CSIT 5500 Advanced Algorithms

2020 Spring Semester

Written Assignment 2 solution

1. (10 points)

q	0	1	2	3	4	5	6	7	8	9	10	11	12
$P[q]$	c	g	t	a	c	g	t	t	c	g	t	a	c
$next(q)$	-1	-1	-1	-1	0	1	2	-1	0	1	2	3	4

2. (10 points)

Stage 0:

i	Ordered pairs	Substring	Rank
8	nil	\$	0
7	nil	e	1
1	nil	i	2
3	nil	i	2
5	nil	i	2
0	nil	m	5
4	nil	m	5
2	nil	n	7
6	nil	z	8

Stage 1:

i	Ordered pairs	Substring	Rank
8	(0, 0)	\$\$	0
7	(1, 0)	e\$	1
3	(2, 5)	im	2
1	(2, 7)	in	3
5	(2, 8)	iz	4
0	(5, 2)	mi	5
4	(5, 2)	mi	5
2	(7, 2)	ni	7
6	(8, 1)	ze	8

Stage 2:

i	Ordered pairs	Substring	Rank
8	(0, 0)	\$\$\$\$	0
7	(1, 0)	e\$\$\$	1
3	(2, 4)	imiz	2
1	(3, 2)	inim	3
5	(4, 1)	ize\$	4
0	(5, 7)	mini	5
4	(5, 8)	mize	6
2	(7, 5)	nimi	7
6	(8, 0)	ze\$\$	8

Stage 3:

i	Ordered pairs	Substring	Rank
8	(0, 0)	$$$$$$$$	0
7	(1, 0)	e$$$$$$$	1
3	(2, 1)	imize$$$	2
1	(3, 4)	inimize$	3
5	(4, 0)	ize$$$$$	4
0	(5, 6)	minimize	5
4	(6, 0)	mize$$$$	6
2	(7, 8)	nimize$$	7
6	(8, 0)	ze$$$$$$	8

3. (10 points) For $0 \leq i \leq n$, let $V[i]$ denote the truth value whether the first i characters of s can be reconstituted as a sequence of valid words.

   Base case: $V[0] = \text{True}$.
   Recursive case: $V[i] = \text{OR}_{j=0}^{i-1}(V[j] \text{ AND } \text{dict}(s[j+1, i]))$

   We compute $V[j]$ in increasing order of j. The solution is $V[n]$.

   There are $O(n)$ subproblems. Each subproblem can be solved in $O(n)$ time. So, the running time is $O(n^2)$.

   The recurrence relation is to find a suffix w of $s[1, i]$ such that w is a word in the dictionary and $s[1, i-|w|]$ can be reconstituted as a sequence of valid words. Base on the optimal substructure, $V[i-|w|]$ is computed correctly. So, $V[i]$ represents whether the first i characters of s can be reconstituted as a sequence of valid words, and thus $V[n]$ is the desired answer.