HW # 2 Solutions

1. Machine speed $= 10^{-9}$ sec/op $= 10^{9}$ op/sec.

$T(n) = 15n^2, 8n^3, 2^n, 3^n, n!, n\log n$.

Total operations in 1 day $= 86400 \times 10^9$ operations.

$$15n^2 = 86400 \times 10^9.$$

$$\boxed{n = \sqrt{\frac{86400 \times 10^9}{15}}}$$

You have to simplify using calculator.

Similarly for $8n^3, 2^n, 3^n$.

for $n!$, $n\log n$ try using any programming language. (We will not give such functions in examination).

2. $A = \langle 13, 57, 19, 28, 21, 68, 17, 54 \rangle$

(i)

13	57	19	28	21	68	17	54

(ii)

13	57	19	28	21	68	17	54

(iii)

13	57	19	28	21	68	17	54

(iv)

13	19	57	28	21	68	17	54

V

13	19	28	57	21	68	17	54

VI

13	19	21	28	57	68	17	54

VII

13	19	21	28	57	68	17	54

VIII

13	17	19	21	28	57	68	54

IX

13	17	19	21	28	54	57	68

Merge

13	57	19	28	21	68	17	54

13	57	19	28

21	68	17	54

13	57

19	28

21	68

17	54

13 | 57 | 19 | 28 | 21 | 68 | 17 | 54

13	57

19	28

21	68

17	54

13	19	28	57

17	21	54	68

13	17	19	21	28	54	57	68

Similarly for array B.

(3) Direct from slides. (Average case complexity for sequential search).

Prove. $\sum_{i=1}^{n} i = \frac{n(n+1)}{2}$

Base case: $n=1$

$1 = \frac{1(1+1)}{2}$.

$1 = 1$.

Assuming it is true for 'n'.

Inductive step.

$$\sum_{i=1}^{n} i + (n+1) = \frac{n(n+1)}{2} + (n+1)$$

$$= \frac{n(n+1) + 2(n+1)}{2}.$$

$$= \frac{(n+1)(n+2)}{2}.$$

$\therefore$ It is true for $(n+1)$.

$$\boxed{\text{Hence } \sum_{i=1}^{n} i = \frac{n(n+1)}{2}}$$

4. Plot graphs using any programming language.

From $n \geq 44$, $T_2(n) \leq T_1(n)$.

$\therefore [44, \infty) \rightarrow$ algorithm 2 is better performing.

To obtain the above values, I have assumed log base $\rightarrow$ '2'.

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