What are the internal nodes of the suffix tree?
(the algorithm is given below)

BWT_T	$BWT_{\underline{T}}$
i	m
p	s
s	$
s	s
m	p
$	s
p	p
i	i
s	s
s	s
i	i
i	i

```
S = empty stack
S.push(([1...n], [1...n], 0))
while S is not empty do
        ([i,j],[i',j'],d) = S.pop()
        output ([i,j],d)
        Σ' = idx.enumerateLeft(i,j)
        I = ∅
        for c ∈ Σ' do
                I = I ∪ {idx.extendLeft(c,[i,j],[i',j'])}
        for ([i,j],[i',j']) ∈ I do
                if idx.isRightMaximal(i',j') then
                        S.push(([i,j],[i',j'],d+1))
```

Suffixes

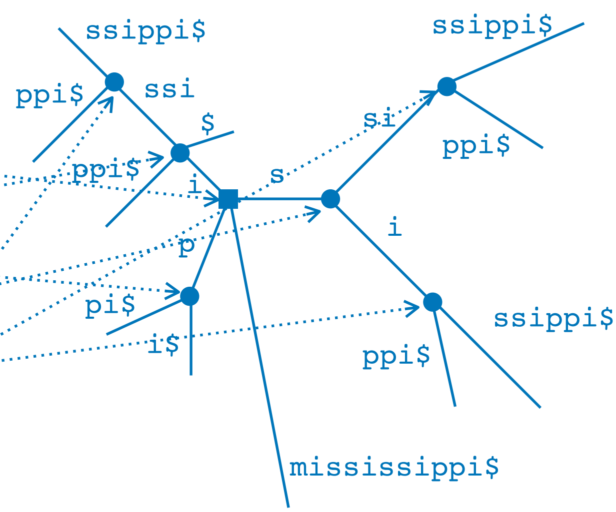
T		*<u>T</u>*	
$mississipp	**i**	$ippississi	**m**
i$mississip	**p**	im$ippissis	**s**
ippi$missis	**s**	ippississim	**$**
issippi$mis	**s**	issim$ippis	**s**
ississippi$	**m**	ississim$ip	**p**
mississippi	**$**	m$ippississ	**i**
pi$mississi	**p**	pississim$i	**p**
ppi$mississ	**i**	ppississim$	**i**
sippi$missi	**s**	sim$ippissi	**s**
sissippi$mi	**s**	sissim$ippi	**s**
ssippi$miss	**i**	ssim$ippiss	**i**
ssissippi$m	**i**	ssissim$ipp	**i**

S

[4,5], [4,5], 4
[11,12], [4,5], 3
[9,10], [4,5] , 2
[9,12], [9,12], 1
[7,8], [7,8], 1
[2,5], [2,5], 1
[1,12], [1,12], 0

Output

[1,12], 0
[2,5], 1
[7,8], 1
[9,12], 1
[9,10], 2
[11,12], 3
[4,5], 4



i	j	i’	j’	d	Σ’
1	12	1	12	0	{$,i,m,p,s}

“$” + “” in suffixes of *T*,
“” + “$” in suffixes of *T̲*

“p” + “” in suffixes of *T*,
“” + “p” in suffixes of *T̲*

	l	Is right maximal?
$	[1,1], [1,1]	✗
i	[2,5], [2,5]	✓
m	[6,6], [6,6]	✗
p	[2,5], [2,5]	✓
s	[9,12], [9,12]	✓

---

i	j	i’	j’	d	Σ’
2	5	2	5	1	{m,p,s}

“m” + “i” in suffixes of *T*,
“i” + “m” in suffixes of *T̲*

“s” + “i” in suffixes of *T*,
“i” + “s” in suffixes of *T̲*

	l	Is right maximal?
m	[6,6], [2,2]	✗
p	[7,7], [3,3]	✗
s	[9,10], [4,5]	✓

---

i	j	i’	j’	d	Σ’
7	8	7	8	1	{i,p}

	l	Is right maximal?
i	[3,3], [7,7]	✗
p	[8,8], [8,8]	✗

---

i	j	i’	j’	d	Σ’
9	12	9	12	1	{i,s}

	l	Is right maximal?
i	[4,5], [9,10]	✗
s	[11,12], [11,12]	✗

---

i	j	i’	j’	d	Σ’
9	10	4	5	2	{s}

	l	Is right maximal?
s	[11,12], [4,5]	✓

---

i	j	i’	j’	d	Σ’
11	12	4	5	3	{i}

	l	Is right maximal?
i	[4,5], [4,5]	✓

---

i	j	i’	j’	d	Σ’
4	5	4	5	4	{m,s}

	l	Is right maximal?
m	[6,6], [4,4]	✗
s	[9,9], [5,5]	✗

Construct the Burrows-Wheeler Transform of `ATATAGCGCGCT`.

$ATATAGCGCGC	**T**
AGCGCGCT$ATA	**T**
ATAGCGCGCT$A	**T**
ATATAGCGCGCT	**$**
CGCGCT$ATATA	**G**
CGCT$ATATAGC	**G**
CT$ATATAGCGC	**G**
GCGCGCT$ATAT	**A**
GCGCT$ATATAG	**C**
GCT$ATATAGCG	**C**
T$ATATAGCGCG	**C**
TAGCGCGCT$AT	**A**
TATAGCGCGCT$	**A**

Count the number of occurrences of `GCG` in `ATATAGCGCGCT`

	L
`$ATATAGCGCGC`	**T**
`AGCGCGCT$ATA`	**T**
`ATAGCGCGCT$A`	**T**
`ATATAGCGCGCT`	**$**
`CGCGCT$ATATA`	**G**
`CGCT$ATATAGC`	**G**
`CT$ATATAGCGC`	**G**
`GCGCGCT$ATAT`	**A**
`GCGCT$ATATAG`	**C**
`GCT$ATATAGCG`	**C**
`T$ATATAGCGCG`	**C**
`TAGCGCGCT$AT`	**A**
`TATAGCGCGCT$`	**A**

$	**0**
A	**1**
C	**4**
G	**7**
T	**10**

i = m

(sp, ep) = (1,n)

while *sp ≤ ep* **and** *i ≥ 1* **do**

   $c = p_i$

   $sp = C[c] + rank_c(L, sp-1)+1$

   $ep = C[c] + rank_c(L, ep)$

   i = i - 1

if *ep < sp* **then**

   return *0*

else

   return *ep - sp + 1*

iteration		1	2	3
c		G	C	G
sp	1	(7 + 0 + 1) = 8	(4 + 0 + 1) = 5	(7 + 0 + 1) = 8
ep	13	(7 + 3) = 10	(4 + 2) = 6	(7 + 2) = 9
i	3	2	1	0

Number of occurrences:

(ep - sp + 1) = (9 - 8 + 1) = **2**

Give the wavelet tree representation of the following BWT.

1	A
2	T
3	$
4	T
5	G
6	A
7	A
8	C