CS590 – Algorithms Assignment 4

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Q4. Find the maximum alignment for *X* = dcdcbacbbb and *Y* = acdccabdbb by using the Smith-Waterman algorithm. Execute the pseudocode algorithm and fill the necessary tables *H* and *P* in a bottom-up fashion. Reconstruct the strings *X*‘ and *Y*‘ using the tables H and P.

Table for H:

0	0	0	0	0	0	0	0	0	0	0
0	-1	-1	2	1	0	-1	-1	2	1	0
0	-1	1	1	4	3	2	1	1	1	0
0	-1	0	3	3	3	2	1	3	2	1
0	-1	1	2	5	5	4	3	2	2	1
0	-1	0	1	4	4	4	6	5	4	4
0	2	1	0	3	3	6	5	5	4	3
0	1	4	3	2	5	5	5	4	4	3
0	0	3	3	2	4	4	7	6	6	6
0	-1	2	2	2	3	3	6	6	8	8
0	-1	1	1	1	2	2	5	5	8	10

Table for P:

-	d	d	d	l	l	d	d	d	l	l
-	d	d	u	d	d	l	l	u	d	d
-	d	u	d	u	d	d	d	d	l	l
-	d	d	u	d	d	l	l	u	d	d
-	d	u	u	u	d	d	d	l	d	d
-	d	l	u	u	d	d	u	d	d	d
-	u	d	l	d	d	u	d	d	d	d
-	u	u	d	d	u	d	d	l	d	d
-	d	u	d	d	u	d	d	d	d	d
-	d	u	d	d	u	d	d	d	d	d

15. 1-2

Show, by means of a counterexample, that the following "greedy" strategy does not always determine an optimal way to cut rods. Define the ***density*** of a rod of length i*i* to be p_i / i*pi*/*i*, that is, its value per inch. The greedy strategy for a rod of length n*n* cuts off a first piece of length i*i*, where 1 \le i \le n1≤*i*≤*n*, having maximum density. It then continues by applying the greedy strategy to the remaining piece of length n - i*n*−*i*.

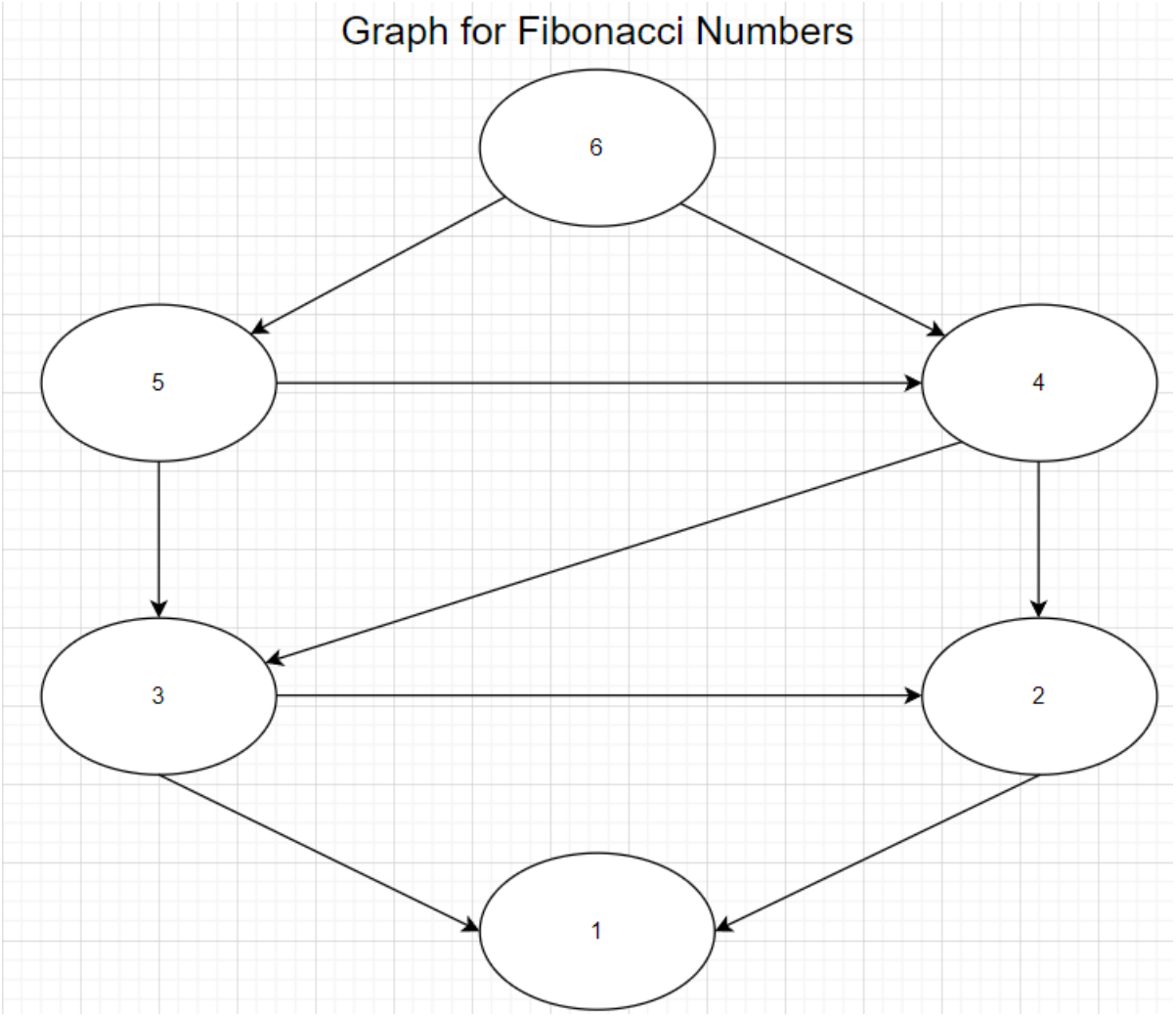
Let p1 = 0, p2 = 4, p3 = 7 and n = 4. The greedy strategy would first cut off a piece of length 3 since it has highest density. The remaining rod has length 1, so the total price would be 7. On the other hand, two rods of length 2 yield a price of 8.

15. 1-5

The Fibonacci numbers are defined by recurrence (3.22). Give an O(n)$O(n)$-time dynamic-programming algorithm to compute the nth Fibonacci number. Draw the subproblem graph. How many vertices and edges are in the graph?

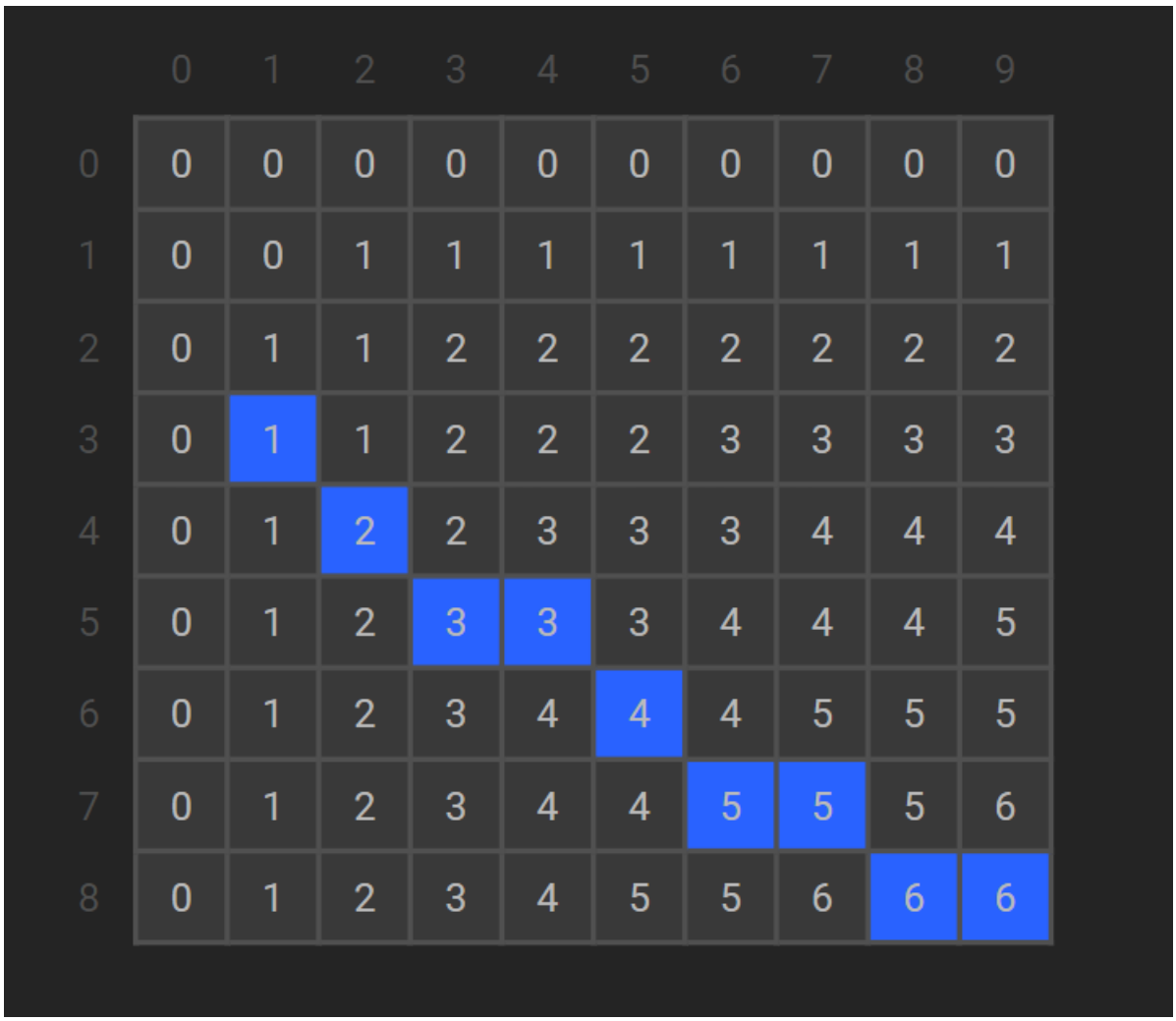
Algorithm for Fibonacci:

```
FIBONACCI(n)
   let fib[0..n] be a new array
   fib[0] = 1
   fib[1] = 1
   for i = 2 to n
      fib[i] = fib[i - 1] + fib[i - 2]
   return fib[n]
```


Graph for Fibonacci Numbers
6
5
4
3
2
1

15. 4-1

Determine an LCS of ⟨1,0,0,1,0,1,0,1⟩ and ⟨0,1,0,1,1,0,1,1,0⟩.



	0	1	2	3	4	5	6	7	8	9
0	0	0	0	0	0	0	0	0	0	0
1	0	0	1	1	1	1	1	1	1	1
2	0	1	1	2	2	2	2	2	2	2
3	0	1	1	2	2	2	3	3	3	3
4	0	1	2	2	3	3	3	4	4	4
5	0	1	2	3	3	3	4	4	4	5
6	0	1	2	3	4	4	4	5	5	5
7	0	1	2	3	4	4	5	5	5	6
8	0	1	2	3	4	5	5	6	6	6

The LCS is ⟨1,0,0,1,1,0⟩ or ⟨1,0,1,0,1,0⟩.