PASSIVES

Steve Pulman,
University of Cambridge Computer Laboratory,
Corn Exchange Street,
Cambridge CB2 3QG, UK.

ABSTRACT

The English passive construction has played a central role in the to-ings and fro-ings of grammatical theory over the last 30 years, from the earliest days of transformational grammar, to more recent, surface oriented theories of syntax. The casual reader of the linguistic literature might therefore suppose that the computational linguist looking for an off the shelf analysis of passives would be able to choose from among several competing analyses, each of which accommodated the facts, but perhaps derived them from (or from them) different theoretical principles. Unfortunately, this is not the case, as we shall see. All of the analyses that I am familiar with are incomplete, or inaccurate in some respects, or simply unprogrammable in any straightforward form. The present paper is an attempt to remedy this situation, and to provide such an off the shelf analysis of the syntax and semantics of passives. The analysis of this central construction will be couched within a simple and computationally tractable syntactic and semantic formalism, and should translate easily to most currently popular formalisms. It will be quite eclectic, freely borrowing from several different grammatical theories.

Two unsatisfactory analyses

The original starting point for the analysis here was that presented in Gazdar et al. 1985 (also found unsatisfactory by Kilbury 1986). In the GPSG framework, passive VP rules are derived by a metarule from active VPs:

1. VP $\rightarrow$ NP, W $\Rightarrow$ VPpas $\rightarrow$ W, (PPby)

The interpretation of this metarule is as follows: for every rule expanding VP which introduces an NP daughter, there is also to be a rule which has the VP marked as passive, does not contain that NP daughter, and may contain a PP headed 'by'. Feature principles ensure that the verb heading the VP will have passive morphology in this latter case.

There are several problems with this account. An engineering problem concerns the interpretation of GPSGs for computational purposes. One more or less workable construal regards the metagrammar as a set of instructions for producing a 'compiled' object grammar consisting of context free rules augmented with some feature matching mechanism. However, this treatment produces large

numbers of such rules. When 'slashed' versions of VP rules are also compiled out the multiplicative effect can lead to many hundreds of VP rules in a linguistic description. While not fatal, this is still a problem for constructing efficient parsers.

There are also several descriptive problems. As Kilbury points out, the metarule as it stands would apply to VPs which require a sentential subject, like 'bother', on one of its subcategorisations. Thus we will be able to generate junk like:

2. That Kim left was bothered (by Sandy).

Similarly, for VPs introducing complements of verbs like 'elect' we will get two outputs from the metarule, only one of which is a sensible one:

3. VP → V[21] NP NP ('elect' etc are V[21])
4. a We elected Kim president
   b Kim was elected president
   c *President was elected Kim

The metarule will, however, fail to apply in the case of VPs introducing a sentential object, since there is no NP daughter, failing to generate perfectly good examples like 6b:

5. VP → V[..] S'
6. a They vehemently denied that there had been a plutonium leak
   b That there had been a plutonium leak was vehemently denied.

Most of these problems are fairly easily fixable: for examples like 2, it is a reasonable response to say that they are syntactically ok, but sortally deviant: the obvious fix for things like 6 is to regard sentential complements of this type as dominated by NP, as many other accounts have done. More serious is the fact that the metarule treatment will also fail to get the right results in those instances where the passivised NP is not a daughter of VP. There are several different cases here: so-called 'double passives' like:

7. a Kim was taken advantage of
   b Advantage was taken of Kim

If 'take advantage of' is treated as a complex V only one passive will be derived, for 'advantage' will not be a daughter of NP. There are also 'prepositional passives' like:

8. a Kim can't be relied on
   b That meal wasn't paid for

where the 'object' NP is actually inside a PP, as required in order to also be able to generate:

9. a On Kim, you can rely absolutely
   b For that meal, the company will pay

Passives for which there is no active equivalent will fail to be derived (by the metarule, at least):

10. a Sandy was said to be a CND activist
    b *They said Sandy to be a CND activist

Finally, there is a problem about agent PPs. The metarule treatment allows for an optional agent phrase as a constituent of the passive VP. The ID/LP format presupposed in GPSG allows for some freedom of ordering between PPs that are introduced by a VP: thus the output of the metarule for an input VP → V[..], NP, PP will allow possibilities like:

11. a A book was given by Kim to Sandy
    b A book was given to Sandy by Kim

But optional PP modifiers of VP are (correctly) introduced by a rule VP → VP PP. There is thus no way of accounting for cases where a non-subcategorised-for PP intervenes between verb and agent PP:

12. John was [[[[arrested] in the park] on Friday] by the Special Branch]

even though such cases are freely possible. (The same problem occurs with Bach's (1980) analysis of passives).

Bresnan (1982) presents an analysis of passives within the LFG framework. Lexical entries for passive forms of verbs are derived from those for the active form via a lexical rule which makes the appropriate morphological and semantic changes. Then passive VPs are parsed using the same context free phrase structure rules as for actives, with principles of functional coherence and completeness making sure that subcategorisation requirements are met, and the appropriate interpretations arrived at.

There are several problems with the proposed lexical treatment of passives, at least one of which could be regarded as fatal. It is not clear how passives with no active source are derived, although presumably the required lexical form could simply be listed. Cases where the passivised NPs are not daughters of VP are dealt with by making them ambiguous, by stipulation in the 'take advantage of' case, and by a lexical rule in the 'prepositional passive' cases:

13. V → [V P]v

This has the unfortunate effect that the unpassivised, unmoved versions of these phrases are also syntactically 'ambiguous', i.e. they receive two or more parses, corresponding to no discernible semantic difference:

14. a Kim can be [relied on]
    b [On Kim], you can always [rely]
    c You can [[rely on] [Kim]]
    d You can [rely [on Kim]]

In the case of those verbs which can take two prepositions, the rule must presumably have applied twice:

15. a The bed has been thoroughly [[rolled around]v on]v
    b On the bed, the children rolled around
    c ?Around on the bed, the children rolled

giving the curious consequence that the unpassivised version will now be three ways ambiguous:

16. a [rolled [around [on [the bed]]]]
    b [[rolled around] [on [the bed]]]
    c [[[rolled around] on] [the bed]]

Bresnan's lexical rules operate within the lexicon and not during a derivation. They 'express patterns of redundancy that obtain among large but finite classes of lexical entries' (Kaplan and Bresnan 1982, 180). This has the consequence that the lexical analysis can only be sustained if there is a finite number of passivisable verbs in English. For all practical purposes, we can suppose that there is, but there is an argument to be made that theoretically, there is an infinite number of such verbs, arising as a result of regular and productive morphological processes.

A simple version of this argument can be made as follows: there is presumably no upper limit to the number of proper names in English: we can always make up new ones, and we can always concatenate existing names to form new ones: Slater-Walker, Hewlett-Packard, etc. But we can form verbs using 'ise' from all of these: Bresnanise, Hewlett-Packard-ise, etc. And these verbs are all passivisable (Thatcherised, Marks-and-Spencerised) hence there is a potentially infinite number of passive verbs. Without an infinitely large lexicon the lexical treatment will be unable to cope. It is not clear to me how central the claim quoted above is to the theory of LFG. But either it will have to be abandoned, or some other way of handling passives will have to be found within that theory.

A unification-based analysis

The analysis here will be couched within a simple unification-enriched context-free formalism. The intention is not to promote the formalism, but to use it to

describe the analysis in a way that will make it clear, and easy to translate into your own favourite formalism. The semantics of the features in the rules is that provided by ordinary (i.e. Prolog-style) unification. The semantic expressions associated with the rules are instructions for building logical forms in a kind of 'intensionless Montague': a typed higher order logic, like that in PTQ without the intension and extension operators. Semantic translations are assembled on a rule to rule basis by function application and composition. (I assume some separate mechanism for those cases where quantifier scope is not determined by the syntax.) An example set of rules will illustrate:

16. S[type decl] → NP[agr X] VP[agr X]
    : NP (VP)

i.e. agr on NP must be identical to that on VP; the semantics of the S is what you get by applying the meaning of the NP to that of the VP.

17. NP[agr X] → Det[agr X] Nbar[agr X]
    : Det (Nbar)
18. Nbar[agr X] → N[agr X]
    : N
19. VP[agr X] → V[agr X, subcat np] NP
    : V (NP)

A simple set of global default values for features is assumed: thus if a feature does not explicitly appear on a category that it is a possible feature for, the default value, if any, will be placed on it, otherwise it will get a 'don't care' variable.

Unbounded dependencies can be accommodated by a version of the 'gap-threading' mechanism described in Karttunnen (1986). The semantics of unbounded dependencies can be treated in the same way as GKPS 1985: a constituent normally of type α, with a gap of type β, will be of type $\beta \rightarrow \alpha$. Gaps are of course NPs, PPs etc. which are missing an NP or PP.

So much for background. Using this type of machinery we can obviate the need for a passive metarule. Essentially the idea is to capture literally the observation that, syntactically, a passive VP is just like an active VP except that the verb has passive morphology, and there is an NP missing. The missing NP is treated as a kind of 'bounded dependency'. In the same way that GPSG style analyses introduce unbounded dependencies at the top of a sentence for wh-constructions, we will introduce a bounded dependency at the top of a passive VP.

We will assume that regular passive verbs are derived by a productive morphological process attaching a passive affix, en/ed. (See Russell et al 1986 for details of the morphological analysis system which is used). The semantic consequences of this are discussed below. This process will apply to any verb of the appropriate class, whether or not it is itself the product of prior morphological

processes. The syntactic effect of this affixation is that passive verbs are marked [vform passive], or something similar: 'vform' here is essentially the same feature used in GPSG85, appearing also on the VP constituent. We also introduce a feature distinguishing passive from active VPs: [passive +/-]. This feature can also occur on NPs, for a reason that will be immediately apparent. The default value for passive is -.

There are at least two rules introducing passive VPs, one as postnominal modifiers, and one as complements to 'be' and 'get' etc:

20. VP[agr X, vform Y] →
    Vbe[agr X, vform Y]
    VP[vform passive, passive +]
    : Vbe (VP)

The behaviour of the passive feature is written into the VP rules for the different types of verb that can passivise (I am assuming a GPSGish treatment of subcategorisation here).

Thus a VP rule for a transitive VP might look like:

21. VP[agr X, vform Y, passive Z] →
    V[agr X, vform Y, subcat trans]
    NP[passive Z]
    : V (NP)

Under normal circumstances, the rule will generate ordinary transitive VPs, but when appearing as complement to 'be' etc. will require passive morphology on the verb, and will contain that curious object, an NP marked [passive +]. Such NPs are introduced by a rule:

22. NP[passive +] → ϵ : λP $\exists$ x (P x)

A passive NP is an empty NP, but a different type of empty NP from unbounded dependency gaps. (This prevents the same NP from being both passivised and wh-moved in the same VP). It means, roughly, 'something'. All other NPs default to passive -.

Syntactically, then, a passive version of a transitive VP looks just like the active, except that the object is empty. Notice that the features guarantee that the passive NP is empty if and only if the verb is in the passive form. The attraction of this treatment is that it is the SAME rule that generates both the active and the passive versions: no extra rules are involved.

We do similar things with the other types of VP which can passivise:

(i) verb-particles:

23. VP[vform X, passive Y] →
V[vform X, subcat prt]
P
NP[passive Y]

-giving things like:

24. The light was switched off

Notice that we can choose whether it is the moved (NP P) or the unmoved (P NP) version which is capable of passivising: but only one of them, for otherwise passives will get two parses.

(ii) phrasal verbs:

25. VP[vform X, passive Y] →
V[vform X, subcat phr]
P
P
NP[passive Y]

-giving:

26. John was looked up to by his children

(iii) the raised version of 'object raising' verbs:

27. VP[vform X, passive Y] →
V[vform X, subcat objr]
NP[passive Y]
VP

(iv) both types of dative:

28. VP[vform X, passive Y] →
V[vform X, subcat dat]
NP[passive Y]
PP
29. VP[vform X, passive Y] →
V[vform X, subcat datmvt]
NP[passive Y]
NP

We prevent passive from applying where it should not by simply leaving out the passive feature on the relevant rules: it then defaults to value -.

For passives that have no active equivalent, we rely on the same mechanism. There are two types of case, those like 'said', 'rumoured' etc., and those like 'surprised at', 'astonished at'. For the 'say' type cases, the passive version will

be derived by the object raising rule above. Their passive entry will be listed directly in the lexicon with the relevant subcategorisation. There will be no entry for the active version on that subcategorisation. The absence of the active version guarantees that we will not generate things like:

30. *They rumoured him to be a spy

because the only lexical entry for 'rumour' with the appropriate subcategorisation is the passive form, and the features guarantee that this cannot cooccur with a full NP in this structure. The familiar 'promise/persuade' alternation is precisely the inverse of this: we can simply arrange for the lexical entry for 'promise' on this subcategorisation to be marked as not undergoing affixation by the passive morpheme. Thus we will get the following pattern:

31. John promised/persuaded Bill to leave
32. Bill was *promised/persuaded to leave

For the 'surprised' cases, we assume that there are actually two different verbs, with different semantics: the ordinary transitive verb denotes an event, and behaves regularly:

33. John surprised Bill
34. Bill was surprised by John

The other denotes a state and does not have an active form: it subcategorises for 'at' and is listed directly as a passive, with the appropriate semantics:

35. *The noise was surprising at Bill
36. Bill was surprised at the noise.
37. VP[vform passive] →
    V[vform passive, subcat srprs] P[at] NP

Now we turn to the 'rely on' type of case. Here the problem is that the missing NP is not a daughter of the VP: a fatal problem for the metarule treatment. Our solution is to pass on the bounded NP dependency down through a PP:

38. VP[vform X, passive Y] →
    V[vform X, subcat rly] PP[passive Y]
38. PP[passive X] → P NP[passive X]

However, this is as far as the passive feature can go, unlike true unbounded dependencies:

39. a On John, you can depend
    b John, you can depend on
    c John can be depended on
    d John, you can depend on the promises of
    e*John can be depended on the promises of

This can be simply achieved by not mentioning the passive feature anywhere else.

A notorious problem for many analyses of passive is the case of verbs like 'sleep' and 'walk' which appear to be subcategorised as intransitives, but occur in passives like the following:

40. This bed was slept in by the queen
41. The new grass shouldn't be walked over.

Apparently, an NP inside an optional modifier can be passivised. A simple account of this can be given by adding the following rule:

42. VP[vform passive, passive +] →
    V[vform passive, subcat intr] P

(We don't need to bother looking for an NP which is always passive). This claims that any intransitive verb can behave in this fashion, which seems approximately correct:

43. The plane was first flown in last year
44. The film was snored through/sneered at by most of the audience

However, the putative PP modifier has been flattened, into a P NP[passive +] sequence (i.e. just a P): this is in order to facilitate the semantic treatment of this construction, and has no adverse syntactic effects. It can be thought of as an implementation of the 'reanalysis' treatment of phenomena like this often advocated within the Government and Binding framework.

This treatment has the added advantage of simplifying our statement of affixation of the passive morpheme, which now might as well apply freely to any verb, independently of its subcategorisation. Of course, the result might not be well-typed, as in the case of these intransitive verbs: we will return to this matter when discussing their semantics below. Passive forms of other verbs which really don't passivise can never figure in a VP, given the rules, features and subcategorisation regime we are assuming.

A remaining problem is that of 'double passives' like

45. a Advantage was taken of John
    b John was taken advantage of.

There are several solutions one might explore here. We could have a rule for just this handful of verbs of the form: (keep tabs on, lay siege to, take pity on)

46. VP[vform X, passive Y] →
    V[vform X, subcat idiom]
    NP[passive Y]
    PP

where the NP must be as required by the verb. Then for the other passive we could assume a complex lexical entry for 'taken advantage of' which is subcategorised as an ordinary transitive. This is the suggestion made by many linguistic treatments. Within the feature system used here it is in fact possible to do all this by brute force: assume that the NP rules percolate up from their head a feature 'nform' which has as value the actual stem of the noun. Then we have two rules:

47. VP[vform X, passive Y] →
    V[vform X, subcat idiom, needs Z]
    NP[passive Y, nform Z]
    PP
48. VP[vform passive, passive +] →
    V[vform passive, subcat idiom, needs Z]
    NP[nform Z]
    PP[passive +]

Then this idiomatic sense of 'take' is entered in the lexicon as V[....subcat idiom, needs advantage] etc. The active form only gets parsed by rule 47, but both passive versions are accepted. (Incidentally, the idea of making different features share variable values can enforce correct verb-particle combinations, particular required PP forms, etc).

This concludes the list of some of the syntactic problems faced by any analysis of verbal passives, and solved by that presented here. I have not to date encountered any other examples of passives in English which will not yield to some combination of the methods used in the preceding. While I would be the first to concede that these analyses leave a great deal to be desired in terms of elegance, explanatory power, and the other grand criteria by which syntactic theories can be judged, they are conceptually and computationally quite simple and appear to be descriptively adequate, although somewhat longwinded: a more economical grammatical formalism might express things more succinctly.

I have said nothing about adjectival passives: these seem to be of two types, those that are already lexicalised as distinct items, like 'closed', and those produced by (fairly) productive derivational rules, where the subcategorisation of the verb (minus the passivised NP) is inherited by the adjective:

49. The door remained open/closed
50. The bottle remained empty/filled with wine

It is simple to incorporate a lexical treatment of this phenomenon into the analysis here, and so I will say nothing more about them (see Levin and Rappaport 1986 for a detailed study).

Semantics of Passives

I turn now to the semantics of passives. We have been assuming that the passive form of a verb, unless it is irregular, is derived by a morphological rule of affixation. The semantic effect of passive morphology on a verb is to switch around its first two arguments. Thus a transitive verb, in simplified form, would be represented as, say:

51. hit: λeso (hit e s o)

(where a λ is followed by a sequence of variables, this is to be regarded as a shorthand for a 'curried' expression: i.e. λxyz ... = λx λy λx ...). The first variable in 51 is an 'event' variable: I am assuming the Davidsonian(1980) analysis of verbs here: more on this below. I assume an affixation rule something like:

52. V $\rightarrow$ V Af : Af (V)

Affixes are in general (polymorphic) things which take verbs to verbs: the relevant ones here introduce tenses and the passive.

(i) past/present= λVe (V e) $\wedge$ (past/present e)
(ii) passive is of type (e$\succ$(e$\succ$(e$\succ\alpha$)))) $\succ$ (e$\succ$(e$\succ$(e$\succ\alpha$)))).

For transitive verbs passive amounts to λVexy (V e y x) Intuitively, tenses are predicates on events, and passive is an operator that has the effect of switching round the first two (non-event) arguments of the verb it applies to. The easiest way to see how all this fits together is to give sample derivations from the following little grammar (I will omit the feature specifications on rules for simplicity):

S $\rightarrow$ NP VP : $\exists$e (NP (VP e))
; the event variable is bound at the top level
NP $\rightarrow$ Name : λP (P Name)
; the rule raises the type
VP $\rightarrow$ Vtr NP : λea (NP (λb (V e a b)))
; VPs are of type (e$\succ$ (e$\succ$t))
VP $\rightarrow$ Vbe VP : λea (Vbe e) $\wedge$ ((VP e) a)
; assume that 'be' etc just carries tense
VP $\rightarrow$ VP PP : λea ((VP e) a) $\wedge$ (PP e)
; PP modification is treated as a predication
; on the event
PP $\rightarrow$ P NP : λx (NP (λy (P x y)))
; PPs are of type (e$\succ$t)

Given these rules, and lexical entries, a VP like 'hit Bill' will be translated, after some variable renaming and a few rounds of beta reduction, as:

53. λea (hit e a Bill) $\wedge$ (past e)

Modifying this VP with a PP like 'in Cambridge', will give a VP with translation:

54. λea (hit e a Bill) $\wedge$ (past e)
$\wedge$ (in e Cambridge)

Incorporating this into a sentence with subject 'John', the above rules will get us:

55. $\exists$e (hit e John Bill) $\wedge$ (past e)
$\wedge$ (in e Cambridge)

as a translation of 'John hit Bill in Cambridge': 'there was a hitting by John of Bill event, in the past, in Cambridge'

In the case where we have a passive like 'Bill was hit', application of the passive affix to the verb produces:

56. [λVexy (V e y x)] (λeso (hit e s o))

reducing to:

57. λexy (hit e y x)

The VP containing the empty passive NP will translate as:

58. λea ([λP ($\exists$i (P i))]
(λb ([λexy (hit e y x)] e a b)))

Notice that the passive morpheme has changed the order in which the verb expects its arguments. This beta-reduces to:

59. λea $\exists$i (hit e i a)

Incorporating this with the VP that introduced the passive VP as complement to 'was' gives us:

60. λea $\exists$i (hit e i a) $\wedge$ (past e)

If we now combine this with the subject we will get, after reduction:

61. $\exists$ei (hit e i Bill) $\wedge$ (past e)

'There was a past hitting by something of Bill event'.

Notice that agent phrases for passives are treated in exactly the same way as any optional VP-modifying PP. So a VP like 'was hit by John' - given some obvious assumptions about the translation of agentive 'by', and some way of selecting the translation appropriate to the sentence (as opposed to a locative or temporal 'by') - will translate as:

62. λea $\exists$i (hit e i a) $\wedge$ (past e) $\wedge$ (agent e John)

Notice that agentive PPs are not required to be adjacent to the passive verb, correctly. There is thus no syntactic connection between the presence of an agent phrase and passive morphology. This means that a sentence like:

63. John hit Bill by Fred

on the agent reading of the PP, is treated as syntactically well-formed, but thematically incoherent in the same way that:

64. John hit Bill with a hammer with a chair

is, where the PPs both have instrument readings.

We need an axiom achema to make the translations of 'John hit Bill' and 'Bill was hit by John' inter-deducible. This is not something extra demanded by this analysis, however: it is already needed to establish the connection between agents and certain types of events to account for the interpretation of agent phrases in nominalisations where the passive is not involved:

65. The hitting of Bill by John was an accident

For the most part, this semantic analysis extends straightforwardly to the other cases of passives discussed earlier. Their are three cases which need further comment, however. For datives, I assume that the NP PP and NP NP forms have different subcategorisations which are related by an obvious redundancy rule in the lexicon. However, we can assume that the verb has the same semantics in both cases:

66. λexyz (give e x y z)

Associated with the rule that generates the ditransitive form will be a 'dative' operator, defined thus:

67. λVexyz (V e x z y)

This has the effect of switching round the final two arguments of the verb. The rules will be:

68. VP $\rightarrow$ Vdat NP PP
    : λex (PP (λz (NP (λy (Vdat e x y z)))))
69. VP $\rightarrow$ Vdm NPi NPj
    : λex (NPj (λz (NPi (λy (V e x y z)))))
    where V is actually the dative operator applied to Vdm

I assume that argument PPs like those associated with datives translate as something having the type of an NP, rather than a PP, as befits their interpretation. This can be implemented simply by marking these PPs as arguments and making the translation of a PP constituent so marked consist simply of the

daughter NP: the preposition contributes nothing to the meaning. In the case of the Vdat rule, when the verb is in the passive, things are exactly analogous to the earlier cases (modulo differences caused by the fact that the verb is of a different type): the passive morpheme simply switches round the arguments corresponding to subject and direct object. In the case of the Vdat rule, when in the active, the dative operator shifts the final two arguments, so that eventually the innermost term containing the verb will be of the form ... give e x z y. In the passive, what the dative operator applies to is of the form ... give e y x z, because of the prior result of attaching the passive affix. Thus the result of the dative operator is of the form ... give e y z x.

I will spare you the sequence of beta reductions involved, but with the rules and lexical entries given the right results are achieved. (For those with long linguistic memories, the sequence of lambda manipulations involved may seem strongly reminiscent of the standard theory TG treatment of constructions like this).

The treatment of argument PPs here is also needed for the 'rely on' type cases. The semantics of the rule is simple:

70. VP $\rightarrow$ Vr PP : λex (PP (λy (Vr e x y)))

The PP here also has the type of NP.

The final wrinkle concerns the appearance of intransitive verbs in passives. Applying a passive affix to an intransitive verb directly results in something that is not well typed: intransitives are here of type (e$\succ$(e$\succ$t)). The simplest course is to assume that under these circumstances the passive affix is simply ignored. Then we can associate with the relevant rule the semantics as follows:

71. VPpas $\rightarrow$ Vintr P
: λex ($\exists$i ((Vintr e) i) $\wedge$ (P e x))

Given that the meaning of 'sleep' is λex (sleep e x), this will produce a translation of 'This bed was slept in recently' as:

72. $\exists$eib (sleep e i) $\wedge$ (bed b) $\wedge$ (past e)
$\wedge$ (in e b) $\wedge$ (recent e)

'There has been a past sleeping of something event and that event was in this bed and recent'.

While this may seem a little clumsy, it seems to produce acceptable results. No other analysis I am familiar with has anything at all to say in detail about the semantics of these cases.

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