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Problem 1.

$$\begin{aligned}P(x) &= 5x^3 - 2x^2 + 3x - 7 \\P(x) &= -7 + 3x - 2x^2 + 5x^3 \\P(x) &= -7 + 3x + x(-2x + 5x^2) \\P(x) &= -7 + x(3 + x(-2 + 5x)) \\P(2) &= -7 + 2(3 + 2(-2 + 5 \cdot 2)) \\P(2) &= -7 + 2(3 + 2(8)) \\P(2) &= -7 + 2(3 + 16) \\P(2) &= -7 + 2(19) \\P(2) &= -7 + 38 \\P(2) &= 31\end{aligned}$$

3 additions

3 multiplications

Problem 2.

[23, 17, 14, 6, 13, 10, 5, 18]

a) Mergesort

[23, 17], [14, 6], [13, 10], [18, 5] – 4 compares
[23, 17, 14, 6], [18, 13, 10, 5] – 5 compares
[23, 18, 17, 14, 13, 10, 6, 5] – 7 compares

b) Quicksort

[23, 17, 14, 6, 13, 10, 5, {18}] – 1 compare
[5, 17, 14, 6, 13, 10, {18}, 23] – 6 compares
[{23}] – 0 compares
[5, 17, 14, 6, 13, {10}] – 2 compares
[5, 13, 14, 6, {10}, 17] – 1 compare
[5, 6, 14, {10}, 13, 17] – 2 compares
[5, 6, {10}, 14, 13, 17]
[5, {6}] – 1 compare
[{5}] – 0 compares
[14, 13, {17}] – 2 compares
[14, {13}] – 1 compare
[{14}] – 0 compares

c) Heapsort

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      (23)
    (17) (14)
  (6) (13) (10) (5)
(18)
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      (23)
    (17) (14)
  (18) (13) (10) (5)
(6)

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18 > 6

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      (23)
    (18) (14)
  (17) (13) (10) (5)
(6)
18 > 17
23 > 18
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Problem 3.

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

Master theorem:

$f(n) = O(n^{\log_b(a)-\epsilon})$ for some constant $\epsilon > 0$, then $T(n) = \Theta(n^{\log_b(a)})$

$\Theta(n^{\log_2(2)}) = \mathbf{\Theta(n)}$