String Matching

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Programming, Data Structures and Algorithms using Python

Week 10

String matching

- Searching for a pattern is a fundamental problem when dealing with text
  - Editing a document
  - Answering an internet search query
  - Looking for a match in a gene sequence

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  - `an` occurs in `banana` at two positions
- Formally
  - A text string `t` of length n
  - A pattern string `p` of length m
  - Both `t` and `p` are drawn from an alphabet of valid letters, denoted Σ
  - Find every position `i` in `t` such that `t[i:i+m] == p`

Brute force

- Nested loop
  - For each starting position `i` in `t`, compare `t[i:i+m]` with `p`

```
def stringmatch(t,p):
  poslist = []
  for i in range(len(t)-len(p)+1):
    matched = True
    j = 0
    while j < len(p) and matched:
      if t[i+j] != p[j]:
        matched = False
      j = j+1
    if matched:
      poslist.append(i)
  return(poslist)
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  - `t = aaa...a`, `p = aaab`
- Can also do nested scan from right to left
  - Worst case still $O(nm)$, `t = aaa...a`, `p = baaa`
  - Can reversing the scan help?

```
def stringmatchrev(t,p):
  poslist = []
  for i in range(len(t)-len(p)+1):
    matched = True
    j = len(p)-1
    while j >= 0 and matched:
      if t[i+j] != p[j]:
        matched = False
      j = j-1
    if matched:
      poslist.append(i)
  return(poslist)
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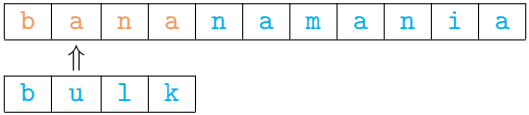

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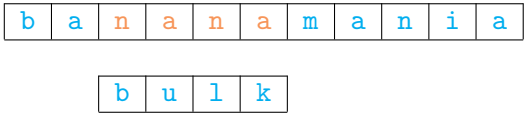

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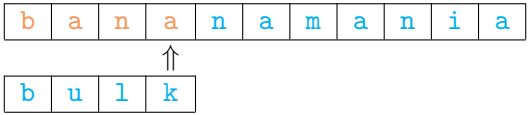

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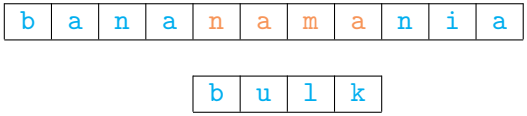

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- Don't need to check all of `t` to search for all occurrences of `p`!
- Formalized in Boyer-Moore algorithm