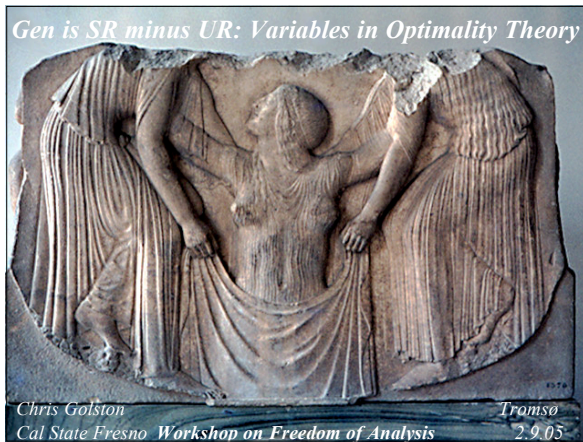
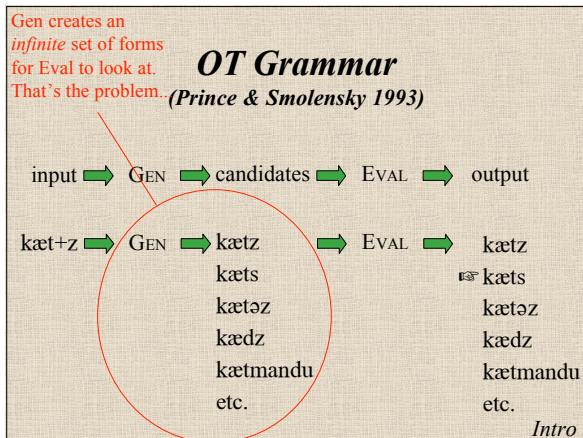




3 Proposals

- (i) URs are treelets with variables.
- (ii) Gen unifies treelets, fills in variables.
- (iii) SRs are treelets with variables solved.

Intro



Is an infinite number of candidates ok?

“there is no bound on the size of a candidate and every candidate set, from every input, is infinite.... No Gen-imposed bound on the number of epenthesis operations is appropriate. Rather, the economy of epenthesis should and does follow from constraint interaction.

In this context, it is appropriate to point out that OT shares with the rest of generative grammar a commitment to *well-definition* but not to *efficient computation*.” (McCarthy 2002, 9)

Intro

I confess my bias

A commitment to *well-definition* without a commitment to *efficient computation* is worrisome but probably necessary; a commitment to it without a commitment to *possible computation* seems to me untenable.

Speech is produced in real time; a model of grammar that requires *infinite* time is not a possible model of how humans speak.

Intro

Gen is what the grammar adds to stored representations (UR) to make phonetically detailed programs for speech productions (SR).

In a realistic mental model this means that Gen is what is stripped from SR to make it storable or, what is added to UR to make it sayable: Gen = SR minus UR

To understand Gen, we therefore need a good understanding of UR (what is stored) and SR (what guides articulation and perception).

The more alike they are, the less Gen has to do.
The less alike they are, the more Gen has to do.

Intro

Lexicon Optimization

OT has a mechanism built into it that makes inputs as similar to outputs as possible.

Everything that doesn't alternate is in UR.

(Prince & Smolensky 93; Inkelas 94; *alii*; see Krämer 04)

Intro

If URs (input; what is memorized and stored) and SRs (output; what guides articulation and perception) are very similar,

we shouldn't need Gen to create an infinite set of SR candidates to choose from.

Intro

Phonology as Algebra

URs (inputs) are little trees with variables.

Gen unifies little trees, solves for variables (that's all).

SRs (outputs) are little trees without variables.

Intro

Gen

Things my Gen doesn't generate

/kæt-z/ Onset LarAgr etc.

[ z] *!

[ z] *! *

...or motorcycles, fevers, bananas, aged cheddar, furniture, yo mama, dental work, naked pictures of Avril Lavigne.

I can't even produce these; how could I GENERATE them?

Gen

cf. Reiss's NoBANANA

"Note that the claim intended by the constraint NoBANANA, that no representation of a sentence contains bananas, is probably true for all human languages. However, there are an infinite number of true claims of this type. No language requires speakers to dance a jig to express iterativity, no language has pizza as an element of syntactic trees; *etc...*

We do not want our model of grammar to express every true statement about what structures do not occur, since there are an infinite number of such statements and the grammar must be storable in finite terms if it is to be instantiated in human brains. (Reiss 2002, 2)

(Morén this conference)

Gen

Gen

Gen

Gen

Gen

This is related to Containment (Prince & Smolensky 1993).

But Containment only requires that the output include the input.

I'm proposing that the output *only* include the input.

(This will be interesting for epenthesis. See below.)

Still more things my Gen doesn't generate

/kæt-z/	Onset	LarAgr	etc.
[k-ætʒ]		*!	
[kæ-tʒ]		*!	
etc.	*!		

There is no evidence that Gen mucks around with the basic sound-meaning correspondence in this way.

There's no reason to abandon Saussure yet...

Gen

Reasonable Restriction 4:

Consistency Of Exponence:

Gen cannot change the morphological affiliation of material.

(Prince & Smolensky 1993)

'Contra Walker & Feng (2004), we...argue that CoE should not and cannot be "demoted" to the status of a violable constraint, but rather *should play a central role in our understanding of Gen.*'

(van Oostendorp, this conference; my emphasis)

Gen

all such commonsense considerations...

Gen only generates

things that a human can say.

things that a given speaker can say.

things that the given speaker intends to say.

Gen cannot change the morphological affiliation of material.

...lead to *lemmas*

Gen

Lemmas

'[t] child develops a system of *lemmas*, packages of syntactic information, one for each lexical concept. At the same time, the child quickly acquires a closed class vocabulary, a relatively small set of frequently used function words. These words mostly fulfill syntactic functions; they have elaborate lemmas but lean lexical concepts. This system of lemmas is largely up and running by the age of four. From then on, *producing a word always involves the selection of the appropriate lemma.*'

(Levelt et al 1999, 2; my emphasis)

Gen

*i.e., my Gen probably **does** generate*

	AgrLar	Onset	etc.
☞ ['kæts]			
['kæʒ]		*!	
['kæʒə]			*!

ie, every form of every lemma I plan to say.

cat is *always* pronounced ['kæt]

plural is *always* [z, s, əz]

['kæt] • [z, s, əz] = candidates

1 • 3 = 3

Gen



Not all cases are this simple: e.g., *vomit-s*...



vomit has at least 2 allomorphs

['vɑ.miɾʔt]
 ['vɑ.mi.r]ɪŋ

2•3 = 6 candidates

s
 z
 əz

Gen

and more allomorphs once we consider more phonetic detail

vomit has at least 4 allomorphs

['vɑ.miɾʔt]
 ['vɑ.mi.r]ɪŋ
 ['vɑ.mi.rʰ]o.ɪi
 [ɿvɑ.mi.rʰ]o.ɪi.əɪm



Swedish metal band



exit

so *vomit-s* requires at least 4•3 = 12 candidates

Gen

is this an infinite regress?

not at all

it's a finite regress

which is infinitely smaller than an infinite regress

Gen

And aren't these the candidates we most want to consider?

	AgrLar	SonPk	*ə
['vɑ.miɾʔts]			
['vɑ.miɾʔtz]	*!		
['vɑ.miɾʔt.əz]			*!
['vɑ.mi.rs]		*!	
['vɑ.mi.rz]		*!	
['vɑ.mi.rəz]			*!
[ɿvɑ.mi.rʰs]		*!	
[ɿvɑ.mi.rʰz]	*!	*	
[æv.ɪl lə'vɪn]			
etc.			

nobody misses this candidate now that she's banished

Gen

General Restriction on Gen:

Gen generates only the lemmas of the intended utterance.

from which it follows that it only generates

- things that humans can say
- things that the speaker in question can say
- things that the speaker in question intends to say

Gen

Underlying Representations

a chef's tour...

UR



kæt

UR is a string of sounds
(Panini, Saussure, Sapir)

UR



-cont	-hi	-nas
+hi	-cor	-back
-ant	-rd	-hi
-lo	-nas	-lo
-cor	+lo	-cor
-voi	-back	-cont
-nas	-ant	-voi
-rd	+voi	-rd
-back	+cont	-ant
:	:	:
etc	etc	etc

UR is a string of unordered sets of features
(Jakobson, Fant & Halle; Chomsky & Halle)

UR



root

lar suplar

 man pl

 | |

 stop dor

root

lar suplar

 man pl

 | |

 low front

root

lar suplar

 man pl

 | |

 stop cor

UR is a string of nested sets of features
(Clements '85)

UR



No STOP	ALIGN COR	No DOR	No FRONT	No LO
				

UR is a set of constraint violations
(Golston '96)

UR



all of these are wrong

URs must be more
hierarchically structured
for reasons
independent of phonology
the reason is *short term memory*
which holds very very few *chunks*

7±2 (Miller 1956)
4±1 (Cowan 2001)

UR

3 things you must assume
in this life

- URs are stored in long term memory (LTM)
- the path to LTM leads *through* STM
- STM can hold 4±1 chunks

UR

so URs must be bundled into 4±1 chunks
(to be learnable)



kæ.lɪ.fɔːn.jə

is **not** a possible UR for *California*
because it has 10 chunks

✓kæ.lɪ.fɔːn.jə

1 2 3 4

is a possible UR for *California*
because it has 4 chunks
(each with 2-4 chunks)

✓(kæ.lɪ)(fɔːn.jə)

1 2

is a possible UR for *California*
because it has 2 chunks
(each with 2 chunks)

UR

so URs are stored with lots of structure
(presumably prosodic structure)

Within OT, the result is forced by Lexicon Optimization.

“...if no alternations occur in a morpheme’s shape, the learner will never posit an input deviating from the actual observable output form. Due to Lexicon Optimization, the input simply equals the output unless there is reason to deviate.” (Kager 1999, 414)

“Exactly parallel results extend to syllable structure and even stress, where nonalternating.” (Inkelas 1994, 15)

UR

LO is probably necessary in OT, but not sufficient:

‘While the idea of maximally transparent mapping between underlying form and surface form is a potentially nice idea, the facts of loanword adaptation and deneutralization explored here show that the human mind seeks statistical lexical regularities in the form of morpheme structure constraints, and that *there is more to constructing URs than minimizing constraint violation.*’

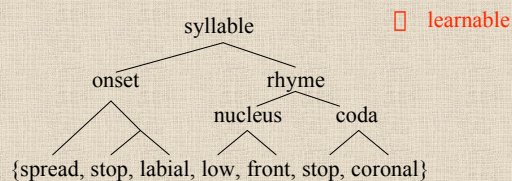
(Vaux & Nevins, this conference; my emphasis)

we step back for a moment
to consider what all this means

Distinctive features exist to distinguish meanings

[pæt, bæt, mæt]

Prosody exists so large sets of features can be learned
{spread, stop, labial, low, front, stop, coronal}



UR

so how might such
URs be instantiated in
a real brain?

UR

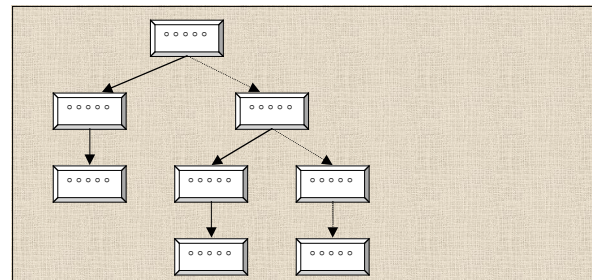
Treelets

(Marcus, *The Algebraic Mind*)

'complex, structured knowledge can be encoded in a neural substrate using a set of prestructured templates that I call treelets'

(Marcus 2001, 108)

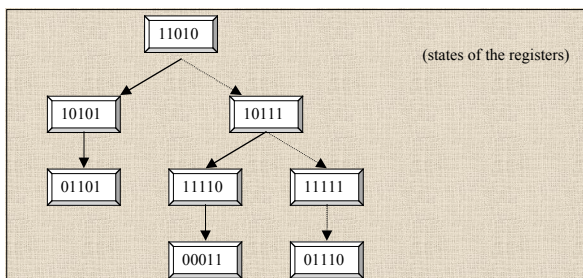
UR



'Empty treelets. Rectangles indicate register sets. Circles indicate individual registers within a register set. The figure as a whole depicts a single empty treelet. Solid and dashed lines indicate two distinct types of pointers between register sets.'

(Marcus 2001)

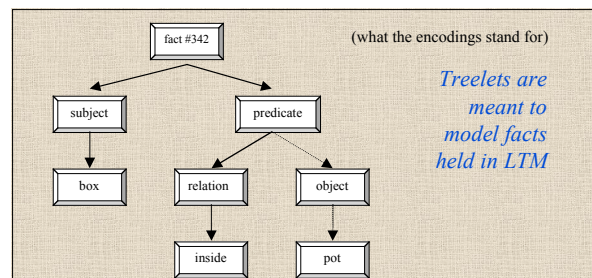
UR



'A filled in treelet standing for box inside pot. Each register set contains the distributed encoding of an atomic element. Relations between elements are given by prewired pointers...'

(Marcus 2001)

UR



Treelets are meant to model facts held in LTM

'Learning a new fact consists of setting the values of the register sets within a treelet to appropriate values.'

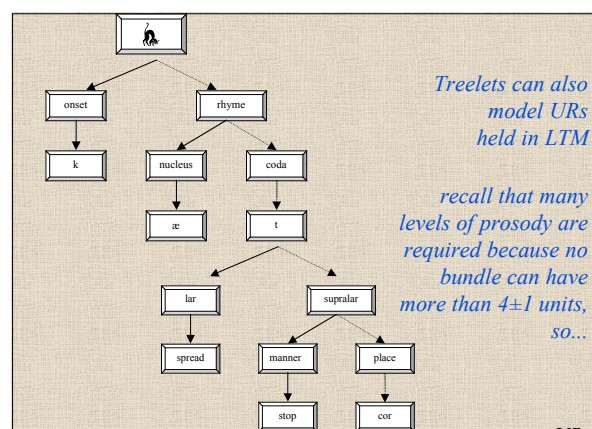
(Marcus 2001)

UR

'Fundamental to my proposal are the assumptions that the mind has a large stock of empty treelets on hand and that new knowledge can be represented by filling in an empty treelet (that is, by storing values in the register set) or by adjusting the values contained in an existing treelet.'

(Marcus 2001, 108)

UR

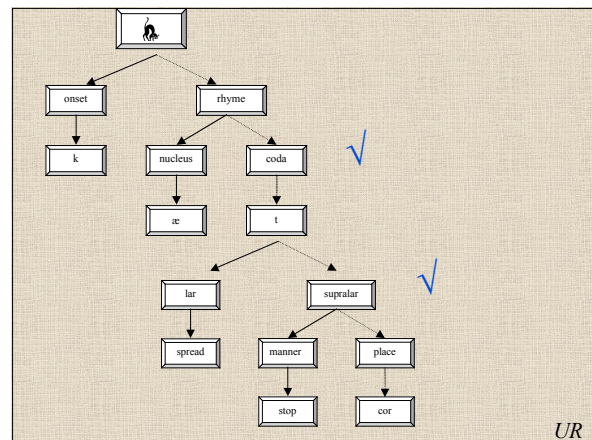


recall that many levels of prosody are required because no bundle can have more than 4±1 units, so...

UR

Prosodic structure exists in order to bundle distinctive features for Short Term Memory.
Prosody is a compression device.

UR



UR

These treelets cannot yet handle **alternations**.

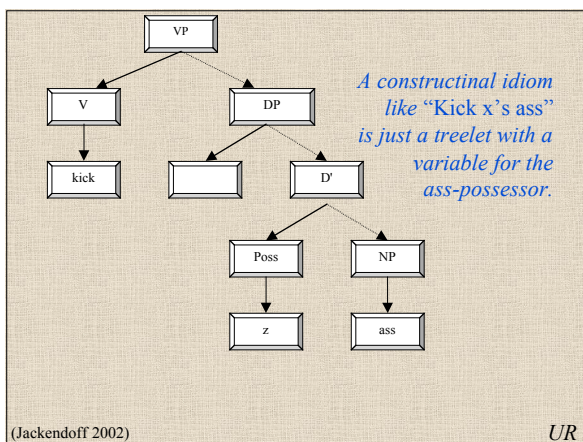
For this we need **variables**.

UR

Treelets with Variables

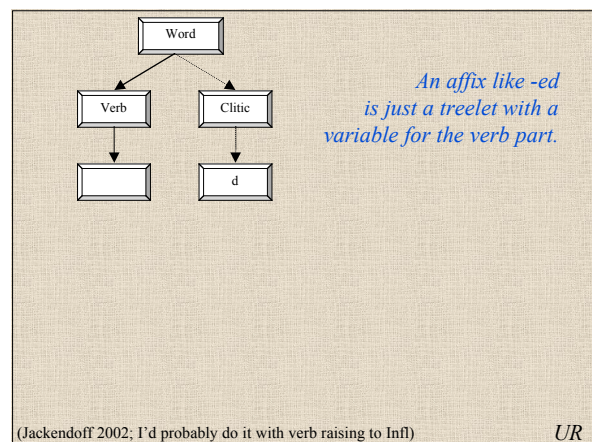
not all parts of a treelet
need to be filled in:
empty register sets are variables

UR



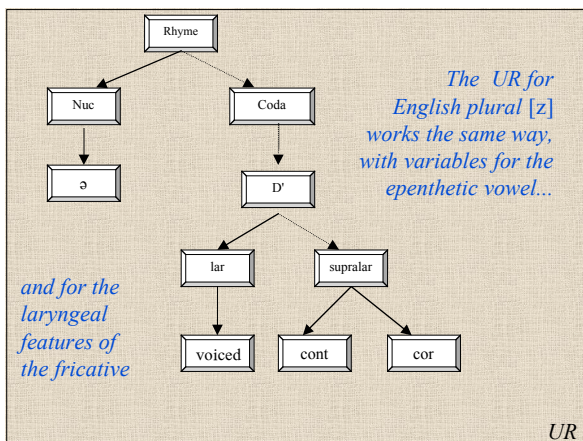
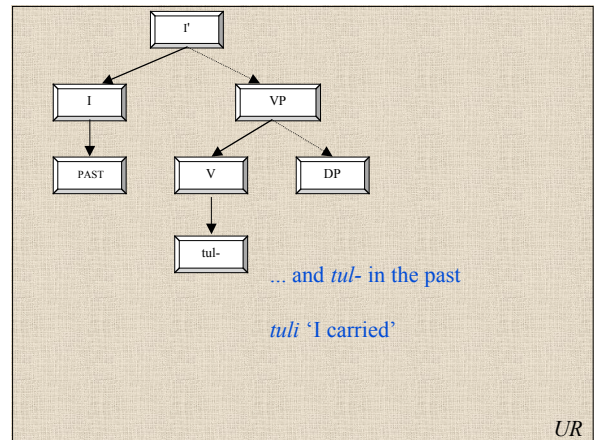
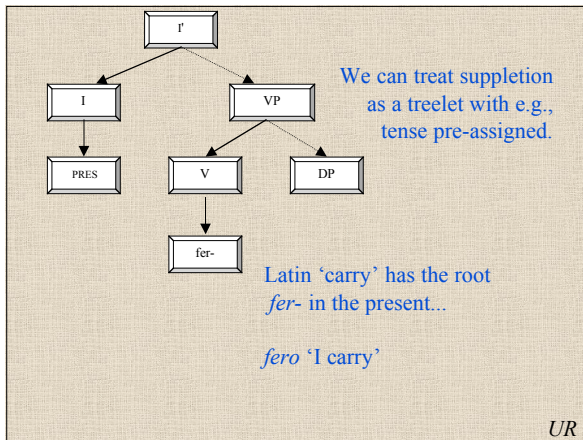
(Jackendoff 2002)

UR



(Jackendoff 2002; I'd probably do it with verb raising to Infl)

UR



3 Proposals (yet again)

- (i) URs are treelets with variables.
- (ii) Gen unifies treelets, fills in variables.
- (iii) SRs are treelets with variables solved.

UR

Surface Representations

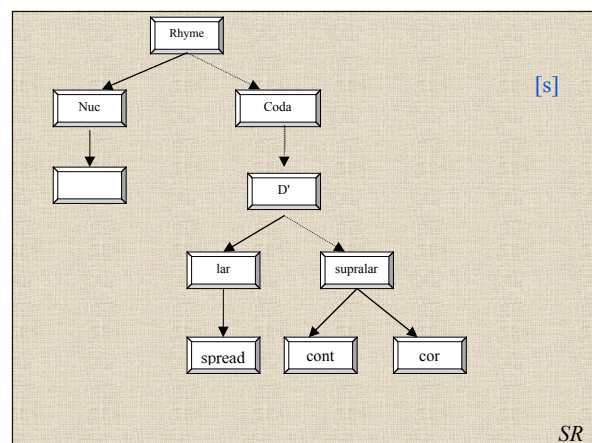
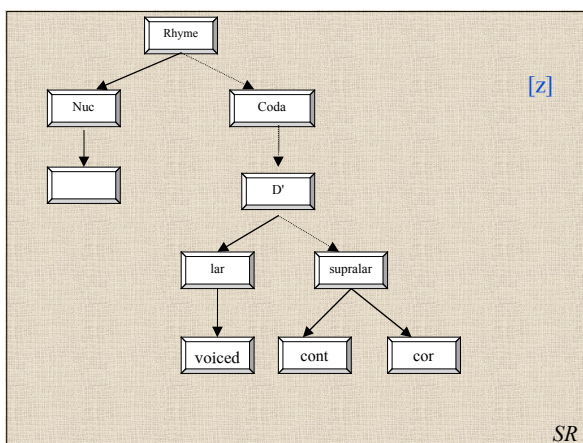
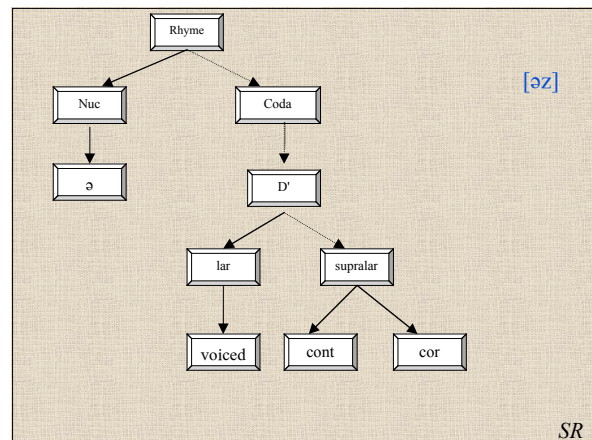
SR

(iii) SRs are treelets with variables solved.

as long as variables only range over finite sets, Gen will be finite

SR

So Gen will produce 3
candidate SRs for
'plural'...



Gen just merges/unifies each of these
with the various allomorphs of the root lemma [s]

$$(\# \text{ allomorphs}) \cdot (\# \text{ allomorphs}) = (\# \text{ candidates})$$

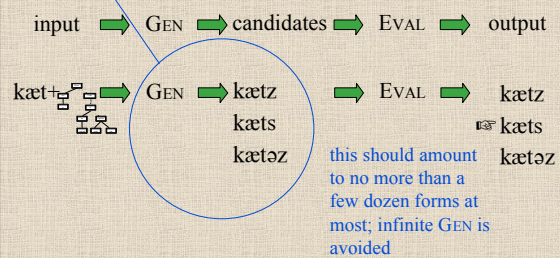
Eval then picks out the optimal candidate, as usual.

[I haven't figured out how the problems Bye raised yesterday for allomorphy selection will play out here.]

SR

GEN creates the
product of the
allomorphs of the
intended lemmas

OT Grammar (revised)



Wrapping Up

- (i) URs are treelets with variables.
- (ii) Gen unifies treelets, fills in variables.
- (iii) SRs are treelets with variables solved.



In Case Someone Asks...

Q1: What about epenthesis?

Won't epenthesis now have to be part of each morpheme, since the candidate set only includes "allomorphs" of the intended message? Isn't epenthesis extra-morphemic?

Reply:

Yes. Happily, though, there's evidence that epenthesis happens in perception (Dupoux et al. 2001) and because of language-specific constraints. The grammar is thus responsible for putting extra empty slots on morphemes, as there's no reason to think that eg, Japanese speakers hear ebuzo as polymorphemic.

Q1

Q2: What about redundancy?

Now there's all sorts of redundancy in the URs. Isn't that a bad thing? Things that always get added by rule in old fashioned phonology will all be stored in this kind of phonology. The grammar is no longer the repository of regularity.

Reply:

Redundancy is the new black. Lexicon Optimization makes redundancy inevitable. There are parallels outside of language to make us feel humble...

Q2

This is how DNA is stored in an organism; every cell has copies of everything.

Nobody asks nature to be elegant and neat. Information is cheap, perhaps, and best stored everywhere so that it doesn't need to be recreated everywhere.

Q2

Within OT at least,

the grammar shapes the lexicon

so the lexicon is *not*
the repository of lawlessness

but a reflection of the grammar

the structural redundancy (syllables, feet)
is what makes URs learnable in the first place

URs are trees and the tree shapes are grammatical



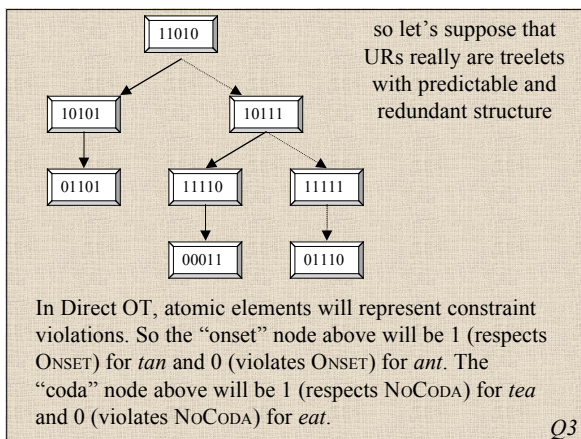
Q2

Q3: Is Direct OT dead?

So Direct OT (Golston 1996) is dead? Because desiderata aren't learnable?

No. Direct OT, like all other theories of UR has to chunk things for the trip through STM. This can be done for autosegmental representations by chunking segments into syllables, etc., and the same can be done for Direct OT. You store for each syllable/foot the constraints that a given morpheme violates...

Q3



Q3

Q4: Loss of generalization

Plural, 3sg, and possessive -s all work alike. But now their URs are responsible for all of this. Why doesn't plural work one way, 3sg another, possessive yet another?

The problem stems from Lexicon Optimization, not from the proposals laid out here. LO drives regularities from the grammar to UR, just as Natural Selection drives reflections of the environment to the genome.

Q4