1. We now that a laptop on average takes 10^{-6} seconds to execute a single algorithm step. when does the code finish if $n = 10^8$.

$$\begin{aligned} &for \quad i = 1 : n \\ &\quad sum{+}{+} \end{aligned}$$

$\sum_{i=1}^{n} 1 = \Theta(n)$. $10^8 \cdot 10^{-6} = 10^2$ seconds.

2. Using the same computer when does the code finish if $n = 10^8$

$$\begin{aligned} &for \quad i = 1 : n^2 \\ &\quad for\, j = 1 : i \\ &\quad sum{+}{+} \end{aligned}$$

$\sum_{i=1}^{n^2} \sum_{j=1}^{i} c = \sum_{i=1}^{n^2} c \cdot i = \Theta(n^4)$. $(10^8)^4 \cdot 10^{-6} = 10^{32} \cdot 10^{-6} = 10^{26}$.

3. Using the same computer when does the code finish if $n = 10^8$

$$\begin{aligned} &for \quad i = 1 : log_2(n) \\ &\quad for\, j = 1 : i \\ &\quad sum{+}{+} \end{aligned}$$

$\sum_{i=1}^{log_2(n)} \sum_{j=1}^{i} c = \sum_{i=1}^{log_2(n)} c{\cdot}i = \Theta(log_2^2(n))$. $(log_2(10^8))^2{\cdot}10^{-6} = (8^2{\cdot}log_2(10)){\cdot}$ 10^{-6}.

4. Using the same computer when does the code finish if $n = 10^8$.

$$\begin{aligned} &for \quad i = 1 : n \\ &\quad for\, j = 1 : i^2 \\ &\quad for\, k = 1 : j \\ &\qquad\qquad sum{+}{+} \end{aligned}$$

$\sum_{i=1}^{n} \sum_{j=1}^{i^2} \sum_{k=1}^{j} c = \sum_{i=1}^{n} \sum_{j=1}^{i^2} c \cdot j = \sum_{i=1}^{n} i^4 = \Theta(n^5)$. $(10^8)^5 \cdot 10^{-6} = 10^{34}$.

5. Using the same computer when does the code finish if $n = 10^8$.

$$\begin{aligned} &for \quad i = 1 : n \\ &\quad for\, j = 1 : s[i] \\ &\quad sum{+}{+} \end{aligned}$$

$|S| = n, \sum_{i=1}^{n} s[i] = n^3 . \sum_{i=1}^{n} \sum_{i=1}^{s[i]} 1 = \sum_{i=1}^{n} s[i] = \Theta(n^3)$. $(10^8)^3 \cdot 10^{-6} = 10^{18}$.

6. Using the same computer when does the code finish if $n = 10^8$

$$\begin{gathered} for \qquad i = 1 : n \\ if\, i < log_2(n) \\ sum++ \\ else \\ break \end{gathered}$$

$\sum_{i=1}^{log_2(n)} 1 = \Theta(log_2(n))$. $8 \cdot log_2(10) \cdot 10^{-6}$.

7. Using the same computer when does the code finish if $n = 10^8$.

$$\begin{gathered} for \qquad i = 1 : n \\ if\, i\%2 == 1 \\ sum+ = f(i) \\ else \\ sum+ = g(i) \end{gathered}$$

$\sum_{i=1}^{\frac{n}{2}} i + \sum_{i=1}^{\frac{n}{2}} i^2 = \Theta(n^3)$.

8. Characterize linear search.

$\Omega(1), O(n)$.

9. Characterize binary search.

$\Omega(1), O(log_2(n))$.