attention only on the nasals. What will you reconstruct for these? How many nasals do you postulate for Proto-Tulu? State your evidence.
NOTE: *j* = [ǰ], IPA [dʒ]; *ṇ* = IPA [ɳ].

	Shivalli	*Sapaliga*	*gloss*
1.	a:ṇɨ	a:nɨ	'male'
2.	uṇɨ	a:nɨ	'dine'
3.	maṇṇɨ	mannɨ	'soil'
4.	ko:nɛ	ko:nɛ	'room'
5.	e:ṇɨ	ya:nɨ	'I'
6.	ninɛ	ninɛ	'wick'
7.	ja:nɛ	da:nɛ	'what'
8.	sanɛ	tanɛ	'conceiving'

(Bhat 2001: 11)

Exercise 5.3 Polynesian

The Polynesian languages of the Pacific form a subgroup of the Oceanic branch of the Austronesian family of languages. (1) What are the sound correspondences found in these data? What sound do you reconstruct for the proto-language to represent each sound correspondence set? (2) What sound change or changes have taken place in each of these languages? (3) What is the best reconstruction (proto-form) for 6, 16, 20 and 32? Show how your postulated sound changes apply to each of these to produce the modern forms.
NOTE: <'> = [ʔ].

	Māori	*Tongan*	*Samoan*	*Rarotongan*	*Hawai'ian*	*gloss*
1.	tapu	tapu	tapu	tapu	kapu	'forbidden', 'taboo'
2.	pito	pito	pito	pito	piko	'navel'
3.	puhi	puhi	—	pu'i	puhi	'blow'
4.	taha	tafa 'edge'	tafa	ta'a	kaha	'side'
5.	tae 'trash'	ta'e	tae	tae	kae	'excrement'
6.	taŋata	taŋata	taŋata	taŋata	kanaka	'man, person'
7.	tai	tahi	tai	tai	kai	'sea'
8a.	kaha	kafa	'afa	ka'a	'aha	'strong'
8b.	ma:rohi-	malohi	malosi	ma:ro'i	—	'strong'

	Māori	*Tongan*	*Samoan*	*Rarotongan*	*Hawai'ian*	*gloss*
9.	karo	kalo	'alo	karo	'alo	'dodge'
10.	aka-	aka	a'a	aka	a'a	'root'
11.	au	'ahu	au	au	au	'gall'
12.	uru 'tip of weapon'	'ulu	ulu	uru	ulu 'centre'	'head'
13.	uhi	ufi	ufi	u'i	uhi	'yam'
14.	ahi	afi	afi	a'i	ahi	'fire'
15.	ɸa:	fa:	fa:	'a:	ha:	'four'
16.	ɸeke	feke	fe'e	'eke	he'e	'octopus'
17.	ika	ika	i'a	ika	i'a	'fish'
18.	ihu	ihu	isu	puta-i'u 'nostril' (puta 'hole')	ihu	'nose'
19.	hau 'wind' (hauku: 'dew' [-ku: 'showery weather'])	hau	sau	'au	hau	'dew'
20.	hika	—	si'a	'ika	hi'a	'firemaking'
21.	hiku 'fishtail'	hiku	si'u	'iku	hi'u	'tail'
22.	ake	hake	a'e	ake	a'e	'up'
23.	uru	—	ulu	uru	ulu	'enter'
24.	maŋa	maŋa	maŋa	maŋa	mana	'branch'
25.	mau 'fixed'	ma'u	mau	mau	mau	'constant'
26.	mara 'marinated'	—	mala	mara	mala	'fermented food'
27.	noho	nofo	nofo	no'o	noho	'sit'
28.	ŋaru	ŋaru	ŋalu	ŋaru	nalu	'wave'
29.	ŋutu	ŋutu	ŋutu	ŋutu	nuku	'mouth'
30.	waka	vaka	va'a	vaka	wa'a	'canoe'
31.	wae	va'e	vae	vae	wae	'leg'
32.	raho 'testicle'	laho	laso	ra'o	laho	'scrotum'
33.	rou 'long forked stick'	lohu	lou	rou	lou	'fruit-picking pole'
34.	roŋo	(loŋo-) (loŋo-a:'a 'noise', loŋo-noa 'silence')	loŋo	roŋo	lono	'hear'
35.	rua	-lua (in compounds)	lua	rua	lua	'two'

Table 1. Polynesian consonants correspondence sets and reconstruction.

	Mao	Ton	Sam	Rar	Haw	PP
C1	t	t	t	t	k	*t
C2	p	p	p	p	p	*p
C3	h	h	s	ʔ	h	*s
C4	h	f	f	ʔ	h	*f
C5	ø	ʔ	ø	ø	ø	*ʔ
C6	ŋ	ŋ	ŋ	ŋ	n	*ŋ
C7	ø	h	ø	ø	ø	*h
C8	k	k	ʔ	k	ʔ	*k
C9	m	m	m	m	m	*m
C10	r	l	l	r	l	*L
C11	ɸ	f	f	ʔ	h	*f
C12	n	n	n	n	n	*n
C13	w	v	v	v	w	*V

Table 2. ‘Distance’-encoding of Polynesian languages

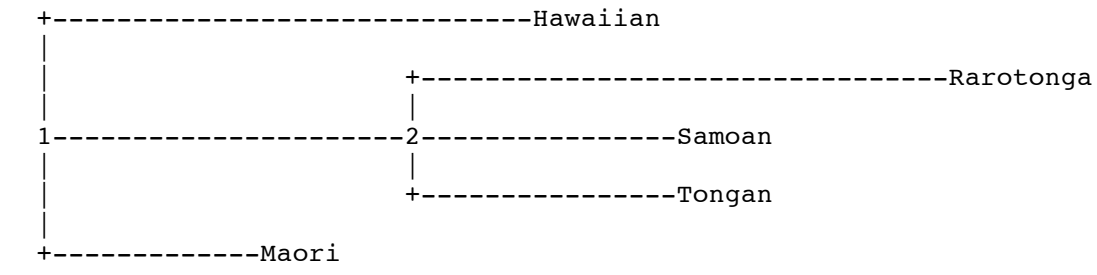
	Mao	Ton	Sam	Rar	Haw
Mao	0	6	6	4	5
Ton	6	0	4	5	8
Sam	6	4	0	5	6
Rar	4	5	5	0	8
Haw	5	8	6	8	0

Table 3. ‘Character’-encoding of correspondence sets. In total, there are 14 necessary changes. Parsimony results in needing minimally 16 changes

	Mao	Ton	Sam	Rar	Haw
C1	1	1	1	1	2
C2	1	1	1	1	1
C3	1	1	2	3	1
C4	1	2	2	3	1
C5	1	2	1	1	1
C6	1	1	1	1	2
C7	1	2	1	1	1
C8	1	1	2	1	2
C9	1	1	1	1	1
C10	1	2	2	1	2
C11	1	2	2	3	4
C12	1	1	1	1	1
C13	1	2	2	2	1

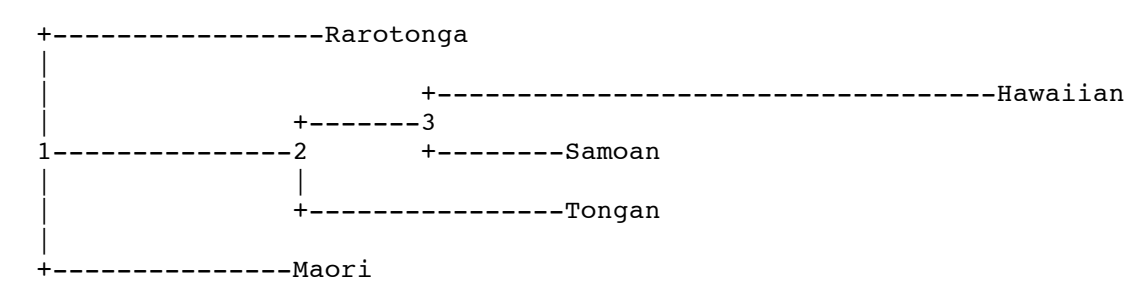
Discrete character parsimony algorithm, version 3.65

6 trees in all found



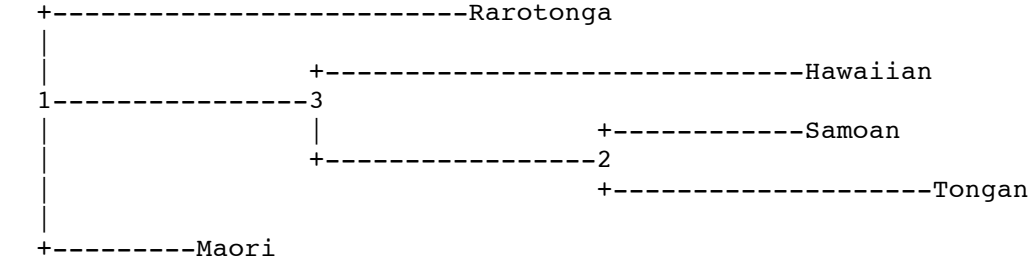
requires a total of 16.000

between	and	length
1	Hawaiian	3.67
1	2	2.67
2	Rarotonga	4.00
2	Samoan	2.00
2	Tongan	2.00
1	Maori	1.67



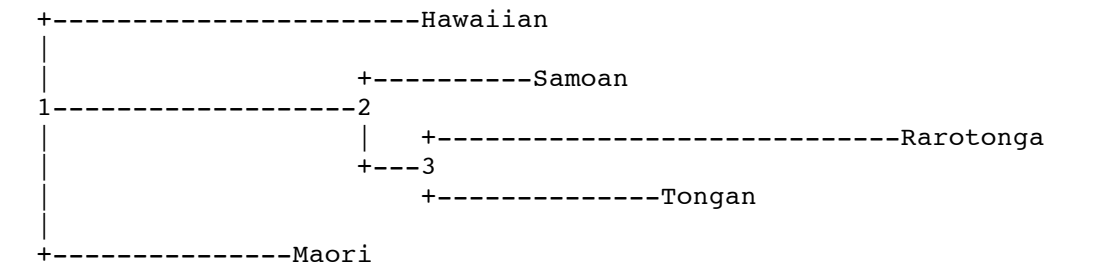
requires a total of 16.000

between	and	length
1	Rarotonga	2.42
1	2	2.17
2	3	1.00
3	Hawaiian	4.75
3	Samoan	1.25
2	Tongan	2.25
1	Maori	2.17



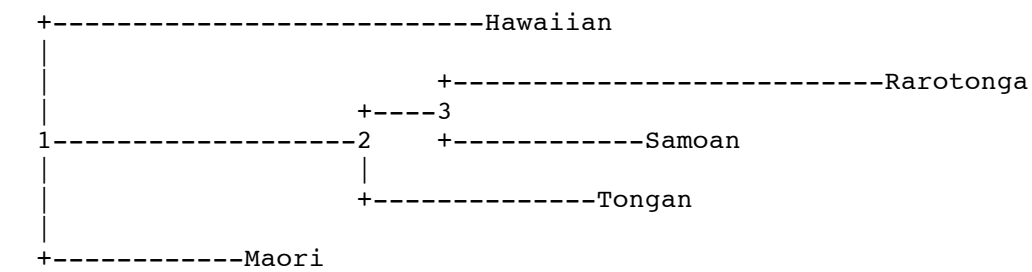
requires a total of 16.000

between	and	length
1	Rarotonga	3.12
1	3	2.00
3	Hawaiian	3.62
3	2	2.12
2	Samoan	1.50
2	Tongan	2.50
1	Maori	1.12



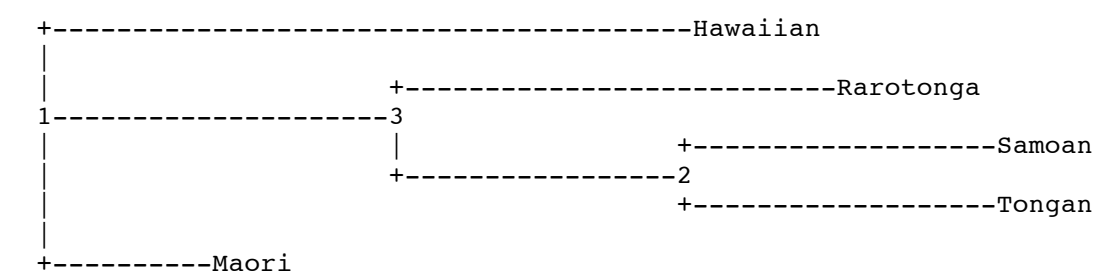
requires a total of 16.000

between	and	length
1	Hawaiian	3.17
1	2	2.67
2	Samoan	1.50
2	3	0.50
3	Rarotonga	4.00
3	Tongan	2.00
1	Maori	2.17



requires a total of 16.000

between	and	length
1	Hawaiian	3.67
1	2	2.67
2	3	0.67
3	Rarotonga	3.67
3	Samoan	1.67
2	Tongan	2.00
1	Maori	1.67



requires a total of 16.000

between	and	length
1	Hawaiian	4.12
1	3	2.17
3	Rarotonga	2.79
3	2	1.79
2	Samoan	2.00
2	Tongan	2.00
1	Maori	1.12

Table 4. Transition probabilities between consonants (intuitive estimation). Only the probabilities presently relevant are given. Direction of change is from row to column.

	t	k	h	s	ʔ	f	ɸ	ø	ŋ	n	r	l	w	v
t		0.5												
k	0.5				0.9									
h				0.2	0.7	0.2	0.2	0.7						
s			0.8		0.8	0.6	0.6	0.9						
ʔ		0.1	0.3	0.2		0.2	0.2	0.7						
f			0.8	0.4	0.8		0.5	0.9						
ɸ			0.8	0.4	0.8	0.5		0.9						
ø			0.3	0.1	0.3	0.1	0.1							
ŋ										0.5				
n									0.5					
r												0.5		
l											0.5			
w														0.5
v													0.5	

Table 5. Most likeley probabilities for each correspondence set and each possible root. Informative correspondences are set in boldface. The mean is taken only over the informative sets. Root 6 is the most likely.

	R1	R2	R3	R4	R5	R6	R7
C1	0.50	0.50	0.50	0.50	0.50	0.50	0.50
C2	1.00	1.00	1.00	1.00	1.00	1.00	1.00
C3	**0.41**	**0.41**	**0.41**	**0.41**	**0.45**	**0.45**	**0.56**
C4	**0.51**	**0.51**	**0.51**	**0.51**	**0.64**	**0.64**	**0.64**
C5	**0.30**	**0.30**	**0.34**	**0.34**	**0.49**	**0.70**	**0.49**
C6	0.50	0.50	0.50	0.50	0.50	0.50	0.50
C7	**0.30**	**0.30**	**0.34**	**0.34**	**0.49**	**0.70**	**0.49**
C8	0.81	0.81	0.81	0.81	0.81	0.81	0.81
C9	1.00	1.00	1.00	1.00	1.00	1.00	1.00
C10	0.50	0.50	0.50	0.50	0.50	0.50	0.50
C11	0.32	0.32	0.32	0.32	0.32	0.32	0.32
C12	1.00	1.00	1.00	1.00	1.00	1.00	1.00
C13	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Mean Infor.	0.38	0.38	0.40	0.40	0.52	**0.62**	0.55

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Software

These are all free software packages that run on a wide variety of platforms:

NJplot: Rerooting of trees
<http://pbil.univ-lyon1.fr/software/njplot.html>

SplitsTree: Phylogenetic network analysis
<http://www.splitstree.org/>

Phylip: Maximum parsimony (and much more)
<http://evolution.genetics.washington.edu/phylip.html>

WALS Interactive Reference Tool: Language Maps
(distributed with Haspelmath *et al.* 2005)