = 2^i \quad i \in \mathbb{N}^+$

16 1
16 3✓
16 5✓
16 7✓
16 9✓
16 11✓
16 13✓
16 15✓
16 17✓

$K = N-1$

$$T = \sum_{D=1}^{\log_2 N} \left(\sum_{K=1}^{\frac{N}{2}} 1 \right)$$

$$T = \sum_{D=1}^{\log_2 N} \frac{N}{2} = \frac{N}{2} * \log_2 N$$

$$A = \frac{N}{2} * \log_2 N$$

$$\frac{2N-2-N}{2}$$

$$K = N-1 - \sum_{D=1}^{\frac{N}{2}} 1 = N-1-\frac{N}{2} = \frac{N-2}{2}$$

$$A = \frac{N}{2} * \log_2 N - \sum_{D=1}^{\frac{N}{2}} \log_2(N) = 0$$

$$T = \frac{N}{2} * \log_2 N$$

$$A = 0$$

$$K = \frac{N-2}{N}$$

Affine Cipher Encryption

$y = (ax+b) \bmod 26$

$y^{-1} = (a^{-1}(x-b)) \bmod 26$

```
invA(int a) {
int result=-1
for(i=0; i<26; i++) {
    if (a*i%26==1) {
        result=i;
    }
}
return result;
}
```

```
void Enc (char ad[20], int a, int b, int c, char encrypt[20]) {
    int i=0;
    for(i=0; i<l; i++) {
        encrypt[i] = 65+((a*ad[i]+b)%26);
    }
    encrypt[i]='\0';
```

```
void inenc (char encrypt[20], inenc[20], int invA, int b, int l) {
    i=0;
    for (i=0; i<l; i++) {
        inv enc[i]=(65+(invA*encrypt[i]-b))%26;
    }
        inenc[i]='\0';
```

```
int main() {
int a, b, invA, c;
char ad[20], encryp[20], inenc[20];
scanf("%[^ns]", ad);
do {
 scanf("%d %d", &a, &b);
 invA= invA(a)
} while (invA==-1)
c=strlen(ad);
```

RECURSIVE

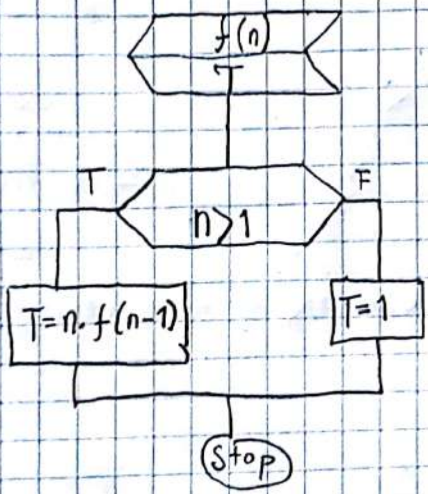
$f \longrightarrow f$

$f \rightarrow g \quad g \longrightarrow h \quad h \longrightarrow f$

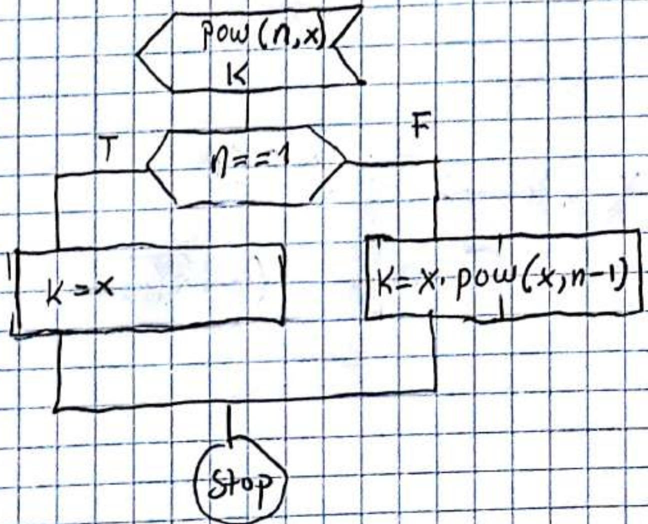
$n! = n.\underbrace{(n-1).(n-2) \ldots 1}_{(n-1)!}$

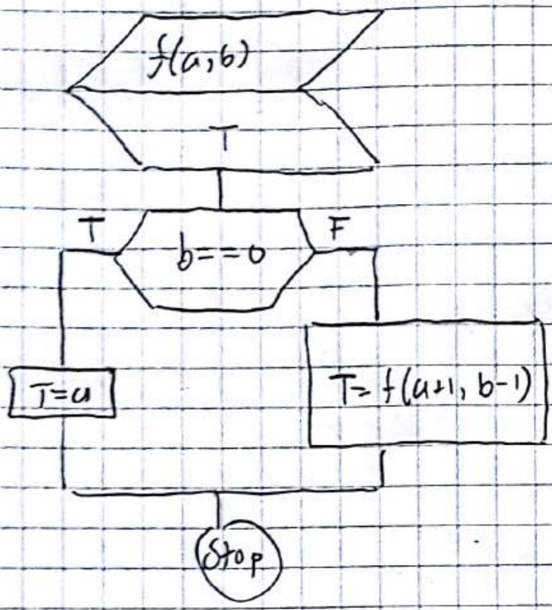
$n! = n.(n-1)!$

$f(n) = n.f(n-1)$



$x^n = x . x^{n-1}$





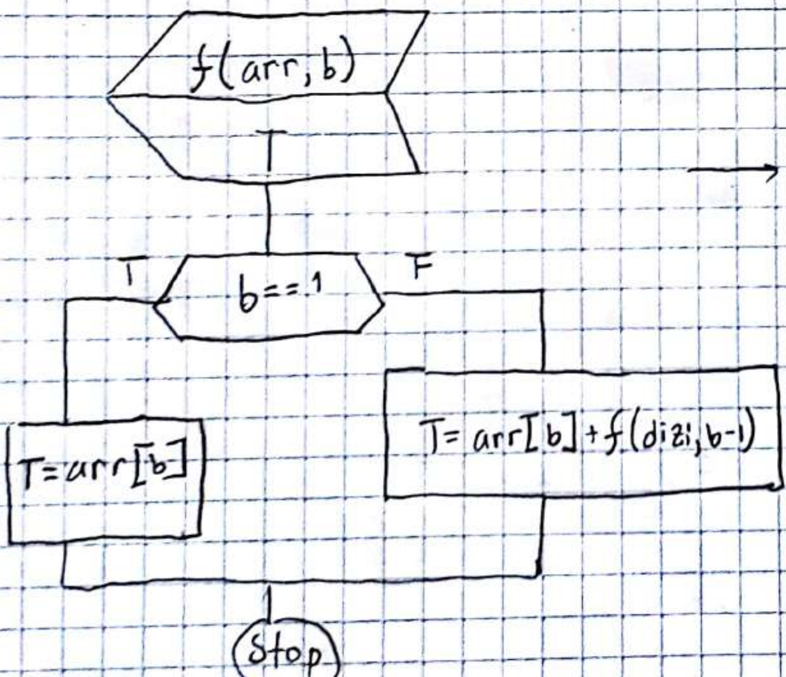
→ a+b

f(3,2)

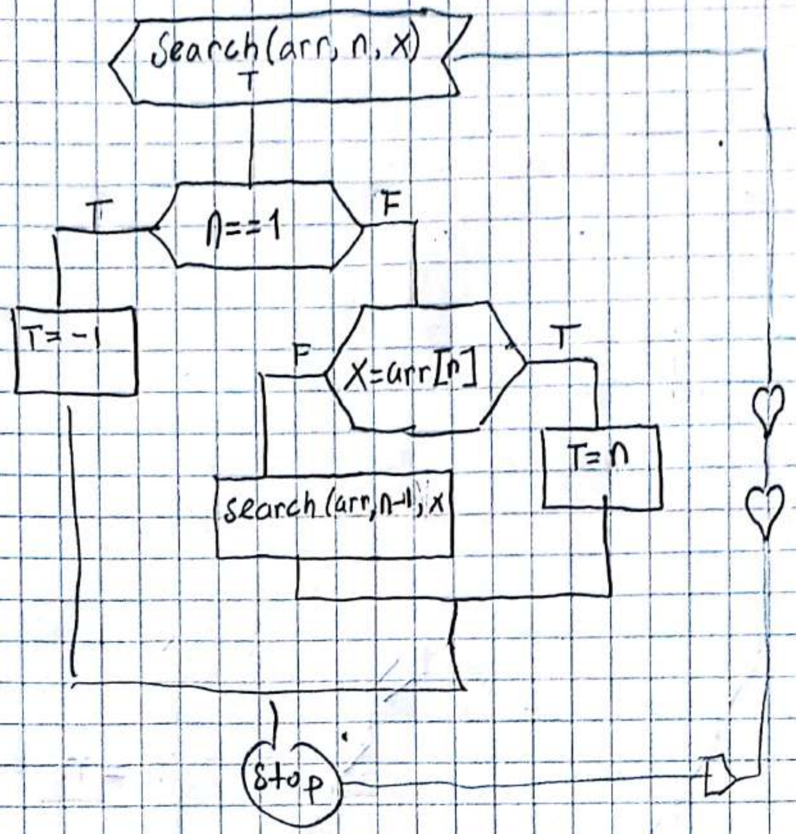
↓

4, 1

5, 0



→ sum of all elements of array

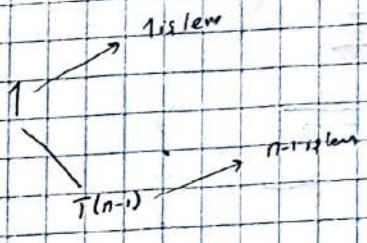


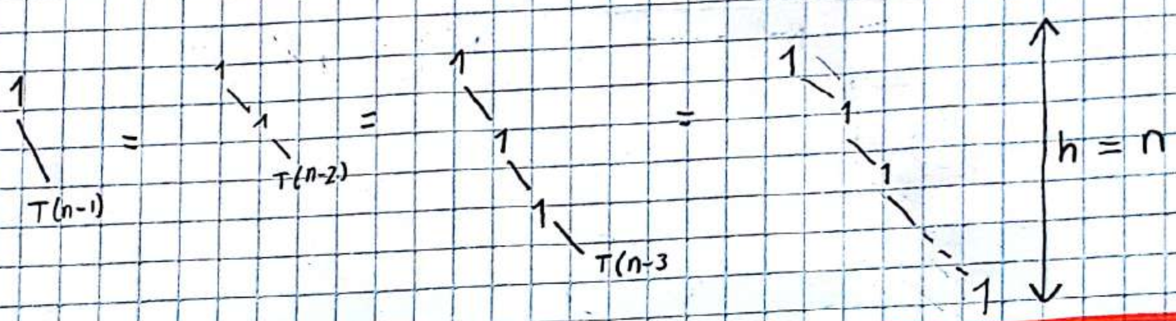
search(arr, n, x)
T
T
n==1
F
T= -1
F
X=arr[n]
T
T=n
search(arr, n-1, x)
stop

Recursion Tree

$f(n) = x * f(n-1)$ Factorial

$T(n) = 1 + T(n-1)$

$T(n) =$ 

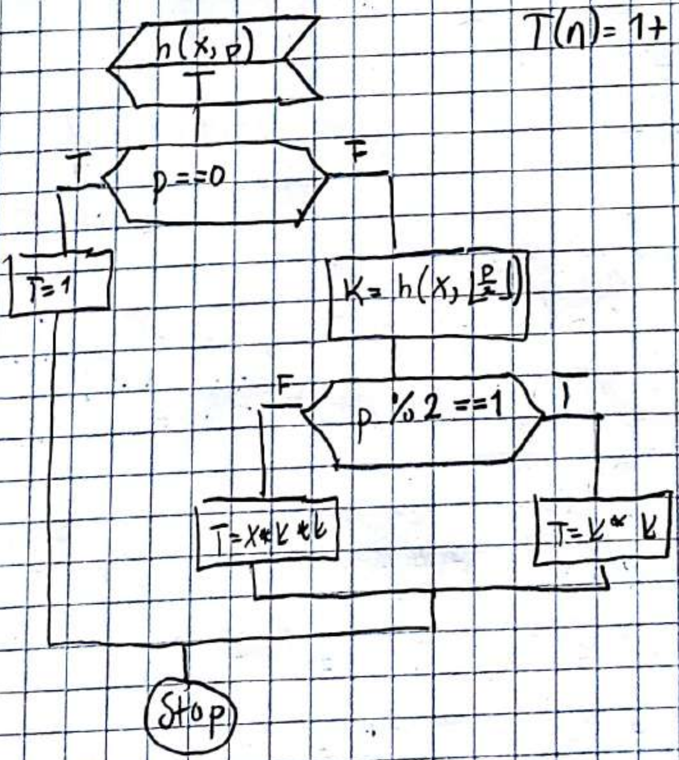


Power

$x^7 = x.(x^3)^2$

$x^6 = (x^2)^3$

$x^{11} = x.(x^5)^2$

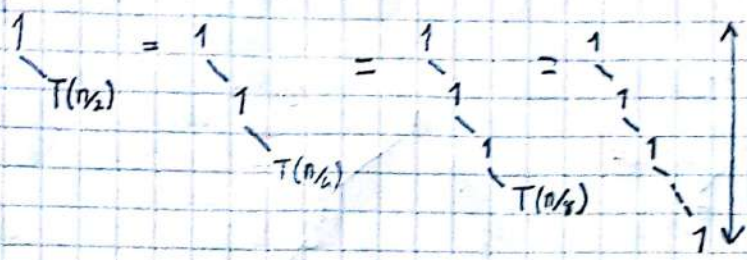


$T(n) = 1 + T(n/2)$

$h(x, 7)$

$k = h(x, 3)$

$T(n) =$



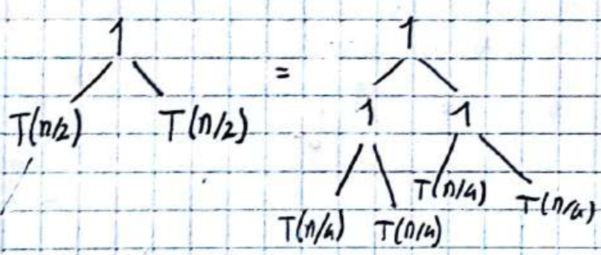
$h = \lg n$

$\sum_{i=0}^{\lg n} 1$

$T(n) = \lg n$

Eğer pow fonksiyonunda k yerine $pow(x, \lfloor \frac{p}{2} \rfloor)$ yazılsaydı

$T(n) = 2.T(n/2) + 1$



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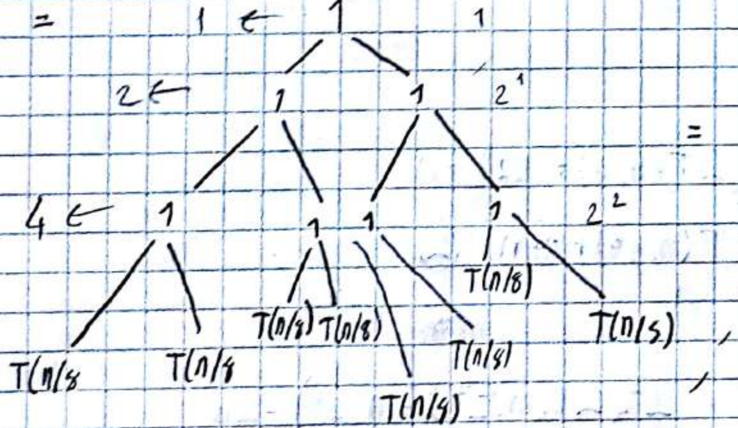

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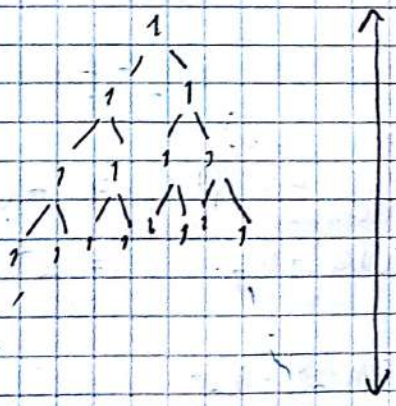


$h = \sum_{i=0}^{\lg n} 2^i = 2n - 1$

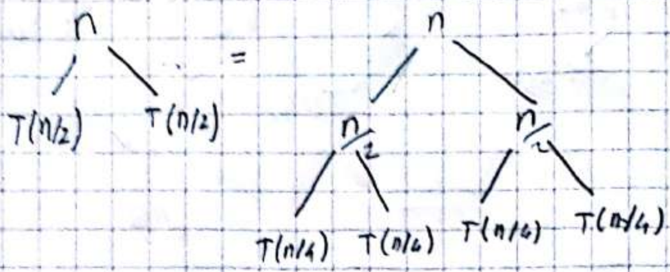
$h = \lg n$

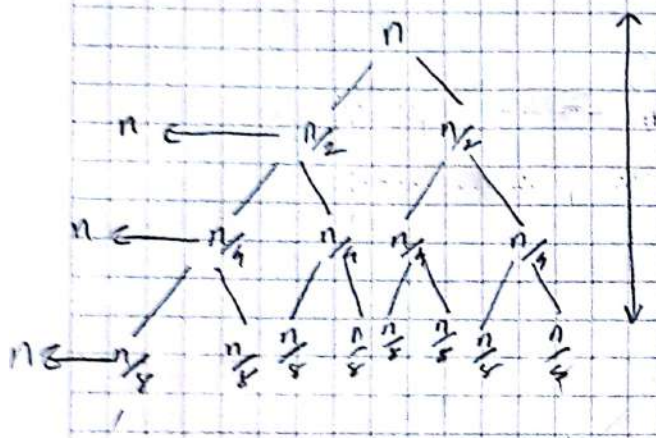
$T(n) = 2n - 1$

$\frac{2^{\lg n + 1} - 1}{2 - 1}$

$T(n) = n + 2T(n/2)$

$T(n/2) = n/2 + 2T(n/4)$





$n \cdot \lg n$

$\lg n$

$$n \sum_{i=0}^{\lg n} \frac{1}{2^i}$$

$$T(n) = \begin{cases} 1 & n = 1 \\ 2T(n/2) + 1 & n > 1 \end{cases}$$

$2^{\log_2 n}$

$T(n) = 2T(n/2) + n$ ①

$T(n/2) = 2T(n/4) + n/2$

$= 2(2T(n/4) + n/2) + n$

$= 2^2 \cdot T(n/2^2) + n + n$ ②

$T(n/2^2) = 2T(n/2^3) + n/2^2$

$2^2(2T(n/2^3) + n/2^2) + 2n$

$T(n) = 2^3 T(n/2^3) + 3n$ ③

$T(n) = 2^k \cdot T(n/2^k) + kn$

$T(n/2^k) = T(1)$

$\frac{n}{2^k} = 1$

$k = \lg n$

$T(n) = 2^k \cdot T(1) + kn$

$T(n) = n \cdot 1 + n \lg n$

$\rightarrow O(n \lg n)$

$T(n) = a * T(n-(3/b)) + 1$

1

h

$a=1$
$b=3$

$Tx(n) = a.T(n-b)+1$

$Ty(n) = T(n-(n/a)) + b.T(n-1) + 1 + 1 - 1$ hX ve hy Tx ve Ty 'nin max recursive treesi ise hy = 2* hX için a ve b=?

$b=1$ için $h=n$

$b=2$ için $h=n-1$

⋮

$T(n-(n/a))+1$ ve $b.T(n-1)+1$ ağaçları ayrı incelenirse

$\downarrow$ $\log_{\frac{a}{a-1}} n$

$\downarrow$ $h=n$

$T(n) = 2T(n/2 + 1 \ldots$

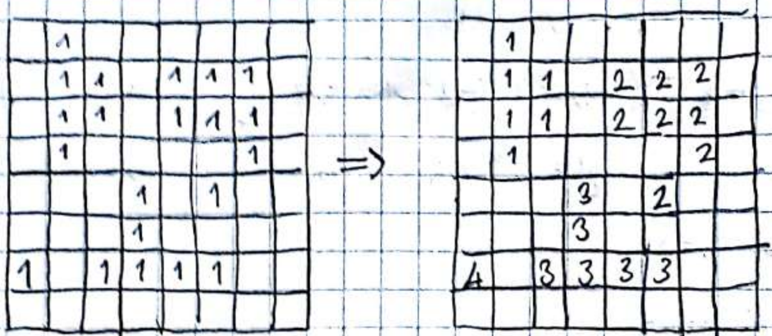
Normal fibonacci $\theta(n)$

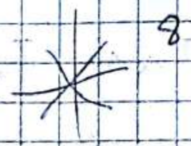
$fib(t) = fib(t-1) + fib(t-2)$

$T(n) = T(n-1) + T(n-2) + 1$

$T(n) = (1.618\ldots)^n < 2^n$

$F = \begin{bmatrix} 1 & 1 \\ 1 & 0 \end{bmatrix} \qquad F^n = \begin{bmatrix} fib(n+1) & fib(n) \\ fib(n) & fib(n-1) \end{bmatrix}$





Connected component labeling

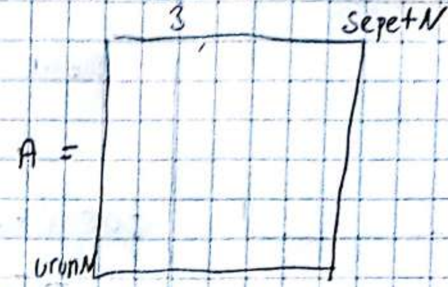
```
dfs(x, y ...)
int dx [] = {-1, 0, 1, 0}
int dy [] = {0, -1, 0, 1}
label [x][y] = current_label
for(i=0; i<4; i=i+1)
    dfs( x+dx[i], y+dy[i], ...)
```

$T(n) = T(N/2 + (?)) + 1$

```
for i=1 : N
    a = S[i][1]
    b = S[i][2]
    A[b][a] = 1
END
```

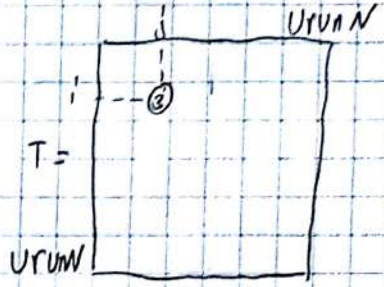
S =

SepetId	UrunId
1	178
1	242
2	178
3	14
1	162
1	14




```
for i=1 : N
    for j=1 : N
        if (A[i][j] ==1)
            T[j][i]= i
```

?




```
for i=1 : UrunN
    for j=i+1 : UrunN -1
        for k=1 : SepetN
            if( A[i][k]==1 AND A[j][k]==1)
                T[i][j] = T[i][j]+1
            END
        END
    END
END
```

T[i][j] += A[i][k] * A[j][k]

3'lü sepet

T[i][j][n] += A[i][k] * A[j][k] * A[n][k]

B	C	K	D	O	E
F	A	K	L	_	M
N	P	U	Ş	İ	R
V	G	Y	T	Z	G

ALİ_OKULA_GİTTİ

Frekans

02	24	[illegible]	25	15	23	- - -

Kelime N

T =

Kelime N

Metin = 14 128 15 14 2 4 128

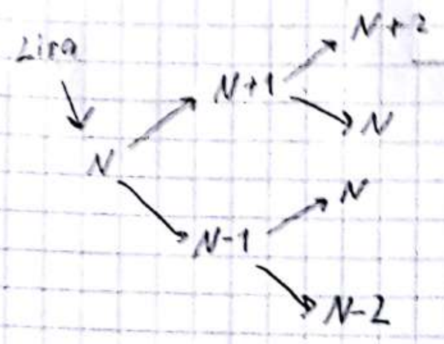
for i=1 : M

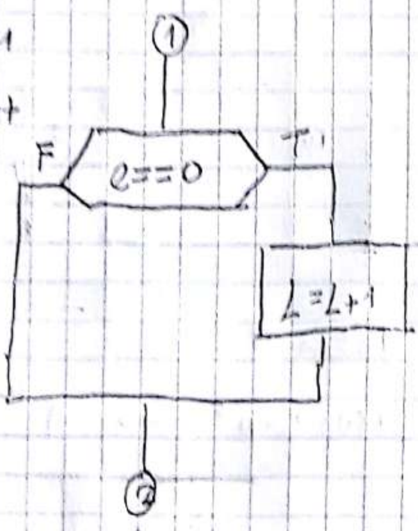
T[m[i]][m[i+1]] += 1

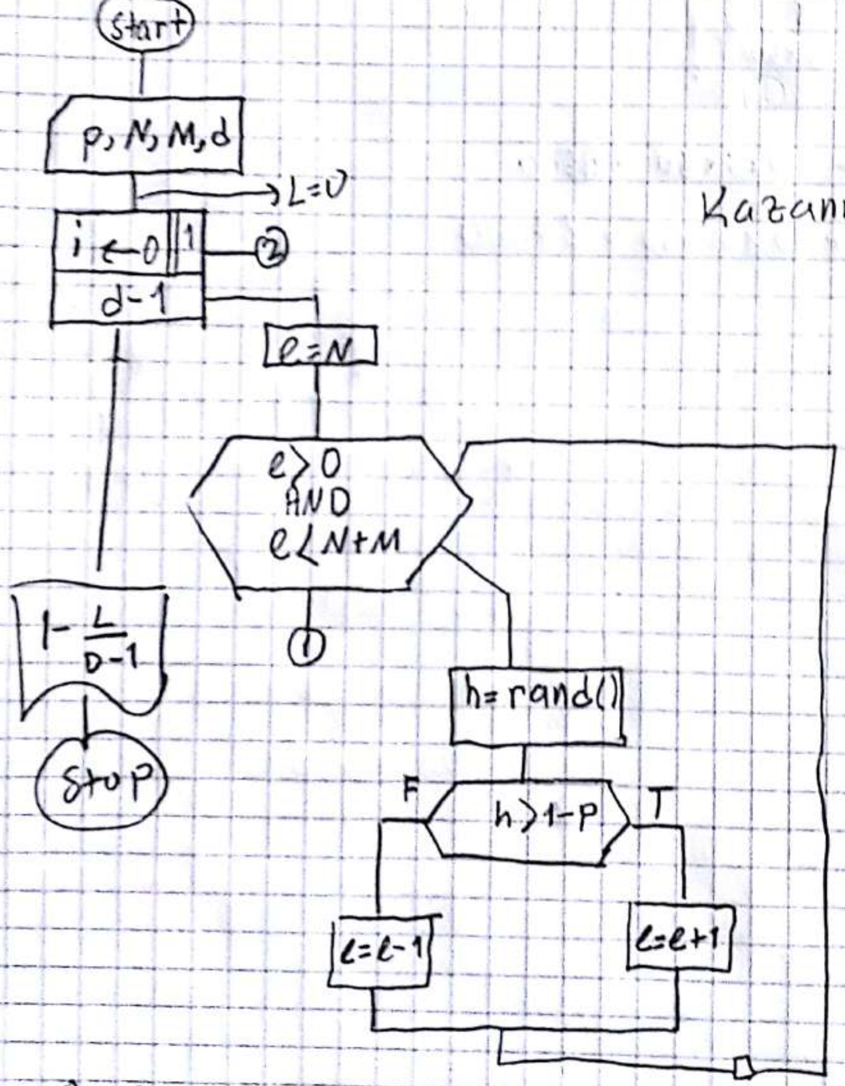
Bitiş N+M veya 0

adım p olasılıkla 1 TL kazan

1-p 〃 〃 kaybet







Kazanma olasılığı $< \left(\frac{p}{1-p}\right)^M$

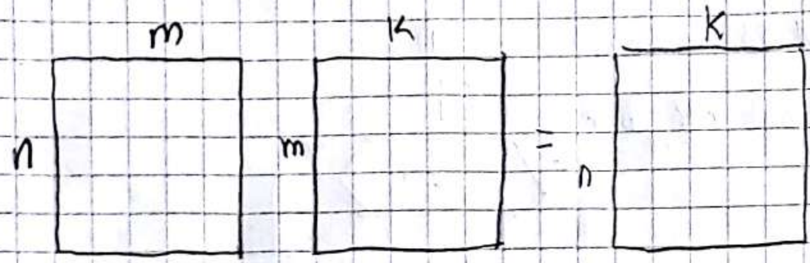
$p = 0.473$ $N=100$ $M=10 \rightarrow 0.339$

$p = 0.473$ $N=1000$ $M=10 \rightarrow 0.341$

$p = 0.473$ $N=100$ $M=100 \rightarrow 0.000018$

〃 $N = 1{,}000{,}000$ $M=100 \rightarrow 0.000021$:D?

ABCDEF → probability ??



$n \times k \times m$

$n \times n \times n = n^3 \longrightarrow n^{\log_2 7}$

A	B	C	=	X
10×30	30×5	5×60		10×60

$(AB)C = 10 \times 30 \times 5 + 10 \times 5 \times 60 = 4500$

$A(BC) = 30 \times 5 \times 60 + 10 \times 30 \times 60 = 27000$

External Merge Sort