

Lecture Notes

on

Shell Sort



July 2020 (Be safe and stay at home)



Shell Sort

- Shell short is named after Donald Shell.
- It is also called diminishing increment sort & is a variation of the basic insertion sort algorithm.
- It avoid to compare adjacent element until the last step of the algorithm achieved.
- The running time of shell sort is highly dependent on the selection of an increment sequence $h_i, h_{i-1},, 1$ that effectively partition the original list into a set of sub-lists.



Shell Sort

1 By Donald Shell:

$$h_t = n/2$$
 increment series as: n/2, n/4, n/8.....1.

- 2 By Hibbard: sequence of increment as $1,3,7,.....2^i-1$
- 3 By Knuth:

$$h_i = 1$$

 $h_i = h_i * 3 + 1$
stop when $h_i >= n$



Algorithm

```
\begin{array}{lll} shell-sort(a,n) & h=1; \\ & hille(h<=n) \\ & h=3*h+1; \\ do & h=(h-1)/3 \\ & for(i=h+1 \ to \ n) \\ & v=a[i] \\ & j=i \\ & while \ a[j-h]>v \\ & a[j]=a[j-h] \\ & j=j-h; \\ & if \ j<=h \ then \\ & a[j]=v \\ & while \ h!=1 \end{array}
```



Running Example:

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
a[15]	Α	S	0	R	Т	1	N	G	Ε	Α	Х	М	Р	L	Е

Step 01:

n = 15

$$while(h <= h)$$

$$h=3*1+1=4$$

$$while(4 <= 15)$$

$$h=3*4+1=13$$

$$h=3*13+1=40$$

Now increment is computed in

reverse

$$h=(h-1)/3 = (40-1)/3 = 13$$

$$h=(13-1)/3=4$$

$$h=(4-1)/3=1$$

therefore, increment values are

13,4,1.



													14	
Α	S	0	R	Т	1	Ν	G	Ε	Α	Χ	М	Р	L	Е

for
$$i=13+1$$
 to 15

$$v=a[14], v=L$$

$$i = 14$$

if
$$j <= h (14 <= 13)$$

$$i = 15$$

$$v=a[15], v=E$$

$$i = 15$$

$$a[15]=a[2]$$

$$j=2$$

if
$$j < =13$$

$$a[2] = E$$



1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Α	E	0	R	Т	1	N	G	Ε	Α	X	M	Р	L	S

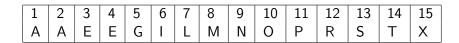
Compare A,T, E, P E,I,X,L O,N,A,S R,G,M

													14	
Α	Ε	Α	G	Ε	1	N	М	Р	L	0	R	Т	Χ	S



1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Α	Ε	Α	G	Ε	I	N	М	Р	L	0	R	Т	Χ	S

now, h=1 compare the adjecent elements





Q & A?

Queries are welcome on slack channel for discussion