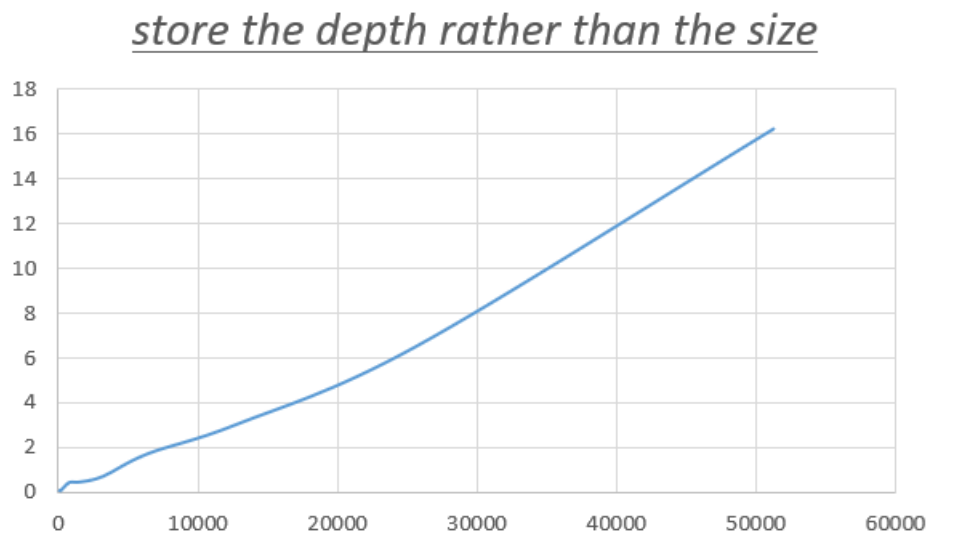
My conclusion: In practice, WQUPC is linear.

1. *store the depth rather than the size*

n	time(milliseconds)	ratio	lg ratio
50	0.03	——	——
100	0.04	1.33	0.41
200	0.08	2.00	1.00
400	0.21	2.63	1.40
800	0.42	2.00	1.00
1600	0.44	1.05	0.07
3200	0.69	1.57	0.65
6400	1.70	2.46	1.30
12800	3.02	1.78	0.83
25600	6.49	2.15	1.10
51200	16.21	2.50	1.32



lg ratio seems to converge to a constant 1.14
Running time is about aN^b with b=1.14
Run the program (for a sufficient large value of N)

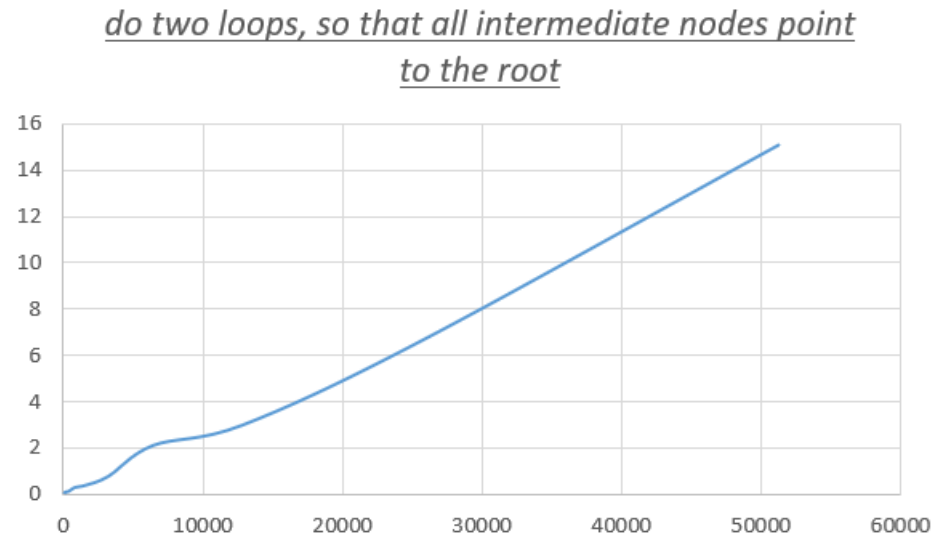
n	time(milliseconds)
102400	32.72

$32.72 = a * 102400^{1.14}$
$\Rightarrow a = 6.35 * 10^{-5}$

Running time is about $6.35 * 10^{-5} * N^{1.14}$ milliseconds.

2. *do two loops, so that all intermediate nodes point to the root*

n	time(milliseconds)	ratio	lg ratio
50	0.03	——	——
100	0.04	1.33	0.41
200	0.08	2.00	1.00
400	0.11	1.38	0.46
800	0.27	2.45	1.29
1600	0.37	1.37	0.45
3200	0.75	2.03	1.02
6400	2.09	2.79	1.48
12800	2.97	1.42	0.51
25600	6.62	2.23	1.16
51200	15.11	2.28	1.19



lg ratio seems to converge to a constant 1.09
Running time is about aN^b with b=1.09
Run the program (for a sufficient large value of N)

n	time(milliseconds)
102400	34.67

$34.67 = a * 102400^{1.09}$
$=> a = 1.20 * 10^{-4}$

Running time is about $1.20 * 10^{-4} * N^{1.09}$ milliseconds.