

SEMANTIC ALGEBRA

[Version for the Internet]

SEMANTIC ALGEBRA FOR COINERS OF SCIENTIFIC LUGANDA TERMS:

I Introduction:

Semantic algebra purports to be a powerful tool for analysing the semantic structure of scientific English terms so as to facilitate the synthesis of their scientific Luganda equivalents. It is to be reasonably assumed that once a REDENET specialist has identified the semantic structure of the English term, he/she will profitably consult the list in this handout for eventual Luganda equivalent morphs which represent the morphemes in the English or anglicised term.

Semantic algebra is based on the hypothesis which states that in any language or at least in Luganda and English the semantic structure of an expression accords with the morphemic sequencing

$$[[[[[L]_{Lxm} M_{ext}]M_{rel}]M_{cat}]M_{infl}] \rightarrow [L']_{Lxm} \{W\}_{WF}$$

where

$[L]_{Lxm}$ = lexeme

M_{ext} = extensional morpheme

M_{rel} = relational morpheme

M_{cat} = categorial morpheme

M_{infl} = inflectional morpheme

$[L']_{Lxm}$ = resultant lexeme

$\{W\}_{wf}$ = resultant word - form

A lexeme is a set of word - forms which inflectionally issue from it . A derivational process leads to the formation of another lexeme. A morpheme is a set of minimal (ie. unanalysable) units of form having the same meaning. For example, considering the morpheme PERFECTIVE in English.

$[\text{SIMPLE PERFECTIVE}]_{Mpm} \rightarrow \{ - \text{ed}, - \text{t}, - \text{en}, \text{ablaút}, \emptyset \}_{Mp}$
which can be exemplified as follows:

ask : asked (-ed)
 dwell : dwelt (-t)
 take : taken (-en)
 sing : sung (ablaút)
 cut : cut (Ø)

The morphs (M_p = morph) -ed , -t , -en , ablaút, Ø realise the morpheme PERFECTIVE (M_{pm} = morpheme). A word is a meaningful string of morphs.

Word - forms are generated from lexemes. For instance,

$[[MAN]_{Lxm} PLURAL_{Mpm}] \rightarrow \{men\}_{Wf}$
 $[[SING]_{Lxm} PAST_{Mpm}] \rightarrow \{sang\}_{Wf}$

Extensional morphemes extend or modify a lexeme.
 Relational morphemes are the semantic roles (or functions) in the predication

$\phi < \alpha_1, \dots, \alpha_n >$

where

ϕ = Predicate
 α = argument with $1 \leq i \leq n$

Categorial morphemes are the ultimate categories of thinking. Finally, inflectional morphemes operate on lexemes.

II Extensional Morphemes:

Morphemes	English Morphemes	Luganda Morphemes
Initial, INIT		-al
Direction (Positive), DIRP	ad-, ac-, af-, ag-, al-, an-, ap-, ar-	-Ir, -wIr
Direction (Negative), DIRN	a-, ab-, abs-, ap(o)-	-wIk
Medial, MED		- mu
Diminutive, DIM	- cle, - cule, - et, - ling, - ole	-ak, aka-
Diminutive, DIM	extra-, ultra-, over-	-IrIr, -VCVC eri-, ogu-, Sse

Excessive, EXC	ultra-, extra	-angul(ul), -Ssukka (-)
Reversative, REV	-de-, un-, dis-	- Uk(Uk), -UI(UI)
Reflexive, REFL	self-, aúto-	e-
Reciprocal, RECI	inter-	-(AG)an, -wan
Possible, POSS	-able, ible	-Ik
Mutative, MUT	-ize, ify	-w(al), -Uk, -l, -k
Passive, PASS		-Ibw
Causative, CAUS	-ify, ize, -ate	-y
Instrumental, INST		-Is -wIs
Relative, REL		-Ir
Iterative, ITER		verb stem duplicated; - atirir
Duplicative, DUPL	diplo-, dupl-	-at, -biriwaz -
Ornate, ORN	-ate, -ize	-Agany, -wan(y)
Privative, PRIV	de -	- Uk - UI , - wUk , wUI
Collective, COLL	-ile , - il , - ism	wa - , omu -
Unit , UNIT	- ad	wa -
Masculine, MASC>	- or , he -	sse - , - ssajja
Feminine, FEM	- ess , she - , -trix , - ine	nna - , - kkazi
Extended, EXT		olu -
Negative, NEG	non - , a - , in -	- wUfu
Massive, MASS		wa - , omu - , wali - , wamu -
Partial, PART		- ako , - nnatundu , -ttundu
Whole, HOLO	holo -	- nnalamba , nnamba
Singular, SG	appropriate morph	appropriate prefix
Plural, PL	appropriate morph	appropriate prefix
Gradation, GRAD	see SI affixes	see SI affixes
Equative, EQU	iso -, equi -	- enkana(y)a - , =
Prime , PRIM	arch - , proto - , ante - , antero - , fore -	sse -, ka -, nna - , wa - , - nnadda , - ssooka , - ssaala , nnumberi
Salient, SAL		SSE -
Partner, PARN		wa -

Posterior, POST	met(a)- , post -	sse - , - ggoba, - wlvu
Similar, SIM	- (o)id , - like , - y , homo - , - iform , an(a) -	- wlfu
Dissimilar, DISS		
Pertinent, PERT	hetero -, dis -	- nna -
Pejorative, PEJ	- al , - (i)an , - ary	appropriate prefix
Meliorative, MEL		appropriate prefix
Synonym, SYNO		
Antonym, ANTO		
Anterior, ANTE	un - , dis - , a -	
Fractional, FRAC	ante - , pre- fore	
Ordinal, ORD		
Cardinal, CARD	- th	
Multiple, MULT	- teen , - ty	-jjingi , -(y)ingi
Distributive, DIST	multi- , -ple , poly -	- ang
Habit, HABI		
Origin, ORIG		omu(nna)- , 7 ⁰ ki -
Proximity, PROX	- ian , - in(e)	- ssegera
Around, AROU	juxta - , anchi -	- bbuga
Across, ACRO	circum - , peri -	- ssala , - nnakkati
Backwards, BACK	trans - ,dia, per -, ultra - , pel -	
Emerging, EMER	retro - , ab	
Forwards, FORW	- escent	
With , WITH	ad -	- nna
Without , WITO	- y , - ate	- wUfu
Beyond, BEYO	a - , an -	
Opposite, OPPO	ultra -	
	anti -, re - countre -, contra -, ob - oc - , of -, op -	- kkonta
Middle, MID	mes(o)-	- kkati
Within, WITI	intra -	- nnanda

Both, BOTH	ambi - , amphi -	-X_{N, P1} + Y_{num} + e
Intro, INTRO	intro -	- jjingira
Outside, OUTS	ex -, e -, ec -, ef -, exo -, extra -	- nnabweru
Outwards, OUTW		
Inside, INSI	en -, em - endo -, ento- , in-	- nnanda
Inwards, INWA		
Well, WELL	eu -	- nnalungi , - ddungi
Badly, BADL	mal -	-nnabi
Minor, MINO	by(e)- , anchi -, dys -	- nnampi , aka -
Mistakenly, MIST		- ssoba
Former, FORM	ex -	- ali
On, ON	epi -	- jjako
Deviation, DEVI	ab -	
This side, THIS	cis -	- nnano
That side, THAT	trans - , cross -	- nnali
Definite, DEFI		
Indefinite, INDE		
All -inclusive, ALLI	all -, pan - , omni -	- nnoona
ACADEMIC FIELD, ACAD	- ic(s) , - logy , - graphy, - nomy, -metry , -metric	kanna - , kalojja -, kapima -
SECOND-IN-RANK, SECO	vice - , pro - , deputy	
HALF, HALF	semi - , demi - , hemi -	
NOSOLOGICAL, NOSO	(1) - itis (2) - asis , - osis , - iasis, - stasis (3) - algia , - algesia , - odyinia (4) - oma , - cele (5) - graphy , - graph;	(1) kaasa - (2) kasa - (3) kama - (4) kamba - (5) kalojja - , ekirojja - ; ekiraga -

III. SI AFFIXES IN LUGANDA (Final Version)

E 10¹⁸ exa- = -kajja

PE 10¹⁵ peta- = -ssejja

macromacro-	=	-nnajja	T	10^{12}	tera-	=	-nnajja
ultramacro-	=	-wajja	G	10^9	giga-	=	-wajja
macro-	=	-lijja	M	10^6	mega-	=	-lijja
maxi-	=	-mujja	k	10^3	kilo-	=	-mujja
hyper-	=	-kijja	h	10^2	hecto-	=	-kijja
super-	=	-jja	da	10^1	deca-	=	-jja
epi-	=	-jjako					
hypo-	=	-kkako	E	10^{18}	exa-	=	-kajja
sub-	=	-kka	d	10^{-1}	deci-	=	-kka
infra-	=	-kikka	c	10^{-2}	centi-	=	-kikka
mini-	=	-mikka	m	10^{-3}	milli-	=	- mukkaa
micro-	=	-likka	u	10^{-6}	micro-	=	-likka
ultramicro	=	-wakka	n	10^{-9}	nano-	=	-wakka
micromicro-	=	- nnakka	p	10^{-12}	pico-	=	- nnakka
			f	10^{-15}	femto-	=	-ssekka
			a	10^{-18}	atto-	=	-kakka

IV. Relational Morphemes

I recognise and abbreviate the following relational morphemes:

Bearer (Latin ferens), FE

Event, EV

Affected, AF

Effected, EF

Operator, OP

Agent, AG

Instrument, IN

Recipient, RE

Nonevent, NE

Positioner, PO
 Location, LO
 Temporal, TE

In Luganda , the normal suffixes - a , - e , - i , - o and - u , are extentional morphs which realise the following morphemes:

PROG[RESSIVE] → {a}
 PERF[ECTIVE] → {e}
 DISP[OSITIONAL] → {i}
 MANI[FESTATIONAL] → {o}
 DEMU[TATIVE] → {u}

V. Categorical Morphemes

I posit and abbreviate the following morphemes:

Space, L
 Time, T
 Change, C
 Nonchange, Q
 Material Objective, R
 Plant, F
 Animal, Z
 Human, H
 Institution, I
 Sensum, S
 Mental, M

For convenience, the categories C and Q can be subdivided into Happening (Ch) and Act (Ca); State (Qs) and Position (Qp).

In Luganda nominal prefixes are relational and categorial at the same time.

VI. Examples of Formalising Sematic Structures

With - fumb- "cook" (the verb) and - fumbir- "cook at/in" we derive effumbiro "kitchen", omufumbiro "kitchen worker" and omufumbi "cook" in (1) - (3)

(1) [<<<< [FUMB] REL> MANI> LO> L>]_{Lxm} → [EFFUMBIRO]_{Lxm}
 ↓ ↓ ↓ ↓
 {fumb ir o eli } → {effumbiro}_{Wf}

(2) [<<<< [FUMB] REL > MAM >AG >H >] → [OMUFUMBIRO]

↓
omu

(3) [<<< [FUMB] DISP > AG > H >] → [OMUFUMBI]

(4) [<< [COOK] AG > H >] → [COOK]_{Lxm}

↓ ↓
{cook ∅} → {cook}_{wf}

(5) [<< [COOK] IN > R >] → [COOKER]

(6a) [<< [BEG] RE > H >] → [BEGGAR]

(6b) [<<<<< [SAB] AUG >CAUS >DISP >RE > H >] → [OMUSABIRIZI]
omusabirizi "beggar"

(7) [<<< [TUM] PERF > AF > H >] → [OMUTUME]

- tum - "send"
omutume "messenger"

(8) [[<< [COLLECT] RE > H >] [<< [DEBT] AF > R >]] → [DEBT
COLLECTOR]

(9) [< [BAKE] LO > L] → [BAKERY]

(10) [<<<<< [CONCEPT] PERT > CAUS > EF > M > PL >] →

↓ ↓ ↓ ↓ ↓
{concept} {ual} {ize} {ation} {s}
{conceptualizations}_{wf}

(11) [<<<< [SECT] PERT > OPPO > NE > Q >] → [ANTISECTARIANISM]

(12) [<<<<<< [POLE] PERT >CAUS > REV > ITER > EF > C >] → [RE-
DEPOLARIZATION]

(13) [[<< [DWELL] PO > H > << [TOWN] LO > L >] PL] → {town dwellers}

with - sumulul - "open" (the verb) ebisumuluzo "keys" is formalized in (14).

(14) { <<<<<< [SUMULUL] CAUS > MAM > IN > R > PL > } {ebisumuluzo}

with - lab- "see" (the verb) bassabalabirizi "archbishops" is formalised in (15)

(15) { <<<<<<< [LAB] AUG >DISP >AG > H > PL >PRIM > PL > } →
{bassabalabirizi}

- (16) < [WEALTH] WITH > → [WEALTHY]
- (17) [POOR] = [< [WEALTH] WITO >]
- (18) [PUPIL] = [<< [TEACH] RE > H >]
- (19) [<< [PECK] AG > Z > << [WOOD] AF > F >] → [WOODPECKER]
- (20) [<< [ABSORB] IN > R > << [SHOCK] AF > S >] → [SHOCKABORBER]
- (21) [<< [STUDY] RE > H > < < [UNIVERSITY] AG > I >] → [UNIVERSITY STUDENT]
- (22) [SEMESTER] = [< [STUDY] TE > T]
- (23) [< [WIDE] MUT >] → [WIDEN]
- (24) [[[NE] Q] < [FE] R] > → < [[FE] R] [[NE] Q] > → < [GOLD] [PURE] > → [PURE GOLD]
- (25) [<< [FALL] LO > L > << [WATER] AF > R >] → [WATERFALL]

The foregoing examples of formalizing sematic structure on the basis of predications accord with the hypothesis stated in Section I. In particular, example (15) shows that the sequence

< [L] M_{ext} > M_{rel} > M_{cat} > M_{infl} > is morphemically cyclic.

Assuming that every predicate and argument of a predication can be uniquely assigned a relational and a categorial semantic component, I am inclined to think that a general combination of relational and categorial components of meaning leads to a periodic system of semantic elements. In the next Section I posit such a system which is part of a revised theory of scientific terminology.

VII. A Revised Theory of Scientific Terminology

In this Section I present a revised version of my theory of Scientific terminology.

Axiom 1: The ultimate categories of human thought Are (in ascending order of semantic complexity): space, time, change, nonchange, material object, plant, animal, human, institution, sensum and mental.

Axiom 2: The ultimate relational components of meaning in human thought are (in ascending order of semantic complexity): ferens, event, affected, effected, operator, agent, instrument, recipient, nonevent, positioner, location and temporal.

Definition: A semantic element πY is that unit of meaning of an expression formed by the relational π and categorical Y components of meaning.

Hypothesis 1: $\langle \langle \langle [L]_{Lxm} M_{ext} \rangle M_{rel} \rangle M_{cat} \rangle M_{infl} \rangle \rightarrow [L']_{Lxm}, \{W\}_{Wf}$

where the sequence $M_{sub} \rangle ext, M_{sub} \rangle rel, M_{sub} \rangle cat, M_{sub} \rangle infl$ is cyclic

Hypothesis 2: Semantic elements form a periodic system (see Table).

Formation Rule 1: $\langle \langle \langle [L] M_{sub} \rangle ext \rangle M_{sub} \rangle rel \rangle M_{sub} \rangle cat \rangle M_{sub} \rangle infl \rangle$ is a well-formed lexeme or a well-generated word-form.

Formation Rule 2: If Φ is a predicate and $\pi_i Y_i$ an element, $\Phi \langle \pi_1 Y_1 + \dots + \pi_n Y_n \rangle$ is a well-formed predication.

Transformational Rule: $\Phi \langle \pi_1 Y_1 + \dots + \pi_n Y_n \rangle = [\Phi]_{\pi_1} Y_1 + \dots + [\Phi]_{\pi_n} Y_n$

Replacement Rule: If $\Phi \langle \pi_1 Y_{1i} + \dots + \pi_n Y_n \rangle$ and $Y \langle \alpha_1 + \dots + \alpha_n \rangle$ are equivalent predications, then $\alpha_1 = [\alpha]_{\pi_1} Y_1, \dots, \alpha_n = [\alpha]_{\pi_n} Y_n$

Bridging Rule: An expression is a term if and only if it fulfills the PEGITOSCA Criterion.

Group Period	1	2	3	4	5	6	7	8	9	10	11
I	F1	Ft	Fe	Fq	Fr	Ff	Fz	Fh	Fi	Fs	Fm
III	A1		Ac	Aq	Ar	Af	Az	Ah	Ai	As	Am
IV	E1		Ec	Eq	Er	Ef	Ez	Eh	Ei	Es	Em
V	O1		Oc	Oq	Or	Of	Oz	Oh	Oi	Os	Om
VI							Dz	<u>Dh</u>	Di		
VII	I1		Ic	Iq	Ir	If	Iz	Ih	Ii	Is	Im
VIII							Rz	Rh	Ri		

IX				Nq							
X							Pz	Ph	Pi		
XI	L1										
		Tt									

Table: A Periodic System of Semantic Elements

Upper case letters stand for relational components of meaning while lower case letters represent the categories. For instance, "Ai" stands for "affected institution". Notice the notational unambiguosness engendered by the employment of "K" for "event" (Luganda Kituukirira) and of "D" for "agent" i.e. "doer".

In the light of the developments in this Section so far, I am occasioned to revisit the formalization of semantic structure in Section VI with a view of reducing the rather unwieldy bracketing.

- (1)' [<< [FUMB] REL > MANI > LI] → [EFFUMBIRO]
- (2)' [<< [FUMB] REL > MANI > Dh] → [OMUFUMBIRO]
- (3)' [< [FUMB] DISP > Dh] → [OMUFUMBI]
- (4)' [[COOK] DH]
- (5)' [[COOK] IR]
- (6a)' [[BEG] Rh]
- (6b)' [<<< [SAB] AUG > CAUS > DISP > Rh]
- (7)' [< [TUM] PERT > Ah]
- (8)' [COLLECT] < Rh + Ar > = [COLLECT] Rh + [COLLECT] Ar >
= < [COLLECTOR] + [COLLECT] Ar >
= [DEBT COLLECTOR]
- (9)' [[BAKE] LI]
- (10)' { <<< [CONCEPT] PERT > CAUS > Em > PL }

- (11)' [<< [SECT] PERT > OPPO > Nq]
- (12)' [<<<< [POLE] PERT > CAUS > REV > ITER > Kc]
- (13)' [DWELL] < [Ph] PL + LI > = << [DWELL] Ph > PL + [DWELL] LI >
= {town dwellers}
- (14)' { <<< [SUMULUL] CAUS > MANI > Ir > PI }
- (15)' [<<<<< [LAB] AUG > DISP > Dh > PL > PRIM > PL]
- (16)' see (16)
- (17)' see (17)
- (18)' [PUPIL] = [[TEACH] Rh]
- (19)' [PECK] < Dz + Af > = > [PECK] Dz + [PECK] Af >
= < [PECKER] + [WOOD] >
= [WOODPECKER]
- (20)' [ABSORB] < Ir + As > = < [ABSORBER] [SHOCK]
= [SHOCK ABSORBER]
- (21)' [STUDY] < Rh + Di > = < [STUDENT] + [UNIVERSITY]
= [UNIVERSITY STUDENT]
- (22)' [SEMESTER] = [[STUDY] Tt]
- (23)' see (23)
- (24)' Nq < Fr > = < [F r] Nq >
= < [GOLD] PURE >
= [PURE GOLD]
- (25)' [FALL] < A r + L I > = < [FALL] A r + [FALL] L I >
= < [WATER] + [FALL] >
= [WATERFALL]

VIII. CONCLUSION

This in-house handout for REDNET collaborators constitute a major advance towards our quest for the most efficient way of modernising the scientific lexicon of Luganda. As part of continuous training of the terminology elaborators, more emphasis will be put on the ability to recognise extensional morphemes and formalization of semantic structure . However it should be readily conceded that

owing to the rather erratic polyfunctionality of English affixes, the list in Section II is need of completion . Meticulous attention should be directed to neo- Latin affixes employed in the biological terminology generally in biological nomenclature in particular.