Problem 4 solution
Winter 2010 601 final exam

Here again are the data you were asked to account for:

1. abo 'I see'
2. ḡmo 'I say'
3. ḡŋa 'he says'
4. kæŋa 'she eats'
5. adŋa 'she saw'
6. ჭŋja 'he will take'
7. akjmo 'I shall see'
8. kætamq 'we (incl) did'
9. adq 'she sees'
10. ḡtabo 'I said'
11. kæŋmo 'we (incl) shall do'
12. akjna 'she will see'
13. kæqta 'he did'
14. kæmo 'we (incl) do'
15. kæŋna 'he will do'
16. kæŋata 'he ate'
17. kæŋina 'she will eat'
18. këk 'he does'
19. ḡnta 'she took'
20. ḡŋimo 'we (incl) shall take'
21. ḡtabo 'I took'
22. ḡŋimo 'I shall eat'
23. amq 'we (incl) see'
24. ḡŋimo 'I shall take'

Whenever you get such a problem, the natural thing to do is start with the translations and use them as clues to groupings of related forms in the language that the data come from. For example, the translations will allow us to extract all the forms from this data which contain references to first person singular forms. If we pull just these forms out from the above data, we get the following:

1. abo 'I see'
2. ḡmo 'I say'
7. ḡna 'she will see'
21. ḡtabo 'I took'
10. ḡtabo 'I said'
11. kæŋmo 'we (incl) shall do'
12. akjna 'she will see'
4. kæna 'she eats'
5. adŋa 'she saw'
17. kæŋina 'she will eat'
9. adq 'she sees'
13. kæqta 'he did'
14. kæmo 'we (incl) do'
15. kæŋna 'he will do'
16. kæŋata 'he ate'
19. ḡnta 'she took'
20. ḡŋimo 'we (incl) shall take'
22. kæŋima 'we (incl) shall take'
24. ḡŋimo 'I shall take'

While the rest of the word changes as the root meaning and tense change, what remains the same throughout is that the final syllable of the word is either [bo] or [mo]. Furthermore, we see that we invariably get [mo] when the immediately preceding vowel is nasalized, and otherwise are left with [bo]. Since [m] is a voiced bilabial nasal stop and [n] a voiced bilabial oral (i.e., non-nasal) stop, the matchup between the nasality value of these bilabial stops, on the one hand, and that of the preceding vowels on the other, isn't really surprising. We can identify /bo/ as the phonological form of the affix meaning ‘1st person’.

Similarly, to identify the forms marking third person feminine, we can isolate the following words:

4. kæŋa 'she eats'
5. adŋa 'she saw'
17. kæŋina 'she will eat'
19. ḡnta 'she took'
9. akjna 'she sees'
12. ḡjna 'she will see'

Again, the semantic constant through all these forms is the idea ‘she’, and the phonological constant is [dŋ]~[ŋa], where again, the nasalization of the alveodental stop is predictable on the basis of the preceding vowel’s [nasal] value. A message should be starting to get through.
We use the same general approach to identifying the form/meaning correspondences for the roots. The example which contain the root for ‘see’, for example, are the following:

1. abo ‘I see’
5. adqata ‘she saw’
7. akjmo ‘I shall see’
9. adq ‘she sees’
23. amo ‘we (incl) see’
12. akjnq ‘she will see’

The only formal constant here is appearance of [a] in the first syllable. We therefore have little choice but to identify this phonetic constant with the semantic constant ‘see’. And so on for the rest of the roots.

When we carry out this process for all of the roots suggested by the translation, and all of the person and tense markers, we wind up with the following preliminary set of results

<table>
<thead>
<tr>
<th>Roots</th>
<th>Suffixes</th>
</tr>
</thead>
<tbody>
<tr>
<td>a ‘see’</td>
<td>kijŋ ‘future’</td>
</tr>
<tr>
<td>a ‘say’</td>
<td>kaŋŋ ‘3rd masculine’</td>
</tr>
<tr>
<td>kaŋ ‘eat’</td>
<td>ŋaŋŋ ‘3rd feminine’</td>
</tr>
<tr>
<td>q ‘take’</td>
<td>ta ‘past’</td>
</tr>
<tr>
<td>keŋ ‘do’</td>
<td>bo mo ‘1st singular’</td>
</tr>
<tr>
<td>keŋ ‘do’</td>
<td>mo  ‘1st plural’</td>
</tr>
</tbody>
</table>

Our next task is to determine the phonemic form—the fundamental mentally real phonological shape—of each suffix. For the cases where there’s no alternation in the phonetic appearance of the word-part, this task is easy—what you see is, presumably, what’s there in the mind. The trick is to identify what’s going on in the cases where there’s an alternation.

It doesn’t look like much of a trick at first. We’ve seen that where there is an alternation, it involves the consonant of a suffix taking the form of the corresponding nasal version of the consonant which appears when there is no preceding nasal. If we assume that there is a simple nasalization rule

\[ C_{[\text{nasal}]} \rightarrow [\text{nasal+}]/V/_{[\text{nasal+}]}, \]

and that the phonemic forms of the consonants are all unasalized—the phonologically more natural assumption, as vs. taking the consonants to be phonemically nasal, and undergoing denasalization following a non-nasal vowel—we’ll get the right answers—almost! The fly in the ointment is, of course, the [t] of the past tense suffix. Why does that never become [n] following a nasal vowel? It’s voiceless, true, but that doesn’t seem to matter in the case of [k], which alternates with [ŋ] in the case of the future tense and 3rd person masculine forms. This is a bit of an embarrassment, in fact, because it’s not particularly easy to exclude /t/ from a rule such as the one just given, in view of the fact that /d/ clearly does undergo the rule in the case of 3rd person feminine /dəŋ/. To exclude /t/ from a rule which applies to both /k/ and /d/ will yield something very ugly. Is there another way?

There is, and it should occur to you if we regard the problem in a slightly more abstract way, as being a case where there is a rule which we don’t want to apply to a certain phonetic element. The task is exempting that element from the rule’s domain of application. Do we know a way to do that besides hand-tailoring the way the rule is written so as to be inapplicable to this element? Indeed we do: if we can somehow ensure that
this segment only comes into existence after the rule in question applies, then the segment will be unaffected by the rule and we’ll have the desired outcome. But what’s the thinking here—how can we use rule ordering to exempt /t/ from the rule if it’s part of the phonemic form of the past tense morpheme /ta/?

And if you think of it that way, you’ll see that the answer is: there’s no way to use rule ordering if we already have the /t/ as part of the past suffix—therefore, to use the ordering approach, let’s assume that /t/ isn’t part present in the phonemic form, the psychologically real phonological shape, of the past tense suffix. If it isn’t, then it has to be brought into being later. But how? What we’re talking about is, in effect, the creation of an alveodental stop where there was nothing before. We’ve seen this, though, have we not?—in the case of the rules which introduce [a] in the morphology of the plural/possessive/etc. and the morphology of the past tense. This is no different, except that we have a rule ∅ → t, rather than an insertion rule creating a schwa. But the idea is the same. If this rule applies only after the nasalization rule has applied, the t so created will never undergo that rule and will remain unnasalized. But what triggers the application of this t-introduction rule—under what conditions does it go into action?

The answer will come you if you think about where the past tense affix shows up in phonological terms. Every suffix we’ve seen has the shape CV, where V is either nasal or non-nasal. We never see any vowel sequences. That could, of course, be an artifact of the data selection—but we have the right, in doing these problems, to assume that the data are truly representative. If so, no solution which takes the presumed segment preceding the past tense suffix to be a vowel can be faulted for that assumption. Now, what would trigger creation of a t in the environment V[ ]? One obvious candidate would be the appearance of another vowel: VV → VtV. In other words, if when we added the past tense to a suffix of the form CV, the past tense consisted of just a single vowel, we’d wind up with CVV. Given the clear CVCV... pattern of the language, it would not be in the least strange if a rule existed to break up a sequence of vowels to maintain that consonant-vowel-consonant... pattern in the language. A consonant would therefore be needed to do the job... and why not t, then?

So we get a very simple, elegant solution to the problem by assuming that the past tense suffix has the phonemic form /a/, and that the t-insertion rule mentioned above exists in the form

∅ → t/V_\_V

and is ordered after the nasalization rule given above. There are no exceptions: the nasalization process—an assimilation phenomenon of a very common type—applies across the board to any phonemically present consonant following a nasal vowel... but since t is only introduced later, by a rule that breaks up vowel sequences, it isn’t a phonemically present consonant and so comes along too late for the nasalization rule to apply to change it to [n].

We’re just about done with the problem now; all we have to do is state the order in which the word parts are combined in order to give rise to the forms we see in Wuorani. And here, really, there’s not much we can do except identify the order that we see. If you break up all of the words into their parts, you’ll notice that no suffix ever precedes the future, whereas the future precedes all person suffixes. But you’ll also see that third person, which follows the future, invariably precedes the past tense. Since precedence is a transitive relationship—if A precedes B and B precedes C, then A precedes C—we can impose a strict linear ordering on these suffixes along the lines just referred to. Specifically, we now have a solution to the Wuorani data which takes the following form:
Phonemic forms:

<table>
<thead>
<tr>
<th>Root</th>
<th>future</th>
<th>3rd</th>
<th>past</th>
<th>1st</th>
</tr>
</thead>
<tbody>
<tr>
<td>a ‘see’</td>
<td>kį</td>
<td>ką (masc.)</td>
<td>a</td>
<td>bo (sing.)</td>
</tr>
<tr>
<td>a ‘say’</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ką ‘eat’</td>
<td>dą(fem.)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>q ‘take’</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ką ‘do’</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Phonological rules:

\[
C \begin{array}{c} \text{[nasal]} \end{array} \rightarrow \begin{array}{c} \text{[nasal] +} / \text{[nasal]+} \end{array} > \\
\emptyset \rightarrow t/VV
\]

The combination of all of the possibilities identified in the table of phonemic forms, together with the operation of the phonological rules, yields exactly the observed data—as long as we assume that semantic compatibility considerations allow only one of the tense markers, and one of the subject markers, to appear in any given word.

Note that I didn’t penalize anyone for not seeing the use of rule ordering in solving the problem of the nasal/non-nasal alternations in the data set. I was quite happy if you just itemized a set of separate nasalization rules, one for /b/, one for /d/ etc. But it was important that you noted the different positions in the word where future appeared as vs. past tense, or 3rd person as vs. first person subject.