and has tried to show that the nature and role of features employed is criterial in defining the structural interaction of these representations in phonological derivation. Although there are a number of further arguments to motivate the type of prosodic structure here, this present model of a surface phonology is motivated principally by the striving for maximal correspondence between phonological contrast and phonetic interpretability.

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On the interaction of theories of Lexical Phonology and theories of phonological phenomena

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Introduction

In this article[1] I will discuss how our notions of the nature of phonological processes may lead us to radically differing positions on the organization of phonology with respect to the lexicon. Specifically, I will show that much of the evidence adduced for phonological "level ordering" is simply an artifact of one particular conception of phonological processes. If one abandons such assumptions, it then becomes possible to provide a unified account of the application of phonological processes. This account can achieve maximal simplicity. This may be stated in terms of a minimalist hypothesis given below.

(1) Processes apply whenever the conditions that trigger them are satisfied.

What this means is that phonological processes are not grouped according to the particular stratum or strata in which they apply. They apply anytime their structural conditions are satisfied.

I will deal with three examples that have been or could be used as evidence for level ordering following the assumptions of rule-based phonology. I will show that in each case, if such assumptions are abandoned, as I feel they should be, then the evidence for level ordering evaporates and the minimalist hypothesis can be successfully maintained. The examples will treat: French vowel nasalization and liaison phenomena, Japanese *Cy* sequences and the behaviour of Russian *yers*. I begin the discussion with the notion of cyclicity.

1 Cyclicity

Since the dawn of generative phonology there has been an awareness of the interaction of morphological (or syntactic) structure and a variety of phonological phenomena. This awareness dates back to at least 1956 (Chomsky, Halle & Lukoff 1956) with the postulation of the transformational cycle. Further refinements included the Principle of Strict Cyclicity (PSC) (Chomsky 1973; Kean 1974; Mascaro 1976). Kean formulates the PSC as follows (Kean 1974:179):

(2) '...on any cycle A no cyclic rule may apply to material within a previous cycle B without making crucial use of material uniquely in A'.

I accept the notion of the cycle along with the PSC as crucial parts of a theory of UG.[2] The cyclic domains which I posit do not necessarily agree with earlier assumptions, however. I do agree with Halle (1986) regarding the cyclic or non-cyclic status of affixes:[3]

> I shall assume that whether or not an affix is cyclic is not a property of the morphological rule by which it is assigned, but is rather an idiosyncratic and variable property of the affix. (Halle 1986:6).

Some examples of this idiosyncratic nature include English strong verb (non-cyclic) vs. weak verb (cyclic) inflectional morphology. Thus the past tense forms of the verbs *keep* and *peep* are represented as follows:

(3) a. Non-cyclic [keep + past] b. Cyclic [[peep] past]

Da Silva (1988) has shown that the diminutive suffix in (Brazilian) Portuguese is cyclic, whereas in French, where it is considerably less productive (and less compositional), it is non-cyclic.

(4) a. Non-cyclic French [sonn + ette] 'buzzer' b. Cyclic Portuguese [[camØ] inha] 'little bed'

With these preliminaries in mind, let us proceed to the French analysis.

2 French nasalization

In his 1982 GLOW talk, Vergnaud proposed treating French liaison consonants as floating segments; that is, as segments not associated to a skeletal point. Following up this suggestion, Prunet (1986) presents an

analysis of cases where the liaison consonant is *n*. His analysis depends crucially on cyclic versus non-cyclic domains, as we shall see anon.

Let us consider the representation of the masculine singular adjective *bon* 'good'. This is shown in (5) below.

(5)
```
    N
    |
  x x
  | |
  b o N
```

Note that the stem final segment, *N*, is not associated to a skeletal position. If the word is pronounced in isolation, the *N* will dock on the preceding nuclear position forming a nasal vowel.

(6)
```
    N
    |
  x x
  | |\
  b o N
```

This form is pronounced [bõ] in isolation. The facts that interest us here are the forms *bon ami* [bonami] 'good friend' and *son ami* [sõnami] 'his/her friend'. The idea is to explain the absence of nasalization on the initial vowel in *bon ami* and its presence on the initial vowel of *son ami*. Prunet offers arguments to show that the possessive pronoun *son* is syntactically further removed from the head noun than the prenominal adjective *bon*. What is required is that *bon ami* has no internal cycle, while *son ami* does. The derivations follow.

(7) a. bon ami b. son ami

```
ON        ONON        N        ONON
| |       | | |       |        | | |
[x x  +   x x x]      [[x x ]  + x x x]
| |       | | |       | |      | | |
b o N     a m i       s o N    a m i
```

In (7) we see the initial representations of the forms *bon ami* and *son ami*. Crucially the former form involves no internal cycle while the latter form does. We pick up the derivation at the innermost cycle.

(8) a.
```
ON        ONON
| |       | | |
[x x  +   x x x]
| |       | | |
b o N     a m i
```
b.
```
N
|
[x x ]
| |
s o N
```

In (8a) there is an accessible onset (O) in the first cycle, while in (8b) no such constituent is available. Accordingly the floating *N* may associate to the available onset in (9a) but must attach to the nucleus in (9b).

```
(9) a. ON        ONON      b.   N
       | |      / | | '        |
      [x x    +   x x x]      [x x  ]
       | |      | | |         | |\
       b o N    a m i          s o N
```

Following Vergnaud's convention, a skeletal point must intervene when segmental material is linked directly to a syllabic constituent. This completes the derivation of *bon ami*.

```
(10)  ON      O NON
      | |    /  | | |
     [x x   x +  x x x]
      | | /     | | |
      b o N     a m i
```

We continue with *son ami*. At this point we pass to the next cycle as shown below.

```
(11)    N      ONON
        |      | | |
      [x x   +  x x x]
       | |\     | | |
       s o N    a m i
```

There is now an available onset to which the nasal element may associate. The PSC will prevent tampering with the internal structure of the previous cycle and so *N* will remain linked to the nucleus. However, it will spread into the following empty onset yielding the following structure:

```
(12)    N      O NON
        |    /  | | |
      [x x   x +  x x x]
       | |\ /     | | |
       s o N      a m i
```

Note the double linking of the nasal element. It is linked to the preceding nucleus, which is the result of the internal cycle, and it is linked to the following onset which took place in the final cycle. Crucially, no level ordering is required. The linking takes place whenever its conditions of application are met. What this analysis implies is that the sequence *ṽNv* is a sure indicator of an internal cycle.

Prunet goes on to discuss the behaviour of the element *non-* in compounds. *Non-* occurs in both cyclic and non-cyclic environments. As Prunet notes, there is a close correlation between cyclicity and compositionality. Compositional use of *non-* before vowel-initial stems yields *nõn*+v... following the *son ami* model. Non-compositional *non-* yields *non*+v.... Thus, in the forms of (13a) the form *non-* is pronounced [nõn...], while in (13b) it is pronounced [non...]. The forms of (13a) have an internal cycle; those of (13b) do not (taken from Prunet 1986:150).

(13) a.	non-attraction	'non-attraction'
	non-oppression	'non-oppression'
	non-expansion	'non-expansion'
b.	nul et non avenu	'null and void'
	nonobstant	'notwithstanding'
	un pacte de non-aggression	'non-aggression treaty'

3 Japanese Cy sequences

The following examples concern the treatment of Japanese *CyV* clusters. Here I follow the analysis provided by Yoshida (1988). As Yoshida notes, suffix-initial *r-*, *s-* and *y-* are deleted following a consonant-final verb stem. This pattern is illustrated in the following examples:

(14)		Present		Causative		Volitional	
ne-	'sleep'	ne+ru	[neru]	ne+sase	[nesase]	ne+yoo	[neyoo]
mi-	'see'	mi+ru	[miru]	mi+sase	[misase]	mi+yoo	[miyoo]
kak-	'write'	kak+ru	[kaku]	kak+sase	[kakase]	kak+yoo	[kakoo]
yor-	'visit'	yor+ru	[yoru]	yor+sase	[yorase]	yor+yoo	[yoroo]

A rule-based approach would posit a process along the lines of (15).

(15) $\{r,s,y\} \rightarrow \emptyset \ / \ C ___$

Rule (15) does not apply to the first two (vowel-final stems). Its structural description is satisfied by the final two consonant-final stems and the suffix-initial consonant is accordingly deleted.

What is of interest here is that rule (15) would lead one to expect that *Cr*, *Cs* and *Cy* sequences are absent in Japanese. This expectation is confirmed for the first two sequences. However, Japanese abounds in forms transcribed with *Cy* as the following examples show:

(16) Some *Cy* transcriptions

gyaku	'reversal'	byakko	'white fox'	myoo	'strange'
tya	'tea'	ryoo	'quantity'	zyuu	'ten'

Now the problem is to explain why the forms of (16) and the many others like them do not undergo rule (15). It will be immediately noted that the forms of (16) have no internal structure whereas the forms undergoing rule (15) all contain an intervening morpheme boundary between the left context of rule (15) and the segment that is to be deleted. The standard solution would call for labelling rule (15) as a lexical (rather than post-lexical) rule and appealing to a requirement that it apply only in derived contexts. In this way the forms in (14) will correctly undergo the rule, while those in (16) will be prevented from doing so. This solution makes a crucial distinction between two types of rules: lexical and post-lexical. Is such a distinction truly required?

A government-based analysis (Kaye, Lowenstamm & Vergnaud 1985, 1990; Kaye, in press; Charette 1988) such as that proposed by Yoshida (1988) deals with these data rather differently. Consider the form *kak+ru*. Its structure appears below.

(17)
```
ON    ON
| |     |
x x x + x x
| | |   | |
k a k   r u
```

The first question that must be settled is to which position the final onset will link. Yoshida notes that since *k* and *r* occupy adjacent positions and since Japanese contains no branching onsets, then if *r* is to be associated with the onset, it must govern the preceding position.

(18)
```
ON    ON
| |   | |
x x x + x x
| | |   | |
k a k   r u
```

But neither *r* nor *k* have the correct governing properties to satisfy a structure like (18): *r* cannot govern at all and *k* cannot be governed by *r* (it may be governed by some other segment). Accordingly, the onset may not associate to the r-position. This leads to the structure shown in (19).

(19)
```
ON    ON
| |  /  |
x x x + x x
| | |   | |
k a k . r u
```


In (19) the onset is now associated to the k-position. In this structure there are no governing requirements imposed on this segment. The *k* does not govern anything. The position to its left is a nucleus and as such is ungovernable by a non-nuclear position. This implies that any non-nuclear segment may occupy the position occupied by *k* in (19). In fact this is true. Suffix-initial consonants undergo no modification when following a vowel-final stem.

The form of (19) is composed of two onset-nucleus sequences: *ka* and *ku*. Crucially, the stem-final *k* must be syllabified into the final onset position. Any *r* which receives no syllabic interpretation is inaudible. In this manner Yoshida derives the forms *kaku*, *kakase* and *kakoo*.

The suffix-initial segments *-r*, *-s* and *-y* share similar governing properties and so they do not appear in onset position when a preceding point must be governed. This situation does not obtain in vowel-final stems and in such cases these segments do occupy onset positions as shown below.

(20) ne+ru [neru]

a.
```
ON   ON
| |    |
x x + x x
| |   | |
n e   r u
```

b.
```
ON   ON
| |  | |
x x + x x
| |   | |
n e   r u
```

The onset position available in (8a) may be filled by the r-position. The preceding point is nuclear and so *r* has no governing responsibilities.

This brings us to the problem of the so-called *Cy* sequences in Japanese. If *y* cannot govern any preceding segment, how can such sequences exist? Concretely if a structure like (21a) is excluded, how can a form like (22) be well-formed?

(21) tor+yoo [toroo] 'let's take'

a. Ill-formed structure
```
ON    ONON
| |    | |  |
x x x + x x  x
| | |  | |  |
t o r  I o  o
```

b. Correct structure
```
ON    ONON
| |  /  |  |
x x x + x x  x
| | |  | |  |
t o r  I o  o
```

(22) toryoo [toryoo] 'paint'

Yoshida notes that a sequence *CyV* has four possible analyses:

(23)

```
a.        b.        c.        d.
 RON       O N       O N       O N
 | | |     /\ |      | |       | |
 x x x     x x x      x x       x x
 | | |     | | |     /\ |      | /\
 C I V     C I V     C I V     C I V
```

The structures in (23) represent (a) a transconstituent sequence *Cy*, (b) a branching onset *Cy*, (c) a complex segment c^y and (d) a light diphthong *yV*. The *ry* sequence in (22) could not be analysed as in (23a) because of the inappropriate governing properties of *I*. There are two principled reasons for excluding (23b) as the structure in question: (1) branching onsets are not independently attested in Japanese and (2) for all languages that contain branching onsets the head (left-most) position of the onset must be associated with a segment capable of governing. This yields the familiar constraints that one observes in languages that truly do have branching onsets. Now in Japanese, virtually any consonant in the language may occupy the first position of a *Cy* sequence. Examples taken from Yoshida are given below.

(24)

kyaku	'visitor'	syaberu	'talk'	tya	'tea'
hyaku	'hundred'	nyanko	'kitty'	myaku	'pulse'
ryaku	'omission'	pyuure	'puree'	gyaku	'reversal'
zyama	'hindrance'	byooki	'illness'		

The absence of constraints between the segment occupying the putative onset head position and the following glide is sufficient to rule out structure (23b). Similarly, structure (23c) has both members of the *Cy* cluster occurring in onset position; this time in the form of a complex segment. Both segments are attached to a single onset form. Once more severe constraints holding between segments occupying the *C* position should be observed. They are not, as we have mentioned above. In authentic complex segments such constraints are invariably present. For example, prenasalized stops are limited to voiced stops. A labialized series of consonants is generally limited to the velar series, and so on.

The remaining structure, (23d), is consistent with the observed distributional constraints on Japanese *Cy* clusters. In this structure the *yV* sequence is analysed as a light diphthong. Given the principle of free co-occurrence (Kaye 1985) we would expect no constraints on a segmental position in an onset with respect to that in a nucleus. This is indeed the case as the forms of (24) illustrate.

We are now in a position to contrast the structure of (21) with that which underlies (22).

(25) = tor+yoo (21)

```
ON    ONON
| |  /  |  |
x x x + x x  x
| | |   | |  |
t o r   I o  o
```

(26) = toryoo (22)

```
ONO N ON
| | | |   |
x x x x   x
| | | /\  |
t o r I o o
```

Crucially, the segment *I* in (26) does not have an independent point to which it is associated. It shares a nuclear point with *o* in the light diphthong *yo*. This now explains the apparent contradiction concerning the treatment of *Cy* sequences. In fact none of the purported cases are true sequences. Thus, there is no need to posit a lexical rule of Y-deletion. We maintain our position that all phonological processes apply when their structural conditions are met.

4 Russian yers

The final example concerns the behaviour of Russian yers. I will begin with the presentation of the analysis found in Halle (1986:7-9). Halle begins by presenting the two rules given in (27).

(27) a. Yers are nonhigh (i.e., [e] or [o], respectively) before a syllable whose head vowel is a yer.
b. Yers are deleted.

The application of these rules is illustrated in the forms in (28).

(28) a. meš-Uk-a → meš-k-á 'bag' (gen. sg.)
b. meš-Uk-Ik-a → meš-óč-k-a 'little bag' (gen. sg.)

Halle notes that in (28a) the yer (represented as *U*) is not followed by another yer and hence will not undergo rule (27a). It is therefore subject to rule (27b) and is deleted in the course of the derivation.

The form in (28b) contains successive yers (*U* and *I*). The first yer meets the conditions of rule (27a) and is lowered, bleeding rule (27b). The second yer, not being followed by a yer does not undergo (27a) and must undergo (27b). This yields the output form of (28b). What is sig-

nificant is what happens when yers are involved in prefixed forms. The relevant examples follow.

(29) a. sU-žIg-l-U → s-žeg-l → [žžók] 'burned' (masc. sg.)
b. sU-žIg-l-á → so-žg-l-á → [sažglá] 'burned' (fem. sg.)

Halle notes that the most natural morphological bracketing for these forms would be as follows:

(30) (((sU-(žIg))-l)-U)
(((sU-(žIg))-l)-á)

The problem is that applying the rules of (27) in a cyclic fashion will yield incorrect results. The innermost cycle in which these rules may apply is (sU-žIg) in both cases. We would then expect the initial yer in both masculine and feminine forms to undergo lowering and hence be immune from the effects of (27b). Now this is perfectly true for the feminine form but not for the masculine. The problem is, why should the word final suffix vowel have an influence on events transpiring in an earlier cycle?

Halle's solution is to make two key assumptions: (1) prefixes in Russian are non-cyclic affixes and (2) the yer lowering rule is assigned to both cyclic and noncyclic strata. At the noncyclic stratum it precedes the rule of yer deletion. To see how this solution works, let us consider the feminine form: (((sU-žIg)-l)-á). In the innermost cycle (sU-žIg) rule (27a) does not apply since rules of the cyclic stratum require an internal cycle which is not present here. At the following cycle (sU-žIg-l), yer deletion still does not apply because of the Principle of Strict Cyclicity. The form emerges from the cycle intact: sU-žIg-l-á. At this point we enter the noncyclic stratum. (27a) ordered before yer deletion now applies to the full substring, lowering the initial yer. (27b) applies to the remaining yer *I* deleting it.

The masculine form follows the same derivation until we arrive at the final cycle: (sU-žIg-l-U). The conditions for yer lowering are satisfied twice: *U* followed by *I* and *I* followed by *U*. Strict cyclicity prevents (27a) applying in the former case, however. The initial *U* and the following *I* were both present in the innermost cycle. If yer lowering applied it would make no crucial use of any material outside of this cycle thus violating the PSS. So yer lowering will only apply in its rightmost context. *I* is lowered. In the noncyclic stratum the remaining yers are deleted yielding the correct form. Crucial to this analysis are the assumptions that phonological rules must be labelled as to the stratum or strata on which they are to apply. Yer lowering must apply at both cyclic and noncyclic strata. Yer deletion must apply only at the noncyclic level. The question remains: are

these assumptions necessary? In order to answer this question I will briefly discuss the analysis of Moroccan Arabic (MA) found in Kaye (in press). This discussion is couched in the Government-based phonological framework referred to above.

In MA there are wholesale alternations involving the cold vowel v^o [ɨ] alternating with ∅. Consider the following forms:

(31) a. tan ktɨb 'I am writing' b. tan kɨtbu 'we are writing'

In MA non-branching nuclei may only be associated with the cold vowel. No other element is permitted in this context. Positions containing only the cold vowel are treated as empty positions by the theory. Empty positions are subject to the Empty Category Principle (ECP).

(32) A properly governed empty position receives no phonetic interpretation.

Let us now consider the structures underlying the forms of (31).

(33) a. Singular b. Plural

```
N   N   N          N   N   N
|   |   |          |   |   |\
x x x x x x        x x x x x x x
|   |   |          |   |   | |/
k   t   b          k   t   b u
```

Form (33a) corresponds to the singular verb stem; (33b) contains the plural suffix *-u:*. The question here involves the pronunciation of the empty nuclei. According to (32) they will not be pronounced if they are properly governed. Otherwise they will be realized phonetically. In MA proper government is right headed. A nucleus which is not itself governed may serve as a proper governor for an empty nucleus. MA licenses empty nuclei in domain final position. It shares this property with languages such as English and Wolof. Japanese, Italian and many other languages do not license domain-final empty nuclei. In (33a) the final empty nucleus is licensed and hence not pronounced. It may not serve as a proper governor.[4] Therefore, the medial nucleus, that occurring between the *t* and the *b*, is not properly governed and must itself be pronounced. Since it is not governed it may serve as a governor for the first nucleus. This nucleus is properly governed and thus not phonetically realized. The governing patterns are shown below.

(34)

```
      licensed
N  N  N
|  |  |
x x x x x x
|  |  |
k Ø t v°b
[kØtib]
```

Form (33b) differs from (33a) in that its final nucleus is not empty but the long vowel (branching nucleus) *u:*. This nucleus may govern the empty nucleus to its left. This disqualifies that middle nucleus as a possible governor and so the first nucleus is not governed and accordingly surfaces with phonetic content.

(35)

```
N  N  N
|  |  |\
x x x x x x x
|  |  | |/
k v°t Ø b u
[kitØbu:]
```

It is important to note that no cyclic structure is required to derive these forms. The singular form has no affixation and there is no evidence that the MA plural suffix is cyclic. With the minimalist hypothesis, governing relations are established as soon as the required conditions are found. Concretely, government relations are established at the innermost cycle and may not be changed subsequently. Phonological processes are not labelled with respect to the stratum in which they apply. Indeed, in this view, there are no phonological strata.

Let us now compare the MA analysis with the case of Russian yers that seemed to call for a stratal phonology. The relevant forms are repeated here without their bracketing.

(36) = (29) a. sU-žIg-l-U → s-žeg-l → [žžók] 'burned' (masc.sg.)
b. sU-žIg-l-á → so-žg-l-á → [sažglá] 'burned' (fem.sg.)

Suppose that we assume that Russian yers behave like empty nuclei – that is, that they are subject to the ECP. Remarkably, the Russian facts are now identical in all respects to the MA situation. The analysis follows:

(37)

```
N  N   N          N  N   N
|  |   |          |  |   |
x x x x x x x      x x x x x x x
|||||||            |||||||
sUž I g l U        sUž I g l a
```

The configurations of nuclei are identical to those found in our MA examples repeated below.

(38) = (33) a. Singular b. Plural

```
N  N  N          N  N  N
|  |  |          |  |  |\
x x x x x x      x x x x x x x
|  |  |          |  |  | |/
k  t  b          k  t  b u
```

Note that each yer position in (37) corresponds exactly to an empty nuclear position in (38). If yers are subject to the ECP we would then expect them to undergo the same fate as the empty position in MA; they would not be pronounced when properly governed. The governing relations are compared in (39) and (40).

(39)

```
      licensed
N  N  N          N  N  N
|  |  |          |  |  |\
x x x x x x      x x x x x x x
|  |  |          |  |  | |/
k Ø t v°b        k v°t Ø b u
```

(40)

```
      licensed
N  N   N          N  N   N
|  |   |          |  |   |
x x x x x x x      x x x x x x x
|||||||            |||||||
sUž I g l U        sUž I g l a
```

Russian shares the property of licensing final empty nuclei[5] with MA. This licensed empty nucleus may not properly govern. This means that in both cases the preceding yer will be realized phonetically. It in turn governs the first yer/empty nucleus which is not pronounced. In the right-hand forms a final yer/empty nucleus is replaced by a full nucleus. This nucleus may, of course, properly govern the preceding yer/empty nucleus. This leaves the first yer/empty nucleus ungoverned and hence pronounced. The cases are indeed exactly parallel. Given the parallelism between the MA facts and the Russian facts, one would like to assume

that they are two instances of a unified phenomenon.[6] Crucially the MA case requires no internal cycles. It is then reasonable to assume that no such structures are involved in the Russian case.

In this paper I have tried to show that claims involving stratal ordering of phonological phenomena are strictly bound to a particular notion of a phonological process. Such level ordering is indeed required if one adheres to the view that phonology is rule-based and that phonological processes are essentially random events. If phonology is viewed as principle-based and if some attention is given to the nature and causes of phonological phenomena, the arguments for a level ordered phonology disappear, at least in the three cases discussed here. It would be interesting to find out if applying this approach to other cases that seem to call for level ordering would yield similar results.

Notes

1 My thanks to Monik Charette and Iggy Roca for their valuable suggestions. They should not be assumed to agree with anything presented in the text.
2 I leave open the question as to whether the PSC is a genuine principle of grammar, or rather an instantiation of some more general principle. E.g. it may be possible to derive the PSC from the Projection Principle.
3 This is not to say that cyclic vs. non-cyclic status is totally unrelated to morphological or syntactic considerations. It seems clear that the notion of *compositionality* does play a role here. Nothing in my argument hinges on the arbitrariness of the relation between cyclicity and morphosyntactic structure. Indeed, the theory would become more interesting to the extent that cyclic status may be derived from other aspects of linguistic structure. My personal view is that Halle's position cited below is overly pessimistic.
4 In this respect licensed final empty nuclei behave like properly governed ones. A unification might seem possible by considering this final licensing to be but an instance of proper government. Licensed final nuclei do behave differently from properly governed empty nuclei in their own licensing properties. The former may license onset government in forms like English *vestØ* while the latter may not as shown by *fasʃØn*. See Charette (1988) for discussion of this issue.
5 I believe that the yer *U* will turn out to be an empty nucleus. It differs from *I* in not triggering palatalization.
6 It would appear that Yawelmani vowel-Ø alternations, traditionally analysed as epenthesis, are but another manifestation of proper government.

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