

Using Trace Tables

Supplement to the Trace Tables handout.

Problem Statement

In the Algorithm below, presented in Pseudo Code, trace the algorithm using a trace table, for N = 6.

```
SUM = 0
loop COUNT from 1 to (N div 2)
    if N mod COUNT = 0 then
        SUM = SUM + COUNT
    end if
end loop
if SUM = N then
    output "perfect"
else
    output "not perfect"
end if
```

Problem Solution

Setup : add line numbers to help trace the steps

```
1 SUM = 0
2 loop COUNT from 1 to (N div 2)
3
      if N mod COUNT = 0 then
4
           SUM = SUM + COUNT
5 end if
6 end loop
7 if SUM = N then
8 output "perfect"
9 else
 output "not perfect"
10
11 end if
```

Problem Solution

Setup : Identify values/variables that do not change

```
SUM = 0
                1
We are given that
                2 loop COUNT from 1 to (N div 2)
N = 6
                3
                        if N mod COUNT = 0 then
                4
                              SUM = SUM + COUNT
and can derive that
                        end if
                 5
N div 2 is equal to 3
                6 end loop
and neither value will
                 7 if SUM = N then
Be changed.
                        output "perfect"
                 8
                  else
                9
                        output "not perfect"
                10
                11 end if
```

Problem Solution

Set up the trace table

Values th:	at do not chan ge in this block:				
N	= 6				
()	N div 2) = 3	Line #	Count	Sum	Output
1 SUM	= 0				
2 100p	COUNT from 1 to (N div 2)				
3	if N mod COUNT = 0 then				
4	SUM = SUM + COUNT				
5	end if				
6 end	1000				
7 if S	SUM = N then				
8	output "perfect"				
9 else					
10	output "not perfect"				
11 end	if				

Begin the trace

SUM = 0 update the table

Values that do not change in this block:				
N = 6				
(N div 2) = 3	Line #	Count	Sum	Output
> SUM = 0	1		0	
2 loop COUNT from 1 to (N div 2)				
<pre>3 if N mod COUNT = 0 then</pre>				
4 SUM = SUM + COUNT				
5 end if				
e end loop				
7 if $SUM = N$ then				
8 output "perfect"				
0 alea				
10 output "not perfect"				
to output not perfect				
ii end if				

Begin the trace

COUNT is assigned 1,

loop will for continue for COUNT =1, then 2, then 3

Values that do not change in this block:				
N = 6				
(N div 2) = 3	Line #	Count	Sum	Output
1 SUM = 0	1		0	
loop COUNT from 1 to (N div 2)	2	1	0	
$3 if N \mod COUNT = 0 then$				
4 $SUM = SUM + COUNT$				
5 end if				
6 end loop				
7 if SUM = N then				
8 output "perfect"				
9 else				
10 output "not perfect"				
11 end if				

Begin the trace

N mod COUNT is 0 (6 mod 1 = 0) continue to line 4

Values that do not change in this block:				
N = 6				
(N div 2) = 3	Line #	Count	Sum	Output
1 SUM = 0	1		0	
2 loop COUNT from 1 to (N div 2)	2	1	0	
3 if N mod COUNT = 0 then	3	1	0	
4 $SIM = SIM + COUNT$				
5 end if				
e end loop				
7 if SUM = N then				
8 output "perfect"				
9 else				
10 output "not perfect"				
and if				
II end II				

Begin the trace

SUM was 0, COUNT is 1, now SUM is 1

Values that do not change in this block:				
(N div 2) = 3	Line #	Count	Sum	Output
<pre>1 SUM = 0 2 loop COUNT from 1 to (N div 2) 3 if N mod COUNT = 0 then 4 SUM = SUM + COUNT 5 end if 6 end loop 7 if SUM = N then 8 output "perfect" 9 else 10 output "not perfect" 11 end if</pre>				

Begin the trace

Line 5 ends the if, line 6 ends the loop The next line will be line 2 with COUNT = 2

Values that do not change in this block:				
N = 6				
(N div 2) = 3	Line #	Count	Sum	Output
1 SUM = 0	1		0	
2 loop COUNT from 1 to (N div 2)	2	1	0	
3 if N mod COUNT = 0 then	3	1	0	
4 $SUM = SUM + COUNT$	4	1	1	
5 end if	5,6	1	1	
e end loop				
7 if SUM = N then				
8 output "perfect"				
9 else				
10 output "not perfect"				
11 and if				
in end in				

Begin the trace

COUNT = 2, continue the loop

Values that do not change in this block:				
N = 6				
(N div 2) = 3	Line #	Count	Sum	Output
<pre>1 SUM = 0 2 loop COUNT from 1 to (N div 2) 3 if N mod COUNT = 0 then 4 SUM = SUM + COUNT 5 end if</pre>	1 2 3 4 5,6	1 1 1 1	0 0 1 1	
6 end loop	Z	2	1	
7 if SUM = N then				
8 output "perfect"				
9 else				
10 output "not perfect"				
11 end if				

Begin the trace

6 mod 2 does = 0 so continue to line 4

Values that do not change in this block: N = 6				
(N div 2) = 3	Line #	Count	Sum	Output
<pre>(Ndiv2)=3 1 SUM = 0 2 loop COUNT from 1 to (N div 2) 3 if N mod COUNT = 0 then 4 SUM = SUM + COUNT 5 end if 6 end loop 7 if SUM = N then 8 output "perfect" 9 else 10 output "not perfect" 11 end if</pre>	Line # 1 2 3 4 5,6 2 3	Count 1 1 1 2 2 2	Sum 0 0 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	

Begin the trace

SUM was 1, COUNT is 2, now SUM = 2 + 1 = 3

Values that do not change in this block:				
N = 6				
(N div 2) = 3	Line #	Count	Sum	Output
1 SUM = 0	1		0	
2 loop COUNT from 1 to (N div 2)	2	1	0	
<pre>3 if N mod COUNT = 0 then</pre>	3	1	0	
4 $SUM = SUM + COUNT$	4	1	1	
5 end if	5,6	1	1	
end loop	2	2	1	
7 if SUM = N then	3	2	1	
/ II SOM - N Chen	4	2	3	
8 output perfect				
9 else				
10 output "not perfect"				
11 end if				

Begin the trace

Line 5 ends the if, line 6 ends the loop The next line will be line 2 with COUNT = 3

Values that do not change in this block:				
N = 6	1100.00	C	C	0.1.1
(N dN 2) = 3	Line #	Count	Sum	Output
1 SUM = 0	1		0	
2 loop COUNT from 1 to (N div 2)	2	1	0	
<pre>3 if N mod COUNT = 0 then</pre>	3	1	0	
4 $SUM = SUM + COUNT$	4	1	1	
5 end if	5,6	1	1	
a end loop	2	2	1	
o the roop	3	2	1	
7 II SOM - N Chen	4	2	3	
8 output perfect	5.6	2	3	
9 else				
10 output "not perfect"				
11 end if				

Begin the trace

COUNT = 3 continue loop

Values that do not change in this block:				
N = 6				
(N div 2) = 3	Line #	Count	Sum	Output
1 SUM = 0	1		0	
2 loop COUNT from 1 to (N div 2)	2	1	0	
<pre>3 if N mod COUNT = 0 then</pre>	3	1	0	
4 $SUM = SUM + COUNT$	4	1	1	
5 end if	5,6	1	1	
end loop	2	2	1	
7 if SUM = N then	3	2	1	
/ II SOM - N Chen	4	2	3	
8 output perfect	5.6	2	3	
9 else	2	3	3	
10 output "not perfect"				
11 end if				

Begin the trace

6 mod 3 = 0 so continue to line 4

Values that do not change in this block:				
$N = 6$ $(N \operatorname{div} 2) = 3$	Line #	Count	Sum	Output
((((((((((((((((((((((((((((((((((((1	count	0	output
$2 \log COUNT from 1 to (N div 2)$	2	1	0	
3 if N mod COUNT = 0 then	3	1	0	
4 SUM = SUM + COUNT	4	1	1	
5 end if	5,0	1	1	
6 end loop	2	2	 1	
7 if SUM = N then	4	2	3	
8 output "perfect"	5.6	2	3	
9 eise	2	3	3	
11 end if	3	3	3	

Begin the trace

SUM was 3, COUNT is 3, SUM = 3 + 3 = 6

Values that do not change in this block:				
N = 6 (N div 2) = 3	Line #	Count	Sum	Output
1 SUM = 0	1		0	
2 loop COUNT from 1 to (N div 2)	2	1	0	
<pre>3 if N mod COUNT = 0 then</pre>	3	1	0	
4 SUM = SUM + COUNT	4	1	1	
5 end if	5,6	1	1	
e end loop	2	2	1	
7 if SUM = N then	3	2	1	
output "perfect"	4	2	3	
alee	5,6	2	3	
9 erse	2	3	3	
to output not perfect	3	3	3	
11 end 11	4	3	6	

Begin the trace

Line 5 ends if, line 6 ends loop COUNT goes to 4 control goes to line 2

Values that do not change in this block:				
N = 6				
(N div 2) = 3	Line #	Count	Sum	Output
1 SUM = 0	1		0	
2 loop COUNT from 1 to (N div 2)	2	1	0	
3 if N mod COUNT = 0 then	3	1	0	
4 $SUM = SUM + COUNT$	4	1	1	
5 end if	5,6	1	1	
e end loop	2	2	1	
7 if sum = N then	3	2	1	
/ II Som - N chen	4	2	3	
o alca	5,6	2	3	
9 else	2	3	3	
10 output "not perfect"	3	3	3	
11 end 11	4	3	6	
	5,6	3	6	

Begin the trace

COUNT is 4. 4 > 3 so control goes to line 7

Values that do not change in this block:				
N = 6				
(N div 2) = 3	Line #	Count	Sum	Output
1 SUM = 0	1		0	
2 loop COUNT from 1 to (N div 2)	2	1	0	
$3 if N \mod COUNT = 0 then$	3	1	0	
4 $SIM = SIM + COUNT$	4	1	1	
5 and if	5,6	1	1	
a end loop	2	2	1	
6 end 100p	3	2	1	
7 II SOM - N then	4	2	3	
8 output perfect	5.6	2	3	
9 else	2	3	3	
10 output "not perfect"	2	्र २	्र २	
11 end if	<u>J</u>	2	6	
		2	6	
	5,0	2		
	2	3	6	

Begin the trace

SUM is 6, N is 6, so continue with line 8

Values that do not change in this block:				
$N = 0$ $(N \operatorname{div} 2) = 3$	Line #	Count	Sum	Output
(14 01 2) = 5	Life #	count	Sum	Output
1 SUM = 0	1		0	
2 loop COUNT from 1 to (N div 2)	2	1	0	
<pre>3 if N mod COUNT = 0 then</pre>	3	1	0	
4 SUM = SUM + COUNT	4	1	1	
5 and if	5,6	1	1	
s and loop	2	2	1	
6 end 100p	3	2	1	
7 if SUM = N then	4	2	3	
8 output "perfect"	5.6	2	<u>२</u>	
9 else	2,0	2	2	
10 output "not perfect"	2	2	<u> </u>	
11 end if	3	3	3	
	4	3	6	
	5,6	3	6	
	2	4	6	
	7	4	6	
			Ŭ	

Begin the trace

output perfect

Values that do not change in this block:				
(N div 2) = 3	Line #	Count	Sum	Output
1 SUM = 0	1		0	
2 loop COUNT from 1 to (N div 2)	2	1	0	
3 if N mod COUNT = 0 then	3	1	0	
4 $SUM = SUM + COUNT$	4	1	1	
5 end if	5,6	1	1	
e end loop	2	2	1	
7 if SUM = N then	3	2	1	
8 output "perfect"	4	2	3	
Q alea	5,6	2	3	
10 output "not perfect"	2	3	3	
and if	3	3	3	
I end II	4	3	6	
	5,6	3	6	
	2	4	6	
	7	4	6	
	8	4	6	perfect
				•

Begin the trace

After line 8 the control goes to line 11 which ends this block

Values that do not change in this block:				
N = 6				
(N div 2) = 3	Line #	Count	Sum	Output
1 SUM = 0	1		0	
2 loop COUNT from 1 to (N div 2)	2	1	0	
<pre>3 if N mod COUNT = 0 then</pre>	3	1	0	
4 $SUM = SUM + COUNT$	4	1	1	
5 end if	5,6	1	1	
end loop	2	2	1	
7 if sum = N then	3	2	1	
7 II Som - N chen	4	2	3	
8 olco	5,6	2	3	
9 else	2	3	3	
10 output "not perfect"	3	3	3	
11 ena 11	4	3	6	
	5,6	3	6	
	2	4	6	
	7	4	6	
	8	4	6	perfect
	11	4	6	⁻ perfect

Alternative

COUNT	N mod COUNT	SUM	output
		0	
1	0	1	
2	0	3	
3	0	6	perfect

When the COUNT is 4, and the loop would not be executed, it would not be necessary to show that in the trace table.

Showing the value of N mod COUNT as a column would not be a bad idea.

When there are only a couple of things that happen within a loop and it is easy to record the values as they exit the loop, and not necessary to show the result of every line in the loop, but it can be easier to make a mistake.