Problems from the NACLO contests

2010 Contest (problems A-P)

2010 Solutions

(A) Gelda's House of Gelbelgarg (1/1)

English systematically differentiates classes of nouns between whether they're Count – that is, are treated grammatically as if they can be counted, like *five cows* – or whether they're considered Mass, which can't themselves be counted. (This is a grammatical property of the *words*, not the items in question – even though rice comes in individual pieces you can't refer to five of them as "five rices" – you have to specify some measure word like "five *grains* of rice".)

Mass nouns tend to be liquids, undifferentiated masses, or masses of many, many tiny things (like rice), but as above it's a grammatical property: that's why even once you know a word is Count or Mass you can't be *sure* of the type of object it refers to. But you can still take a pretty good guess.

The properties of Count nouns are: they can co-occur with numerals, they can take "a"/"an" as an article, they co-occur with "fewer" but not "less" and "many" but not "much", and you can't leave a singular count noun "bare" – that is, *without* an article ("the","a"/"an"), quantifier (like "some", "every"), or numeral. Meanwhile, Mass nouns can occur "bare", can't occur with numerals or "a"/"n" without a "measure" or "container" word like "grain", "tablespoon", "plate", and co-occur with "less" but not "fewer" and "much" but not "many".

In addition, some words act as "measures" or "containers" – they can take an "of <something>" phrase and, whether or not it's Mass or Count, turn it into Count. Words like these are necessary to use Mass nouns with numerals, "a"/"an", etc.

How could you determine these properties in this problem if you didn't already know all this? Easy – put in words you do know in place of the unknown ones. For example, if a word like "water", "rice", "porridge", etc. fits in the same places that "meembel" does and makes good English sentences, but not in the places "gelbelgarg" does, then it's very likely that "meembel" is something like water, rice, or porridge. Meanwhile, "burger(s)" fits in the same places "gelbelgarg" does, but not "meembel", making it very likely that a "gelbelgarg" is some kind of discrete item.

2010 Solutions

(B) Say it in Abma (1/2)

In order to work out which word in the above sentences encodes the meaning associated with the individual words in the English translation we need to compare sentences with common meanings. For example 'water' appears in the translation of a., b., i., and k. Since 'runs' appears in e., j., and k. we can conclude that *sileng* = 'water' and *mworob* = 'runs'. This then allows us to conclude that *mwamni* (a. & b.) = 'drink', *mwabma* (e. & i) = 'here', *mwelebte* (i) = 'carry (as one carries water)', *mwesak* (h. & j.) = 'up'. We can deduce from these examples that the word order is virtually the same as in English.

A comparison of c. and d. shows us that *nutsu* = 'child'. A comparison of f. and g. shows us that *mwisib* = 'down' and also 'go down' or 'move downwards'. Since we know that f. is literally 'pulls + 'Mabontare' + 'down', we can deduce that *tela* (h.) = 'axe' and *mweselkani* (h.) = 'carry (as one does an axe)'. An analysis of i. shows us that the meaning encoded by English 'bring' is expressed by two words in Abma: *mwelebte* 'carry as one does water' (since it is not the same verb as in h. which involves carrying an axe) followed by the word *mwabma* translated as 'here' in e. We can analyse the meaning of English 'bring' as being made up of the meaning of 'carry' plus the idea of 'moving towards speaker's location', i.e., 'here'.

A comparison of b. and d. shows that *mwatbo* = 'keep doing something', and that (as in English) it immediately precedes the other verb in the same sentence.

The words/verbs which express directional meanings, 'up', 'down', 'here' follow the other verb (d.) or the verb+Object noun (b.)

Having worked out the meaning of each word and the order in which words must combine in sentences, we can accurately translate the English sentences in 1 and the Abma sentences in 2.

While analysing the data it is very useful to create a dictionary as one goes along. Our analysis of sentences a. to k. above gives us the following results:

mwamni	drink	*mwisib*	(go) down
mwatbo	keep (doing)	*mwesak*	(go) up
mwerava	pull	*mweselkani*	carry (of axe)
mworob	run	*mwelebte*	carry (of water)
mwegau	grow	*sileng*	water
mwegalgal	crawl	*nutsu*	child
mwabma	(go) here, approach	*tela*	axe

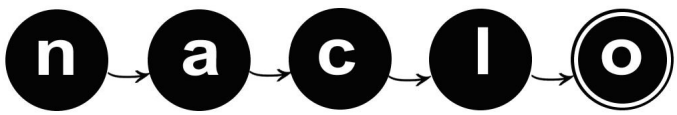
We can now refer to this word list plus the words given in the table below when constructing our answers to Questions 1 and 2.

2010 Solutions

(B) Say it in Abma (2/2)

	ENGLISH	ABMA
1.	The teacher carries the water down.	***Sesesrakan mweselkani sileng mwisib.***
2.	The child keeps eating.	***Nutsu mwatbo mwegani.***
3.	Mabontare eats taro.	***Mabontare mwegani bwet.***
4.	The child crawls here.	***Nutsu mwegalgal mwabma.***
5.	The teacher walks uphill.	***Sesesrakan muhural mwesak.***
6.	The palm-tree keeps growing downwards.	***Butsukul mwatbo mwegau mwisib.***
7.	He goes up.	***Mwesak.***

	ABMA	ENGLISH
1.	*Sesesrakan mweselkani bwet mwabma.*	**The teacher carries the taro here/in this direction.**
2.	*Sileng mworob mwisib.*	**The water runs down.**
3.	*Mwelebte bwet mwesak.*	**He brings the taro up.**



(C) Lost in Yerevan (1/1)

This is a fairly simple problem to solve. One possible way to start is to look for the station on the map that has three words in its name. Then, based on its spelling as well as the spelling of the other given station names, one can easily determine that Armenian is written left to right and that both vowel and consonant sounds are represented as single characters in Armenian. Note that some sounds (e.g., "ts", map to multiple letters in English). After a few iterations, it is easy to reconstruct the entire part of the Armenian alphabet that is needed for this problem. The only "tricky" part has to do with the "T" character which doesn't appear in the names of the labeled stations, though it appears in the name of the subway system (METROPOLITEN).

(D) Huevos y Pimientos (1/1)

D1.

a. This sentence can be translated in two different ways:

pepinos y pimientos rojos
pimientos rojos y pepinos

b. This one can only be translated this way:

pomelos y pimientos rojos

D2.

a. TRUE- the eggs are unambiguously green
b. FALSE- the ham is unambiguously green

D3. jamon y huevos verdes

The "trick" is to reverse the word order to preserve the ambiguity.

2010 Solutions

(E) Texting, Texting, One Two Three (1/2)

From examining repeated elements and letters, we can work out most, but not all, of the character codes for the letters, along with SPACE being 1, the SHIFT sequence that creates a capital letter being 33, and the END MESSAGE sequence being 331 (SHIFT + SPACE, a sequence that otherwise wouldn't be used).

Lowercase 'z' doesn't appear in the plaintext, but knowing that uppercase 'Z' is 3323444 and "shift" is 33 we can conclude that lowercase 'z' is 23444.

The system we find is a "variable-length", rather than "fixed-length", code system. Although some of the codes are much longer than three digits, overall most codes are much shorter, because very common characters (like e, t, "space", etc.) are given very short codes whereas only fairly rare letters are given the longer codes.

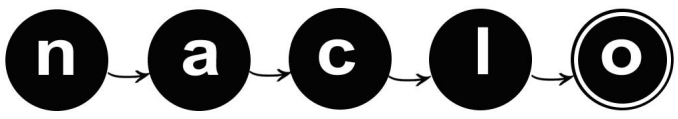
a	31	**n**	42
b	2341	**o**	32
c	242	**p**	342
d	233	**q**	23442
e	21	**r**	44
f	244	**s**	43
g	341	**t**	22
h	231	**u**	241
i	41	**v**	2342
j	23443	**w**	344
k	2343	**x**	23441
l	232	**y**	343
m	243	**z**	23444

Two letters remain, however, 'r' and 'x', neither of which appear in the plaintext. To determine their values, we have to work out the overall logic of the system.

Looking at the numerical codes, we notice that they aren't random: there are frequently repeated initial subcodes, and a lot of gaps. For example, many codes begin in 23-, 234-, and 34-, but none begin in, for example, 1-.

But why shouldn't a code begin with 1? If you consider the use of such a device, what would happen if a letter code began with one? What would happen is that, since 1 is "space", the device wouldn't know whether that 1 was intended as a space or as the first number of a longer code.

Looking further, we can see that *none* of the codes begins with another letter's code. That is, since 'a' is 31, no other letters' codes have 31- as their first two numbers, since 'b' is 2341, no other codes have these as their first four numbers, etc.

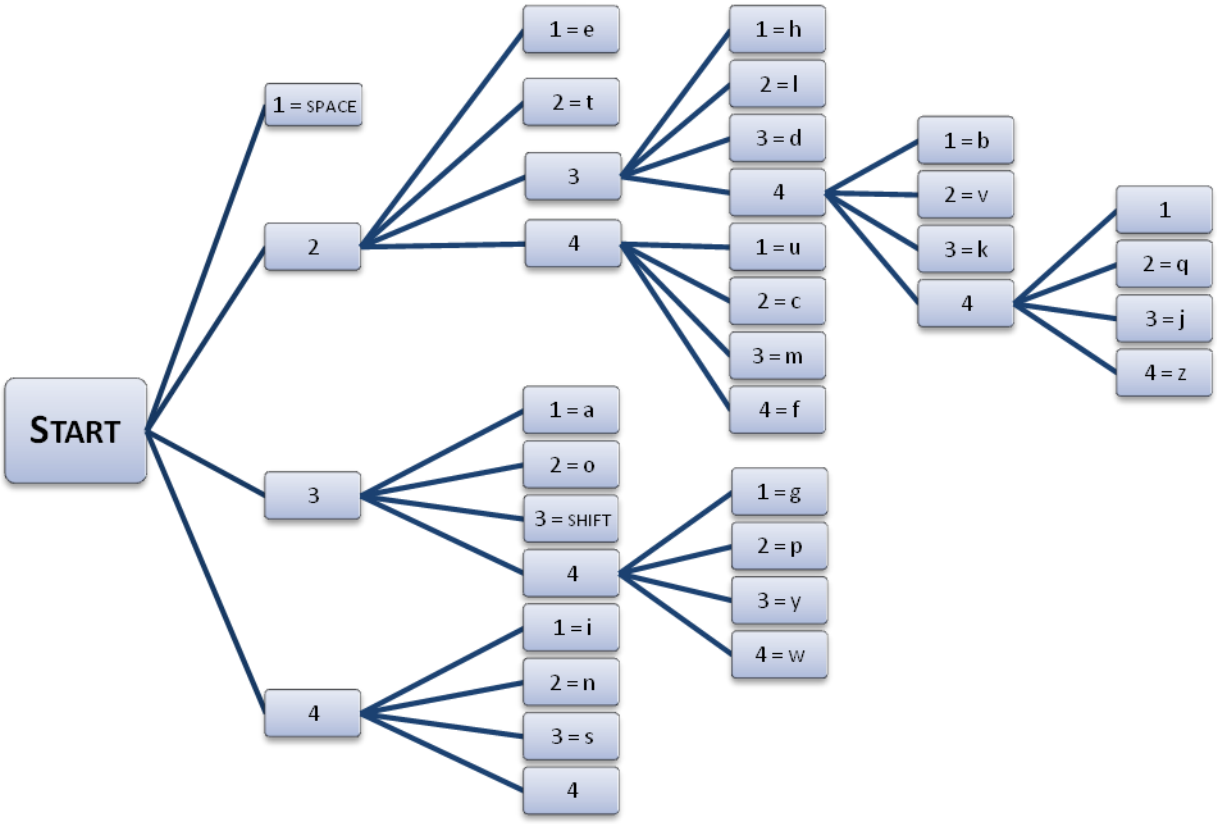


2010 Solutions

(E) Texting, Texting, One Two Three (2/2)

"Fixed-length" code systems, like the original three-number code system, always know when the user has keyed in a complete code. But since this system has "variable-length" codes, it needs some system to tell it whether some sequence, of whatever length, is a complete code or just the first part of a longer one. In this case, it knows when a code is complete because no beginning part of a valid code is a valid code.

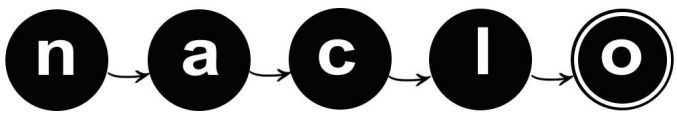
It's especially clear if we draw a "tree" of the codes: only those nodes that don't have further "branches" are assigned characters. Assigning "31" to "a" is fine, because there aren't any "311", "312", etc. to confuse the system. On the other hand, we can't assign "34" to anything because then it would prevent "341", "342", etc. from being entered.



Looking carefully at our tree, there are exactly two "free" nodes – that is, ones that don't already have a character assigned and that don't have any "branches": "44" and "23441". These are where "r" and "x" have to go – if they go anywhere else, the internal logic of the system is compromised.

Since frequent letters (like "e","t","a","o","i","n","s") get short codes, and rare letters (like "q","j","z") get long codes, "r" must be "44" while "x" is "23441".

Now we have all 26 letters, SPACE, SHIFT, and the END sequence, and can encode and decode any message for this device.



2010 Solutions

(F) Türkış Delıt (1/1)

The two suffixes in the problem have the following meaning:

consonant (ç or c) + vowel is "-er" in English and means "maker of something"

s + vowel + z is "-less" in English and means "without"

Whether the first consonant of the first suffix ("-er") is **ç or c** depends on the previous sound:

if the last sound of the stem is a voiced consonant or a vowel, the first consonant of the suffix is **c** (also voiced)

if the last sound of the stem is voiceless consonant, the first consonant of the suffix is **ç** (also voiceless)

The vowel depends on the last vowel in the stem:

if last vowel in the stem is a front, unrounded vowel (**e, i**), the suffix vowel is **-i**

if last vowel in the stem is a front, rounded vowel (**ö, ü**), the suffix vowel is **-ü**

if last vowel in the stem is a back, unrounded vowel (**a, ı**), the suffix vowel is **-ı**

if last vowel in the stem is a back, rounded vowel (**o, u**), the suffix vowel is **-u**

To summarize – the vowel in the suffix is the narrow vowel of the same type as the vowel preceding it. This is called *vowel harmony*

F1.

ikbalsiz, takatsiz – the vowels in the suffixes of these two words do not conform to the rules of vocal harmony and we can assume they are not of Turkish origin.

F2.

milkman - sütçü

speechless – sözsüz

F3.

linguist – dilci

mute - dilsiz

molder – kalıpçı

loose - kalıpsız

(G) Tangkhul Tangle (1/2)

Note that all but one of the Tangkhul sentences (sentence g) consistof two words. The two words consist of recurring components. For the first word, these are i, na, ā, ni, and thum. For the second word, these are masik, thāi, rā, ser, ngāi, ngarok, hāira, ei, lā, and ra. The word in the one word sentence (g) is drawn from components in the second set. In exactly one of the English sentences (sentence 5), the pronoun standing for the person doing the action of the verb is enclosed in parenthesis, showing that it is not present in the Tangkhul original. From this we may infer that:

1. sentences g and 5 match.
2. the final word in in each Tangkhul sentence is the verb.
3. The first words in each two-word Tangkhul sentence must be a pronoun.

The pronouns vary in person and number. First person includes the speaker (I, we), second person includes the one being addressed (you), and third person refers to some other entity (he, she, it, they).

	sg	dl	pl	tot
1st	0	1	1	2
2nd	1	0	1	2
3rd	1	2	1	4
tot	2	3	3	8

Exactly one of the Tangkhul pronouns occurs twice (āni, in b and h).This must be 3rd dual. Therefore, these sentences must match sentences 6 and 7. The component ā occurs four times, like third person; the component ni occurs three times, like dual. Working in this direction, it is possible to establish the following equivalences:

1st	i
2nd	na
3rd	ā

sg	(unmarked)
dl	ni
pl	thum

(G) Tangkhul Tangle (2/2)

This establishes the following matches between the Tangkhul and English: a=4, c=1, d=9, e=2, f=8, i=3. Tangkhul sentences a and c both contain masik; the English equivalents both contain "pinch/pinched". d, e, and f all contain thāi; the English equivalents all contain "see/saw." Tangkhul sentences i and g both contain "rā"; the English equivalents both contain "come". Thus, the first part of the final word in the Tangkhul sentences is the verb root ("pinch", "see", or "come"). It follows that b=6 and h=7. Now that the sentences are matched, it is possible to determine the meanings of the verb suffixes:

ser	all
ngarok	reciprocal (X one another)
ngāi	desiderative (want to X)
hāira	perfective (have Xed)
ei	past
ra	future
lā	interrogative

These are not problematic, except for ser. Transitive verbs are verbs which take object and intranstivie verbs are verbs which do not. If ser is suffixed to the transitive verb masik "pinch", we get to "pinch all". That is, it quantifies over the object. However, if it is suffixed to the intranstive verb rā "see", we get "call come". That is, it quantifies over the subject. Given this observation, and the above equivalences, it is possible to provide the correct translations for G2 and G3.

2010 Solutions

(H) Ardhay Uzzlepay (1/4)

	Standard Minangkabau	Sorba	English Translation
a	*raso*	*sora*	'taste, feeling'
b	*rokok*	*koro*	'cigarette'
c	*rayo*	*yora*	'celebrate'
d	*susu*	*sursu*	'milk'
e	*baso*	*sorba*	'language'
f	*lamo*	*morla*	'long time'
g	*mati*	*tirma*	'dead'
h	*bulan*	*larbu*	'month'
i	*minum*	*nurmi*	'drink'
j	*lilin*	*lirli*	'wax, candle'
k	*mintak*	*tarmin*	'request'
l	*cubadak*	*darcuba*	'jackfruit'
m	*mangecek*	*cermange*	'talk'
n	*bakilek*	*lerbaki*	'lightning'
o	*sawah*	*warsa*	'rice field'
p	*pitih*	*tirpi*	'money'
q	*manangih*	*ngirmana*	'cry'
r	*urang*	*raru*	'person'
s	*apa*	*para*	'father'
t	*iko*	*kori*	'this'
u	*gata-gata*	*targa-targa*	'flirtatious'
v	*maha-maha*	*harma-harma*	'expensive'
w	*campua*	*purcam*	'mix'

2010 Solutions

(H) Ardhay Uzzlepay (2/4)

H1.

Standard Minang-kabau	Sorba	English
rancak	caran	'nice'
jadi	dirja	'happen'
makan	karma	'eat'
marokok	kormaro	'smoking'
ampek	peram	'hundred'
limpik-limpik	pirlim-pirlim	'stuck together'
dapua	purda	'kitchen'

A comparison of a-c would indicate that to form a Sorba word one takes the consonant and vowel of the last syllable, e.g. *so* from *raso*, ko from *rokok* and yo from *rayo* and one places it at the beginning of the word. If the last syllable ends in a consonant, e.g. final *k* in *rokok* then one deletes it.
So we might state the rules as:

1. Delete the word final consonant: (*rokok* > *roko*)
2. Take the final syllable (or C + V) and make it the first syllable (*roko* > koro, *raso* > *soro, rayo* > *yora*)

However, if we apply these rules to the following words (d-w) we fail to create the correct Sorba word. We notice that a common feature of Sorba words is that the third sound MUST BE *r*. So we need a rule which inserts *r*, unless the standard language word begins with *r.* Notice how this is requirement for a Sorba word.

As we need to stipulate that the third sound must be *r*, we must add another rule:

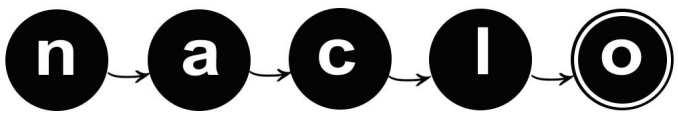
Rule 3: Add *r* to initial CV unless the following sound is *r.*

Notice that we have to spell out the condition in which the rule applies (i.e. in the absence of following r), so we don't get a sequence of *r*+*r*

We can see from examples h-r that our rule 1 applies.

The reduplicated words in u and v show us that each part of the reduplication must undergo the Sorba formation rules, e.g., *gata-gata* > *targa-targa* (NOT *targataga*). So we would need to stipulate that reduplicated words are treated like two words, and not as a single word.

Rule 1. Treat reduplicated words as a sequence of two identical words.
Rule 2. Delete any sound which follows the final CV sequence of a word.
Rule 3. Move the final CV sequence to the start of the word
Rule 4. If the third sound of the new word is not *r*, insert *r* (after the first CV sequence).



(H) Ardhay Uzzlepay (3/4)

Example w *campua* > *purcam* (NOT *puarcam* or *arcampu*). This shows us that only the initial Consonant and Vowel of the final syllable is moved to the front of the word to form a Sorba word, so that we need to modify our Rule 1. Furthermore, a word final vowel which follows another vowel is not treated as a final syllable for the Sorba formation.

Modified Rule 1: Delete any sound which follows the final CV sequence.

So after inspection of all the words we can express the rules for converting a standard Minangkabau word into a Sorba word as:

H2. We can only work back to a set of possible standard Minangkabau words because of two difficulties or problems:

'r' problem: we can't know if 'r' in *lore* was in standard word or whether it was inserted by Sorba 'r' insertion rule, e.g., standard *elo* or *relo* > Sorba *lore*

final sound problem: we can't know if standard word ends in consonant or one or two vowels or not as Sorba deletes final consonant/vowel following a vowel. *lore* could be derived from *elo, relo, eloa, reloa* or *eloC* or *reloC* where 'C' stands for any possible final consonant.

H3. We can see that the word formation rules for converting a Minangkabau word into Solabar are:
1. Delete the sound which follows the final CV sequence.
2. Move the final CV sequence to the beginning of the word.
3. Add *la* to the new word initial CV sequence
4. Delete the sound which follows the new final CV sequence
5. Add *r* to the word.

In converting *baso* we don't need to apply Rule 1.
We apply rule 2 > soba
We apply rule 3 > solaba
We don't need to apply rule 4.
We apply rule 5 > solabar

In converting *campua* and *makan*:
Rule 1 applies: > campu > maka
Rule 2 applies: > pucam > kama
Rule 3 applies: > pulacam > kalama
Rule 4 applies: > pulaca (doesn't apply)
Rule 5 applies: > pulacar > kalamar

(H) Ardhay Uzzlepay (4/4)

The Solabar equivalent of the Sorba word *tirpi* 'money' is tilapir.

To answer this question we need to reconstruct the form of the Standard word. Luckily for us it is given in the initial list (p.) as *pitih*. By applying our rules we get: *pitih* > *piti* > *tipi* > *tilapi* > *tilapir*.

However, if instead of assuming that rule 3. is "add *la*..." which we cannot be sure about from the data given, since the syllable following *la* has the vowel 'a' in all three words (plus *solabar*), it is possible that the rule should be add l+vowel where vowel is a copy of the following vowel. This would then open the possibility that that our answer could be *tilipir.* Now given that the final vowel of our Solabar data set only contains the vowel *a,* maybe our rules 4 and 5 should really be collapsed to a single rule: "substitute *ar* for the sound or sounds which follow the first C in the 'new' final syllable. If we applied this rule and allowed for the other two possibilities we would have to allow the possibility of getting Solabar forms: *tilipir, tilapir, tilipar, tilapar.*

In order to disconfirm the incorrect hypotheses we would need to see how a Minangkabau word such as *lilin* 'wax' forms its Solabar form. If it is *lilalir* then we know that our original rules are correct. If it is *lilalar* we know that we need to change our rules. Notice that if the final syllable were always required to end in *ar* then there is no way of distinguishing between our Rule 3 "Add *la*..." or a rule which says "Add lV where V = same as V in final syllable".

Notice that a rule which requires the final syllable to end in *ar* would make for a more complex set of rules. As our rules stand, Rules 1 and 4 are identical - they just apply at different stages in the word formation process. This would not be the case if the Solabar words had to end in *ar*; Rule 4 would be different from Rule 1.

H4. 'ng' is one sound because the Sorba for standard Minangkabau *manangih* 'cry' is *ngirmana*. if 'ng' were two sounds the Sorba word would begin with *g* and end in *n* by our rules. i.e., *girmanan*.

Notice that we would need to create some special specific complicated rules to get a sequence of two consonants (as opposed to two letters representing a single sound) at the beginning of this Sorba word and to exclude them for other words, e.g., how would we prevent *mintak* from being coverted to Sorba *ntarmi* rather than the correct *tarmin?*

We are always looking for the simplest solution or explanation to account for the facts we observe.

2010 Solutions

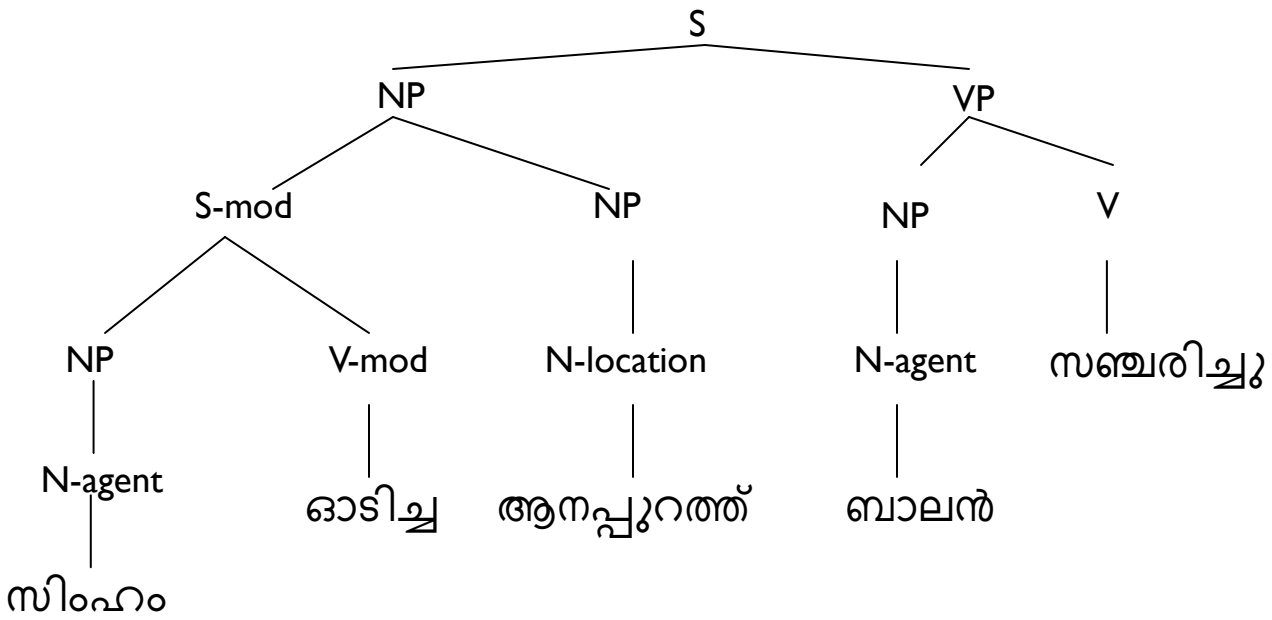
(I) Dogs and cats on trees (1/1)

I1 (3 points).

1. The elephant chased the lion.
2. The lion chased the elephant.
3. [Not a Malayalam sentence]
4. The boy rode on the back of the elephant.
5. [Not a Malayalam sentence]

I2 (1 point). Draw the tree for any sentence that uses the V-mod rule. (You may use the English translations in place of the Malayalam words at the bottom of the tree.)

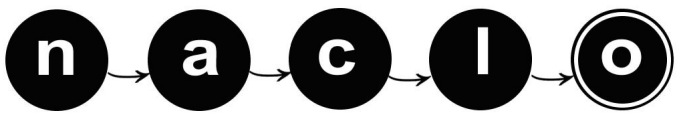
Only sentence 4 uses the V-mod rule.



I3 (1 point). Explain what is wrong with the examples that are not actual sentences of Malayalam.

Sentence 3 is not licensed by this grammar (is not a sentence of Malayalam) because both of the nouns are in the N-patient form, but the grammar rules only allow one of these per (simple) sentence.

Sentence 5 is not licensed by this grammar (is not a sentence of Malayalam) because the first verb is not in the V-mod form. Plain verbs can only come at the end of the sentence, according to our rules.



2010 Solutions

(J) Plains Cree (1/3)

J1 (1 point). Below are six related words, meaning "little hat", "little nail", "little door", "little head", "minute", and "little chair". Which means which?

cipahikanis	minute
miscikwanis	little head
cehcapiwinis	little chair
sakahikanis	little nail
ascocinis	little hat
iskwahcemis	little door

J2 (4 points).

a. ᑎᐸᐦᐃᑲᐣ	tipahikan
b. ᐊᓀᔑᑎᓂᓀ	ascocinis
c. ᔉᑲᐦᐃᑲᐣ	sakahikan
d. ᒥᓀᑎᑲ·ᐣ	mistikwan
e. ᑭᐸᐦᐃᑲᓂᓀ	cipahikanis
f. ᐃᓀᑲ·ᐦᐣᒉᒥᓀ	iskwahcemis
g. ᔉᑲᐦᐃᑲᓂᓀ	sakahikanis
h. ᑌᐦᑕᐱᐃ·ᐣ	tehtapiwin
i. ᒥᓀᑭᑲ·ᓂᓀ	miscikwanis
j. ᐃᓀᑲ·ᐦᑌᑦ	iskwahtem
k. ᐊᓀᑐᑎᐣ	astotin
l. ᒉᐦᓚᐱᐃ·ᓂᓀ	cehcapiwinis

2010 Solutions

(J) Plains Cree (2/3)

J3 (5 points). Explain your answer.
For the first part, the rule for forming the diminutive in Cree is to add an *–is* suffix at the end of the word and change ("mutate") every instance of <t> to <c>.

There are many logical routes through the first part, many of them very good. Here's one way, which requires making comparatively few assumptions about what individual symbols might mean. First, we notice that the twelve items can be paired up into six very similar pairs:

ᓴᑲᐦᐃᑲᓱ	⇔	ᓴᑲᐦᐃᑲᓯᓀ
ᒥᓀᑎᑲ·ᓱ	⇔	ᒥᓀᒋᑲ·ᓯᓀ
ᐊᓀᑐᑎᓱ	⇔	ᐊᓀᔑᒋᓯᓀ
ᑎᐸᐦᐃᑲᓱ	⇔	ᒋᐸᐦᐃᑲᓯᓀ
ᑌᐦᑕᐱᐃ·ᓱ	⇔	ᕽᐦᓱᐱᐃ·ᓯᓀ
ᐃᓀᑲ·ᐦᑌᕀ	⇔	ᐃᓀᑲ·ᐦᕽᒥᓀ

From the second column being longer, and all ending in the same symbol, we can be pretty sure these are the *–is* forms. (And that this writing s------ystem writes left-to-right.)

We can notice now that, disregarding the different endings for a moment, that each item from the first column is *almost*, but not quite, identical to its sister in the second column. The remaining difference is that every time one of { ᑎᑐᑌᑕ } appears in the first column, it is replaced by { ᒋᔑᕽᓱ } in the second – that is, just like in the Roman alphabet versions, a "mutation" is happening to make the derived form.

At this point it's simple to match the Roman pairs to Syllabics pairs based on *where* in the word these mutations occur. Each pair has a different pattern of mutation:

sakahikan ⇔ *sakahikanis* has no mutations,
as does ᓴᑲᐦᐃᑲᓱ ⇔ ᓴᑲᐦᐃᑲᓯᓀ
tipahikan ⇔ *cipahikanis* has one at the beginning,
as does ᑎᐸᐦᐃᑲᓱ ⇔ ᒋᐸᐦᐃᑲᓯᓀ
mistikwan ⇔ *miscikwanis* has one in the middle,
as does ᒥᓀᑎᑲ·ᓱ ⇔ ᒥᓀᒋᑲ·ᓯᓀ
iskwahtem ⇔ *iskwahcemis* has one towards the end,
as does ᐃᓀᑲ·ᐦᑌᕀ ⇔ ᐃᓀᑲ·ᐦᕽᒥᓀ

(J) Plains Cree (3/3)

tehtapiwin ⇔ *cehcapiwinis* has two at/towards the beginning,
as does ᑌᑊᑕᐱᐞᐣ ⇔ ᖁᑊᑲᐱᐞᓂᔅ
astotin ⇔ *ascocinis* has two towards the end,
as does ᐊᖢᑐᑎᐣ ⇔ ᐊᖢᔑᑎᓂᔅ

At this point, we can also do a number of checks as well to show the internal consistency of our answer – that our answer for *iskwahcemis* has the same sequence at the end as *mistikwan* and *miscikwanis* have at the beginning, that *sakahikan* and *tipahikan* have the same endings, etc.

The system that emerges is the following. The full-size symbols represent CV sequences; there is one per syllable. The shape of them represents the consonant, and the direction they are rotated represents the vowel.

	a	e	i	o
no consonant	ᐊ		ᐃ	
t	ᑕ	ᑌ	ᑎ	ᑐ
p	ᐸ		ᐱ	
c	ᒐ	ᖁ	ᒋ	ᒍ
k	ᑲ			
s	ᔑ			

You can see one pattern clearly between *t, p*, and no-consonant. There are two rotational patterns in Syllabics, actually, although it can't be concluded for certain just based on these data: asymmetrical symbols (like the <c> series) flip, but symmetrical symbols (like the <t> series) rotate. (Otherwise, if they flipped like the other series, you wouldn't be able to tell apart <ta> and <ti> or <te> and <to>.)

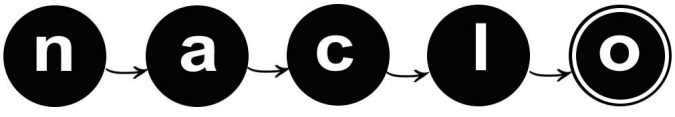
There is one full-sized character per syllable; characters not represented in this way are given superscript characters. <s>, <m>, and <n>, when not right before a vowel, are represented by ᐢ, ᐟ, and ᐣ,respectively. <h> is represented wherever it occurs by ᑊ -- if it occurs before a vowel, the ᑊ is used before the appropriate bare vowel character. <w>, when it occurs before a vowel, is represented by the dot · *after* the vowel; like *h*, if the syllable is just wV the dot is used before the bare vowel character.

2010 Solutions

(K) F u cn rd ths (I/I)

There are many ways to solve this problem. One particularly short one: I and K are long enough that they can only be "customer understood" and "customer disconnected" in some order. The first character of all the notes is 'c', and the presence of two copies of the same character in I makes I "customer disconnected" and K "customer understood". K has every character in "understood", reading off which gives 8 characters. After filling these (and 'c') in where they occur, the remainder of the problem is trivial.

I.	C	IV.	B	VII.	O	X.	Q	XIII.		XVI.		XIX.	J
II.	E	V.	D	VIII.	N	XI.	G	XIV.		XVII.	K	XX.	L
III.	R	VI.	H	IX.	P	XII.	I	XV.	A	XVIII.	F	XXI.	M



2010 Solutions

(L) Real Money (1/1)

First off, we can divide words into classes: numerals, tubers, monetary amounts, and functional (that is, grammatical) elements. Given that "huh" appears twice, it can't be a tuber, and must in fact be "one". Therefore "kinsa" is 3, and "papa"/"lumu"/"oqa" are the tubers. (They are, in fact, in their correct order in the English translation, although it's not necessary to make this assumption to solve the puzzle.)

"Ima", occuring only when more than one kind of tuber is mentioned, is "and"; in Quechua this occurs after the conjoined elements rather than in between. This leaves "hayk'apaqmi", which must then mean something like "How much is it for..." (and does).

This leaves figuring out the monetary amounts. "-paqmi" in every answer, making it likely that it's the "it's for" meaning in both the questions and answers. Removing the numeral elements, we are left with "-ral" and "miyun". (Recognizing these as Quechua renderings of the "real" and "medio" mentioned in the introduction, although again not necessary to find the solution, would accelerate finding a solution, since a "miyun" is, as noted, half a "-ral".)

The "search space" through which a solver must trek to find reasonable values of "-ral", "miyun", and the remaining numerals can be lessened considerably by noticing that, from the first translated line, the only value that "pisqaral" can have is either 40, 50, or 60 centavos. If the three types of tubers cost 5, 10, and 15, then no matter which costs which a collection of one, one, and three of them must be one of 40, 50, or 60.

From this point, the solver can proceed to test various hypotheses about the values of pisqa- and -ral. Most of these hypotheses will quickly lead to absurdity when considered against the other sentences: "rals" and "miyuns" worth strange fractions of centavos or even negative centavos, numerals denoting complex fractions like 5/3, etc.

Only one consistent system emerges:

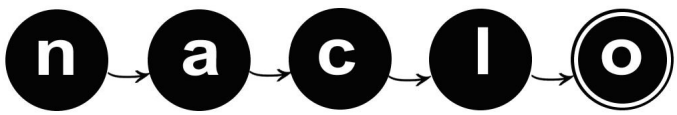
A "ral" is worth 10 centavos and a "miyun" is worth 5.
A "papa" (potato) costs 5 centavos, an "uqa" (oca) costs 10, and a "lumu" (cassava) costs 15.
The numbers are "huh" = 1, "iskay" = 2, "kinsa" = 3, "pisqa" = 5, and "soqta" = 6.

The three questions at the bottom are thus:

Q. ¿Hayk'apaqmi suqta uqa? ("How much is it for six ocas?")
A. Suqtaralpaqmi. ("For 60 cents.")

Q. ¿Hayk'apaqmi iskay lumu, huh papa ima? ("How much is it for 2 cassavas and 1 potato?")
A. Kinsaral miyunpaqmi. ("For 35 cents.")

Q. ¿Hayk'apaqmi huh papa? ("How much is it for one potato?")
A. Miyunpaqmi. ("For 5 cents.")



2010 Solutions

(M) No smoke without fire (1/2)

M1. For any given pair of sentences, the entailment and presupposition relationships may or may not hold, together or separately.

a. A pair of sentences in which sentence A **neither entails nor presupposes** sentence B.

A. Shaun White is a Winter Olympian.
B. The 2010 Winter Olympics were in Vancouver.

Explanation: Sentences A and B are unrelated.

Entailment: Given that sentence A is true, there is no way to know whether sentence B is true or false. If Shaun White is a Winter Olympian, the 2010 Winter Olympics may or may not have taken place in Vancouver. Thus, there is no entailment relationship between these two sentences.

Presupposition: When uttering sentence A, a speaker would not take sentence B for granted (or assume that sentence B is background information against which the truth or falsity of sentence A would be judged). A speaker would not utter "Shaun White is a Winter Olympian" and assume the belief/take for granted that the 2010 Winter Olympics were in Vancouver.

b. A pair of sentences in which sentence A **entails and presupposes** sentence B.

A. Shaun White continues to rule the halfpipe
B. Shaun White had been ruling the halfpipe.

Entailment: If sentence A is true, sentence B is necessarily true. The entailment relationship between these sentences relies on the meaning of the verb *continue* – to *continue to rule* the halfpipe, Shaun White had to be ruling the halfpipe already. Thus, sentence A entails sentence B.

Presupposition: When uttering sentence A, a speaker would take sentence B for granted (or assume that sentence B is background information against which the truth or falsity of sentence A would be judged). A speaker who utters "Shaun White continues to rule the halfpipe" assumes the belief/takes for granted that Shaun White had been ruling the halfpipe. Thus, sentence A presupposes sentence B.

(M) No smoke without fire (2/2)

M1. For any given pair of sentences, the entailment and presupposition relationships may or may not hold, together or separately.

c. A pair of sentences in which sentence A **presupposes but does not entail** sentence B.

A. I did not see Shaun White win the gold medal in the 2010 Winter Olympics.
B. Shaun White won the gold medal in the 2010 Winter Olympics.

Entailment: If sentence A is true, sentence B *may or may not* be true. The absence of an entailment relationship between these sentences relies on the words "did not see" – if it is true that I *did not see* Shaun White win the gold medal, then Shaun White may or may not have won the gold medal. Thus, sentence A does not entail sentence B.

Presupposition: When uttering sentence A, a speaker would take sentence B for granted (or assume that sentence B is background information against which the truth or falsity of sentence A would be judged). Specifically, a speaker who utters "I did not see Shaun White win the gold medal in the 2010 Winter Olympics" assumes the belief that Shaun White did actually win the gold medal in the 2010 Winter Olympics. Thus, sentence A presupposes sentence B.

d. A pair of sentences in which sentence A **entails but does not presuppose** sentence B.

A. Shaun White did not win the gold medal in the 2010 Winter Olympics.
B. Shaun White did not both win the gold medal in the 2010 Winter Olympics and injure his ankle.

Entailment: If Shaun White did not win the gold medal in the 2010 Winter Olympics, then he necessarily did not *both* win that gold medal *and* injure his ankle, since he definitely did not win the gold medal. If one fact is not the case (the fact presented in sentence A), then both facts cannot be the case, either (the fact presented in sentence A + the new fact added to it in sentence B). Thus if sentence A is true, sentence B is *necessarily* true. Thus, sentence A entails sentence B.

Presupposition: When uttering sentence A, a speaker would not take sentence B for granted (or assume that sentence B is a background against which the truth or falsity of sentence A would be judged). Specifically, by uttering "Shaun White did not win the gold medal in the 2010 Winter Olympics" a speaker could not assume the belief that Shaun White did not both win the gold and injure his ankle, or that Shaun White either won a gold medal or injured his ankle. Whether Shaun White injured his ankle would not be information taken for granted when uttering "Shaun White did not win the gold medal in the 2010 Winter Olympics." Thus, sentence A does not presuppose sentence B.

2010 Solutions

(N) Tale of Kieu (1/2)

N1 (11 points). Show which lines from the two Vietnamese versions are translated by each line in the English version. We've given you one correspondence to get you started.

English	Chữ Nôm	Quốc Ngữ
1. A hundred years—in this life span on earth	f	II
2. talent and destiny are apt to feud.	a	V
3. You must go through a play of ebb and flow	e	I
4. and watch such things that make you sick at heart.	d	IV
5. Is it so strange that losses balance gains?	b	VI
6. Blue Heaven's habit is to strike a rose from spite.	c	III

N2 (4 points). Explain your answer.

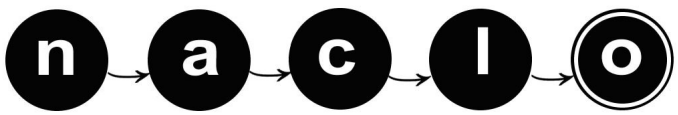
The key to solving Problem N, "Tale of Kieu" is given in the directions, namely that characters may contain both information about meaning (relating Chữ Nôm to English) and pronunciation (relating Chữ Nôm to Quốc Ngữ). The first step, however, is to hypothesize that the passage given is poetry in regulated verse, with alternating lines having 6 and 8 syllables. This can be inferred from the following information:

The English translation is typeset as verse poetry, with alternate lines indented.
Three Chữ Nôm lines have six characters (b, e, f); three have eight characters (a, c, d).
Three Quốc Ngữ lines have six (one syllable) words (I, II, VI); three have eight words (III, IV, V).
The fact that line 5 matches line VI is given.

This narrows the set of possible solutions greatly. Lines 1, 3, and 4 must be matched with (b), (e), and (f), and I, II, and VI. The same is true of the balance of the lines. It is then possible to see that (a) must match (V) since the first and third characters and words of (a) and (V), respectively, are identical. This leaves five matches to make on semantic grounds and five to make on phonetic grounds.

Evidence for the matches between English and Chữ Nôm comes largely from the characters on the first page:

E	CN			Chữ Nôm	English
1	f	年	year; person's age		year
		人	man, human, humankind		on this earth
2	a	告	tell; announce; inform; accuse	窖	feud
4	d	見	see, observe, perceive		watch
		病	illness; sickness; disease	疸	sick
		心	heart; mind; intelligence; soul		heart
5	d	豆	peas; beans	豐	gains
6	c	天	sky; heaven; god		heaven
		上	top; highest; go up		heaven



2010 Solutions

(N) Tale of Kieu (2/2)

There is one crucial special case. It can be inferred that the shared component of the characters 沐 and 沖 from the first page has a meaning related to water. In line (e), there are two characters with this component, which matches well with "ebb and flow" from line (3).

The evidence for matching Chữ Nôm and Quốc Ngữ comes from two sources. First, there is evidence that is internal to the poem. It is already known that (a) matches (V). The sixth character in (V) is 羅 là. The first character in (b), 邏, shares a component with 羅 là; the first word in VI has a similar pronunciation. Likewise, the third characters of lines (d) and (f) have the related characters 乛 and 𠀧 and the third words of lines (II) and (IV) have the similar-sounding words trong and trông. Also, the fifth characters of (c) and (d) are 𠱠 and 罵, corresponding to má in (III) and mà in (IV). This, however, is uninformative since both lines are of equal length and it is already known that the other eight-syllable lines, (a) and (V), belong together. The characters on the first page provide enough evidence to associate the rest of the lines:

CN	QN	Chữ Nôm		Chữ Nôm	
b	VI	皮	bì; bề	彼	bể
c	III	工	gồng	紅	hồng
d	IV	弄	lòng		lòng
e	I	皮	bì; bề		bỉ
f	II	南	nam		năm

(O) Possessed in Vanuatu (1/3)

In 1-3 we notice that the possessor relationship is expressed by a word beginning with *ra-* and that the distinctive features of the possessor are expressed by what is suffixed to *ra-*, e.g., *-lah* 'their', *-han* 'his' and *-ham* 'your'. We can check this further by comparing 1-3 with other forms beginning with *ra*: 11, 12 , 25 and 35 which have *ra-hak* 'my', 9 *ra-tah* 'our' and also in 24 *ratalaw* 'their both' and 33 *ra-tamlaw* 'your two.

By comparing 3, 5 & 18, which are all translated as 'your X' we see that Tanna has different ways of expressing 'your' and that this depends on the nature of the relationship between the possessor and possessed, e.g., in 3 the thing possessed is not part of the possessor, nor is it a kin relation of the possessor. (Linguists refer to this type of possession as 'alienable possession'.) In 5 there is a relation between a person and something that they may drink, while in 18 there is a kin relationship between one person and another (referred to by the whole phrase).

your (alienable) = *raha-m* (3)

your (drink) = *nəm-əm* (5) (compare 32)

your (kin) = *-m* (18) (compare 6)

By comparing 11 and 12 (and also 25 and 35), we can see that *rahak* corresponds to 'my'. By comparing these with 14 and 16, we see that 'my' is expressed differently depending on the nature of the possession relationship: 11 and 12 involves 'inalienable' possession, 14 is a kin relationship,16 is a relationship between eater and food. By comparing these with 17 we see that the 'possessor of bodypart' is expressed in the same way as the kin possessor. This gives us:

my (alienable) = *rahak*

my (food) = niŋək (16 & 34)

my (kin) = KIN-*k* (14)

my (bodypart) = BODYPART-*k* (17).

By comparing forms that are minimally different, we are able to see that there are *four* types of possessor relation that are formally distinguished or expressed in different ways in Tanna: alienable, food, drink and kin/bodypart.

By comparing forms that translate English 'their', 'our' and 'your' we also see that Tanna distinguishes not just between singular and plural, but between singular (=1), dual (=2) and plural (>2). A comparison between 6 and 18 shows us the singular vs dual contrast for kin possessor translated as 'your'.

2010 Solutions

(O) Possessed in Vanuatu (2/3)

We can analyse the various examples with 'their' in the translation as follows:

	alienable	kin	bodypart	food	drink
dual	*ra-talaw* 24			*niŋ-law* 7	
plural	*ra-lah* 1			*niŋ-lah* 21	

We can do likewise for other pronouns, e.g., *your*.

When the translation lacks a pronoun - where the possessor is expressed by a noun as in 4 'rat's tail' we find *neɲikə kahaw*. To work out which part is which we need to compare with 23 *neɲikən* 'his tail' which shows that *neɲikə* = 'tail' and *-n* = 'his'. By comparing with 29, we can verify that bodypart possession involving a possessor referred to by a noun is expressed by putting the word for the bodypart first and then the word for the possessor: *neɲikə kahaw* (lit. tail rat) or *nelka ɲukah* (lit. leg pig) [we can compare with 15 'big pig' which is *ɲukah asoli* (lit. pig big). 13 and 27 are also of this type.

This contrasts with alienable possession involving nouns as in 8, 20, 28. Each of these involves use of *raha*. The order is POSSESSED - *RAHA* -POSSESSOR.

8. *nenien raha Enteni* 'speech *raha* Tanna'

20. *narunien raha Tjotam* 'knowledge *raha* Tjotam'

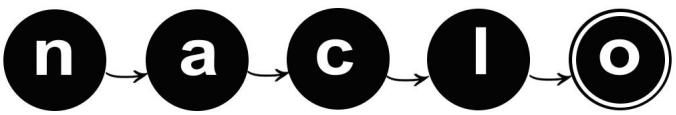
28. *nerow raha jow* 'spear *raha* turtle'

O1. In 1-5 below we can see that the same English construction (possessor word + possessed word) is used even though the types of possession differ. In 1 and 3 it is a whole-part of body relation, in 2. it is a possession relation between the speaker owner and something that is not a part of of the speaker. In 4, the relationship is between two men and a person who is in the named kin relation (*brother of*) to them, and similarly in 5.

To work out the correct Tanna translation we need to see how these different types of possession relationships are expressed. In looking through the Tanna data we will have already noticed that there are different ways of expressing possession depending on the nature of the relationship.

Our answer for 5 would come from comparing 6 (has 'child') and 9 (has 'our' referring to just speaker and addressee).

1.	rat's ear	mətəliŋ(ə) kahaw
2.	my two dogs (that I own)	raha-k kuri mil
3.	their bellies (speaking of several people)	narfu-lah
4.	their brother (= of those two men)	pia-law
5.	our child (= child's mother speaking to child's father)	nete-tah



2010 Solutions

(O) Possessed in Vanuatu (3/3)

O2. 1 and 2 involve alienable possession with possessor expressed by noun. We know this must involve *raha* and the order: possessed + *raha* + possessor.

3 is complex because we need to form 'your picture' which is treated like a whole-part relationship (= *narme* [from 10]) and then combine with 'my' expressing an alienable possession involving *raha-k*. This comes before the possessed. The 'your' singular 'whole' possessor is marked by *-m* (as in 18 and 19).

1.	Tjawkelpi's house	nima raha Tjawkelpi
2.	the pig's canoe	neŋow raha pukah
3.	My picture of you (=the one that I own that is an image of you)	raha-k narme-m
4.	The house belonging to you two is big	ra-tamlaw nima asoli
5.	Where is my lobster (that I am going to eat)?	niŋək jerehi ije?

The models for 4: X is 'big' are 15 and 35.

The models for 5 are 16, 25 & 33

O3.

'Their' in Tanna	**Used when....**
-law	two possessors of a kin relation or a body part (-law is suffixed/added to kin term or bodypart term)
-lah	more than two possessors of a kin relation or a body part (-lah is suffixed/added to kin term or bodypart term)
ra-lah	more than two possessors of something that is not their food or drink, or part of them or a kin relation (= alienable)
ra-talaw	two possessors of something that is not their food or drink, or part of them or a kin relation (=alienable)
niŋ-lah	more than two possessors of something to eat
niŋ-law	two possessors of something to eat

2010 Solutions

(P) Khipu (1/1)

provided by Reed Blaylock

P1 (6 points). This khipu has lost one of its strings. Can you figure out what was on it? Draw the missing string where the dotted line is.

missing string is 14,175. The khipu would be formed with one knot in the 10,000's place, 4 in the 1000's place, 1 in the 100's place, 7 in the 10's place, and 5 in the 1's place.

P2 (4 points). Explain your answer.

Every knot represents the number 1. Knots in different places represent different values, on a logarithmic scale. That is, knots at the top of the rope correspond to the 1's place, while knots below are grouped into 10's, 100's, 1000's, and 10,000's respectively. When the knots are added together, they determine a single larger number. The leftmost string always represents the largest number. The sum of all the strings on the right adds up to the number on the most left string.

In the khipu (set of strings) with the missing rope, the total number is 41, 723. The other ropes, from left to right, are: 20,231, 40, ???, 6,671, and 606. The mysterious string should be 14,175. The khipu would be formed with one knot in the 10,000's place, 4 in the 1000's place, 1 in the 100's place, 7 in the 10's place, and 5 in the 1's place.