

Sort_recursive(i_start, i_end)

Global array

i_up = i_start

i_down = i_end

i_pivot = (i_start + i_end) / 2

WHILE i_up < i_down

IF array[i_up] < array[i_pivot] and array[i_down] > array[i_pivot]:

i_up++

i_down--

ELSE IF array[i_up] >= array[i_pivot] and array[i_down] > array[i_pivot]

i_down--

ELSE IF array[i_up] < array[i_pivot] and array[i_down] < array[i_pivot]

i_up++

ELSE IF array[i_up] >= array[i_pivot] and array[i_down] < array[i_pivot]

array[i_up], array[i_down] = array[i_down], array[i_up]

IF i_up == i_pivot

i_pivot = i_down

i_up ++

ELSE IF i_down == i_pivot

i_pivot = i_up

i_down++

ELSE

i_up++

i_down++

IF i_start < i_end

Sort_recursive(i_start, i_pivot - 1)

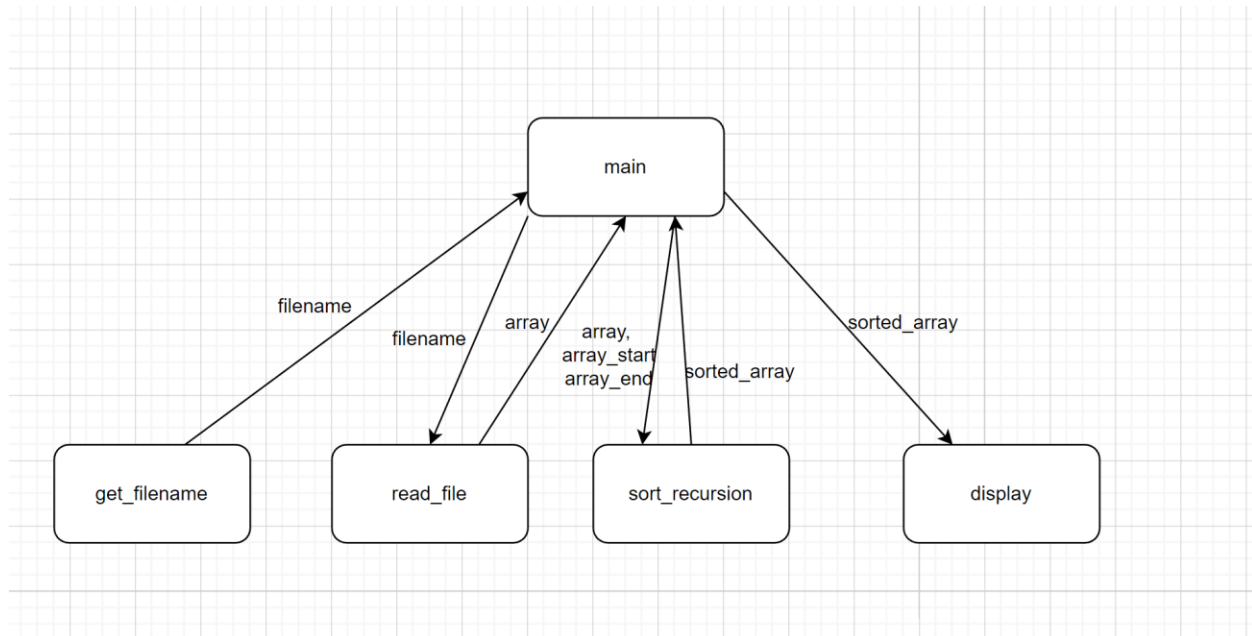
Sort_recursive(i_pivot + 1, i_end)

ELSE

RETURN

Algorithm Metrics:

$O(3n)$, So the while loop is iterative in nature which causes it to be $O(n)$, the recursive function is called twice at the end of the loop so that's 2 $O(n)$'s, thereby meaning that there are 3 $O(n)$ or in other words $O(3n)$.



Modularization Metrics:

get_filename:

Strong Cohesion, only gets the filename and returns it

Trivial Coupling, doesn't receive any data

read_file:

Strong Cohesion, only reads the file and returns it

Simple Coupling, receives one parameter and passes a variable based off of that parameter

sort_recursion:

Strong Cohesion, only sorts the list by means of recursion

Interactive Coupling, Due to the function calling itself several times and passing the parameters it received into itself on the recursion it should technically be Interactive

display:

Strong Cohesion, only displays the results of the sort

Simple Coupling, Receives one parameter from main

Test Cases:

1. [1,5,2,3,4,8,6,45,3,3,15,33,10,500,300,34,23,12,45,67]
2. [12, 20, 40, 19, 10]
3. [0, 0, 0, 0]
4. [1, 2, 3, 4, 5, 6, 7, 8, 9, 10]
5. [1]

Trace:

Context: I put a trace into the program I wrote and this is how it popped out, Called is everytime that the function is called and Iteration should keep track of how many times the while loop goes through, there's 30 something pages of results so good luck with that:

i_end: 10

i_pivot: 9

Iteration: 1

i_up: 8

i_down: 10

i_pivot: 9

[1, 2, 3, 3, 3, 4, 5, 6, 8, 10, 12, 15, 23, 33, 34, 45, 45, 67, 300, 500]

Block 1

Called -----

i_start: 8

i_end: 8

i_pivot: 8

Called -----

i_start: 10

i_end: 10

i_pivot: 10

Called -----

i_start: 12

i_end: 19

i_pivot: 15

Iteration: 1

i_up: 12

i_down: 19

i_pivot: 15

[1, 2, 3, 3, 3, 4, 5, 6, 8, 10, 12, 15, 23, 33, 34, 45, 45, 67, 300, 500]

Block 1

Called -----

i_start: 12

i_end: 14

i_pivot: 13

Iteration: 1

i_up: 12

i_down: 14

i_pivot: 13

[1, 2, 3, 3, 3, 4, 5, 6, 8, 10, 12, 15, 23, 33, 34, 45, 45, 67, 300, 500]

Block 1

Called -----

i_start: 12

i_end: 12

i_pivot: 12

Called -----

i_start: 14

i_end: 14

i_pivot: 14

Called -----

i_start: 16

i_end: 19

i_pivot: 17

Iteration: 1

i_up: 16

i_down: 19

i_pivot: 17

[1, 2, 3, 3, 3, 4, 5, 6, 8, 10, 12, 15, 23, 33, 34, 45, 45, 67, 300, 500]

Block 1

Called -----

i_start: 16

i_end: 16

i_pivot: 16

Called -----

i_start: 18

i_end: 19

i_pivot: 18

Iteration: 1

i_up: 18

i_down: 19

i_pivot: 18

[1, 2, 3, 3, 3, 4, 5, 6, 8, 10, 12, 15, 23, 33, 34, 45, 45, 67, 300, 500]

Block 2

Called -----

i_start: 18

i_end: 17

i_pivot: 17

Called -----

i_start: 19

i_end: 19

i_pivot: 19

Iteration: 2

i_up: 17

i_down: 18

i_pivot: 17

[1, 2, 3, 3, 3, 4, 5, 6, 8, 10, 12, 15, 23, 33, 34, 45, 45, 67, 300, 500]

Block 2

Called -----

i_start: 16

i_end: 16

i_pivot: 16

Called -----

i_start: 18

i_end: 19

i_pivot: 18

Iteration: 1

i_up: 18

i_down: 19

i_pivot: 18

[1, 2, 3, 3, 3, 4, 5, 6, 8, 10, 12, 15, 23, 33, 34, 45, 45, 67, 300, 500]

Block 2

Called -----

i_start: 18

i_end: 17

i_pivot: 17

Called -----

i_start: 19

i_end: 19

i_pivot: 19

Iteration: 2

i_up: 13

i_down: 18

i_pivot: 15

[1, 2, 3, 3, 3, 4, 5, 6, 8, 10, 12, 15, 23, 33, 34, 45, 45, 67, 300, 500]

Block 1

Called -----

i_start: 12

i_end: 14

i_pivot: 13

Iteration: 1

i_up: 12

i_down: 14

i_pivot: 13

[1, 2, 3, 3, 3, 4, 5, 6, 8, 10, 12, 15, 23, 33, 34, 45, 45, 67, 300, 500]

Block 1

Called -----

i_start: 12

i_end: 12

i_pivot: 12

Called -----

i_start: 14

i_end: 14

i_pivot: 14

Called -----

i_start: 16

i_end: 19

i_pivot: 17

Iteration: 1

i_up: 16

i_down: 19

i_pivot: 17

[1, 2, 3, 3, 3, 4, 5, 6, 8, 10, 12, 15, 23, 33, 34, 45, 45, 67, 300, 500]

Block 1

Called -----

i_start: 16

i_end: 16

i_pivot: 16

Called -----

i_start: 18

i_end: 19

i_pivot: 18

Iteration: 1

i_up: 18

i_down: 19

i_pivot: 18

[1, 2, 3, 3, 3, 4, 5, 6, 8, 10, 12, 15, 23, 33, 34, 45, 45, 67, 300, 500]

Block 2

Called -----

i_start: 18

i_end: 17

i_pivot: 17

Called -----

i_start: 19

i_end: 19

i_pivot: 19

Iteration: 2

i_up: 17

i_down: 18

i_pivot: 17

[1, 2, 3, 3, 3, 4, 5, 6, 8, 10, 12, 15, 23, 33, 34, 45, 45, 67, 300, 500]

Block 2

Called -----

i_start: 16

i_end: 16

i_pivot: 16

Called -----

i_start: 18

i_end: 19

i_pivot: 18

Iteration: 1

i_up: 18

i_down: 19

i_pivot: 18

[1, 2, 3, 3, 3, 4, 5, 6, 8, 10, 12, 15, 23, 33, 34, 45, 45, 67, 300, 500]

Block 2

Called -----

i_start: 18

i_end: 17

i_pivot: 17

Called -----

i_start: 19

i_end: 19

i_pivot: 19

Iteration: 3

i_up: 14

i_down: 17

i_pivot: 15

[1, 2, 3, 3, 3, 4, 5, 6, 8, 10, 12, 15, 23, 33, 34, 45, 45, 67, 300, 500]

Block 1

Called -----

i_start: 12

i_end: 14

i_pivot: 13

Iteration: 1

i_up: 12

i_down: 14

i_pivot: 13

[1, 2, 3, 3, 3, 4, 5, 6, 8, 10, 12, 15, 23, 33, 34, 45, 45, 67, 300, 500]

Block 1

Called -----

i_start: 12

i_end: 12

i_pivot: 12

Called -----

i_start: 14

i_end: 14

i_pivot: 14

Called -----

i_start: 16

i_end: 19

i_pivot: 17

Iteration: 1

i_up: 16

i_down: 19

i_pivot: 17

[1, 2, 3, 3, 3, 4, 5, 6, 8, 10, 12, 15, 23, 33, 34, 45, 45, 67, 300, 500]

Block 1

Called -----

i_start: 16

i_end: 16

i_pivot: 16

Called -----

i_start: 18

i_end: 19

i_pivot: 18

Iteration: 1

i_up: 18

i_down: 19

i_pivot: 18

[1, 2, 3, 3, 3, 4, 5, 6, 8, 10, 12, 15, 23, 33, 34, 45, 45, 67, 300, 500]

Block 2

Called -----

i_start: 18

i_end: 17

i_pivot: 17

Called -----

i_start: 19

i_end: 19

i_pivot: 19

Iteration: 2

i_up: 17

i_down: 18

i_pivot: 17

[1, 2, 3, 3, 3, 4, 5, 6, 8, 10, 12, 15, 23, 33, 34, 45, 45, 67, 300, 500]

Block 2

Called -----

i_start: 16

i_end: 16

i_pivot: 16

Called -----

i_start: 18

i_end: 19

i_pivot: 18

Iteration: 1

i_up: 18

i_down: 19

i_pivot: 18

[1, 2, 3, 3, 3, 4, 5, 6, 8, 10, 12, 15, 23, 33, 34, 45, 45, 67, 300, 500]

Block 2

Called -----

i_start: 18

i_end: 17

i_pivot: 17

Called -----

i_start: 19

i_end: 19

i_pivot: 19

Iteration: 4

i_up: 15

i_down: 16

i_pivot: 15

[1, 2, 3, 3, 3, 4, 5, 6, 8, 10, 12, 15, 23, 33, 34, 45, 45, 67, 300, 500]

Block 4

[1, 2, 3, 3, 3, 4, 5, 6, 8, 10, 12, 15, 23, 33, 34, 45, 45, 67, 300, 500]

Called -----

i_start: 12

i_end: 15

i_pivot: 13

Iteration: 1

i_up: 12

i_down: 15

i_pivot: 13

[1, 2, 3, 3, 3, 4, 5, 6, 8, 10, 12, 15, 23, 33, 34, 45, 45, 67, 300, 500]

Block 1

Called -----

i_start: 12

i_end: 12

i_pivot: 12

Called -----

i_start: 14

i_end: 15

i_pivot: 14

Iteration: 1

i_up: 14

i_down: 15

i_pivot: 14

[1, 2, 3, 3, 3, 4, 5, 6, 8, 10, 12, 15, 23, 33, 34, 45, 45, 67, 300, 500]

Block 2

Called -----

i_start: 14

i_end: 13

i_pivot: 13

Called -----

i_start: 15

i_end: 15

i_pivot: 15

Iteration: 2

i_up: 13

i_down: 14

i_pivot: 13

[1, 2, 3, 3, 3, 4, 5, 6, 8, 10, 12, 15, 23, 33, 34, 45, 45, 67, 300, 500]

Block 2

Called -----

i_start: 12

i_end: 12

i_pivot: 12

Called -----

i_start: 14

i_end: 15

i_pivot: 14

Iteration: 1

i_up: 14

i_down: 15

i_pivot: 14

[1, 2, 3, 3, 3, 4, 5, 6, 8, 10, 12, 15, 23, 33, 34, 45, 45, 67, 300, 500]

Block 2

Called -----

i_start: 14

i_end: 13

i_pivot: 13

Called -----

i_start: 15

i_end: 15

i_pivot: 15

Called -----

i_start: 17

i_end: 19

i_pivot: 18

Iteration: 1

i_up: 17

i_down: 19

i_pivot: 18

[1, 2, 3, 3, 3, 4, 5, 6, 8, 10, 12, 15, 23, 33, 34, 45, 45, 67, 300, 500]

Block 1

Called -----

i_start: 17

i_end: 17

i_pivot: 17

Called -----

i_start: 19

i_end: 19

i_pivot: 19

Iteration: 8

i_up: 11

i_down: 12

i_pivot: 11

[1, 2, 3, 3, 3, 4, 5, 6, 8, 10, 12, 15, 23, 33, 34, 45, 45, 67, 300, 500]

Block 2

Called -----

i_start: 4

i_end: 10

i_pivot: 7

Iteration: 1

i_up: 4

i_down: 10

i_pivot: 7

[1, 2, 3, 3, 3, 4, 5, 6, 8, 10, 12, 15, 23, 33, 34, 45, 45, 67, 300, 500]

Block 1

Called -----

i_start: 4

i_end: 6

i_pivot: 5

Iteration: 1

i_up: 4

i_down: 6

i_pivot: 5

[1, 2, 3, 3, 3, 4, 5, 6, 8, 10, 12, 15, 23, 33, 34, 45, 45, 67, 300, 500]

Block 1

Called -----

i_start: 4

i_end: 4

i_pivot: 4

Called -----

i_start: 6

i_end: 6

i_pivot: 6

Called -----

i_start: 8

i_end: 10

i_pivot: 9

Iteration: 1

i_up: 8

i_down: 10

i_pivot: 9

[1, 2, 3, 3, 3, 4, 5, 6, 8, 10, 12, 15, 23, 33, 34, 45, 45, 67, 300, 500]

Block 1

Called -----

i_start: 8

i_end: 8

i_pivot: 8

Called -----

i_start: 10

i_end: 10

i_pivot: 10

Iteration: 2

i_up: 5

i_down: 9

i_pivot: 7

[1, 2, 3, 3, 3, 4, 5, 6, 8, 10, 12, 15, 23, 33, 34, 45, 45, 67, 300, 500]

Block 1

Called -----

i_start: 4

i_end: 6

i_pivot: 5

Iteration: 1

i_up: 4

i_down: 6

i_pivot: 5

[1, 2, 3, 3, 3, 4, 5, 6, 8, 10, 12, 15, 23, 33, 34, 45, 45, 67, 300, 500]

Block 1

Called -----

i_start: 4

i_end: 4

i_pivot: 4

Called -----

i_start: 6

i_end: 6

i_pivot: 6

Called -----

i_start: 8

i_end: 10

i_pivot: 9

Iteration: 1

i_up: 8

i_down: 10

i_pivot: 9

[1, 2, 3, 3, 3, 4, 5, 6, 8, 10, 12, 15, 23, 33, 34, 45, 45, 67, 300, 500]

Block 1

Called -----

i_start: 8

i_end: 8

i_pivot: 8

Called -----

i_start: 10

i_end: 10

i_pivot: 10

Iteration: 3

i_up: 6

i_down: 8

i_pivot: 7

[1, 2, 3, 3, 3, 4, 5, 6, 8, 10, 12, 15, 23, 33, 34, 45, 45, 67, 300, 500]

Block 1

Called -----

i_start: 4

i_end: 6

i_pivot: 5

Iteration: 1

i_up: 4

i_down: 6

i_pivot: 5

[1, 2, 3, 3, 3, 4, 5, 6, 8, 10, 12, 15, 23, 33, 34, 45, 45, 67, 300, 500]

Block 1

Called -----

i_start: 4

i_end: 4

i_pivot: 4

Called -----

i_start: 6

i_end: 6

i_pivot: 6

Called -----

i_start: 8

i_end: 10

i_pivot: 9

Iteration: 1

i_up: 8

i_down: 10

i_pivot: 9

[1, 2, 3, 3, 3, 4, 5, 6, 8, 10, 12, 15, 23, 33, 34, 45, 45, 67, 300, 500]

Block 1

Called -----

i_start: 8

i_end: 8

i_pivot: 8

Called -----

i_start: 10

i_end: 10

i_pivot: 10

Called -----

i_start: 12

i_end: 19

i_pivot: 15

Iteration: 1

i_up: 12

i_down: 19

i_pivot: 15

[1, 2, 3, 3, 3, 4, 5, 6, 8, 10, 12, 15, 23, 33, 34, 45, 45, 67, 300, 500]

Block 1

Called -----

i_start: 12

i_end: 14

i_pivot: 13

Iteration: 1

i_up: 12

i_down: 14

i_pivot: 13

[1, 2, 3, 3, 3, 4, 5, 6, 8, 10, 12, 15, 23, 33, 34, 45, 45, 67, 300, 500]

Block 1

Called -----

i_start: 12

i_end: 12

i_pivot: 12

Called -----

i_start: 14

i_end: 14

i_pivot: 14

Called -----

i_start: 16

i_end: 19

i_pivot: 17

Iteration: 1

i_up: 16

i_down: 19

i_pivot: 17

[1, 2, 3, 3, 3, 4, 5, 6, 8, 10, 12, 15, 23, 33, 34, 45, 45, 67, 300, 500]

Block 1

Called -----

i_start: 16

i_end: 16

i_pivot: 16

Called -----

i_start: 18

i_end: 19

i_pivot: 18

Iteration: 1

i_up: 18

i_down: 19

i_pivot: 18

[1, 2, 3, 3, 3, 4, 5, 6, 8, 10, 12, 15, 23, 33, 34, 45, 45, 67, 300, 500]

Block 2

Called -----

i_start: 18

i_end: 17

i_pivot: 17

Called -----

i_start: 19

i_end: 19

i_pivot: 19

Iteration: 2

i_up: 17

i_down: 18

i_pivot: 17

[1, 2, 3, 3, 3, 4, 5, 6, 8, 10, 12, 15, 23, 33, 34, 45, 45, 67, 300, 500]

Block 2

Called -----

i_start: 16

i_end: 16

i_pivot: 16

Called -----

i_start: 18

i_end: 19

i_pivot: 18

Iteration: 1

i_up: 18

i_down: 19

i_pivot: 18

[1, 2, 3, 3, 3, 4, 5, 6, 8, 10, 12, 15, 23, 33, 34, 45, 45, 67, 300, 500]

Block 2

Called -----

i_start: 18

i_end: 17

i_pivot: 17

Called -----

i_start: 19

i_end: 19

i_pivot: 19

Iteration: 2

i_up: 13

i_down: 18

i_pivot: 15

[1, 2, 3, 3, 3, 4, 5, 6, 8, 10, 12, 15, 23, 33, 34, 45, 45, 67, 300, 500]

Block 1

Called -----

i_start: 12

i_end: 14

i_pivot: 13

Iteration: 1

i_up: 12

i_down: 14

i_pivot: 13

[1, 2, 3, 3, 3, 4, 5, 6, 8, 10, 12, 15, 23, 33, 34, 45, 45, 67, 300, 500]

Block 1

Called -----

i_start: 12

i_end: 12

i_pivot: 12

Called -----

i_start: 14

i_end: 14

i_pivot: 14

Called -----

i_start: 16

i_end: 19

i_pivot: 17

Iteration: 1

i_up: 16

i_down: 19

i_pivot: 17

[1, 2, 3, 3, 3, 4, 5, 6, 8, 10, 12, 15, 23, 33, 34, 45, 45, 67, 300, 500]

Block 1

Called -----

i_start: 16

i_end: 16

i_pivot: 16

Called -----

i_start: 18

i_end: 19

i_pivot: 18

Iteration: 1

i_up: 18

i_down: 19

i_pivot: 18

[1, 2, 3, 3, 3, 4, 5, 6, 8, 10, 12, 15, 23, 33, 34, 45, 45, 67, 300, 500]

Block 2

Called -----

i_start: 18

i_end: 17

i_pivot: 17

Called -----

i_start: 19

i_end: 19

i_pivot: 19

Iteration: 2

i_up: 17

i_down: 18

i_pivot: 17

[1, 2, 3, 3, 3, 4, 5, 6, 8, 10, 12, 15, 23, 33, 34, 45, 45, 67, 300, 500]

Block 2

Called -----

i_start: 16

i_end: 16

i_pivot: 16

Called -----

i_start: 18

i_end: 19

i_pivot: 18

Iteration: 1

i_up: 18

i_down: 19

i_pivot: 18

[1, 2, 3, 3, 3, 4, 5, 6, 8, 10, 12, 15, 23, 33, 34, 45, 45, 67, 300, 500]

Block 2

Called -----

i_start: 18

i_end: 17

i_pivot: 17

Called -----

i_start: 19

i_end: 19

i_pivot: 19

Iteration: 3

i_up: 14

i_down: 17

i_pivot: 15

[1, 2, 3, 3, 3, 4, 5, 6, 8, 10, 12, 15, 23, 33, 34, 45, 45, 67, 300, 500]

Block 1

Called -----

i_start: 12

i_end: 14

i_pivot: 13

Iteration: 1

i_up: 12

i_down: 14

i_pivot: 13

[1, 2, 3, 3, 3, 4, 5, 6, 8, 10, 12, 15, 23, 33, 34, 45, 45, 67, 300, 500]

Block 1

Called -----

i_start: 12

i_end: 12

i_pivot: 12

Called -----

i_start: 14

i_end: 14

i_pivot: 14

Called -----

i_start: 16

i_end: 19

i_pivot: 17

Iteration: 1

i_up: 16

i_down: 19

i_pivot: 17

[1, 2, 3, 3, 3, 4, 5, 6, 8, 10, 12, 15, 23, 33, 34, 45, 45, 67, 300, 500]

Block 1

Called -----

i_start: 16

i_end: 16

i_pivot: 16

Called -----

i_start: 18

i_end: 19

i_pivot: 18

Iteration: 1

i_up: 18

i_down: 19

i_pivot: 18

[1, 2, 3, 3, 3, 4, 5, 6, 8, 10, 12, 15, 23, 33, 34, 45, 45, 67, 300, 500]

Block 2

Called -----

i_start: 18

i_end: 17

i_pivot: 17

Called -----

i_start: 19

i_end: 19

i_pivot: 19

Iteration: 2

i_up: 17

i_down: 18

i_pivot: 17

[1, 2, 3, 3, 3, 4, 5, 6, 8, 10, 12, 15, 23, 33, 34, 45, 45, 67, 300, 500]

Block 2

Called -----

i_start: 16

i_end: 16

i_pivot: 16

Called -----

i_start: 18

i_end: 19

i_pivot: 18

Iteration: 1

i_up: 18

i_down: 19

i_pivot: 18

[1, 2, 3, 3, 3, 4, 5, 6, 8, 10, 12, 15, 23, 33, 34, 45, 45, 67, 300, 500]

Block 2

Called -----

i_start: 18

i_end: 17

i_pivot: 17

Called -----

i_start: 19

i_end: 19

i_pivot: 19

Iteration: 4

i_up: 15

i_down: 16

i_pivot: 15

[1, 2, 3, 3, 3, 4, 5, 6, 8, 10, 12, 15, 23, 33, 34, 45, 45, 67, 300, 500]

Block 4

[1, 2, 3, 3, 3, 4, 5, 6, 8, 10, 12, 15, 23, 33, 34, 45, 45, 67, 300, 500]

Called -----

i_start: 12

i_end: 15

i_pivot: 13

Iteration: 1

i_up: 12

i_down: 15

i_pivot: 13

[1, 2, 3, 3, 3, 4, 5, 6, 8, 10, 12, 15, 23, 33, 34, 45, 45, 67, 300, 500]

Block 1

Called -----

i_start: 12

i_end: 12

i_pivot: 12

Called -----

i_start: 14

i_end: 15

i_pivot: 14

Iteration: 1

i_up: 14

i_down: 15

i_pivot: 14

[1, 2, 3, 3, 3, 4, 5, 6, 8, 10, 12, 15, 23, 33, 34, 45, 45, 67, 300, 500]

Block 2

Called -----

i_start: 14

i_end: 13

i_pivot: 13

Called -----

i_start: 15

i_end: 15

i_pivot: 15

Iteration: 2

i_up: 13

i_down: 14

i_pivot: 13

[1, 2, 3, 3, 3, 4, 5, 6, 8, 10, 12, 15, 23, 33, 34, 45, 45, 67, 300, 500]

Block 2

Called -----

i_start: 12

i_end: 12

i_pivot: 12

Called -----

i_start: 14

i_end: 15

i_pivot: 14

Iteration: 1

i_up: 14

i_down: 15

i_pivot: 14

[1, 2, 3, 3, 3, 4, 5, 6, 8, 10, 12, 15, 23, 33, 34, 45, 45, 67, 300, 500]

Block 2

Called -----

i_start: 14

i_end: 13

i_pivot: 13

Called -----

i_start: 15

i_end: 15

i_pivot: 15

Called -----

i_start: 17

i_end: 19

i_pivot: 18

Iteration: 1

i_up: 17

i_down: 19

i_pivot: 18

[1, 2, 3, 3, 3, 4, 5, 6, 8, 10, 12, 15, 23, 33, 34, 45, 45, 67, 300, 500]

Block 1

Called -----

i_start: 17

i_end: 17

i_pivot: 17

Called -----

i_start: 19

i_end: 19

i_pivot: 19

Sorted: [1, 2, 3, 3, 3, 4, 5, 6, 8, 10, 12, 15, 23, 33, 34, 45, 45, 67, 300, 500]