1. Environment: visual studio code

2. Divide and conquer

Divide the coin pile into three piles A, B, C

To compare:

divide all coins into 3 piles

for example 32 coins

10 group A

10 group B

10 group C

2 left

compare A, B, C

if A = B = C ⇒ compare the last two coins

if there is a group weigh different

then go function recursion until find the fake coin

at level $0 \rightarrow 3^0$ nodes

level $1 \rightarrow 3^1$ nodes

level $2 \rightarrow 3^2$ nodes

$\vdots$

level $n \rightarrow 3^n$ nodes

$$3^n = n - (3^0 + 3^1 + \dots + 3^{n-1})$$

$$= n - \frac{(3^n - 1)}{2}$$

$$3^n = \frac{2n - 3^n + 1}{2}$$

$$2 \times 3^n = 2n - 3^n + 1$$

$$3^n = 2n + 1$$

$$n = \text{ceil}\left[\log_3(2n+1)\right]$$

$$\Rightarrow O(n) = O(\log(n))$$