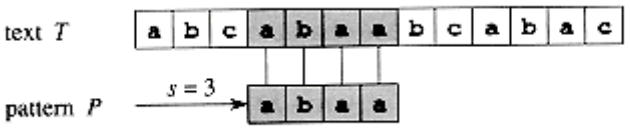
# Pattern Matching

In this chapter, we will primarily talk about two string searching algorithms, the **Knuth Morris Pratt** algorithm and **Z - Algorithm**.

## Introduction

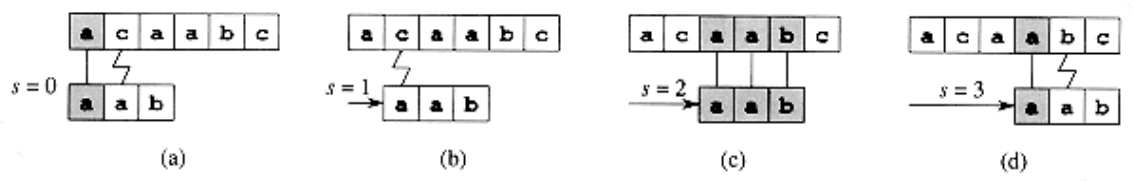
Suppose you are given a string text of length n and a string pattern of length m. You need to find all the occurrences of the pattern in the text or report that no such instance exists.




In the above example, the pattern “abaa” appears at position 3 (0 indexed) in the text “abcabaabcabac”.

## Naive Algorithm

A naive way to implement this pattern searching is to move from each position in the text and start matching the pattern from that position until we encounter a mismatch between the characters or say that the current position is a valid one.




In the given picture, The length of the text is 5 and the length of the pattern is 3. For each position from 0 to 3, we choose it as the starting position and then try to match the next 3 positions with the pattern.

### Naive pattern matching

- For each i from 0 to N - M
- For each j from 0 to M - 1, try to match the jth character of the pattern with (i + j)th character of the string text.
- If a mismatch occurs, skip this instance and continue to the next iteration.
- Else output this position as a matching position.

```
function NaivePatternSearch(text, pattern)
        //   iterate for each candidate position
        for i from 0 to text.length - pattern.length

                // boolean variable to check if any mismatch occurs
                match  = True

                for j from 0 to pattern.length - 1
                        //   if mismatch make match = False
                        if text[i  + j] not equals pattern[j]
                                match = False
                                break


                //   if no mismatch print this position
                if match == True
                        print the occurrence  i
        return
```

**Time Complexity: O(N*M)**, where N is the length of the text and M is the length of the pattern we need to search.