

UCSC Silicon Valley Extension

Advanced C Programming

Comb Sort

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Overview

- When sorting with bubble sort in ascending order, small values at bottom (called turtles) move up slowly.
- Comb sort moves turtles up quickly.
- Gap between elements being compared equals 1 in bubble sort, but is variable in comb sort.

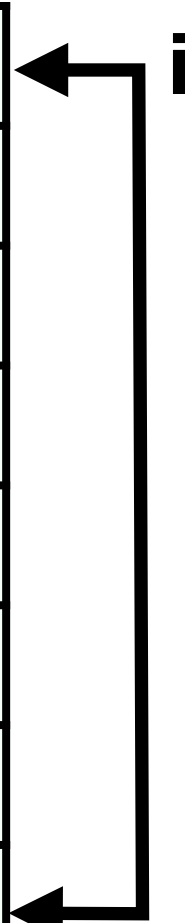
Comb Sort

0	12
1	16
2	21
3	20
4	13
5	17
6	18
7	24
8	15
9	19

$$\text{gap} = n/1.3 = 10/1.3 \approx 7$$

Comb Sort

Iteration 1, gap = 7

0	12	
1	16	
2	21	
3	20	
4	13	
5	17	
6	18	
7	24	
8	15	
9	19	

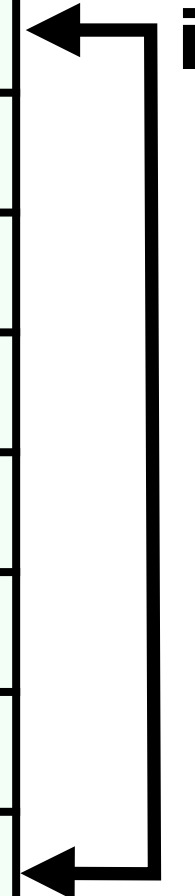
$\text{array}[i] \leq \text{array}[i + \text{gap}]$
 $i++;$

Comb Sort

Iteration 1, gap = 7

0	12
1	16
2	21
3	20
4	13
5	17
6	18
7	24
8	15
9	19

$\text{array}[i] > \text{array}[i + \text{gap}]$
swap and $i++$;



Comb Sort

Iteration 1, gap = 7

0	12
1	15
2	21
3	20
4	13
5	17
6	18
7	24
8	16
9	19

A vertical array of 10 elements is shown. The elements are: 12, 15, 21, 20, 13, 17, 18, 24, 16, 19. The elements at index 2 (21) and index 9 (19) are bolded. A bracket labeled 'i' is positioned to the right of the array, spanning from index 2 to index 9, indicating a comparison between array[2] and array[9].

$\text{array}[i] > \text{array}[i + \text{gap}]$
swap and set new gap;

Comb Sort

0	12
1	15
2	19
3	20
4	13
5	17
6	18
7	24
8	16
9	21

$$\text{gap} = n/1.3 = 7/1.3 \approx 5$$

Comb Sort

Iteration 2, gap = 5

0	12	← i
1	15	
2	19	
3	20	
4	13	
5	17	←
6	18	
7	24	
8	16	
9	21	

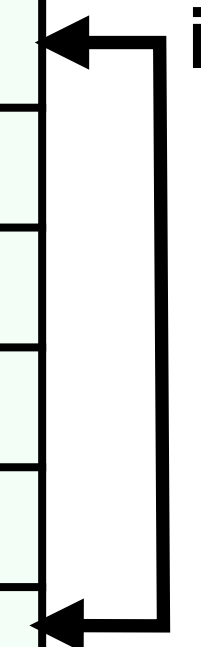
$\text{array}[i] \leq \text{array}[i + \text{gap}]$
 $i++;$

Comb Sort

Iteration 2, gap = 5

0	12
1	15
2	19
3	20
4	13
5	17
6	18
7	24
8	16
9	21

$\text{array}[i] \leq \text{array}[i + \text{gap}]$
 $i++;$

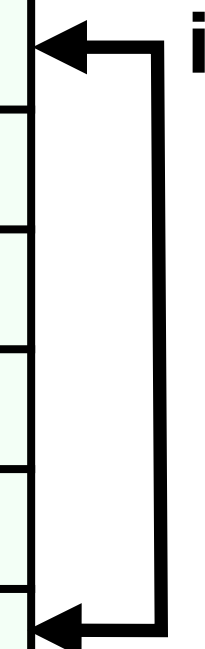


Comb Sort

Iteration 2, gap = 5

0	12
1	15
2	19
3	20
4	13
5	17
6	18
7	24
8	16
9	21

$\text{array}[i] \leq \text{array}[i + \text{gap}]$
 $i++;$

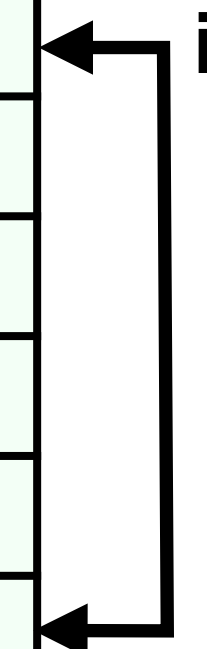


Comb Sort

Iteration 2, gap = 5

0	12
1	15
2	19
3	20
4	13
5	17
6	18
7	24
8	16
9	21

$\text{array}[i] > \text{array}[i + \text{gap}]$
swap and $i++$;



Comb Sort

Iteration 2, gap = 5

0	12
1	15
2	19
3	16
4	13
5	17
6	18
7	24
8	20
9	21

$\text{array}[i] \leq \text{array}[i + \text{gap}]$
set new gap;

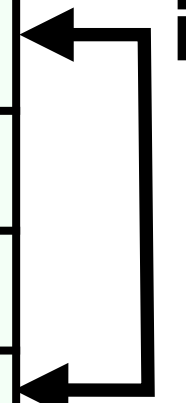
Comb Sort

0	12
1	15
2	19
3	16
4	13
5	17
6	18
7	24
8	20
9	21

$$\text{gap} = n/1.3 = 5/1.3 \approx 3$$

Comb Sort

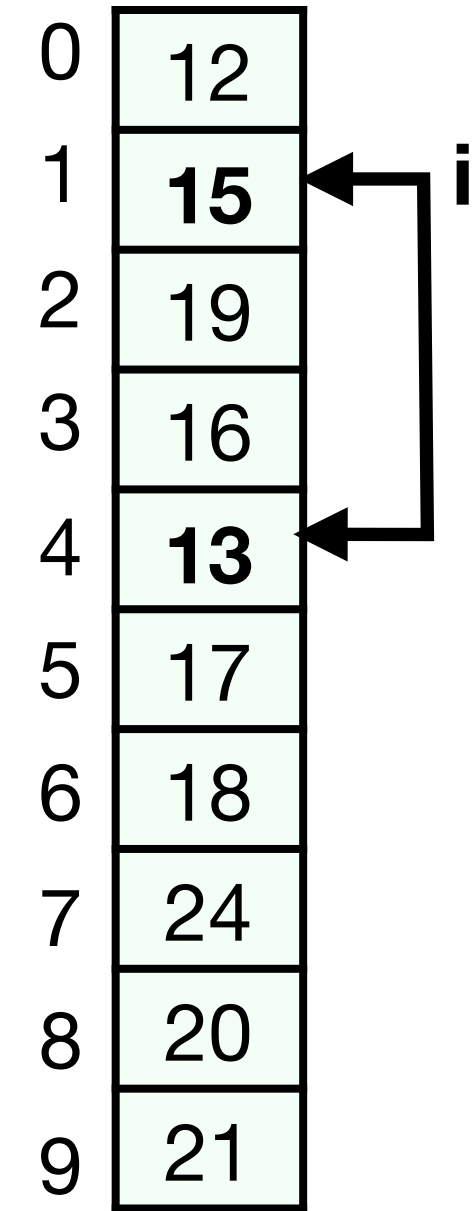
Iteration 3, gap = 3

0	12	
1	15	
2	19	
3	16	
4	13	
5	17	
6	18	
7	24	
8	20	
9	21	

```
array[i] <= array[ i + gap]
i++;
```

Comb Sort

Iteration 3, gap = 3



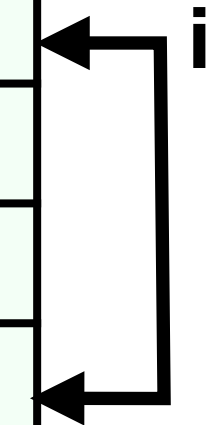
array[i] > array[i + gap]
swap and i++;

Comb Sort

Iteration 3, gap = 3

0	12
1	13
2	19
3	16
4	15
5	17
6	18
7	24
8	20
9	21

$\text{array}[i] > \text{array}[i + \text{gap}]$
swap and $i++$;

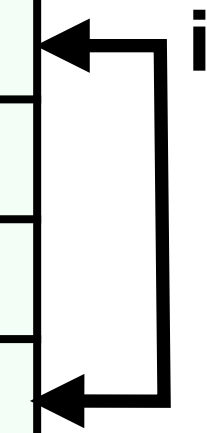


Comb Sort

Iteration 3, gap = 3

0	12
1	13
2	17
3	16
4	15
5	19
6	18
7	24
8	20
9	21

$\text{array}[i] \leq \text{array}[i + \text{gap}]$
 $i++;$



Comb Sort

Iteration 3, gap = 3

0	12
1	13
2	17
3	16
4	15
5	19
6	18
7	24
8	20
9	21

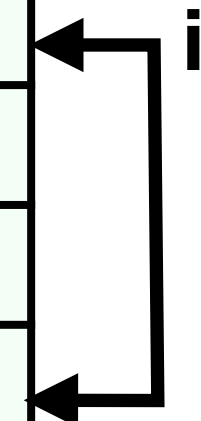
array[i] <= array[i + gap]
i++;

Comb Sort

Iteration 3, gap = 3

0	12
1	13
2	17
3	16
4	15
5	19
6	18
7	24
8	20
9	21

$\text{array}[i] \leq \text{array}[i + \text{gap}]$
 $i++;$

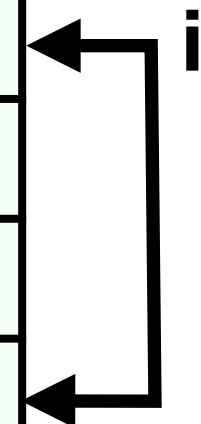


Comb Sort

Iteration 3, gap = 3

0	12
1	13
2	17
3	16
4	15
5	19
6	18
7	24
8	20
9	21

$\text{array}[i] \leq \text{array}[i + \text{gap}]$
set new gap;



Comb Sort

0	12
1	13
2	17
3	16
4	15
5	19
6	18
7	24
8	20
9	21

$$\text{gap} = n/1.3 = 3/1.3 \approx 2$$

Comb Sort

Iteration 4, gap = 2

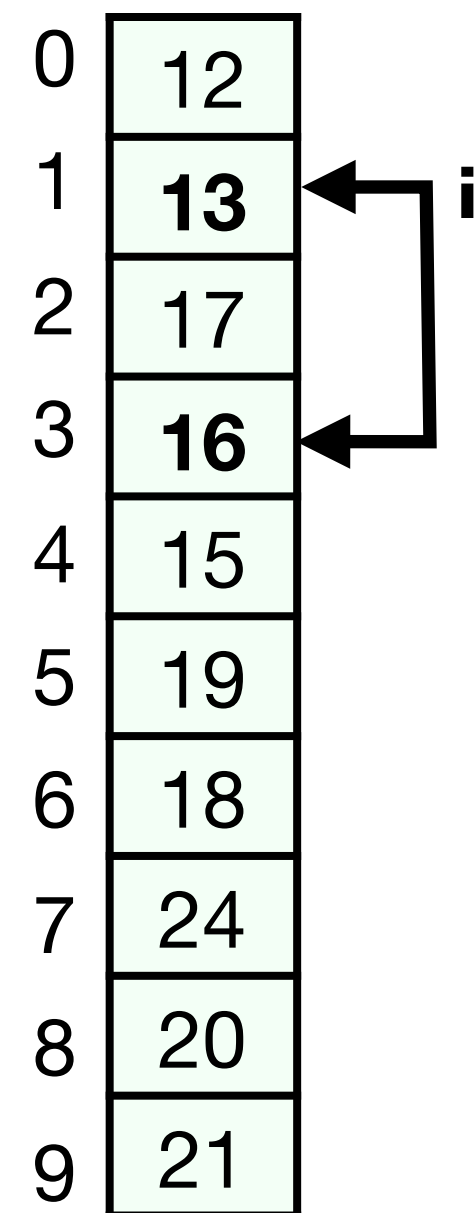
0	12
1	13
2	17
3	16
4	15
5	19
6	18
7	24
8	20
9	21

$\text{array}[i] \leq \text{array}[i + \text{gap}]$
 $i++;$

Comb Sort

Iteration 4, gap = 2

0	12
1	13
2	17
3	16
4	15
5	19
6	18
7	24
8	20
9	21



```
array[i] <= array[ i + gap]  
i++;
```

Comb Sort

Iteration 4, gap = 2

0	12
1	13
2	17
3	16
4	15
5	19
6	18
7	24
8	20
9	21

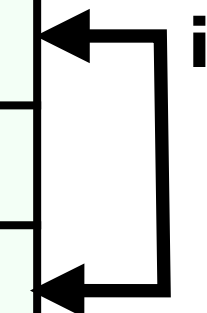
$\text{array}[i] > \text{array}[i + \text{gap}]$
swap and $i++$;

Comb Sort

Iteration 4, gap = 2

0	12
1	13
2	15
3	16
4	17
5	19
6	18
7	24
8	20
9	21

$\text{array}[i] \leq \text{array}[i + \text{gap}]$
 $i++;$



Comb Sort

Iteration 4, gap = 2

0	12
1	13
2	15
3	16
4	17
5	19
6	18
7	24
8	20
9	21

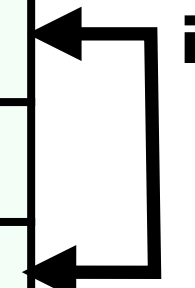
$\text{array}[i] \leq \text{array}[i + \text{gap}]$
 $i++;$

Comb Sort

Iteration 4, gap = 2

0	12
1	13
2	15
3	16
4	17
5	19
6	18
7	24
8	20
9	21

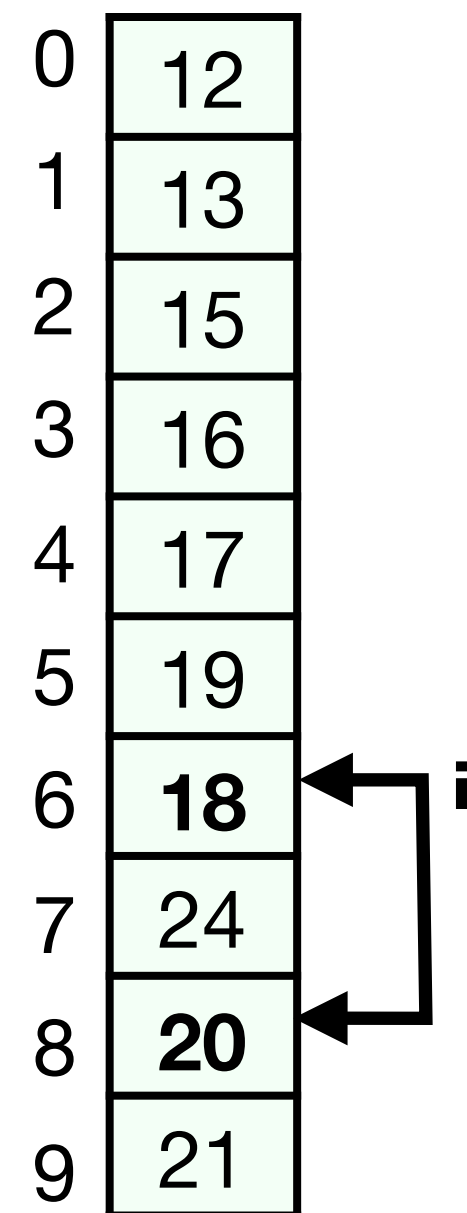
$\text{array}[i] \leq \text{array}[i + \text{gap}]$
 $i++;$



Comb Sort

Iteration 4, gap = 2

0	12
1	13
2	15
3	16
4	17
5	19
6	18
7	24
8	20
9	21



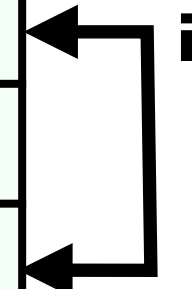
```
array[i] <= array[ i + gap]
i++;
```

Comb Sort

Iteration 4, gap = 2

0	12
1	13
2	15
3	16
4	17
5	19
6	18
7	24
8	20
9	21

$\text{array}[i] > \text{array}[i + \text{gap}]$
swap and set new gap;



Comb Sort

0	12
1	13
2	15
3	16
4	17
5	19
6	18
7	21
8	20
9	24

$$\text{gap} = n/1.3 = 2/1.3 \approx 1$$

Comb Sort

Iteration 5, gap = 1

0	12	← i
1	13	
2	15	
3	16	
4	17	
5	19	
6	18	
7	24	
8	20	
9	21	

```
array[i] <= array[ i + gap]
i++;
```

Comb Sort

Iteration 5, gap = 1

0	12
1	13
2	15
3	16
4	17
5	19
6	18
7	24
8	20
9	21

$\text{array}[i] \leq \text{array}[i + \text{gap}]$
 $i++;$

Comb Sort

Iteration 5, gap = 1

0	12
1	13
2	15
3	16
4	17
5	19
6	18
7	24
8	20
9	21

$\text{array}[i] \leq \text{array}[i + \text{gap}]$
 $i++;$

Comb Sort

Iteration 5, gap = 1

0	12
1	13
2	15
3	16
4	17
5	19
6	18
7	24
8	20
9	21

$\text{array}[i] \leq \text{array}[i + \text{gap}]$
 $i++;$

Comb Sort

Iteration 5, gap = 1

0	12
1	13
2	15
3	16
4	17
5	19
6	18
7	24
8	20
9	21

`array[i] <= array[i + gap]`
`i++;`

Comb Sort

Iteration 5, gap = 1

0	12
1	13
2	15
3	16
4	17
5	19
6	18
7	24
8	20
9	21

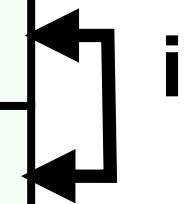
$\text{array}[i] > \text{array}[i + \text{gap}]$
swap and $i++$;

Comb Sort

Iteration 5, gap = 1

0	12
1	13
2	15
3	16
4	17
5	18
6	19
7	24
8	20
9	21

$\text{array}[i] \leq \text{array}[i + \text{gap}]$
 $i++;$

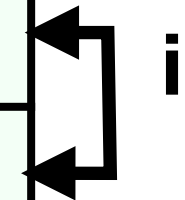


Comb Sort

Iteration 5, gap = 1

0	12
1	13
2	15
3	16
4	17
5	18
6	19
7	24
8	20
9	21

$\text{array}[i] > \text{array}[i + \text{gap}]$
swap and $i++$;



Comb Sort

Iteration 5, gap = 1

0	12
1	13
2	15
3	16
4	17
5	18
6	19
7	20
8	24
9	21

array[i] > array[i + gap]
swap;

Comb Sort

Iteration 6, gap = 1

0	12	← i
1	13	
2	15	
3	16	
4	17	
5	18	
6	19	
7	20	
8	21	
9	24	

```
array[i] <= array[ i + gap]
i++;
```


Comb Sort

Iteration 6, gap = 1

0	12
1	13
2	15
3	16
4	17
5	18
6	19
7	20
8	21
9	24

$\text{array}[i] \leq \text{array}[i + \text{gap}]$
 $i++;$

Comb Sort

Iteration 6, gap = 1

0	12
1	13
2	15
3	16
4	17
5	18
6	19
7	20
8	21
9	24

$\text{array}[i] \leq \text{array}[i + \text{gap}]$
 $i++;$

Comb Sort

Iteration 6, gap = 1

0	12
1	13
2	15
3	16
4	17
5	18
6	19
7	20
8	21
9	24

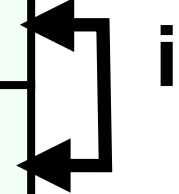
$\text{array}[i] \leq \text{array}[i + \text{gap}]$
 $i++;$

Comb Sort

Iteration 6, gap = 1

0	12
1	13
2	15
3	16
4	17
5	18
6	19
7	20
8	21
9	24

$\text{array}[i] \leq \text{array}[i + \text{gap}]$
 $i++;$

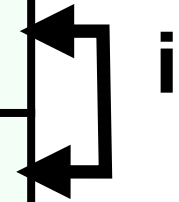


Comb Sort

Iteration 6, gap = 1

0	12
1	13
2	15
3	16
4	17
5	18
6	19
7	20
8	21
9	24

$\text{array}[i] \leq \text{array}[i + \text{gap}]$
 $i++;$

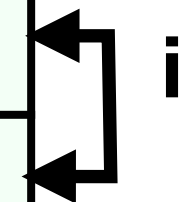


Comb Sort

Iteration 6, gap = 1

0	12
1	13
2	15
3	16
4	17
5	18
6	19
7	20
8	21
9	24

$\text{array}[i] \leq \text{array}[i + \text{gap}]$
 $i++;$



Comb Sort

Iteration 6, gap = 1

0	12
1	13
2	15
3	16
4	17
5	18
6	19
7	20
8	21
9	24

$\text{array}[i] \leq \text{array}[i + \text{gap}]$
 $i++;$

no more swaps and gap = 1; terminate

Comb Sort Solution

0	12
1	13
2	15
3	16
4	17
5	18
6	19
7	20
8	21
9	24

Reference

- https://en.wikipedia.org/wiki/Comb_sort