Applied Algorithms	Date: January 24, 2012
	Rabin-Karp algorithm
Professor: Antonina Kolokolova	Scribe: Md. Asaduzzaman

1 String Matching

1.1 Rabin-Karp algorithm

Rabin-Karp string searching algorithm calculates a numerical (hash) value for the pattern p, and for each m-character substring of text t. Then it compares the numerical values instead of comparing the actual symbols. If any match is found, it compares the pattern with the substring by naive approach. Otherwise it shifts to next substring of t to compare with p.

We can compute the numerical (hash) values using Horner's rule.

Lets assume, $h_0 = k$

$$h_1 = d\left(k - p\left[1\right].d^{m-1}\right) + \ p\left[m+1\right]$$

Suppose, we have given a text t = [3, 1, 4, 1, 5, 2] and m = 5, q = 13;

t_0 = 31415

So t_1 = 10(31415 - 10^{5-1}.t[1]) + t[5+1]

$= 10(31415 - 10^4.3) + 2$

$= 10(1415) + 2 = 14152$

Here p and substring t_i may be too large to work with conveniently. The simple solution is, we can compute p and the t_i modulo a suitable modulus q.

So for each i,

$h_{i+1} = (d\left(h_i - t\left[i+1\right].d^{m-1}\right) + \ t\left[m+i+1\right])$ mod q

The modulus q is typically chosen as a prime such that d.q fits within one computer word.

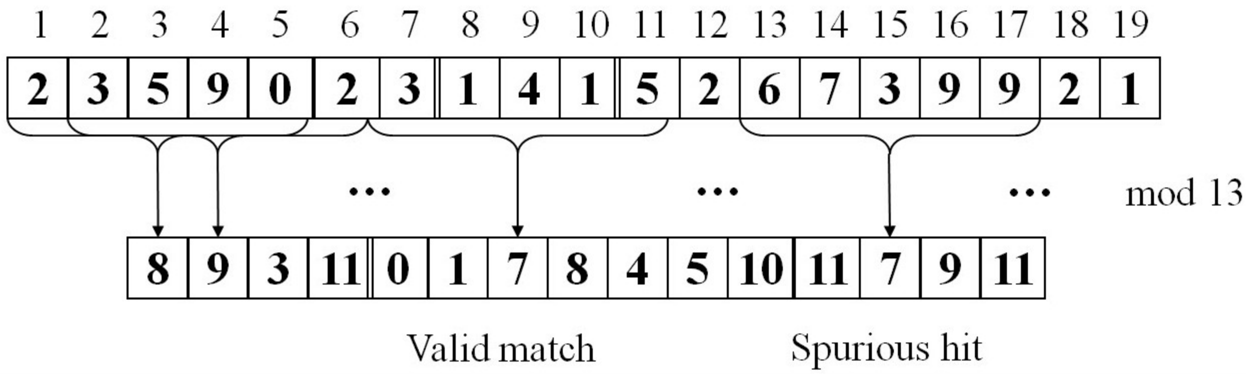
Algorithm

Compute h_p (for pattern p)
Compute h_t (for the first substring of t with m length)
For $i = 1$ to $n - m$
  If $h_p = h_t$
    Match $t[i \dots .i + m]$ with p, if matched return 1
  Else
    $h_t = (d\left(h_t - t\left[i+1\right].d^{m-1}\right) + \ t\left[m+i+1\right])$ mod q
End

Suppose, t= 2359023141526739921 and p = 31415,

Now, h_p = 7 (31415 = 7 (mod 13))

substring beginning at position 7 = valid match



This algorithm has a significant improvement in average-case running time over naive approach.