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

```
shell-sort(a,n)
       h=1;
       while(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
```

Running Example:

a[15]	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	A	S	O	R	T	I	N	G	E	A	X	M	P	L	E

Step 01:
n=15

while(h<=h)
h=3*1+1 =**4**

while(4<=15)
h=3*4+1 =**13**

while(13<=15)
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.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
A	S	O	R	T	I	N	G	E	A	X	M	P	L	E

Step 02:

for i=13+1 to 15

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

j=14

while a[j-h]>v

i.e. a[1]>L

A>L (false)

if j<=h (14<=13)

i=15

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

j=15

while a[15-13]>v

a[2]>E, S>E (True)

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

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

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
A	E	A	G	E	I	N	M	P	L	O	R	T	X	S

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
A	E	A	G	E	I	N	M	P	L	O	R	T	X	S

now, h=1
compare the adjecent elements

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
A	A	E	E	G	I	L	M	N	O	P	R	S	T	X

Q & A?
Queries are welcome on slack channel for discussion