Exact Pattern Matching on Strings: Boyer-Moore

Chapter 2 of Dan Gusfield: *Algorithms on strings, trees, and sequences*

Giulia Bernardini
giulia.bernardini@units.it

Algorithmic Design, Advanced Algorithms for Scientific Computing, Algorithmic Data Mining
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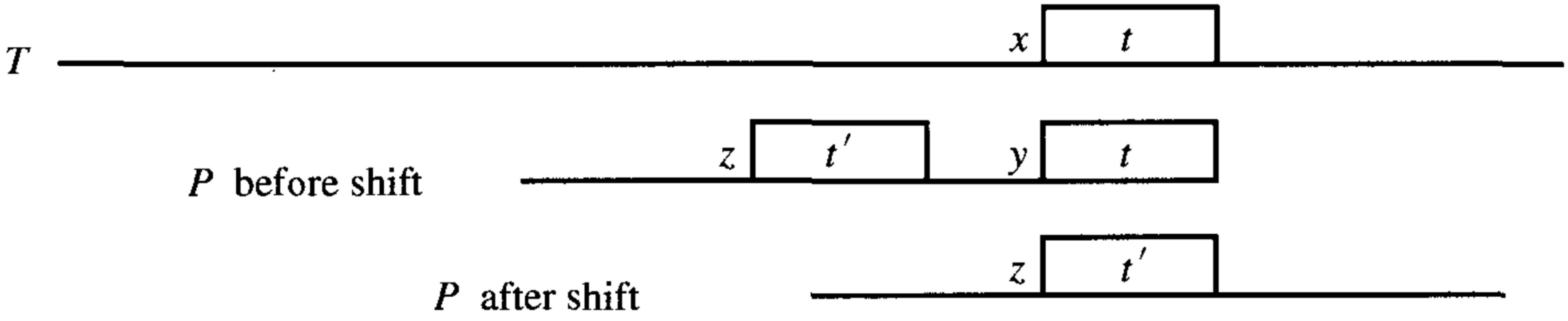
The Boyer-Moore-Galil algorithm

Boyer-Moore-Galil is the practical method of choice for exact matching: it typically examines less than |P|+|T| characters, so it has an expected sublinear running time and a linear worst-case time.

It uses four clever ideas:

1. The characters of the pattern are scanned from right to left
2. It uses the bad character shift rule
3. It uses the good suffix shift rule
4. It uses the Galil rule

The good suffix rule



Preprocessing P for the good suffix rule requires O(|P|) time.

Preprocessing P for the bad character rule

Let Σ be the alphabet of T (note that we can assume $|\Sigma| \leq |T|$).

- Initialise an array of zeroes R of length $|\Sigma| \leq |T|$
- For each $i=1,\ldots,|P|$, $R[P[i]] \leftarrow i$
- At the end, $R[x]$ contains the rightmost position of P where character x occurs; or 0 if x does not occur in P.
- This preprocessing requires $\Theta(|\Sigma|+|P|)$ time

Comparison between Knuth-Morris-Pratt and Boyer-Moore-Galil

- Both use a sliding window of the same length as the pattern. The window delimits a factor of the text to be examined, and slides along the text from left to right. Not all existing pattern matching algorithms use this framework.

KMP

- $\Theta(|P|+|T|)$ worst-case running time
- P is scanned from left to right

BMG

- $O(|P|+|T|)$ worst-case running time; sublinear expected time
- P is scanned from right to left