**Algorithm-1**

|  |  |  |
| --- | --- | --- |
| Step | Cost of each execution | Total # of times executed |
| 1 | 1 | 1 |
| 2 | 1 | Q-P+2 |
| 3 | 1 |  |
| 4 | 1 |  |
| 5 | 1 |  |
| 6 | 6 |  |
| 7 | 7 |  |
| 8 | 1 | 1 |

Multiply col.1 with col.2, add across rows and simplify

T1(n) =

**Algorithm-2**

|  |  |  |
| --- | --- | --- |
| Step | Cost of each execution | Total # of times executed |
| 1 | 1 | 1 |
| 2 | 1 | Q-P+2 |
| 3 | 1 | Q-P+1 |
| 4 | 1 |  |
| 5 | 6 |  |
| 6 | 7 |  |
| 7 | 1 | 1 |

Multiply col.1 with col.2, add across rows and simplify

T2(n) =

**Algorithm-3**

|  |  |  |
| --- | --- | --- |
| Step | Cost of each execution | Total # of times executed in any single recursive call |
| 1 | 4 | 1 |
| 2 | 4 | 1 |
| Steps executed when the input is a base case:1or2 | | |
| First recurrence relation: T(n=1 or n=0) =4 | | |
| 3 |  | 1 |
| 4 | 1 | 1 |
| 5 | 1 | M-L+2 |
| 6 | 6 | M-L+1 |
| 7 | 7 | M-L+1 |
| 8 | 1 | 1 |
| 9 | 1 | U-M+1 |
| 10 | 6 | U-M |
| 11 | 7 | U-M |
| 12 | 3 | 1 |
| 13 | T(n/2) | (cost excluding the recursive call) |
| 14 | T(n/2) | (cost excluding the recursive call) |
| 15 | 5 | 1 |
| Steps executed when input is NOT a base case: all steps | | |
| Second recurrence relation: T(n>1) = T(n/2) +T(n/2)+4 | | |
| Simplified second recurrence relation (ignore the constant term): T(n>1) = 2T(n/2)+O(1) | | |

Solve the two recurrence relations using any method (recommended method is the Recursion Tree). Show your work below:

Level 0 T(n)

/ \

Level 1 T(n/2) T(n/2)

/ \ / \

Level 2 T(n/4) T(n/4) T(n/4) T(n/4)

T3(n) = 2T(n/2) + 4

= T(2T(n/4)+4)+4

T(n) = c + 2c + 4c + ...... + nc

=O(n)

**Algorithm-4**

|  |  |  |
| --- | --- | --- |
| Step | Cost of each execution | Total # of times executed |
| 1 | 1 | 1 |
| 2 | 1 | 1 |
| 3 | 1 | Q-P+2 |
| 4 | 10 | Q-P+1 |
| 5 | 7 | Q-P+1 |
| 6 | 1 | 1 |

Multiply col.1 with col.2, add across rows and simplify

T4(n) = =O(n)

In conclusion, the predicted time complexity usually larger than the real average time. The predictions fit approximate the average time cost. But the difference between prediction and real cost is too large, especially in algorithm 1 and algorithm 2. Therefore, the result is not very reliable and need more accuracy.