Software Testing ℰ
DE - 4

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Q. Consider the sorting program. List out the operators & operands & also calculate the value of software science measures like n, N, V, E, λ, etc.

```
int sort(int x[], int n)
{
  int i,j,save,im1;
  if(n<2) return 1;
  for(i=2; i<=n; i++)
  {
    im1=i-1;
    for(j=1; j<=im1; j++)
    if(x[i]<x[j])
    {
      save=x[i];
      x[i]=x[j];
      x[j]=save;
    }
  }
  return 0;
}
```

Operators	Occurrences	Operands	Occurrences
int	4	Sort	1
( )	5	x	7
,	4	n	3
[ ]	7	i	8
if	2	j	7
<	2	save	3
;	11	im1	3
for	2	2	2
=	6	1	3
-	1	0	1
<=	2	-	-
++	2	-	-
return	2	-	-
{}	3	-	-
n1=14	N1 = 53	n2=10	N2=38

Here $N_1 = 53$ & $N_2 = 38$.

The program length $N = N_1 + N_2$
$= 53 + 38$
$= 91$

Vocabulary of the program $n = n1 + n2 = 14 + 10 = 24$

Volume $V = N * \log_2 N = 91 * \log_2 24 = 417$ bits

The estimate program length N of the program

$= 14 \log_2 14 + 10 \log_2 10$

$= 14 * 3.81 + 10 * 3.32$

$= 53.34 + 33.2 = 86.45$

The potential volume $V^* = 5 \log_2 5 = 11.6$

$n2^* = 3$

Since $L = \frac{V^*}{V} = \frac{11.6}{417} = 0.027$

$D = 1/L = \frac{1}{0.027} = 37.03$

Estimated program Level $L\hat{} = \frac{2}{n_1} \times \frac{n_2}{N_2} = \frac{2}{14} \times \frac{10}{38} = 0.038$

We may use another formula

$V\hat{} = V \times L\hat{} = 417 \times 0.038 = 15.67$

$E\hat{} = V/L\hat{} = D\hat{} \times V$

$= \frac{417}{0.038} = 10973.68$

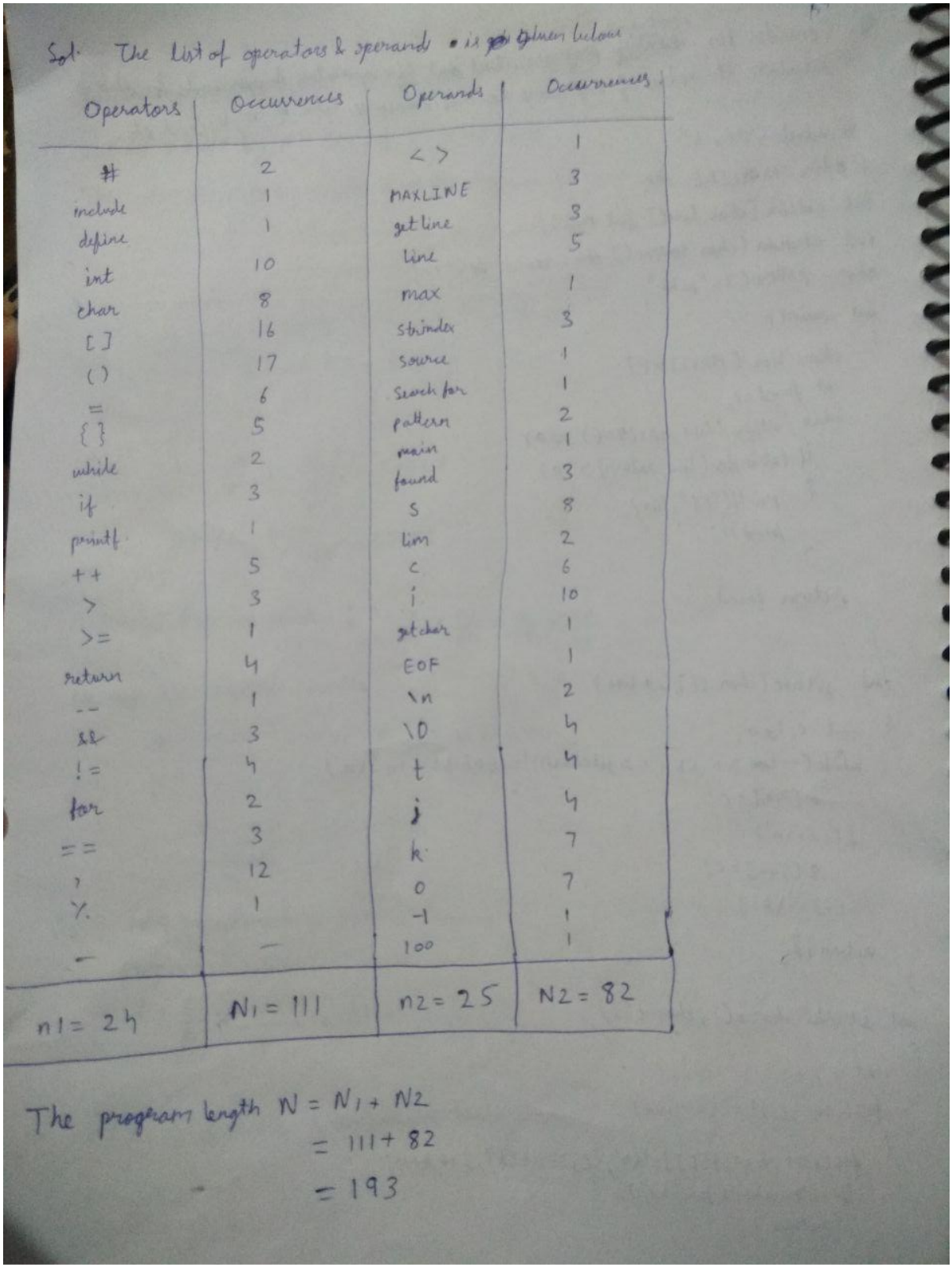
∴, 10974 elementary mental discrimination is required to construct the program.

$T = \frac{E}{\beta} = \frac{10974}{18} = 610 \text{ sec.} = 10 \text{ min.}$

This is probably a reasonable time to produce the program, which is very simple.

Q. Consider the mentioned program. List out the operators & operands & also calculate the values of software science measures like η, N, V, E, λ etc.

```
#include<stdio.h>
#define MAXLINE 100
int getLine(char line[], int max);
int strindex(char source[], char search_for[]);
char pattern[]="ould";
int main()
{
    char line[MAXLINE];
    int found=0;
    while(getLine(line,MAXLINE)>0)
        if(strindex(line,pattern)>=0)
        {   printf("%s",line);
            found++;
        }
    return found;
}
int getline(char s[],int lim)
{ int c,i=0;
  while(--lim>0 && (c=getchar())!=EOF && c!='\n')
      s[i++]=c;
  if(c=='\n')
      s[i++]=c;
  s[i]='\0';
  return i;
}
int strindex(char a[], char t[])
{
  int i,j,k;
  for(i=0;s[i]!='\0';i++)
  {  for(j=i;k=0;t[k]!='\0',s[j]==t[k];j++,k++);
     if(k>0 && t[k]=='\0')
        return i;
  }
  return -1;
}
```



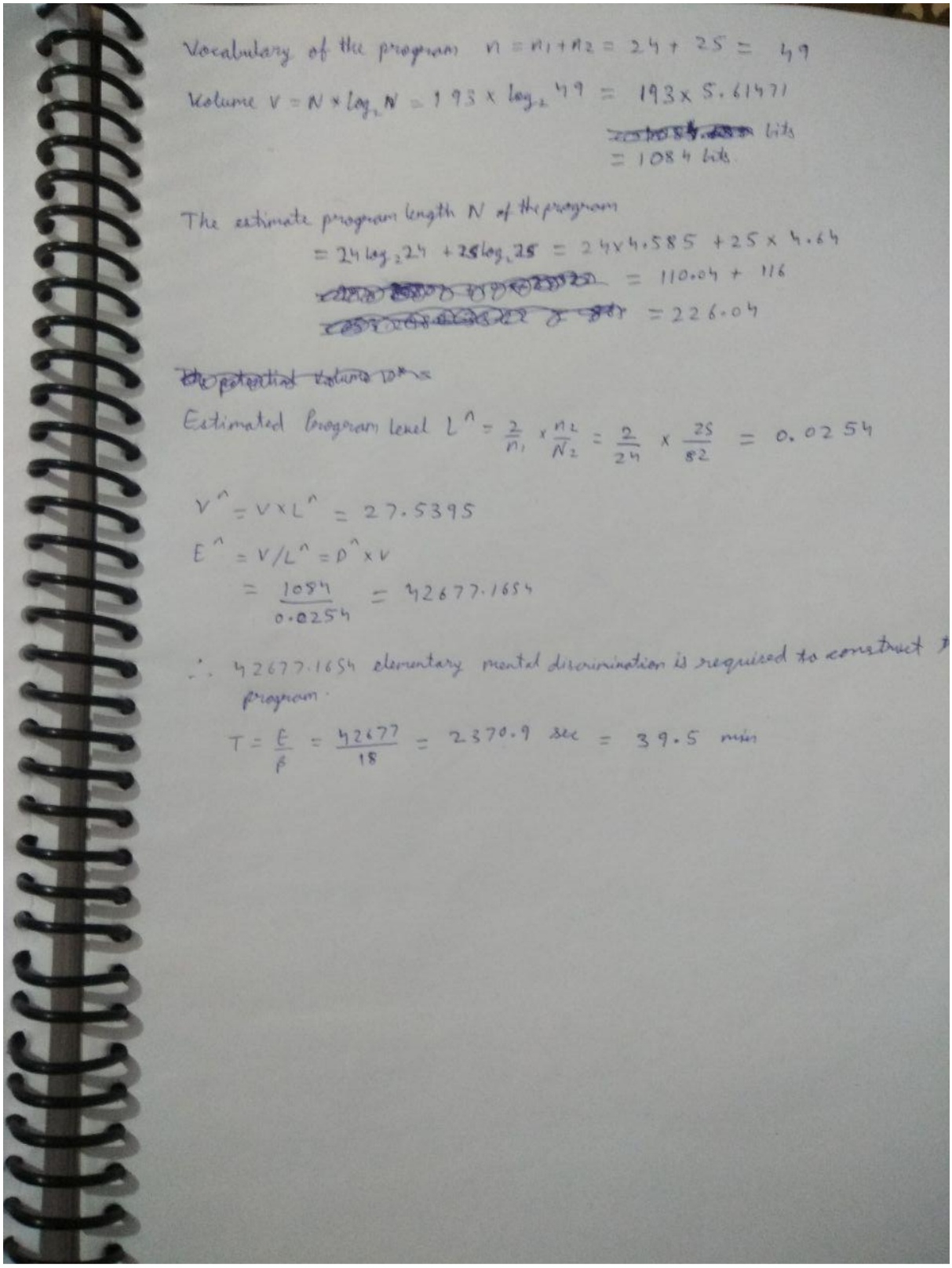
Sol. The list of operators & operands is given below

Operators	Occurrences	Operands	Occurrences
#	2	< >	1
include	1	MAXLINE	3
define	1	getline	3
int	10	line	5
char	8	max	1
[ ]	16	strindex	3
( )	17	source	1
=	6	search for	1
{ }	5	pattern	2
while	2	main	1
if	3	found	3
printf	1	s	8
++	5	lim	2
>	3	c	6
>=	1	i	10
return	4	getchar	1
--	1	EOF	1
&&	3	\n	2
!=	4	\0	4
for	2	t	4
==	3	j	4
,	12	k	7
%.	1	0	7
-	-	-1	1
		100	1
n1 = 24	N1 = 111	n2 = 25	N2 = 82

The program length $N = N_1 + N_2$

$= 111 + 82$

$= 193$



Vocabulary of the program $n = n_1 + n_2 = 24 + 25 = 49$

Volume $V = N \times \log_2 N = 193 \times \log_2 49 = 193 \times 5.61471$

= 1084 bits

The estimate program length N of the program

$= 24 \log_2 24 + 25 \log_2 25 = 24 \times 4.585 + 25 \times 4.64$

$= 110.04 + 116$

$= 226.04$

Estimated program level $\hat{L} = \frac{2}{n_1} \times \frac{n_2}{N_2} = \frac{2}{24} \times \frac{25}{82} = 0.0254$

$\hat{V} = V \times \hat{L} = 27.5395$

$\hat{E} = V/\hat{L} = \hat{D} \times V$

$= \frac{1084}{0.0254} = 42677.1654$

∴ 42677.1654 elementary mental discrimination is required to construct the program.

$T = \frac{E}{\beta} = \frac{42677}{18} = 2370.9 \text{ sec} = 39.5 \text{ min}$