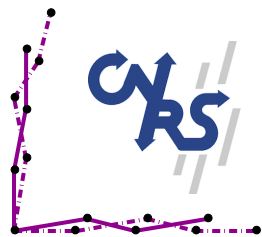


Développement des Algorithmes d'Application Réticulaire

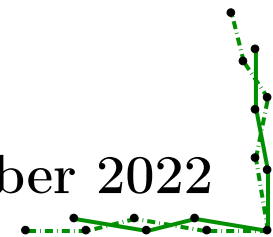
<https://www-apr.lip6.fr/~buixuan/daar2022>

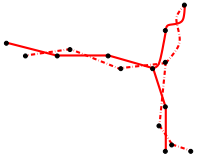
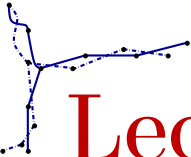
Binh-Minh Bui-Xuan



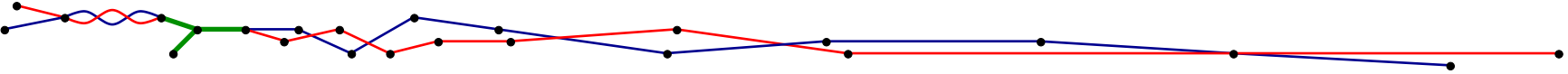
**SORBONNE
UNIVERSITÉ**
CRÉATEURS DE FUTURS
DEPUIS 1257

PARIS, September 2022



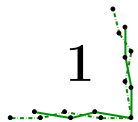
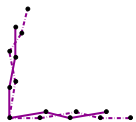


Lecture 3 : factor of a word



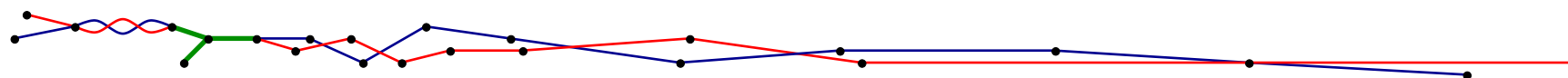
RECALL LECTURE + TME 1 :

- Searching a RegEx : 5 steps, including 4 RegEx transformations
- 5th step : input text + DFA \rightarrow boolean
- 5th step : complexity in $O(n^2)$, with n the input text size





Lecture 3 : factor of a word

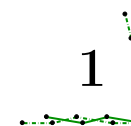
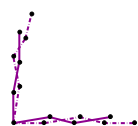


RECALL LECTURE + TME 1 :

- Searching a RegEx : 5 steps, including 4 RegEx transformations
- 5th step : input text + DFA \rightarrow boolean
- 5th step : complexity in $O(n^2)$, with n the input text size

TODAY WORK :

- Factor = RegEx with only concatenation
- Searching a factor : 5th step in $O(n)$?
- Knuth-Morris-Pratt (KMP) algorithm

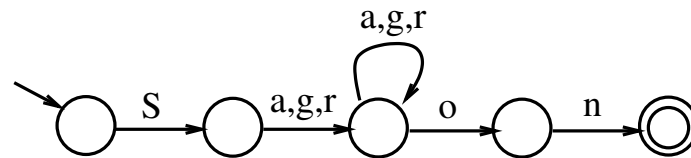


Example of the egrep command

```
>>>> Oui maîtres? <<<< egrep "S(algr)+on" 56667-0.txt
state--Sargon and Merodach-baladan--Sennacherib's attempt
under the Sargonids--The policies of encouragement and
that empire's expansion, and the vacillating policy of the Sargonids
to Sargon of Akkad; but that marked the extreme limit of Babylonian
Arabian coast. The fact that two thousand years later Sargon of
A: Sargon's quay-wall. B: Older moat-wall. C: Later moat-wall of
It is the work of Sargon of Assyria,[44] who states the object of
upon it."[45] The two walls of Sargon, which he here definitely names
the quay of Sargon,[46] which run from the old bank of the Euphrates
to the Ishtar Gate, precisely the two points mentioned in Sargon's
A: Sargon's quay-wall. B: Older moat-wall. O: Later moat-wall of
quay-walls, which succeeded that of Sargon. The three narrow walls
Sargon's earlier structure. That the less important Nimitti-Bêl is not
in view of Sargon's earlier reference.
excavations. The discovery of Sargon's inscriptions proved that in
precisely the same way as Sargon refers to the Euphrates. The simplest
[Footnote 44: It was built by Sargon within the last five years of
Sargon of Akkad had already marched in their raid to the Mediterranean
Babylonian tradition as the most notable achievement of Sargon's reign;
for Sargon's invasion of Syria. In the late omen-literature, too, the
Sargon's army had secured the capture of Samaria, he was obliged to
Sargon and the Assyrian army before its walls. Merodach-baladan was
After the defeat of Shabaka and the Egyptians at Raphia, Sargon was
their appearance from the north and east. In fact, Sargon's conquest of
Sargon was able to turn his attention once more to Babylon, from
On Sargon's death in 705 B.C. the subject provinces of the empire
party, whose support his grandfather, Sargon, had secured.[43] In 668
Sargon's death formed a period of interregnum, though the Kings' List
fifteen hundred years before the birth of Sargon I., who is supposed
>>>> Oui maîtres? <<<<
```

```
>>>> Oui maîtres? <<<< egrep "S[a-z]+on" 56667-0.txt
the Second Dynasty of the Kings' List--Date-formula of
state--Sargon and Merodach-baladan--Sennacherib's attempt
under the Sargonids--The policies of encouragement and
XII.(i) Bronze cone and votive figure, (ii) Stone cylinder
8. Section of the quay-walls and fortification-walls along
15. Section of the Ishtar Gate; after Andrae
that empire's expansion, and the vacillating policy of the Sargonids
to Sargon of Akkad; but that marked the extreme limit of Babylonian
Arabian coast. The fact that two thousand years later Sargon of
A: Sargon's quay-wall. B: Older moat-wall. C: Later moat-wall of
It is the work of Sargon of Assyria,[44] who states the object of
upon it."[45] The two walls of Sargon, which he here definitely names
the quay of Sargon,[46] which run from the old bank of the Euphrates
to the Ishtar Gate, precisely the two points mentioned in Sargon's
A: Sargon's quay-wall. B: Older moat-wall. O: Later moat-wall of
quay-walls, which succeeded that of Sargon. The three narrow walls
Sargon's earlier structure. That the less important Nimitti-Bêl is not
in view of Sargon's earlier reference.
excavations. The discovery of Sargon's inscriptions proved that in
precisely the same way as Sargon refers to the Euphrates. The simplest
Solomon's brazen altar, which under Phoenician influence took the place
Gateway in River-wall. P: Stone piers of Bridge over the Euphrates.
[Footnote 44: It was built by Sargon within the last five years of
to the exigencies of the engraver; cf. King, "Boundary-Stones and
of Hammurabi's rule in Babylon. Soon after the publication of the
disputed by Rîm-Sin and Samsu-iluna. Soon after the first of the deeds
which the Second Dynasty is enumerated between the First and Third,
number of years, if any, during which the Second Dynasty of the List
period of independence for the Second Dynasty which varied, according
regard to the Second Dynasty led to a considerable divergence of
are dated in the second year of Iluma-ilum, the founder of the Second
definitely proves that the founder of the Second Dynasty of the Kings'
his Second Dynasty as also resting on reliable tradition.
or more. Now if we eliminate the Second Dynasty altogether from the
Second, it is equally certain that it could not have fallen earlier
```

Example of the egrep command

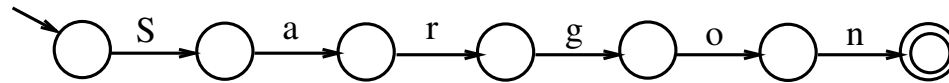


RegEx = "S(a|g|r)+on"

text = "After the defeat of Shabaka and the Egyptians at Raphia, Sargon was"

QUESTION : time complexity ?

Example of the egrep command

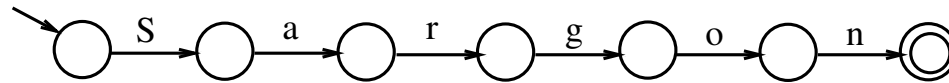


RegEx = "Sargon"

text = "After the defeat of Shabaka and the Egyptians at Raphia, Sargon was"

QUESTION : time complexity ?

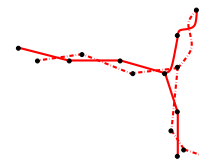
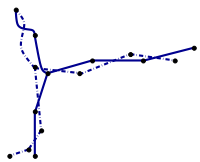
Example of the egrep command



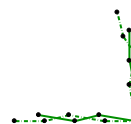
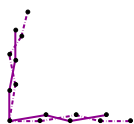
RegEx = "Sargon"

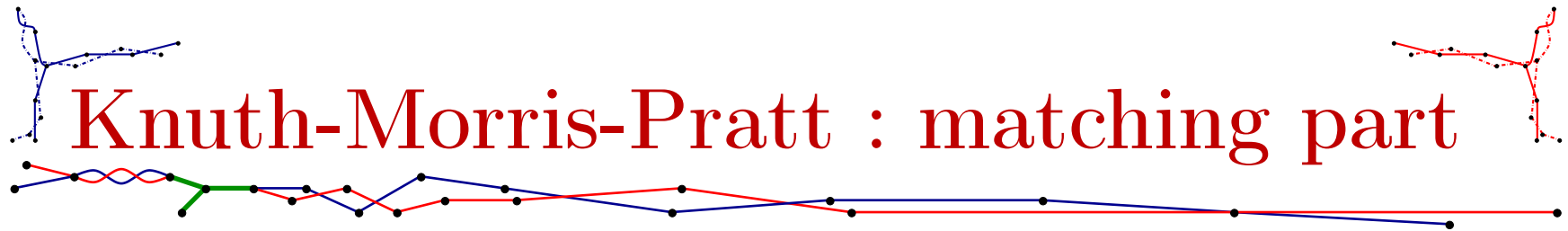
text = "...le district de Sargodha, ainsi que des cultures..."

QUESTION : time complexity ?



Can we do better ? In $O(n)$?

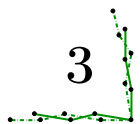
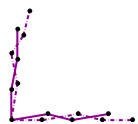


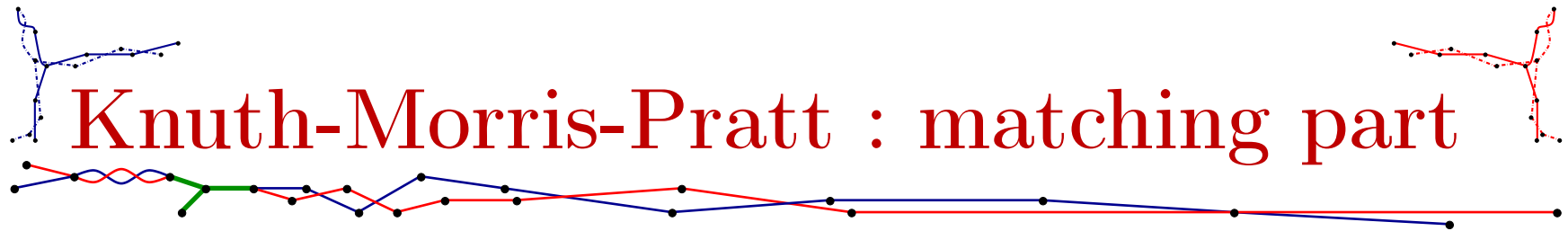


Knuth-Morris-Pratt : matching part

RegEx = "Sargon"

text = "...defeat of Shabaka and..."

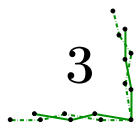
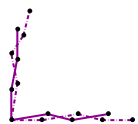


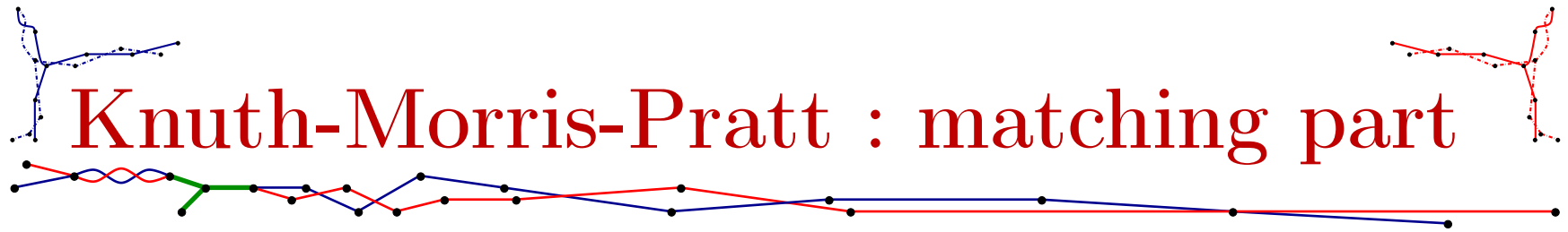


Knuth-Morris-Pratt : matching part

RegEx = "Sargon"

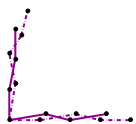
text = "...le district de Sargodha, ainsi que des cultures..."

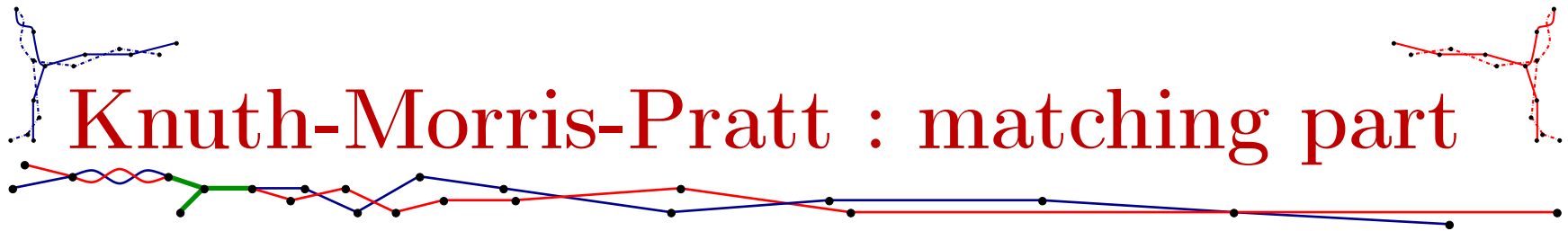




RegEx = "mami"

text = "mam~~a~~n mam~~e~~ mia! mm ma~~a~~ah!"





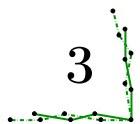
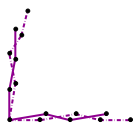
RegEx = "mami"


text = "mam^an mam^é mia! mm ma^aah!"

Factor = [m,a,m,i]

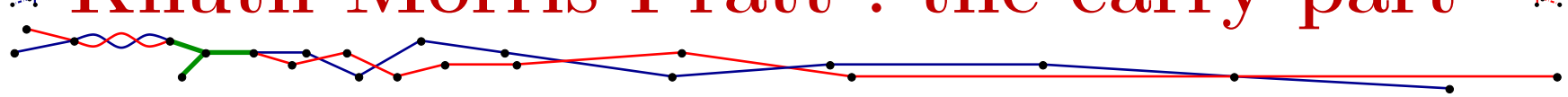

CarryOver = [-1,0,-1,1,0]

QUESTION : suppose table CarryOver is known, how to find Factor ?





Knuth-Morris-Pratt : the carry part

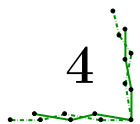
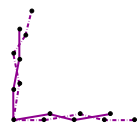


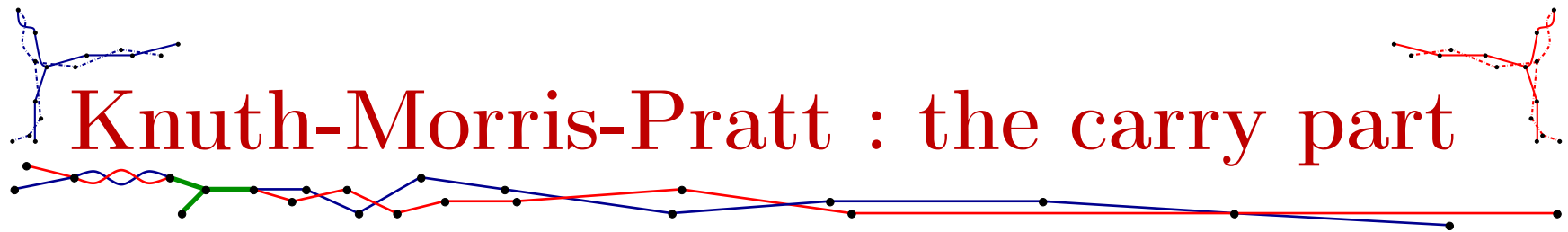
Examples :

$F=[m,a,m,a,m,i,a]$

$F=[c,h,i,c,h,a]$

$F=[S,a,r,g,o,n]$



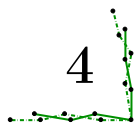
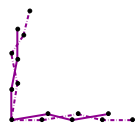



Examples :

$F=[m,a,m,a,m,i,a] \rightarrow C=[-1,0,-1,0,-1,3,0,0]$


$F=[c,h,i,c,h,a]$

$F=[S,a,r,g,o,n]$





Knuth-Morris-Pratt : the carry part

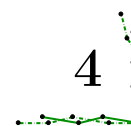
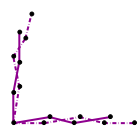


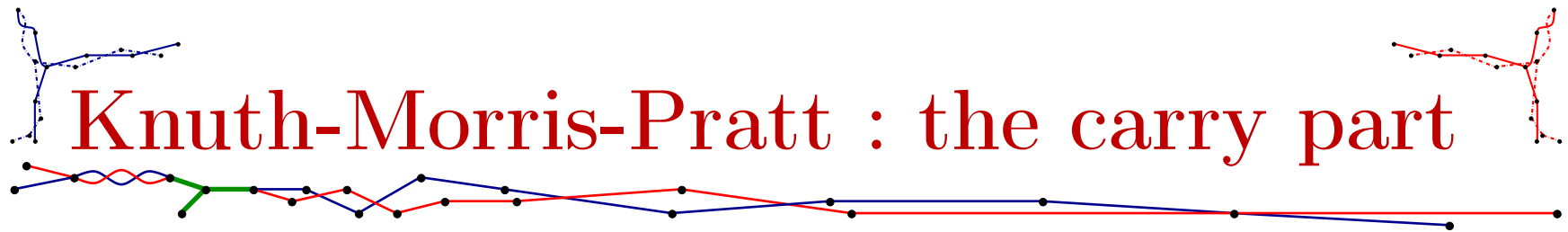
Examples :

$$F=[m,a,m,a,m,i,a] \rightarrow C=[-1,0,-1,0,-1,3,0,0]$$

$$F=[c,h,i,c,h,a] \rightarrow C=[-1,0,0,-1,0,2,0]$$

$$F=[S,a,r,g,o,n]$$





Examples :

$$F=[m,a,m,a,m,i,a] \rightarrow C=[-1,0,-1,0,-1,3,0,0]$$

$$F=[c,h,i,c,h,a] \rightarrow C=[-1,0,0,-1,0,2,0]$$

$$F=[S,a,r,g,o,n] \rightarrow C=[-1,0,0,0,0,0,0]$$

QUESTION : implementation ? \rightarrow to TME 3.

