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DAA- Tutorial - 4

Q1
Sol^n

$T(n) = 3T(n/2) + n^2$

$a = 3, \quad b = 2$

$n^{\log_b a} = n^{\log_2 3}$

$f(n) = n^2$

$f(n) > n^{\log_2 3}$

$\therefore O(n^2)$.

Q2
Sol^n

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

$a = 4, \quad b = 2$

$n^{\log_2 2^2}$

$f(n) = n^2$

$f(n) = n^{\log_b a}$

$O(n^2 \cdot \log n)$

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Q3

Soln

$$T(n) = T(n/2) + 2^n$$

$$a = 1, \quad b = 2$$

$$n^{\log_2 1} = 1$$

$$f(n) > n^{\log_b a}$$

$$O(2^n)$$

Q4

Soln

$$T(n) = 2^n T(n/2) + n^n$$

∴ Cannot apply master's theorem cuz of a is not a constant.

Q5

Soln

$$T(n) = 16T(n/4) + n$$

$$a = 16 \qquad b = 4$$

$$n^{\log_4 16} = n^2$$

$$f(n) = n^{\log_b a}$$

$$\therefore O(n^2).$$

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Q6

Sol^n

$$T(n) = 2T(n/2) + n\log n$$

$$a = 2 \qquad b = 2$$

$$n^{\log_2 2} = n$$

$$f(n) = n\log n$$

$$K = 1$$

$$T(n) = O(n\log^{K+1} n)$$

$$= O(n\log^2 n)$$

Q7

Sol^n

$$T(n) = 2T(n/2) + n/\log n$$

∴ Masters theorem can't be applied because $n/\log n$ is not a polynomic

Q8

Sol^n

$$T(n) = 2T(n/4) + n^{0.51}$$

∴ Master's theorem does not apply cuz $n^{0.51}$ is not a polynomial.

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Q9
Sol^n

$$T(n) = 0.5\,T(n/2) + 1/n$$

$$a = 1/2 \qquad b = 2$$

∴ Master's theorem can't be applied as $a < 1$ so,

Q10
Sol^n

$$T(n) = 16\,T(n/4) + n!$$

$$a = 16, \quad b = 4$$

$$n^{\log_4 4^2} = n^2$$

$$n^2 < f(n) = n!$$

$$T(n) = O(n!)$$

Q11
Sol^n

$$T(n) = 4T(n/2) + \log n$$

$$a = 4, \quad b = 2$$

$$n^{\log_2 2^2} = n^2$$

$$f(n) = \log n < n^2$$

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$$T(n) = O(n^2)$$

Q12
Sol^n

$$T(n) = \sqrt{n}\, T(n/2) + \log n$$

∴ Master's theorem can't be applied cuz a is not constant.

Q13
Sol^n

$$T(n) = 3T(n/2) + n$$

$$a = 3, \quad b = 2$$

$$n^{\log_b a} = n^{\log_2 3}$$

$$f(n) = n \;?\; n^{\log_2 3}$$

$$\therefore O(n)$$

Q14
Sol^n

$$T(n) = 3T(n/3) + \sqrt{n}$$

∴ Masters theorem can't be applied cuz $\sqrt{n}$ is not polynomial.

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Q15
Soln

$T(n) = 4T(n/2) + \Theta n$

$a = 4, \quad b = 2$

$n^{\log_2 2^2} = n^2$

$n^2 > n^1$

$\therefore O(n^2)$

Q16
Soln

$T(n) = 3T(n/4) + n \log n$

$a = 3, \quad b = 4$

$n^{\log_4 3}, \quad f(n) = n \log n$

$k > 1$

$\therefore O(n \log^2 n)$

Q17
Soln

$T(n) = 3T(n/3) + n/2$

$a = 3, \quad b = 3 \qquad n^{\log_3 3} = n$

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[redacted] $f(n) = n$

$\therefore$ [redacted] $O(n \log n)$

Q18

Sol^n

$$T(n) = 6T(n/3) + n^2 \log n$$

$a = 6, \quad b = 3$

$$f(n) = n^2 \log n$$

$$n^{\log_b a} = n^{\log_3 6} = n^{1.63}$$

$$n^{1.63} < n^2 \log n.$$

Q19

Sol^n

$$T(n) = 4T(n/2) + n/\log n$$

$a = 4, \quad b = 2$

$$n^{\log_2 2^2} = n^2$$

$$f(n) = n/\log n$$

$$n^2 > n/\log n$$

$\therefore$ $O(n^2)$

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Q20

Soln

$$T(n) = 7T(n/3) + n^2$$

$$a = 7, \quad b = 3 \qquad f(n) = n^2$$

$$n^{\log_3 7} < n^2$$

$$\therefore O(n^2)$$

Q21

Soln

$$T(n) = 64T(n/3) - n^2 \log n$$

∴ Master's not applicable here coz of $-n^2 \log n = f(n)$.

Q22

Soln

$$T(n) = T(n/2) + n(2 - \cos n)$$

∴ Master's theorem is not applicable coz $f(n)$ is not a polynomial.