

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

$$T(n) = 2T\left(\frac{n}{2}\right) + n, \quad T(1) = 1$$

$$T(n) = 2\left(2T\left(\frac{n}{4}\right) + \frac{n}{2}\right) + n$$

$$T(n) = 4T\left(\frac{n}{4}\right) + n + n$$

$$T(n) = 4\left(2T\left(\frac{n}{8}\right) + \frac{n}{4}\right) + n + n$$

$$T(n) = 8T\left(\frac{n}{8}\right) + n + n + n$$

$$T(n) = 8\left(2T\left(\frac{n}{16}\right) + \frac{n}{8}\right) + n + n + n$$

$$T(n) = 16T\left(\frac{n}{16}\right) + n + n + n + n$$

$$T(n) = 2^k T\left(\frac{n}{2^k}\right) + kn$$

$$\frac{n}{2^k} = 1, \quad n = 2^k, \quad k = \log_2 n$$

$$T(n) = 2^{\log_2 n} \left( T\left(\frac{n}{2^{\log_2 n}}\right) \right) + n \log_2 n$$

$$T(n) = n \left( T\left(\frac{n}{n}\right) \right) + n \log_2 n$$

$$= n(T(1)) + n \log_2 n$$

$$= n + n \log_2 n$$

$$\boxed{O(n \log_2 n)}$$

Substituting Equations

$$T\left(\frac{n}{2}\right) = 2T\left(\frac{n/2}{2}\right) + \frac{n}{2}$$

$$T\left(\frac{n}{4}\right) = 2T\left(\frac{n/4}{2}\right) + \frac{n}{4}$$

$$T\left(\frac{n}{8}\right) = 2T\left(\frac{n/8}{2}\right) + \frac{n}{8}$$