Robin-karp

Hash function,

$$H = S[0] * B^{m-1} + S[1] * B^{m-2} + \text{-----} + S[m-1] * B^{0}$$

Increasing length,

$$H_i = H_{S[0] \text{-----} S[i]}$$

$$H_{i+1} = H_{S[0] \text{-----} S[i+1]}$$

$$H_{i+1} = (H_i * B) + S[i+1]$$

or, $H_i = (H_{i-1} * B) + S[i]$

Fixed length m,

$$H_i = H_{S[i] \text{-----} S[i+m]}$$

$$H_{i+1} = H_{S[i+1] \text{----} S[i+m]}$$

$$H_i = (H_{i-1} - S[i-1] * B^{m-1}) * B + S[i+m-1]$$

Double hasing with mod,

$b_1 = 311$ $m_1 = 1000000007$

$b_2 = 313$ $m_2 = 1000000009$

Fibonacci (log n)

$$\begin{pmatrix} 1 & 1 \\ 1 & 0 \end{pmatrix}^n = \begin{pmatrix} F_{n+1} & F_n \\ F_n & F_{n-1} \end{pmatrix}$$

Generalised Fibonacci series,

$$G(a,b) \rightarrow \begin{cases} G(0) = a \\ G(1) = b \\ G(i) = G(i-1) + G(i-2) \end{cases}$$

Ex –

$G(1,2) \rightarrow 1, 2, 3, 5, 8, 13, \ldots$

Relation –

$$G(a,b,n) = a\,F(n-1) + b\,F(n)$$

Here, $F \rightarrow$ normal fibonacci series.

Number Theory

Date : ....

$(x+y)^n = \sum_{r=0}^{n} {}^nC_r \, x^{n-r} y^r$

$x = y = 1,$

$\sum_{r=0}^{n} {}^nC_r = 2^n$

$Phi(p_1^{a_1} * p_2^{a_2} * p_3^{a_3}) =$

$Phi(p_1^{a_1}) * Phi(p_2^{a_2}) * Phi(p_3^{a_3})$

$Phi(p^a) = p^a - p^{a-1}$

$\left\lfloor \frac{\lfloor \frac{x}{m} \rfloor}{n} \right\rfloor = \left\lfloor \frac{x}{mn} \right\rfloor$

$GCD(a,b) = GCD(a+b, b) = GCD(a-b, b)$

Bitmask

```
unsigned flag[NN>>6];

# define Check(n)
    (flag[n>>6] & (1<<((n>>1) & 31)))

# define Set(n)
    (flag[n>>6] |= (1<<((n>>1)&31)))
```

STL bitset

```
bitset<NN> bs;

bs.set();
bs.reset();
bs.set(5);
bs.set(5,0);

bs.flip();
bs.flip(2);

if(bs[5]==0) cout<< "false";
```

No. of 1's in binary of a number:

```
bitset<64> bs(x);
cout<< bs.count();
```

Harmonic Series

$$H_n = 1 + 1/2 + 1/3 + \text{------} + 1/n$$

Approximation,

$$H_n = \log_e(n) + \gamma$$

γ = Euler's constant $= 0.5772156649$

use this when n is large $(n > 10^6)$ otherwise use loop.

$\gamma = 0.57721566490153286 1$

Euler-Mascheroni Constant