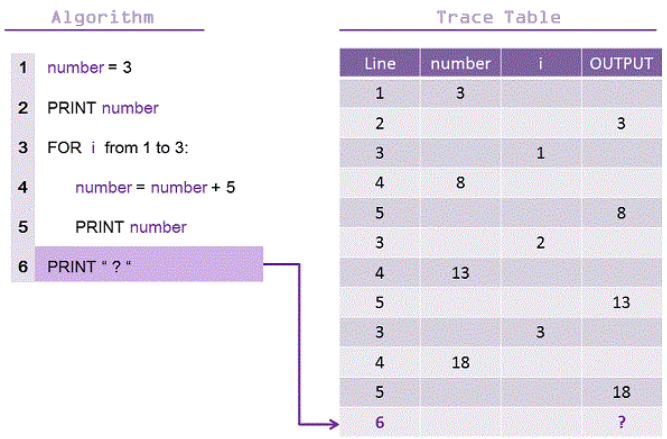


# Using Trace Tables

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
10      output "not perfect"
11 end if
```

# Problem Solution

## Setup : Identify values/variables that do not change

We are given that
N = 6

and can derive that
N div 2 is equal to 3
and neither value will
Be changed.

```
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
```

# Problem Solution

## Set up the trace table

Values that do not change in this block:
N = 6
(N div 2) = 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
```

| Line # | Count | Sum | Output |
|---|---|---|---|
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# Problem Trace

## Begin the trace

SUM = 0 update the table

Values that do not change in this block:
N = 6
(N div 2) = 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
```

| Line # | Count | Sum | Output |
|---|---|---|---|
| 1 | | 0 | |
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# Problem Trace

## 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

```
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
```

| Line # | Count | Sum | Output |
|---|---|---|---|
| 1 | | 0 | |
| 2 | 1 | 0 | |
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# Problem Trace

## 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

```
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
```

| Line # | Count | Sum | Output |
|---|---|---|---|
| 1 | | 0 | |
| 2 | 1 | 0 | |
| 3 | 1 | 0 | |
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# Problem Trace

## Begin the trace

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

Values that do not change in this block:
N = 6
(N div 2) = 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
```

| Line # | Count | Sum | Output |
|---|---|---|---|
| 1 | | 0 | |
| 2 | 1 | 0 | |
| 3 | 1 | 0 | |
| 4 | 1 | 1 | |
| | | | |
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# Problem Trace

## 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

```
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
```

| Line # | Count | Sum | Output |
|---|---|---|---|
| 1 | | 0 | |
| 2 | 1 | 0 | |
| 3 | 1 | 0 | |
| 4 | 1 | 1 | |
| 5,6 | 1 | 1 | |
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# Problem Trace

## Begin the trace

COUNT = 2, continue the loop

Values that do not change in this block:
N = 6
(N div 2) = 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
```

| Line # | Count | Sum | Output |
|---|---|---|---|
| 1 | | 0 | |
| 2 | 1 | 0 | |
| 3 | 1 | 0 | |
| 4 | 1 | 1 | |
| 5,6 | 1 | 1 | |
| 2 | 2 | 1 | |
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# Problem Trace

## 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

```
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
```

| Line # | Count | Sum | Output |
|---|---|---|---|
| 1 | | 0 | |
| 2 | 1 | 0 | |
| 3 | 1 | 0 | |
| 4 | 1 | 1 | |
| 5,6 | 1 | 1 | |
| 2 | 2 | 1 | |
| 3 | 2 | 1 | |
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# Problem Trace

## 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

```
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
```

| Line # | Count | Sum | Output |
|---|---|---|---|
| 1 | | 0 | |
| 2 | 1 | 0 | |
| 3 | 1 | 0 | |
| 4 | 1 | 1 | |
| 5,6 | 1 | 1 | |
| 2 | 2 | 1 | |
| 3 | 2 | 1 | |
| 4 | 2 | 3 | |
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# Problem Trace

## 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
(N div 2) = 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
```

| Line # | Count | Sum | Output |
|---|---|---|---|
| 1 | | 0 | |
| 2 | 1 | 0 | |
| 3 | 1 | 0 | |
| 4 | 1 | 1 | |
| 5,6 | 1 | 1 | |
| 2 | 2 | 1 | |
| 3 | 2 | 1 | |
| 4 | 2 | 3 | |
| 5,6 | 2 | 3 | |
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# Problem Trace

## Begin the trace

COUNT = 3 continue loop

Values that do not change in this block:
N = 6
(N div 2) = 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
```

| Line # | Count | Sum | Output |
|---|---|---|---|
| 1 | | 0 | |
| 2 | 1 | 0 | |
| 3 | 1 | 0 | |
| 4 | 1 | 1 | |
| 5,6 | 1 | 1 | |
| 2 | 2 | 1 | |
| 3 | 2 | 1 | |
| 4 | 2 | 3 | |
| 5,6 | 2 | 3 | |
| 2 | 3 | 3 | |
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# Problem Trace

## Begin the trace

6 mod 3 = 0 so continue to line 4

Values that do not change in this block:
N = 6
(N div 2) = 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
```

| Line # | Count | Sum | Output |
|---|---|---|---|
| 1 | | 0 | |
| 2 | 1 | 0 | |
| 3 | 1 | 0 | |
| 4 | 1 | 1 | |
| 5,6 | 1 | 1 | |
| 2 | 2 | 1 | |
| 3 | 2 | 1 | |
| 4 | 2 | 3 | |
| 5,6 | 2 | 3 | |
| 2 | 3 | 3 | |
| 3 | 3 | 3 | |
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# Problem Trace

## 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

```
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
```

| Line # | Count | Sum | Output |
|---|---|---|---|
| 1 | | 0 | |
| 2 | 1 | 0 | |
| 3 | 1 | 0 | |
| 4 | 1 | 1 | |
| 5,6 | 1 | 1 | |
| 2 | 2 | 1 | |
| 3 | 2 | 1 | |
| 4 | 2 | 3 | |
| 5,6 | 2 | 3 | |
| 2 | 3 | 3 | |
| 3 | 3 | 3 | |
| 4 | 3 | 6 | |
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# Problem Trace

## 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

```
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
```

| Line # | Count | Sum | Output |
|---|---|---|---|
| 1 | | 0 | |
| 2 | 1 | 0 | |
| 3 | 1 | 0 | |
| 4 | 1 | 1 | |
| 5,6 | 1 | 1 | |
| 2 | 2 | 1 | |
| 3 | 2 | 1 | |
| 4 | 2 | 3 | |
| 5,6 | 2 | 3 | |
| 2 | 3 | 3 | |
| 3 | 3 | 3 | |
| 4 | 3 | 6 | |
| 5,6 | 3 | 6 | |
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# Problem Trace

## 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

```
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
```

| Line # | Count | Sum | Output |
|---|---|---|---|
| 1 | | 0 | |
| 2 | 1 | 0 | |
| 3 | 1 | 0 | |
| 4 | 1 | 1 | |
| 5,6 | 1 | 1 | |
| 2 | 2 | 1 | |
| 3 | 2 | 1 | |
| 4 | 2 | 3 | |
| 5,6 | 2 | 3 | |
| 2 | 3 | 3 | |
| 3 | 3 | 3 | |
| 4 | 3 | 6 | |
| 5,6 | 3 | 6 | |
| 2 | 3 | 6 | |
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# Problem Trace

## Begin the trace

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

Values that do not change in this block:
N = 6
(N div 2) = 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
```

| Line # | Count | Sum | Output |
|---|---|---|---|
| 1 | | 0 | |
| 2 | 1 | 0 | |
| 3 | 1 | 0 | |
| 4 | 1 | 1 | |
| 5,6 | 1 | 1 | |
| 2 | 2 | 1 | |
| 3 | 2 | 1 | |
| 4 | 2 | 3 | |
| 5,6 | 2 | 3 | |
| 2 | 3 | 3 | |
| 3 | 3 | 3 | |
| 4 | 3 | 6 | |
| 5,6 | 3 | 6 | |
| 2 | 4 | 6 | |
| 7 | 4 | 6 | |
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# Problem Trace

## Begin the trace

output perfect

Values that do not change in this block:
N = 6
(N div 2) = 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
```

| Line # | Count | Sum | Output |
|---|---|---|---|
| 1 | | 0 | |
| 2 | 1 | 0 | |
| 3 | 1 | 0 | |
| 4 | 1 | 1 | |
| 5,6 | 1 | 1 | |
| 2 | 2 | 1 | |
| 3 | 2 | 1 | |
| 4 | 2 | 3 | |
| 5,6 | 2 | 3 | |
| 2 | 3 | 3 | |
| 3 | 3 | 3 | |
| 4 | 3 | 6 | |
| 5,6 | 3 | 6 | |
| 2 | 4 | 6 | |
| 7 | 4 | 6 | |
| 8 | 4 | 6 | **perfect** |
| | | | |
| | | | |

# Problem Trace

## 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

```
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
```

| Line # | Count | Sum | Output |
|---|---|---|---|
| 1 | | 0 | |
| 2 | 1 | 0 | |
| 3 | 1 | 0 | |
| 4 | 1 | 1 | |
| 5,6 | 1 | 1 | |
| 2 | 2 | 1 | |
| 3 | 2 | 1 | |
| 4 | 2 | 3 | |
| 5,6 | 2 | 3 | |
| 2 | 3 | 3 | |
| 3 | 3 | 3 | |
| 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.