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Runtime analysis

1) Part a) $n = 2$ $I = 1$

$n = 4$ $I = 2$

I = Iterations for the while loop to quit

$n = 16$ $I = 3$

$n = 256$ $I = 4$

$n = 65,536$ $I = 5$

$n = 4294967296$ $I = 6$

The n will never reach a size in which the iterations are more than 5 since 4294967296 is larger than int max. Therefore 5 $\Theta(1)$ meaning the runtime is constant $\Theta(1)$

Part b) for $(I \leq N)$ (N)

if $(I \% \sqrt{n} = 0)$ ($\sqrt{n}$ probability)

for $(k < i^3)$ (i^3)

$$\sum i^3 = N^{3+1} = n^4$$

$$n^4 \cdot n \cdot n^{1/2} = n^{5/2}$$

$\Theta(n^{5/2})$

Part c) for $(I \leq n)$ (n)

for$(k \leq n)$ (n)

if $(A(k) = I)$ $\longrightarrow$ worst case this triggers $1/n$ times

for$(m \leq n, m = m + m)$ $(\log n)$

$$\frac{n^2 \cdot \log n}{n} = n \log n$$

$\Theta(n \log n)$

Part D) $10 \cdot 3/2 = 15$

$\cdot 3/2 = 22$

$\cdot 3/2 = 33$

$\cdot 3/2 = 49$ ~~mmctas~~ Size increases by 50% each iteration

$10 \cdot (3/2)^x = N \rightarrow 10x$

$3/2^x = N/10$

$x = \log_{3/2} N/10$

If statement runs $\log_{3/2} N/2$ times

for loop — If statement — Inner for loop

$$\Theta(n) + \Theta(\log_{3/2} N/10) + \sum^{\log_{3/2} N/10} (10 \times 3/2^k)$$

$$= \Theta(n) + \Theta(\log_{3/2} N/10) + 10 \sum^{\log_{3/2} N/10} (3/2^k)$$

$$= \Theta(n) + \Theta(\log_{3/2} N/10) + 10\Theta(N/10)$$

$\leftarrow$ domination

$$= \Theta(n + \log_{3/2} N/10 + n)$$

$$= \Theta(2n)$$

$$= \Theta(n)$$