

## Appendix 1 - RevBayes Source File

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```
#####
# RevBayes Source File for Linguistomics Project #
#####
clear()
path = "C:/Users/shawn/Documents/Code/Linguistomics/Run/Run1/"
gammapath = path+"Gamma.trees"

# Read in discrete character data
data = readDiscreteCharacterData(path+"Characters.nex")

# Get some useful variables from the data. We need these later on
num_taxa <- data.ntaxa()

# Number of branches in an rooted tree
num_branches <- 2 * num_taxa - 2
taxa <- data.taxa()

# Create helper variables
moves = VectorMoves()
monitors = VectorMonitors()

#####
# Tree Model #
#####

# Outgroup is a clade consisting of one language
out_group = clade("Latin")

# Prior distribution on the tree topology
topology ~ dnUniformTopology(taxa, outgroup=out_group, rooted=TRUE)

# These are moves that change the tree topology
moves.append(mvNNI(topology, weight=num_taxa/2.0))
moves.append(mvSPR(topology, weight=num_taxa/10.0))

# Branch length prior
for (i in 1:num_branches) {
  bl[i] ~ dnExponential(10.0)
  moves.append(mvScale(bl[i]))
}

TL := sum(bl)

psi := treeAssembly(topology, bl)
```

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#####
# Substitution Model #
#####

# This is the number of unique characters from the segment filters
unique_chars = 83

# Jukes-Cantor model
Q <- fnJC(unique_chars)

#####
# Gamma model for among-site variation #
#####
alpha ~ dnUniform(0, 10.0)
moves.append(mvScale(alpha, weight=1))
site_rates := fnDiscretizeGamma(alpha, alpha, 4)

#####
# PhyloCTMC Model #
#####
seq ~ dnPhyloCTMC(tree=psi, Q=Q, type="Standard", siteRates=site_rates)
seq.clamp(data)

#####
# Analysis #
#####

# You can use any node as the argument of model()
mymodel = model(psi)
n_gen = 10

# This prints monitors to the screen
monitors.append(mnScreen(TL, printgen=n_gen))

# This monitors the trees and puts them in a file
monitors.append(mnFile(psi, filename=gammapath, printgen=n_gen))

# Model monitor
monitors.append(mnModel(filename=path+"Gamma.log", printgen=n_gen))
mymcmc = mcmc(mymodel, moves, monitors, nruns=1, combine="mixed")
mymcmc.run(generations=1000)

# Summarizes the MCMC runs
mymcmc.operatorSummary()

#####
# Post processing #
```

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```
#####  
treetrace      = readTreeTrace(gammapath, outgroup=out_group)  
map_tree       = mapTree(treetrace, path+"Gamma_MAP.tree")  
mcc_tree       = mccTree(treetrace, path+"Gamma_MCC.tree")  
consensus_tree = consensusTree(treetrace, path+"Gamma_Consensus.tree")  
  
# Exit the program  
q()
```

## Appendix 2 - Segments used in the word list

Char.	Segment	Words containing this segment
0	e	ego:, ew, jew, k <sup>w</sup> em, kjen, ʃine, ke, ʃe, kome, ʃemut, due, tres, tre, tref, k <sup>w</sup> i: nk <sup>w</sup> e, ʃiŋkwe, grandem, grande, grande, majjorem, mare, le, piskem, peθ, peʃ ʃe, peʃ, peʃte, awem, abe, awikellum, useɿ, passerem, passero, pasəre, bibere, beber, bere, beber, biʃer, bevi, komedere, komer, kome, kumer, manduka:re, mãze, mandza:re, morde:re, morðer, mɔrdere, mɔrdex, murðer, morsika:re, m orsikare, murseka, su:gere, syse, suðe, konspuere, kɔspye, eskupir, sputere, e sputar, sputa:re, kɔʃe, skire, sapere, saber, sape:re, sabeʃ, seber, kogno:skere, konoθer, konoffere, kopeseʃ, kupiser, kuŋaʃte, ko:gita:re, kuide, koðgita:re, kuðgeta, pe:nsa:re, pãse, pensar, pensa:re, pẽse, peŋsa:, time:re, temer, teme:re, temex, timer, temə, temi, teme, tremere, tremet, trema:re, tremex, trimer, do rmire, wi:were, vi:vere, viveʃ, viver, morire, moʃex, muʃer, nata:re, nwota:re, naviga:re, naze, nabegar, navigare, wola:re, vole, vola:re, vole, zvola:re, weni: re, benir, veni:re, veni, kadere, kaer, kade:re, ʃjade, tɔbe, tume, kanta:re, ʃãte, ʃãte, lu:dere, joka:re, zwe, ðoka:re, ðuwe, gela:re, zəle, elar, ðelare, ðale, gla kia:re, glase, gjatʃjare, inglakia:re, ingetsa, so:lem, sole, sɔare, soreli, lune, et wal, estreja, stella, istrelə, ɪʃtrelə, stəle, age, ploje, plɔaje, mare, mex, salem, sale, se, sare, terra, tex, tjera, texə, tjere, θjelo, ʃer, wentum, bjento, ben, fwe go, wiridem, vex, berde, verde, verdi, verde, no:men, no:me, nume, no:minem, nombre, leŋgwa
1	g	ego:, gɔã, grande, grande, grẽðgi, grẽdi, longum, lungo, lõgu, largo, laɣgu, larɣ u, musəga, musəgar, su:gere, sugax, sugar, kogno:skere, ko:gita:re, nabegar, n avigare, nəbəga, naviga, zogax, zuga, gela:re, glakia:re, glase, gjatʃjare, gləsa, inglakia:re, agwə, lago, lagu, fwego, fogu, lãg, leŋgwa, lingwa, liɣwə
2	o:	ego:, k <sup>w</sup> ando:, k <sup>w</sup> o:modo, duo:s, kogno:skere, ko:gita:re, so:lem, no:men, no:me, no:minem
3	ɜ	zə, ɜə, laɜ, mãze, mẽzar, mɛzar, mɛnza, kuɜitar, kuɜitar, naze, zwe, zogax, ɜ uɣar, zuga, zuka, zəle, ɜilar, zəla, pluɜə
4	ə	zə, dowə, amplə, pasəre, bəwrə, mɛnza, musəga, musəgar, musəya, əskupi, sə βe, kuɛʃə, pənsa, pəsa, temə, biwrə, nəda, nəbəga, vənix, bəni, kawrə, kəðə, kənta, zəle, zəla, gləsa, ɿunə, lunə, əstəl, ajɣwə, apə, pluɜə, tərə, tsarə, limbə
5	j	jo, estreja, jubja
6	o	jo, io, jo, kwando, k <sup>w</sup> o:modo, komo, kome, komu, uno, dos, dowə, θinko, maɲo, maɲno, majjorem, longum, longo, lungo, ɿoŋ, larɣo, largo, lato, anʃo, ampjo, wazo, utʃello, paxaro, passero, komedere, komer, kome, morde:re, moʃdɛ, m orðer, moʃdɛ, morsika:re, moskar, morsikare, konspuere, kogno:skere, kono θer, konoffere, kopeseʃ, koposi, koðgita:re, dormi:re, dormir, doʃmiɛ, dormi, mori:, morir, mori:re, moʃex, nwota:re, wola:re, vole, bolar, vola:re, voax, zvo la:re, zvola, joka:re, ðoka:re, zogax, sol, sole, soliculus, soreli, o, pjodɕa, ploje, lago, lago, θjelo, ʃelo, bjento, vento, fokum, fwego, fwəko, fogu, foyu, fok, a ɲo, anno, nomi, nomi, nombre

## Appendix 2 - Segments used in the word list

7	i	io, k <sup>w</sup> is, ki, kwi, ʃine, k <sup>w</sup> id, ʰinko, ʃiŋkwe, siŋk, ʃiŋk, ʃiŋʃ, grēdʒi, piskem, p ejfi, avi, awikellum, bibere, bevi, morsika:re, morsikare, kuspiɤ, kufpiɤ, esku piɤ, əskupi, ʃti, kinɔh, kɔnosi, ko:ɡita:re, kuide, kwidaɤ, koɟita:re, kuɟitaɤ, k uzitaɤ, time:re, temi, trima:, dɔɤmiɤ, dormiɤ, dɔɤmiɤ, durmiɤ, durmi, dwaɤmi, dormi, vivɤ, bibiɤ, viveɤ, viver, biwɤ, vivi, via, muɤiɤ, moriɤ, muri, mɔri, m uri, naviga:re, navigare, naviga, naviga, vɔniɤ, beniɤ, viɤ, vir, bɔni, vini, viɤi: veni, kɛiɤ, ludiɤ, glakia:re, inglakia:re, solculus, soreli, istrelɤ, pluwia, pluɤi, v int, wiridem, nomi, no:minem, ling <sup>w</sup> a, lingwa, limbɔ
8	w	ew, jew, kwi, kwa, kwɛ:, kwando, kwēdu, kwan, kwand, kwant, dowɔ, tɤwɔ, ʃiŋkwe, pwasɔ, awem, aw, awikellum, wazo, bwɔɤ, bɛwɤ, savwɔɤ, kwidaɤ, dwaɤmi, wi:were, biwɤ, nwota:re, wola:re, vwaɤ, weni:re, ʃwɔɤ, kawɤ, ʒwe, ɟuwe, sɔw, etwal, aywa, akkwa, agwɛ, ajɤwɔ, ɛ:w, pluwia, saw, sɛw, wentum, fwego, fwɔko, wiridem, lengwa, lingwa, ligwɛ
9	ɔ	ʒɔ, kɔm, kɔmɛ, mɔrdere, kɔnɛtɤ, kinɔh, dɔɤmiɤ, mɔri, vɔle, sɔw, sɔɔ, sɔl, sɔlɔ, s ɔlej, fwɔko, fɔk, nɔm, nɔɤ
10	ɟ	ɟi, grēdʒi, mandʒa:re, suɟe, koɟita:re, kuɟeta, nɛɟi:, ɟoka:re, ɟuwe, ɟuja, ɟ elare, ɟale, pjodɟa
11	ɹ	ɟi
12	j	jo, jew, kjen, majjorem, ampjo, utʃjel, skuɟpa, kujda, ʃjade, joka:re, ɟuja, gjatʃ jare, jubja, pjodɟa, ploje, plɔaje, tjera, tjere, sjel, ʰjelo, bjento
13	k <sup>w</sup>	k <sup>w</sup> is, k <sup>w</sup> em, k <sup>w</sup> id, k <sup>w</sup> ando:, k <sup>w</sup> o:modo, k <sup>w</sup> i:nk <sup>w</sup> e, ak <sup>w</sup> a
14	s	k <sup>w</sup> is, duo:s, dos, dojs, duas, duɛs, tre:s, tres, trɛs, sɛk, siku, siŋk, piskem, pɛs, pwasɔ, useɔ, passerem, passero, pasɛru, pasɛre, morsika:re, moskar, morsika re, musɔga, musɔgar, musɔya, murseka, su:gere, syse, sugɔɤ, sugar, sysi:, suɟe, konspuere, kɔspye, kuspiɤ, eskupiɤ, əskupi, skuɟpa, sputere, esputar, sputa:re, ski:re, sapere, savwɔɤ, saber, sape:re, sabɛɤ, sɛber, sɔβɛ, savɔ:ɤ, save:, kogno:s kere, kɔnesɛɤ, kuɤiser, kɔnosi, pe:nsa:re, pɔse, pensaɤ, pensa:re, pɛsaɤ, pɛsar, pɔnsa, pɛse, peɤsa:, pɔsa, glase, glɔsa, so:lem, sol, sole, sɔw, sɔɔ, sɔl, sɔlɔ, sɔare, solculus, sɔlej, soreli, ste:lla, estreja, stella, istrelɤ, əstɛl, stɔ:l, stele, stea, sa:l em, sɛl, sal, sale, saw, se, sa:l, sare, sjel, sɛw, sɛl, si:ɤ
15	k	ki, ki:, kwi, kjen, kɛj, kɛj, kwa, ke, ki, kɛ, kwɛ:, kɔ, kwando, kwēdu, kwan, k wand, kwant, kind, kɔm, komo, kome, komu, kɔmɛ, kum, sɛk, ʰinko, ʃiŋkwe, siku, siŋk, ʃiŋk, lunk, ɔark, lark, piskem, awikellum, komedere, komer, kome, kumer, manduka:re, mandukar, minka, morsika:re, moskar, morsikare, murs eka, konspuere, kɔspye, kuspiɤ, kufpiɤ, eskupiɤ, əskupi, skuɟpa, kɔafe, ski:re, kogno:skere, kɔnɛtɤ, konoθer, konoffere, kɔnesɛɤ, kuɤiser, kuɤɛfɔ, kinɔh, ko nosi, kuɤafte, ko:ɡita:re, kuide, kwidaɤ, koɟita:re, kuɟitaɤ, kuɟitaɤ, kujda, kuɟeta, kɛdɛɤ, kadere, kaɤ, kade:re, kɛiɤ, kawɤ, kɔdɛa, kanta:re, kantar, kɛ tar, kɔnta, kinta, joka:re, ɟoka:re, ʒuka, glakia:re, inglakia:re, akkwa, lakum, lak, ɔak, kajlum, fokum, fwɔko, fɔk, fu:k, fok
16	i:	ki:, k <sup>w</sup> i:nk <sup>w</sup> e, maɤi:, sysi:, ski:re, dormi:re, durmi:, wi:were, vi:vere, mori:, mor i:re, muri, nɛɟi:, weni:re, veni:re, viɤi:, si:ɤ, ʃi:l

## Appendix 2 - Segments used in the word list

17	m	k <sup>w</sup> em, k <sup>w</sup> o:modo, kɔm, komo, kome, komu, kɔmɛ̃, ʃʃemu:t, kum, u:num, magnum, maɲo, maɲno, grandem, majjorem, mare, longum, largum, la:tum, amplum, ampjo, amplə, piskem, awem, awikellum, passerem, komedere, komer, kome, kumer, manduka:re, mǎʒe, mandukar, mandɕa:re, mɛ̃ʒaɤ, mɛ̃ʒaɤ, mǎʒa, maɲi:, maɲʃa, minka, morde:re, moɤdɤ, moɤdeɤ, mɔɤdere, moɤdeɤ, muɤdeɤ, mɔɤsika:re, moskar, morsikare, musəga, musəgar, musəya, murseka, time:re, temer, teme:re, temɤ, timer, temə, temi, teme, tremere, tremes, trema:re, tremɤ, trimer, trima:, dormi:re, dɔɤmiɤ, dormir, dɔɤmiɤ, durmir, durmi, dwaɤmi, durmir, dormi, mori:, muɤiɤ, morir, mori:re, moɤɤ, muɤer, muri, mɔɤi, muri:, muri, tumbat, tumba, tume, so:lem, lakum, mare, mɤɤ, maɤ, maɤ, mar, mɤɤ, mar, sa:lem, kajlum, wentum, fokum, wiridem, annum, no:men, no:me, nomi, nomi, nɔm, nume, no:minem, nombre, limbə
18	n	kjen, ʃʃine, k <sup>w</sup> ando:, kwando, kwan, kwand, kwant, kind, u:num, uno, un, unu, k <sup>w</sup> i:nk <sup>w</sup> e, ʃʃinko, ʃʃintʃ, magnum, grandem, grande, grande, gran, grant, longum, longo, lungo, lunk, lung, antʃo, manduka:re, mandukar, mandɕa:re, minka, konspuere, kogno:skere, kɔnɛtɤ, konoθer, konoffere, kunɛʃə, kinɔh, kunɔaʃte, pe:nsa:re, pensar, pensa:re, pɛnsa, nata:re, nadar, nwota:re, nadaɤ, nɛdaɤ, nɛda, nada, naviga:re, naʒe, nabegar, navigare, naviɤaɤ, nɛviɤaɤ, nɛbɛga, nɛɕi:, naviga, naviga, weni:re, vɛniɤ, benir, weni:re, bɛni, vini, weni, kanta:re, kantar, kɛnta, canta:, kinta, inglakia:re, ingetsa, lu:na, lyn, luna, ʌunə, lɔn, lune, lunə, wentum, bjento, vento, ben, vint, vint, annum, anno, enu, an, no:men, nɔ, no:me, nomi, nomi, nɔm, nɔ, nɔɲ, nume, no:minem, nombre, ling <sup>w</sup> a, lingwa, lɛngɛ
19	ẽj	kẽj
20	ẽj	kẽj
21	ʃʃ	ʃʃine, ʃʃemu:t
22	d	k <sup>w</sup> id, k <sup>w</sup> ando:, kwando, kwẽdu, kwand, kind, k <sup>w</sup> o:modo, duo:s, dɔ, dos, dojs, dojʃ, dɔ:, doj, duaj, due, dowə, duas, duɤs, duɤʃ, grandem, grande, grande, grɛdi, komedere, manduka:re, mandukar, morde:re, moɤdɤ, mɔɤdere, moɤdeɤ, kɔide, kwidar, kujda, kɛdɤ, dormi:re, dɔɤmiɤ, dormir, dɔɤmiɤ, durmir, durmi, dwaɤmi, durmi, dormi, nadar, nadaɤ, nɛda, nada, kadere, kade:re, ʃʃjade, kɛdɛa, lu:dere, ludir, pjodɕa, wiridem, berde, verde, verdi, verde

## Appendix 2 - Segments used in the word list

23	a	kwa, k <sup>w</sup> ando:, kwando, kwan, kwand, kwant, duas, magnum, maɲo, maɲɲo, grandem, grande, grande, gran, grant, mare, largum, laɣz, laɣo, largo, laɣu, largu, ʌark, lark, larg, lato, latu, lat, amplum, anʃo, ampjo, amplə, pwasō, a wem, abe, avi, avi, aw, awikellum, wazo, passerem, paxaro, passero, paseru, pasere, manduka:re, mandukar, manɕa:re, mēzax, mēzar, mənza, maɲi:, maɲ ʃa, minka, moskar, morsikare, musəga, musəgar, musəya, murseka, sugax, su gar, skujpa, esputar, kɤafe, sapere, savwax, saber, sape:re, sabex, savø:ɾ, save:, kwidar, kuzitaɣ, kuzitar, kujda, kuɕeta, pensar, pēsax, pēsar, pənsa, pəsa, d waxmi, via, nata:re, nadar, nadaɣ, nəðar, nəda, nada, naviga:re, naze, nabega r, navigare, naviyax, nəviyar, nəbəga, naviga, naviga, bolar, voax, vwar, bula, zvola, zbura, kadere, ʃwax, kaer, kade:re, kawrə, ʃjade, tumbax, tōbax, tōbar, tumba, kanta:re, kantar, kētar, kənta, cantax, kinta, xugar, zogax, zuɣar, zuga, ɕuja, zuka, elar, ɕelare, zilar, zəla, ɕale, glakia:re, glase, gjatʃjare, gləsa, gla ʃa, inglakia:re, ingetsa, lu:na, luna, stella, etwal, estreja, stella, ak <sup>w</sup> a, aywa, akkwa, agwə, age, apə, pluwia, jubja, pjodɕa, lakum, lak, lago, lago, lagu, la yu, ʌak, mare, mar, max, mar, sal, sale, saw, sare, terra, tjera, terra, tsarə, an num, aɲo, anno, aɲ, aɲ, an, ling <sup>w</sup> a, leɲgwa, lingwa
24	i	ki, kind, grēdi, peɟʃi, avi, biβer, minka, kupiser, timer, trimer, naviyax, nəvi yar, kinta, zilar, ingetsa, ɪstrele, vint, verdi, nomi
25	ε	ke, tres, pes, pehō, utʃello, utʃjel, bəwɾə, səβe, kənɛtɣ, kunɛʃə, nɛɕi:, əstɛl, stele, mɛx, sel, terra, tɛxə, tɛrə, tjere, sjel, ʃelo, səw, sel, vento, vert, vɛx, vert, lɛnge
26	ε:	kwe:, u:hɛ:, ʃɛ:ɾ, ɛ:w, tɛ:ɣ
27	ʃ	ʃe, ʃiɲkwe, ʃiɲk, ʃiɲʃ, anʃo, utʃello, utʃjel, ʃɛ:ɾ, ʃjade, ʃāte, gjatʃjare, glaʃa, ʃelo, ʃi:l, ʃer
28	ã	kā, gṵā, gṵā, ʃāte, ā
29	ẽ	kwēdu, grēɕi, grēdi, ẽʃu, mēzax, mēzar, kētar
30	u	kwēdu, komu, kum, u:num, uno, un, uɲ, unu, duo:s, duaj, due, duas, duɛs, duɛ ʃ, siku, magnum, longum, lungu, lōgu, lunk, lung, largum, laɣu, largu, la:tu m, latu, amplum, ẽʃu, awikellum, utʃello, useʌ, utʃjel, paseru, kumer, mandu ka:re, mandukar, murðer, musəga, musəgar, musəya, murseka, sugax, sugar, sudɕe, konspuere, kuspiɣ, kuspiɾ, eskupiɾ, əskupi, skujpa, sputere, esputar, sp uta:re, kupiser, kunɛʃə, kunɔafte, kuzitaɣ, kuzitar, kujda, kuɕeta, durmir, du rmi, durmi:, muɣiɣ, muɣer, muri, muri:, muri, bula, zbura, tumbax, tumba, t ume, ludir, xugar, zuɣar, zuga, ɕuwe, ɕuja, zuka, soliculus, luna, luɐ, ʌunə, lune, lunə, pluwia, jubja, ʃuvə, pluza, lakum, lagu, layu, kajlum, wentum, vɛ tu, fokum, fogu, foyu, annum, enu, nume
31	t	kwant, ʃɛmu:t, tre:s, tɤwa, tres, tre, tref, trɛs, trø:, tre:, trej, grant, la:tum, lat o, latu, lat, pestɛ, utʃello, sputere, esputar, sputa:re, ʃti, kənɛtɣ, kunɔafte, ko: gita:re, kodɕita:re, kuzitaɣ, kuzitar, kuɕeta, time:re, temer, teme:re, temɛx, ti mer, temə, temi, teme, tremere, tremer, trema:re, tremɛx, trimer, trimax, nata: re, nwota:re, tōbe, tumbax, tōbax, tōbar, tumba, tume, kanta:re, ʃāte, kantar, kētar, kənta, ʃāte, cantax, kinta, gjatʃjare, ste:lla, etwal, estreja, stella, ɪstrele, ɪstrele, əstɛl, stō:l, stele, stɛa, la:t, terra, tɛx, tjera, terra, tɛxə, tɛxə, tɛrə, tɛ:ɣ, tj ere, wentum, bjento, vento, vɛtu, vint, vint, vert, vert
32	ẽ	kɔmẽ, pɛse
33	u:	ʃɛmu:t, u:num, u:hɛ:, su:gere, lu:dere, lu:na, plu:ɣ, fu:k

## Appendix 2 - Segments used in the word list

34	œ	œ
35	ũ	ũ
36	õ	õ, lõgu, lõ, pwasõ, pēhõ, tõbe, tõbaḡ, tõbar, nõ
37	ŋ	uŋ, ʃiŋkwe, siŋk, ʃiŋk, ʎoŋ, maŋʃa, peŋsa:, aŋ, noŋ, leŋgwa
38	ø	dø, løn, fø
39	oj	dojs, dojʃ, doj
40	ʃ	dojʃ, duɛʃ, tref, ẽʃu, peʃʃe, pejʃi, pejʃi, peʃ, peʃte, kuʃpiɾ, kʷaʃe, ʃti, konoffere, kunɛʃə, kunɔʃte, ʃwaḡ, ʃāte, iʃtrele, ʃuvə
41	ø:	dø:, trø:, bø:ḡ, savø:ɾ, stø:l, fø:
42	aj	duaj, majjorem, ajɣwə, kajlum
43	e	duɛs, duɛʃ, pasəru, səber, nəðar, nəviɣar, kɛiɾ, luɐ, istrele, iʃtrele, agwə, ʃuvə, teḡe, teḡe, ɛnu, liɣwə
44	r	tre:s, tre, trɛs, trø:, tre:, trej, grandem, grande, gran, grant, majjorem, largum, largo, lark, larg, passerem, passero, bibere, komedere, manduka:re, morde:re, mɔrdere, morsika:re, morsikare, musəgar, murseka, su:gere, konspuere, spute re, ski:re, sapere, sape:re, kogno:skere, konoffere, ko:gita:re, koʒita:re, pe:nsa: re, time:re, teme:re, tremere, trema:re, trima:, dormi:re, durmi, durmi:, dormi, wi:were, vi:vere, mori:, mori:re, muri:, muri, nata:re, naviga:re, navigare, wol a:re, weni:re, kadere, kawrə, kanta:re, lu:dere, joka:re, ɖoka:re, gela:re, ɖelare, glakia:re, gjaʃʃjare, inglakia:re, soreli, mare, mar, ma:r, sare, terra, tjera, terra, tərə, tjere, tsarə, wiridem, verde, vɛrt
45	e:	tre:s, tre:, morde:re, sape:re, save:, pensa:re, time:re, teme:re, kade:re, ste:lla
46	ḡ	tḡwə, ɣḡā, ɣḡā, laḡz, laḡgu, bwaḡ, bebeḡ, bø:ḡ, mēzḡ, moḡdḡ, moḡdek, sugḡ, kuʃpiɾ, kʷaʃe, savwaḡ, sabḡ, kɔnetḡ, koɾeseḡ, kuʒitaḡ, pēsḡ, temḡ, kḡēdḡ, tremḡ, dɔḡmiɾ, doḡmiɾ, dwaḡmi, viḡv, viḡvḡ, muḡiɾ, moḡeḡ, muḡeɾ, nadaḡ, naʋiɣḡ, voḡ, vəniḡ, viḡ, ʃwaḡ, tõbaḡ, zoḡaḡ, plu:ḡ, mḡ, maḡ, meḡ, teḡ, teḡe, teḡe, te:ḡ, si:ḡ, veḡ, vḡ
47	ɑ	tḡwɑ, bwaḡ
48	r	tres, tref, grande, grēɖʒi, grēdi, mare, larɣo, largu, ʎark, paɣaro, pasəru, pasəre, beber, bere, biʃer, bəwɾə, komeɾ, kumer, mandukaɾ, maɖʒa:re, mēzəɾ, moɖer, muɖer, moskaɾ, morsikare, sugaɾ, kuʃpiɾ, eskupiɾ, esputaɾ, sputa:re, sabeɾ, səber, konoθer, kuɾiseɾ, kwidaɾ, kuʒitaɾ, pensaɾ, pensa:re, pēsəɾ, temer, tim er, tremer, tremḡ, trimer, dormiɾ, durmiɾ, bibiɾ, viver, biwɾə, moriɾ, muḡeɾ, muri, nadaɾ, nwota:re, nəðəɾ, nabegaɾ, nəviɣəɾ, bolaɾ, vola:re, vwaɾ, zvola:re, zbura, beniɾ, veni:re, viɾ, kaer, kade:re, kɛiɾ, tumbaɾ, tõbaɾ, kantaɾ, kētaɾ, lud iɾ, xugaɾ, zuɣəɾ, elar, ʒilaɾ, soqare, estreja, istrele, iʃtrele, maɾ, ʃer, berde, verd i, vɛrt, verde, nombre
49	ej	trej, pejʃi
50	ē	sēk, pēsəḡ, pēsəɾ, kḡēdḡ, vētu, vē
51	θ	θinko, peθ, konoθer, θjelo
52	ĩ	sĩku, liɣwə
53	g	magnum, grandem, gran, ɣḡā, grant, longo, lung, largum, larg, naviga:re, na viga, xugaɾ, glaʃʃa, ingetsa, age, lago, leŋge
54	ɲ	maɲo, maɲno, məɲza, maɲi:, koɾeseḡ, kuɾiseɾ, koɾosi, viɲi:, aɲo, aɲ



## Appendix 2 - Segments used in the word list

55	l	longum, lō, longo, lungo, lōgu, lō, lunk, lung, largum, laŋz, larʝo, largo, laŋgu, largu, lark, larg, la:tum, le, lato, latu, lat, amplum, āpl, amplə, awikellum, ut ʃello, uʃjel, wola:re, vole, bolar, vola:re, bula, vōle, zvola:re, zvola, lu:dere, lu dir, gela:re, zəle, elar, dʒelare, zilar, zəla, dʒale, glakia:re, glase, gləsa, glaʃa, i nglakia:re, so:lem, sol, sole, səl, səlɔ, solculus, söləj, soreli, lu:na, lyn, luna, lu e, lön, lune, lunə, ste:lla, etwal, stella, istrelə, iʃtrelə, əstəl, stō:l, stele, pluwia, plʝi, pluʒə, plu:ʁ, ploje, pləʒə, lakum, lak, lago, lago, lagu, layu, la:t, sa:lem, s el, sal, sale, sa:l, kajlum, sjel, ʃjelo, ʃelo, səl, ʃi:l, ling <sup>w</sup> a, lāg, lengwa, lingwa, l iŋwə, lēu, ləŋɛ, limbə
56	ñ	lō, kōspye, nō
57	ʎ	ʎoŋ, ʎark, useʎ, ʎunə, ʎak
58	ʝ	larʝo, musəʝa, naviʝaʁ, nəviʝaʁ, zuʝaʁ, aʝwa, aʝwə, layu, foyu
59	a:	la:tum, manduka:re, mandʒa:re, morsika:re, sputa:re, ko:gita:re, koʒita:re, pe: nsa:re, pensa:re, peŋsa:, trema:re, trima:, nata:re, nwota:re, naviga:re, wola:re, vola:re, zvola:re, kanta:re, canta:, joka:re, dʒoka:re, gela:re, glakia:re, inglakia: re, la:t, ma:r, sa:lem, sa:l
60	p	amplum, āpl, ampjo, amplə, piskem, peθ, peʃfe, pejfi, pejʃi, peʃ, pəs, peʃte, pw asō, pəhō, passerem, paxaro, passero, pasəru, pasəre, konspuere, kōspye, kusp iʁ, kufpiʁ, eskupiʁ, əskupi, skujpa, sputere, esputar, sputa:re, sapere, sape:re, pe:nsa:re, pāse, pensar, pensa:re, pēsəʁ, pēsar, pənsa, pēsə, peŋsa:, pəsa, apə, p luwia, plʝi, pjodʒa, pluʒə, plu:ʁ, ploje, pləʒə
61	ā	āpl, māʒe, pāse, ʃāte, vā, ā, lāg
62	ej	pejfi
63	h	pəhō, u:hɛ:, kinɔh
64	b	abe, bibere, bwaʁ, beber, bere, bebeʁ, biʃer, bəwɾə, bə:ʁ, bevi, bəa, saber, sabəʁ, səber, bibir, biwɾə, nabegar, nəbəga, bolar, bula, zbura, benir, bəni, tōbe, tum bar, tōbaʁ, tōbaʁ, tumba, jubja, bjento, ben, berde, nombre, limbə
65	v	avi, avi, bevi, savwaʁ, savø:ʁ, save:, vivəʁ, vi:vere, viveʁ, viver, vivi, via, navi ga:re, navigare, naviʝaʁ, nəviʝaʁ, naviga, naviga, vole, vola:re, voaʁ, vwar, v ōle, zvola:re, zvola, vənix, veni:re, viʁ, vir, vini, vipit, veni, juvə, vā, vento, vē tu, vē, vint, vint, vək, verde, verdi, vɛrt, vək, vɛrt, verde
66	z	wazo, zvola:re, zvola, zbura
67	x	paxaro, xugar
68	β	biʃer, səβɛ
69	ɣa	bəa, kəɖəa, stɣa
70	ʃ	maŋʃa
71	ð	moɾðer, muɾðer, nəðar
72	y	syse, sysi, kōspye, lyn
73	r	savø:ʁ, mɔʁi, ʃɛ:ʁ
74	qa	kunqafte, sqare, pləʒə
75	q	kʝide, plʝi
76	c	canta:, solculus
77	ts	ingetsa, tsarə
78	ʈ	səl

## Appendix 2 - Segments used in the word list

79	ɛj	sɔləj
80	f	fokum, fø, fwego, fwɔko, fogu, foyu, fɔk, fø:, fu:k, fok
81	g <sup>w</sup>	ling <sup>w</sup> a
82	ẽɥ	lẽɥ

## Appendix 3 - Word Lists by Language

### Latin

Ancestral Class	IPA	Sounds
I	-ego:	ay-g-O
Who-Qui	k <sup>w</sup> -is	kw-e-s
Who-Quem	k <sup>w</sup> -em-	kw-ay-m
What	'k <sup>w</sup> -id	kw-e-d
When-Quando	k <sup>w</sup> -ando:	kw-ah-n-d-O
How-Quomodo	'k <sup>w</sup> o:modo	kw-O-m-oh-d-oh
One	'u:num	U-n-u-m
Two-Duos	duo:s	d-u-O-s
Two-Duae	du-aj	d-u-aj_diphthong
Two-Duas	duas	d-u-ah-s
Three	tr-e:s	t-r-ai-s
Five	'k <sup>w</sup> i:nk <sup>w</sup> -e	kw-E-n-kw-ay
Big	magnum	m-ah-j-n-u-m
Big-Grandem	grandem	j-r-ah-n-d-ay-m
Big-Majjorem	majjorem	m-aj_diphthong-jg-oh-r-ay-m
Long-Longum	'lo-ngum	l-oh-n-g-u-m
Long-Largum	largum	l-ah-r-j-u-m
Wide	'la:tum	l-A-t-u-m
Wide-Amplum	amplum	ah-m-p-l-u-m
Fish-Piskem	piskem	p-e-s-k-ay-m
Bird-Avem	awem	ah-w-ay-m
Bird-Avicellum	-awi-k-ellum	ah-w-e-k-ay-l-l-u-m
Bird-Passerem	passerem	p-ah-s-s-ay-r-ay-m
ToDrink	'bib-ere	b-e-b-ay-r-ay
ToEat	komedere	k-oh-m-ay-d-ay-r-ay
ToEat-Manducare	manduka:re	m-ah-n-d-u-k-A-r-ay
ToBite	morde:re	m-oh-r-d-ai-r-ay
ToBite-Morsicare	morsika:re	m-oh-r-s-e-k-A-r-ay
ToSuck	su:gere	s-U-g-ay-r-ay
ToSpit	konspuere	k-oh-n-s-p-u-ay-r-ay
ToSpit-Sputare	-sputere	s-p-u-t-ay-r-ay
ToKnow	ski:re	s-k-E-r-ay
ToKnow-Sapere	sap-ere	s-ah-p-ay-r-ay
ToKnow-Cognoscere	kogno:skere	k-oh-g-n-O-s-k-ay-r-ay
ToThink	k-o:gita:re	k-O-g-e-t-A-r-ay
ToThink-Pensare	pe:nsa:re	p-ai-n-s-A-r-ay
ToFear	time:re	t-e-m-ai-r-ay
ToFear-Tremere	trem-ere	t-r-ay-m-ay-r-ay

## Appendix 3 - Word Lists by Language

ToSleep	d-ormi:re	d-oh-r-m-E-r-ay
ToLive	wi:were	w-E-w-ay-r-ay
ToDie	mori:--	m-oh-r-E
ToSwim	n-ata:re	n-ah-t-A-r-ay
ToSwim-Navigare	naviga:re	n-ah-v-e-j-A-r-ay
ToFly	wola:re	w-oh-l-A-r-ay
ToCome	weni:re	w-ay-n-E-r-ay
ToFall	k-adere	k-ah-d-ay-r-ay
ToSing-AncestralClass	kanta:re	k-ah-n-t-A-r-ay
ToPlay-Ludere	lu:dere	l-U-d-ay-r-ay
ToPlay-Jiocare	jo-ka:re	jg-oh-k-A-r-ay
ToFreeze	gela:re	g-ay-l-A-r-ay
ToFreeze-Glaciare	gla-kia:re	g-l-ah-k-e-A-r-ay
ToFreeze-Inglaciare	inglakia:re	e-n-g-l-ah-k-e-A-r-ay
Sun	so:lem	s-O-l-ay-m
Sun-Soliculus	soliculus	s-oh-l-e-tya-u-l-u-s
Moon	lu:na	l-U-n-ah
Star	-st-e:lla	s-t-ai-l-l-ah
Water	a-k <sup>w</sup> -a	ah-kw-ah
Rain	plu-wia	p-l-u-w-e-ah
Lake	lakum	l-ah-k-u-m
Sea	mare	m-ah-r-ay
Salt	'sa:lem	s-A-l-ay-m
Earth	t-erra	t-ay-r-r-ah
Sky	'k-ajlum	k-aj_diphthong-l-u-m
Wind	w-entum	w-ay-n-t-u-m
Fire-Focus	f-okum	f-oh-k-u-m
Green	'wiridem	w-e-r-e-d-ay-m
Year	annum	ah-n-n-u-m
Name-Nomen	no:men	n-O-m-ay-n
Name-Nominem	no:min-em	n-O-m-e-n-ay-m
Tongue	ling <sup>w</sup> -a	l-e-n-gw-ah

## French

Ancestral Class	IPA	Sounds
I	-ʒ-ə	gzah-aah
Who-Qui	k-i-	k-e
What	kwa-	k-w-ah
When-Quando	k-ã---	k-an
How-Quomodo	kɔm---	k-euh-m

### Appendix 3 - Word Lists by Language

One	œ---	uuh
Two-Duos	d-ø-	d-uu
Three	tɤwa-	t-rr-w-a
Five	sẽ-k--	s-ehn-k
Big-Grandem	gɤã---	g-rr-an
Long-Longum	lõ-----	l-oon
Long-Largum	laɤʒ--	l-ah-rr-gzah
Wide	le---	l-ay
Wide-Amplum	ã-pl--	NasalA-p-l
Fish-Pescion	pwasõ	p-w-ah-s-on
Bird-Avicellum	wa---z-o----	w-ah-zz-oh
ToDrink	b--waɤ-	b-w-a-rr
ToEat-Manducare	mã-ʒ--e--	m-NasalA-gzah-ay
ToBite	moɤd-ɤ-	m-oh-rr-d-rr
ToSuck	syse--	s-eeh-s-ay
ToSpit	kõ-spye--	k-oon-s-p-eeh-ay
ToSpit-Cracher	kɤaʃe	k-rr-ah-shh-ay
ToKnow-Sapere	savwaɤ-	s-ah-v-w-ah-rr
ToKnow-Cognoscere	kɔ-nɛ-tɤ-	k-euh-n-eh-t-rr
ToThink	kɥ--ide--	k-eu-e-d-ay
ToThink-Pensare	pã-se--	p-NasalA-s-ay
ToFear-Tremere	kɤẽ-d-ɤ-	k-rr-ehn-d-rr
ToSleep	d-ɔɤmiɤ-	d-euh-rr-m-e-rr
ToLive	viv-ɤ-	v-e-v-rr
ToDie	muɤiɤ-	m-u-rr-e-rr
ToSwim-Navigare	na--ʒe--	n-ah-gzah-ay
ToFly	vole--	v-oh-l-ay
ToCome	vəniɤ-	v-aah-n-e-rr
ToFall	ʃwa--ɤ-	shh-w-ah-rr
ToFall-Tumbare	tõ-be-	t-on-b-ay
ToSing-AncestralClass	ʃã-te--	shh-NasalA-t-ay
ToPlay-Jiocare	ʒ-w-e--	gzah-w-ay
ToFreeze	ʒəle--	gzah-aah-l-ay
ToFreeze-Glaciare	gla-s-e--	g-l-ah-s-ay
Sun-Soliculus	sɔləj----	s-euh-l-eh_diphthong
Moon	lyn-	l-eeh-n
Star	e-twa-l-	ay-t-w-ah-l
Water	o----	oh
Rain	plɥ--i-	p-l-eu-e
Lake	lak--	l-ah-k
Sea	mɛɤ-	m-eh-rr

### Appendix 3 - Word Lists by Language

Salt	sɛl--	s-eh-l
Earth	t-e-ʁ-	t-ay-rr
Sky	sjɛl--	s-jg-eh-l
Wind	v-ã----	v-NasalA
Fire-Focus	f-ø---	f-uu
Green	veʁ----	v-ay-rr
Year	ã----	NasalA
Name-Nomen	nõ---	n-oon
Tongue	lã-g--	l-NasalA-g

### Spanish

Ancestral Class	IPA	Sounds
I	-j-o	VdPalatalFricative-oh
Who-Quem	kjen-	k-jg-ay-n
What	k-e-	k-ay
When-Quando	kwando	k-w-ah-n-d-oh
How-Quomodo	komo--	k-oh-m-oh
One	'uno-	u-n-oh
Two-Duos	d-os	d-oh-s
Three	tr-es	t-er-ay-s
Five	'θink-o	th-e-n-k-oh
Big	ma-ɲo-	m-ah-VdPalatalNasal-oh
Big-Grandem	grande-	g-er-ah-n-d-ay
Long-Longum	lo-ngo-	l-oh-n-j-oh
Long-Largum	larɣo-	l-ah-er-juh-oh
Wide	lato-	l-ah-t-oh
Wide-Amplum	antʃ-o-	ah-n-ts-oh
Fish-Piskem	peθ---	p-ay-th
Bird-Avem	abe-	ah-b-ay
Bird-Passerem	pa-xaro-	p-ah-xha-ah-er-oh
ToDrink	beb-er-	b-ay-b-ay-er
ToEat	kome--r-	k-oh-m-ay-er
ToEat-Manducare	mandukar-	m-ah-n-d-u-k-ah-er
ToBite	mord̃er-	m-oh-er-dd-ay-er
ToBite-Morsicare	mo-s-kar-	m-oh-s-k-ah-er
ToSpit-Exconspuere	esku-pir	ay-s-k-u-p-e-er
ToSpit-Sputare	esputar-	ay-s-p-u-t-ah-er
ToKnow-Sapere	sab-er-	s-ah-b-ay-er
ToKnow-Cognoscere	ko-noθer-	k-oh-n-oh-th-ay-er
ToThink	kw--idar-	k-w-e-d-ah-er

### Appendix 3 - Word Lists by Language

ToThink-Pensare	pensar-	p-ay-n-s-ah-er
ToFear	temer-	t-ay-m-ay-er
ToFear-Tremere	trem-er-	t-er-ay-m-ay-er
ToSleep	d-ormir-	d-oh-er-m-e-er
ToLive	bibir-	b-e-b-e-er
ToDie	morir-	m-oh-er-e-er
ToSwim	n-adar-	n-ah-d-ah-er
ToSwim-Navigare	nabegar-	n-ah-b-ay-g-ah-er
ToFly	bolar-	b-oh-l-ah-er
ToCome	benir-	b-ay-n-e-er
ToFall	k-a-er-	k-ah-ay-er
ToFall-Tumbare	tumbar	t-u-m-b-ah-er
ToSing-AncestralClass	kantar-	k-ah-n-t-ah-er
ToPlay-Ludere	ludir-	l-u-d-e-er
ToPlay-Jiocare	xu-gar-	xha-u-j-ah-er
ToFreeze	-elar--	ay-l-ah-er
Sun	sol--	s-oh-l
Moon	luna	l-u-n-ah
Star	estre-ja	ay-s-t-er-ay-VdPalatalFricative-ah
Water	'a-ywa	ah-juh-w-ah
Rain	j-u-bja	VdPalatalFricative-u-b-jg-ah
Lake	lago-	l-ah-j-oh
Sea	mar-	m-ah-er
Salt	sal--	s-ah-l
Earth	'tje-ra	t-jg-ay-r-ah
Sky	'θjelo	th-jg-ay-l-oh
Wind	'bjento-	b-jg-ay-n-t-oh
Fire-Focus	fwego-	f-w-ay-g-oh
Green	ber-de-	b-ay-er-d-ay
Year	a-po-	ah-VdPalatalNasal-oh
Name-Nominem	nom-bre-	n-oh-m-b-er-ay
Tongue	'lengwa	l-ay-nya-g-w-ah

### Italian

Ancestral Class	IPA	Sounds
I	-i-o	e-oh
Who-Qui	k-i-	k-e
What	k-e-	k-ay
When-Quando	kwando	k-w-ah-n-d-oh
How-Quomodo	kome--	k-oh-m-ay

### Appendix 3 - Word Lists by Language

One	'uno-	u-n-oh
Two-Duae	du-e	d-u-ay
Three	'tr-e-	t-r-ay
Five	'tʃɪŋkwe	ts-e-nya-k-w-ay
Big	mappo-	m-ah-VdPalatalNasal-VdPalatalNasal-oh
Big-Grandem	grande-	g-r-ah-n-d-ay
Long-Longum	lu-ngo-	l-u-n-g-oh
Long-Largum	largo-	l-ah-r-g-oh
Wide	lato-	l-ah-t-oh
Wide-Amplum	ampjo-	ah-m-p-jg-oh
Fish-Piskem	peffe-	p-ay-shh-shh-ay
Bird-Avicellum	--u-ttʃ-ello-	u-t-ts-eh-l-l-oh
Bird-Passerem	passero-	p-ah-s-s-ay-r-oh
ToDrink	be---re	b-ay-er-ay
ToEat-Manducare	mandʒ--a:re	m-ah-n-VdPalatoAlveolarSibilant-A-er-ay
ToBite	mordere	m-euh-r-d-ay-r-ay
ToBite-Morsicare	morsikare	m-oh-r-s-e-k-ah-er-ay
ToSpit-Sputare	-sputa:re	s-p-u-t-A-er-ay
ToKnow-Sapere	sap-e:re	s-ah-p-ai-r-ay
ToKnow-Cognoscere	ko-noffere	k-oh-n-oh-shh-shh-ay-r-ay
ToThink	k-odgita:re	k-oh-VdPalatoAlveolarSibilant-e-t-A-r-ay
ToThink-Pensare	pensa:re	p-ay-n-s-A-er-ay
ToFear	teme:re	t-ay-m-ai-r-ay
ToFear-Tremere	trem-a:re	t-r-ay-m-A-r-ay
ToSleep	d-ormi:re	d-oh-r-m-E-r-ay
ToLive	vi:vere	v-E-v-ay-r-ay
ToDie	mori:re	m-oh-r-E-r-ay
ToSwim	nwota:re	n-w-oh-t-A-er-ay
ToSwim-Navigare	navigare	n-ah-v-e-g-ah-r-ay
ToFly	vola:re	v-oh-l-A-er-ay
ToFly-Exvolare	zvola:re	zz-v-oh-l-A-er-ay
ToCome	veni:re	v-ay-n-E-er-ay
ToFall	k-ade:re	k-ah-d-ai-er-ay
ToSing-AncestralClass	kanta:re	k-ah-n-t-A-r-ay
ToPlay-Jiocare	dʒo-ka:re	VdPalatoAlveolarSibilant-oh-k-A-r-ay
ToFreeze	dʒelare	VdPalatoAlveolarSibilant-ay-l-ah-r-ay
ToFreeze-Glaciare	gjattʃjare	g-jg-ah-t-ts-jg-ah-r-ay
Sun	sole-	s-oh-l-ay
Moon	luna	l-u-n-ah
Star	-st-ella	s-t-ay-l-l-ah
Water	akkwa	ah-k-k-w-ah



### Appendix 3 - Word Lists by Language

Rain	pjoddʒ-a	p-jg-oh-d-VdPalatoAlveolarSibilant-ah
Lake	lago-	l-ah-g-oh
Sea	mare	m-ah-r-ay
Salt	sale-	s-ah-l-ay
Earth	't-erra	t-eh-r-r-ah
Sky	'tʃ-elo-	ts-eh-l-oh
Wind	'v-ento-	v-eh-n-t-oh
Fire-Focus	fwɔko-	f-w-euh-k-oh
Green	ver-de-	v-ay-r-d-ay
Year	anno-	ah-n-n-oh
Name-Nomen	no:me-	n-O-m-ay
Tongue	'lingwa	l-e-n-g-w-ah

### Brazilian Portuguese

Ancestral Class	IPA	Sounds
I	-e-w	ay-w
Who-Quem	k-ẽj--	k-nasal_diphthong_portuguese1
What	k-i-	k-e
When-Quando	kwẽ-du	k-w-ahn-d-u
How-Quomodo	komu--	k-oh-m-u
One	ũ---	ooo
Two-Duos	d-ojs	d-oj_diphthong-s
Two-Duas	duəs	d-u-ahh-s
Three	tr-es	t-er-ay-s
Five	'sĩ-k-u	s-een-k-u
Big-Grandem	grẽ-ɖʒi-	g-er-ahn-VdPalatoAlveolarSibilant-e
Long-Longum	lõ-gu-	l-on-g-u
Long-Largum	laɾgu-	l-ah-rr-g-u
Wide	latu-	l-ah-t-u
Wide-Amplum	ẽ-f-u-	ahn-shh-u
Fish-Piskem	pejf-i-	p-ej_diphthong-shh-e
Bird-Avem	avi-	ah-v-e
Bird-Passerem	pa-sɛru-	p-ah-s-ahh-er-u
ToDrink	beb-eɣ-	b-ay-b-ay-rr
ToEat	kome---	k-oh-m-ay
ToEat-Manducare	mẽ-ʒ--aɣ-	m-ahn-gzah-ah-rr
ToBite	moɐdeɣ-	m-oh-rr-d-ay-rr
ToBite-Morsicare	mu-səga--	m-u-s-aah-g-ah
ToSuck	sugaɣ-	s-u-g-ah-rr
ToSpit	ku-spiɣ-	k-u-s-p-e-rr

### Appendix 3 - Word Lists by Language

ToKnow-Sapere	sab-еѡ-	s-ah-b-ay-rr
ToKnow-Cognoscere	ko-пes-еѡ-	k-oh-VdPalatalNasal-ay-s-ay-rr
ToThink	k-uзitaѡ-	k-u-gzah-e-t-ah-rr
ToThink-Pensare	pѣ-saѡ-	p-ehn-s-ah-rr
ToFear	temeѡ-	t-ay-m-ay-rr
ToFear-Tremere	trem-еѡ-	t-er-ay-m-ay-rr
ToSleep	d-oѡmiѡ-	d-oh-rr-m-e-rr
ToLive	viveѡ-	v-e-v-ay-rr
ToDie	moѡeѡ-	m-oh-rr-ay-rr
ToSwim	n-adaѡ-	n-ah-d-ah-rr
ToSwim-Navigare	naviѡaѡ-	n-ah-v-eee-juh-ah-rr
ToFly	vo-aѡ-	v-oh-ah-rr
ToCome	v--iѡ-	v-e-rr
ToFall	k-e-ir-	k-ahh-e-er
ToFall-Tumbare	tѡ-baѡ	t-on-b-ah-rr
ToSing-AncestralClass	kѣ-tar-	k-ahn-t-ah-er
ToPlay-Jiocare	зo-гаѡ-	gzah-oh-g-ah-rr
ToFreeze	зilar-	gzah-eee-l-ah-er
Sun	sѡw--	s-euh-w
Moon	lu-e	l-u-ahh
Star	istre-lѣ	e-s-t-er-ay-l-ahh
Water	'a-gwѣ	ah-g-w-ahh
Rain	f-u-v-e	shh-u-v-ahh
Lake	lagu-	l-ah-g-u
Sea	maѡ-	m-ah-rr
Salt	saw--	s-ah-w
Earth	't-e-ѡѣ	t-ay-rr-ahh
Sky	s-ѣw--	s-eh-w
Wind	'v-ѣ-tu-	v-ehn-t-u
Fire-Focus	f-ogu-	f-oh-g-u
Green	ver-di-	v-ay-er-d-eee
Year	e-nu-	ahh-n-u
Name-Nomen	nomi-	n-oh-m-e
Tongue	'lѣ-gwѣ	l-een-g-w-ahh

### Portuguese

Ancestral Class	IPA	Sounds
I	-e-w	ay-w
Who-Quem	k-ѣѣ--	k-nasal_diphthong_portuguese2
What	k-i-	k-eee

### Appendix 3 - Word Lists by Language

When-Quando	kwě-du	k-w-ahn-d-u
How-Quomodo	komu--	k-oh-m-u
One	ũ---	ooo
Two-Duos	d-oj̃f	d-oj_diphthong-shh
Two-Duas	duẽf	d-u-ahh-shh
Three	tr-ẽf	t-er-ay-shh
Five	'sĩ-k-u	s-een-k-u
Big-Grandem	grě-di-	g-er-ahn-d-eee
Long-Longum	lõ-gu-	l-on-g-u
Long-Largum	largu-	l-ah-er-g-u
Wide	latu-	l-ah-t-u
Wide-Amplum	ẽ-f-u-	ahn-shh-u
Fish-Piskem	p̃ej̃f-i-	p-diphthong_portuguese-shh-eee
Bird-Avem	avi-	ah-v-eee
Bird-Passerem	pa-s̃eru-	p-ah-s-ahh-er-u
ToDrink	b̃ĩβ-er-	b-eee-bb-ay-er
ToEat	kum--er-	k-u-m-ay-er
ToEat-Manducare	mẽ-z--ar-	m-ahn-gzah-ah-er
ToBite	mur̃ðer-	m-u-er-dd-ay-er
ToBite-Morsicare	mu-s̃egar-	m-u-s-aah-g-ah-r
ToSuck	sugar-	s-u-g-ah-er
ToSpit	ku-ʃpir-	k-u-shh-p-e-er
ToKnow-Sapere	s̃eb-er-	s-ahh-b-ay-er
ToKnow-Cognoscere	ku-ɲis-er-	k-u-VdPalatalNasal-eee-s-ay-er
ToThink	k-uʒitar-	k-u-gzah-e-t-ah-er
ToThink-Pensare	pẽ-sar-	p-ehn-s-ah-er
ToFear	timer-	t-eee-m-ay-er
ToFear-Tremere	tr̃im-er-	t-er-eee-m-ay-er
ToSleep	d-urmir-	d-u-er-m-e-er
ToLive	viver-	v-e-v-ay-er
ToDie	mũer-	m-u-rr-ay-er
ToSwim	n-ẽðar-	n-ahh-dd-ah-er
ToSwim-Navigare	nevĩyar-	n-ahh-v-eee-juh-ah-er
ToFly	vw-ar-	v-w-ah-er
ToCome	v--ir-	v-e-er
ToFall	k-e-ir-	k-ahh-e-er
ToFall-Tumbare	tõ-bar	t-on-b-ah-er
ToSing-AncestralClass	kẽ-tar-	k-ahn-t-ah-er
ToPlay-Jiocare	ʒu-ɣar-	gzah-u-juh-ah-er
ToFreeze	ʒilar-	gzah-eee-l-ah-er
Sun	sɔ̃ł--	s-euh-ssha

### Appendix 3 - Word Lists by Language

Moon	lu-ɐ	l-u-ahh
Star	ɨftre-le	eee-shh-t-er-ay-l-ahh
Water	'a-gwɐ	ah-g-w-ahh
Rain	ʃ-u-v-ɐ	shh-u-v-ahh
Lake	layu-	l-ah-juh-u
Sea	mar-	m-ah-er
Salt	sal--	s-ah-l
Earth	't-ɛ-ɾɐ	t-eh-rr-ahh
Sky	s-ɛw--	s-eh-w
Wind	'v-ẽ-tu-	v-ehn-t-u
Fire-Focus	f-oɣu-	f-oh-juh-u
Green	ver-di-	v-ay-er-d-eee
Year	ɐ-nu-	ahh-n-u
Name-Nomen	nomi-	n-oh-m-eee
Tongue	'lĩ-gwɐ	l-een-g-w-ahh

### Catalan

Ancestral Class	IPA	Sounds
I	-ʒ-ɔ	gzah-euh
Who-Qui	k-i-	k-e
What	k-ɛ-	k-eh
When-Quando	kwan	k-w-ah-n
How-Quomodo	kɔm---	k-euh-m
One	'un--	u-n
Two-Duos	d-os	d-oh-s
Three	'tr-ɛs	t-r-eh-s
Five	'siŋk--	s-e-nya-k
Big-Grandem	gran---	j-r-ah-n
Long-Longum	ʎo-ŋ---	yuh-oh-nya
Long-Largum	ʎark--	yuh-ah-er-k
Wide-Amplum	amplə-	ah-m-p-l-aah
Fish-Piskem	peʃ---	p-ay-shh
Bird-Avem	aw--	ah-w
Bird-Avicellum	--u--s-e-ʎ--	u-s-ay-yuh
ToDrink	bɛw--rə	b-eh-w-er-aah
ToEat-Manducare	məɲʒ--a--	m-aah-VdPalatalNasal-gzah-ah
ToBite-Morsicare	mu-səɣa--	m-u-s-aah-juh-ah
ToSpit-Exconspuere	əsku-pi--	aah-s-k-u-p-e
ToKnow-Sapere	səβ-ɛ--	s-aah-bb-eh
ToKnow-Cognoscere	ku-neʃ-ə--	k-u-n-eh-shh-aah

### Appendix 3 - Word Lists by Language

ToThink	k-u-jda--	k-u-jg-d-ah
ToThink-Pensare	pənsa--	p-aah-n-s-ah
ToFear	temə--	t-ay-m-aah
ToSleep	d-urmi--	d-u-r-m-e
ToLive	biw-rə	b-e-w-er-aah
ToDie	muri--	m-u-er-e
ToSwim	n-əda--	n-aah-d-ah
ToSwim-Navigare	nəbəga--	n-aah-b-aah-g-ah
ToFly	bula--	b-u-l-ah
ToCome	bəni--	b-aah-n-e
ToFall	k-aw-rə	k-ah-w-r-aah
ToFall-Tumbare	tumba-	t-u-m-b-ah
ToSing-AncestralClass	kənta--	k-aah-n-t-ah
ToPlay-Jiocare	zu-ga--	gzah-u-g-ah
ToFreeze	zəla--	gzah-aah-l-ah
ToFreeze-Glaciare	glə-s-a--	g-l-aah-s-ah
Sun	səl--	s-euh-l
Moon	ʎunə	yuh-u-n-aah
Star	əst-ɛ-l-	aah-s-t-eh-l
Water	'aj-ɣwə	aj_diphthong-juh-w-aah
Rain	plu-ʒ-ə	p-l-u-gzah-aah
Lake	ʎak--	yuh-ah-k
Sea	mar-	m-ah-r
Salt	sal--	s-ah-l
Earth	't-ɛ-rə	t-eh-r-aah
Sky	s-ɛl--	s-eh-l
Wind	b-en---	b-ay-n
Fire-Focus	f-ɔk--	f-euh-k
Green	vɛr-t--	v-eh-er-t
Year	a-ɲ--	ah-VdPalatalNasal
Name-Nomen	nɔm--	n-euh-m

### Walloon

Ancestral Class	IPA	Sounds
I	-ɖʒ-ɪ	VdPalatoAlveolarSibilant -NearCloseFrontUnrounded
Who-Qui	k-i:-	k-E
What	kwɛ:-	k-w-Eh
When-Quando	kwand	k-w-ah-n-d
How-Quomodo	kɔmɛ--	k-euh-m-ehnn

### Appendix 3 - Word Lists by Language

One	ō---	on
Two-Duos	d-ø:-	d-o
Three	tr-ø:-	t-r-o
Five	sē-k--	s-ehn-k
Big-Grandem	gʁã---	j-rr-an
Long-Longum	lō-----	l-on
Fish-Pescion	p-ehō	p-eh-h-on
Bird-Avicellum	--u:--h-ε:----	U-h-Eh
ToDrink	b---ø:ʁ-	b-o-rr
ToEat-Manducare	maɲ---i:--	m-ah-VdPalatalNasal-E
ToSuck	sysi:--	s-eeh-s-E
ToKnow-Sapere	sav-ø:R-	s-ah-v-o-VIUvularTrill
ToKnow-Cognoscere	ki-nɔh----	k-e-n-euh-h
ToThink-Pensare	pē-se--	p-ehnn-s-ay
ToSleep	dwaʁmi--	d-w-ah-rr-m-e
ToDie	mɔri--	m-euh-VIUvularTrill-e
ToSwim-Navigare	nε--dʒi:--	n-eh-VdPalatoAlveolarSibilant-E
ToFly	vɔle--	v-euh-l-ay
ToCome	vini--	v-e-n-e
ToFall	tʃ-ε:--R-	ts-Eh-VIUvularTrill
ToFall-Tumbare	tum-e-	t-u-m-ay
ToSing-AncestralClass	tʃã-te--	ts-an-t-ay
ToPlay-Jiocare	dʒuw-e--	VdPalatoAlveolarSibilant-u-w-ay
ToFreeze	dʒale--	VdPalatoAlveolarSibilant-ah-l-ay
Sun	sɔb-	s-euh-l-euh
Moon	løn-	l-uu-n
Star	-st-ø:-l-	s-t-o-l
Water	ε:--w-	Eh-w
Rain	plu:ʁ--	p-l-U-rr
Lake	lak--	l-ah-k
Sea	meʁ-	m-ay-rr
Salt	se---	s-ay
Earth	t-ε:ʁ-	t-Eh-rr
Sky	s-i:ʁ--	s-E-rr
Wind	v-ē----	v-ehn
Fire-Focus	f-ø:---	f-o
Green	vεʁ----	v-eh-rr
Year	ã----	an
Name-Nomen	nō---	n-on
Tongue	lœ̃u-----	l-eu_nasalized_diphthong

## Appendix 3 - Word Lists by Language

### Friulian

Ancestral Class	IPA	Sounds
I	-j-o	jg-oh
Who-Qui	kwi-	k-w-e
What	tf-e-	ts-ay
When-Quando	kwant	k-w-ah-n-t
How-Quomodo	tfemurt-	VlAlveoloPalatalSibilantAffricate-ay-m-U -t
One	uŋ--	u-nya
Two-Duos	d-oj-	d-oj_diphthong
Three	'tr-e:-	t-r-ai
Five	'tfɪŋk--	ts-e-nya-k
Big-Grandem	grant--	j-r-ah-n-t
Long-Longum	lunk--	l-u-n-k
Long-Largum	lark--	l-ah-r-k
Fish-Piskem	pɛs---	p-eh-s
Bird-Avicellum	--u--tfjɛ-l--	u-ts-jg-eh-l
ToDrink	bevi--	b-ay-v-e
ToEat-Manducare	manj--a--	m-ah-nya-VdPalatalStop-ah
ToKnow-Sapere	sav-e:--	s-ah-v-ai
ToKnow-Cognoscere	ko-ɲos-i--	k-oh-VdPalatalNasal-oh-s-e
ToThink-Pensare	penʂa:--	p-ay-nya-s-A
ToFear	temi--	t-ay-m-e
ToFear-Tremere	trim-a:--	t-r-e-m-A
ToSleep	d-urmi:--	d-u-r-m-E
ToLive	vivi--	v-e-v-e
ToDie	muri:--	m-u-r-E
ToSwim	n-ada--	n-ah-d-ah
ToSwim-Navigare	naviga--	n-ah-v-e-j-ah
ToFly-Exvolare	zvola--	zz-v-oh-l-ah
ToCome	vipi:-	v-e-VdPalatalNasal-E
ToFall	tfjade--	ts-jg-ah-d-ay
ToSing-AncestralClass	canta:--	tya-ah-n-t-A
ToPlay-Jiocare	dʒuj-a--	VdPalatoAlveolarSibilant-u-jg-ah
ToFreeze-Glaciare	gla-tf-a--	j-l-ah-ts-ah
Sun-Soliculus	sore--li-	s-oh-r-ay-l-e
Moon	lune	l-u-n-ay
Star	-st-ɛ-le	s-t-eh-l-ay
Water	a-g-e	ah-j-ay
Rain	plo--je	p-l-oh-jg-ay

## Appendix 3 - Word Lists by Language

Lake	la:t--	l-A-t
Sea	ma:r-	m-A-r
Salt	sa:l--	s-A-l
Earth	tjɛ-re	t-jg-eh-r-ay
Sky	tʃ-i:l--	ts-E-l
Wind	'v-int--	v-e-n-t
Fire-Focus	f-u:k--	f-U-k
Green	vɛr-t--	v-eh-r-t
Year	a-ŋ--	ah-nya
Name-Nomen	nɔŋ--	n-euh-nya
Tongue	'lɛng-ɛ	l-eh-n-j-eh

### Romanian

Ancestral Class	IPA	Sounds
I	je-w	jg-ay-w
Who-Quem	tʃ-ine	VlAlveoloPalatalSibilantAffricate-e-n-ay
What	tʃ-e-	ts-ay
When-Quando	k-ɪnd	k-eee-n-d
How-Quomodo	kum---	k-u-m
One	unu-	u-n-u
Two-Duos	d-oj-	d-oj_diphthong
Two-Duae	dowə	d-oh-w-aah
Three	tr-ej-	t-r-ej_diphthong
Five	tʃintʃ--	ts-e-n-ts
Big-Majjorem	ma---re-	m-ah-er-ay
Long-Longum	lung--	l-u-n-j
Long-Largum	larg--	l-ah-r-j
Wide	lat--	l-ah-t
Fish-Piskem	pefte-	p-ay-shh-t-ay
Bird-Passerem	pa-səre-	p-ah-s-aah-er-ay
ToDrink	b---ɛa--	b-midfront_diphthong_romanian
ToEat-Manducare	mɪn--ka--	m-eee-n-k-ah
ToBite-Morsicare	murseka--	m-u-r-s-ay-k-ah
ToSuck	sudʒe--	s-u-VdPalatoAlveolarSibilant-ay
ToSpit-Exconspuere	-skujpa	s-k-u-jg-p-ah
ToKnow	ʃti--	shh-t-e
ToKnow-Cognoscere	ku-nɔaʃte--	k-u-n-midback_diphthong_romanian-shh-t-ay
ToThink	k-udʒeta--	k-u-VdPalatoAlveolarSibilant-ay-t-ah
ToThink-Pensare	pə-sa--	p-aah-s-ah



### Appendix 3 - Word Lists by Language

ToFear	teme--	t-ay-m-ay
ToSleep	d-ormi--	d-oh-r-m-e
ToLive	vi-a--	v-e-ah
ToDie	muri--	m-u-r-e
ToSwim-Navigare	naviga--	n-ah-v-e-g-ah
ToFly-Exvolare	zbura--	zz-b-u-er-ah
ToCome	veni--	v-ay-n-e
ToFall	kədə̃a--	k-aah-d-midfront_diphthong_romanian
ToFall-Tumbare	tumba-	t-u-m-b-ah
ToSing-AncestralClass	kinta--	k-eee-n-t-ah
ToPlay-Jiicare	zu-ka--	gzah-u-k-ah
ToFreeze-Inglaciare	ing-ets-a--	eee-n-j-ay-VlAlveolarSibilantAffricate-ah
Sun	sɔ̃are-	s-midback_diphthong_romanian-er-ay
Moon	lunə	l-u-n-aah
Star	-st-ɛ̃a---	s-t-midfront_diphthong_romanian
Water	a-p-ə	ah-p-aah
Rain	plɔ̃a--je	p-l-midback_diphthong_romanian-jg-ay
Lake	lak--	l-ah-k
Sea	mare	m-ah-r-ay
Salt	sare-	s-ah-r-ay
Earth	ts-a-rə	VlAlveolarSibilantAffricate-ah-r-aah
Sky	tf-er--	ts-ay-er
Wind	v-int--	v-eee-n-t
Fire-Focus	f-ok--	f-oh-k
Green	ver-de-	v-ay-er-d-ay
Year	an---	ah-n
Name-Nomen	nume-	n-u-m-ay
Tongue	'limb-ə	l-e-m-b-aah

## Appendix 4 - Segment Groups

### Pulmonic Consonants

Manner	Bilabial	Labial-Velar	Labio-Dental	Linguo-Labial	Dental	Alveolar	Post-Alveolar	Palatal	Velar	Uvular	Pharyngeal-E	Glottal
Nasal	m					n		ɲ	ŋ			
Stop	p b	k <sup>w</sup> g <sup>w</sup>				t d		c ɟ	k g			
Sibilant, Fricative						s z	ʃ ʒ					
Fricative	β		f v		θ ð			j	x ɣ	ʁ		h
Approximant								j				
Tap/Flap						r						
Trill						r				R		
Lateral, Fricative												
Lateral, Ap						l		ʎ				
Lateral, Tap/Flap												

Shaded areas denote articulations judged to be impossible. Where symbols appear in pairs, the one to the right represents a modally voiced consonant.

### Non-Pulmonic Consonants

Manner	Bilabial	Labio-Dental	Velar	Uvular	Pharyngeal-Epiglottal
Ejective, Stop					
Ejective, Fricative					
Ejective, Lateral, Fricative					
Tenuis, Click					
Nasal, Click					
Tenuis, Lateral, Click					
Implosive					

Shaded areas denote articulations judged to be impossible. Where symbols appear in pairs, the one to the right represents a modally voiced consonant.

## Appendix 4 - Segment Groups

### Vowels

	Front	Near-Front	Central	Near-Back	Back
Close	<b>i</b> • <b>y</b>		<b>ɨ</b>		<b>u</b>
Near-close		<b>ɪ</b>			
Close-mid	<b>e</b> • <b>ø</b>		<b>ə</b>		<b>o</b>
Mid					
Open-mid		<b>ɛ</b>			<b>ɔ</b>
Near-open			<b>ɐ</b>		
Open		<b>a</b>			<b>ɑ</b>

Where symbols appear in pairs, the one to the right represents a rounded vowel.

### Long Vowels

	Front	Near-Front	Central	Near-Back	Back
Close	<b>iː</b>				<b>uː</b>
Mid	<b>eː</b>				<b>oː</b>
Open-mid		<b>ɛː</b>			
Open	<b>øː</b>		<b>aː</b>		

### Pulmonic Affricates

Manner	Bilabial	Labio-Dental	Alveolar	Alveolo-Palat	Palato-Alveol	Velar	Uvular	Pharyngeal-E	Glottal
Sibilant			<b>ts</b>	<b>tʃ</b>	<b>tʃ</b>				
Non-Sibilant									
Lateral									

Shaded areas denote articulations judged to be impossible.

### Ejective Affricates

Manner	Bilabial	Labio-Dental	Pharyngeal-E	Glottal
Central				
Lateral				

Shaded areas denote articulations judged to be impossible.

## Appendix 4 - Segment Groups

### Other Segments

<b>e</b> Close-mid Front Vocoid Vowel Continuant	<b>g</b> Velar Voiced Pulmonic Stop Occlusive
<b>oː</b> Mid Back Rounded Vocoid Long Vowel Continuant	<b>ʒ</b> Post-Alveolar Voiced Pulmonic Sibilant Fricative Strident Obstruent Continuant
<b>ə</b> Close-mid Central Vowel	<b>j</b> Palatal Voiced Pulmonic Fricative Obstruent Continuant
<b>o</b> Close-mid Back Rounded Vocoid Vowel Continuant	<b>i</b> Close Front Vocoid Vowel Continuant
<b>w</b> Labial-Velar Vocoid Semivowel Voiced Approximant Continuant	<b>ɔ</b> Open-mid Back Rounded Vocoid Vowel Continuant
<b>dʒ</b> Palato-Alveolar Voiced Sibilant Affricate	<b>ɪ</b> Near-close Near-Front Vowel
<b>j</b> Palatal Vocoid Semivowel Voiced Pulmonic Approximant Continuant	<b>k</b> Labial-Velar Pulmonic Stop Occlusive
<b>s</b> Alveolar Pulmonic Sibilant Fricative Strident Obstruent Continuant	<b>k</b> Velar Pulmonic Stop Occlusive
<b>iː</b> Close Front Vocoid Long Vowel Continuant	<b>m</b> Bilabial Voiced Pulmonic Nasal Occlusive
<b>n</b> Alveolar Voiced Pulmonic Nasal Occlusive	<b>ẽj̃</b> Mid Front Vowel Diphthong
<b>ẽj̃</b> Mid Front Vowel Diphthong	<b>tʃ</b> Alveolo-Palatal Pulmonic Sibilant Affricate
<b>d</b> Alveolar Voiced Pulmonic Stop Occlusive	<b>a</b> Open Near-Front Vocoid Vowel Continuant
<b>ɪ</b> Close Central Vowel	<b>ɛ</b> Open-mid Near-Front Vocoid Vowel Continuant
<b>ɛː</b> Open-mid Near-Front Vocoid Long Vowel Continuant	<b>tʃ</b> Palato-Alveolar Pulmonic Sibilant Affricate
<b>ã</b> Near-open Central Nasal Vowel	<b>ẽ</b> Near-open Central Rounded Nasal Vowel
<b>u</b> Close Back Rounded Vocoid Vowel Continuant	<b>t</b> Alveolar Pulmonic Stop Occlusive
<b>ẽ</b> Open-mid Near-Front Nasal Vowel	<b>uː</b> Close Back Rounded Long Vowel
<b>œ̃</b> Open-mid Near-Front Rounded Nasal Vowel Diphthong	<b>ũ</b> Open Back Nasal Vowel
<b>õ</b> Close-mid Back Rounded Nasal Vowel	<b>ŋ</b> Velar Voiced Pulmonic Nasal Occlusive
<b>ø</b> Close-mid Front Rounded Vocoid Vowel Continuant	<b>oj̃</b> Mid Front Vowel Diphthong
<b>ʃ</b> Post-Alveolar Pulmonic Sibilant Fricative Strident Obstruent Continuant	<b>øː</b> Open Front Rounded Vocoid Long Vowel

## Appendix 4 - Segment Groups

<b>aj</b> Mid Front Vowel Diphthong	<b>ɐ</b> Near-open Central Rounded Vowel
<b>r</b> Alveolar Voiced Pulmonic Trill Rhotic Vibrant Liquid	<b>eː</b> Mid Front Vowel Long Vowel Continuant
<b>ʁ</b> Uvular Voiced Pulmonic Fricative Rhotic Strident Obstruent Continuant Liquid	<b>ɑ</b> Open Back Vowel Continuant
<b>f</b> Alveolar Voiced Pulmonic Tap/Flap Rhotic Vibrant Liquid	<b>ej</b> Mid Front Vowel Diphthong
<b>ẽ</b> Close Back Nasal Vowel	<b>θ</b> Dental Pulmonic Fricative Obstruent Continuant
<b>ĩ</b> Close Front Nasal Vowel	<b>g</b> Velar Voiced Pulmonic Stop Occlusive
<b>ɲ</b> Palatal Voiced Pulmonic Nasal Occlusive	<b>l</b> Alveolar Vowel Voiced Pulmonic Lateral Approximant Rhotic Liquid
<b>õ</b> Open-mid Back Rounded Nasal Vowel	<b>ʎ</b> Palatal Vowel Voiced Pulmonic Lateral Approximant Rhotic Liquid
<b>ʁ</b> Velar Voiced Pulmonic Fricative Obstruent Continuant	<b>aː</b> Open Central Vowel Long Vowel Continuant
<b>p</b> Bilabial Pulmonic Stop Occlusive	<b>ã</b> Near-close Back Nasal Vowel
<b>ej</b> Mid Front Vowel Diphthong	<b>h</b> Glottal Pulmonic Fricative
<b>b</b> Bilabial Voiced Pulmonic Stop Occlusive	<b>v</b> Labio-Dental Voiced Pulmonic Fricative Strident Obstruent Continuant
<b>z</b> Alveolar Voiced Pulmonic Sibilant Fricative Strident Obstruent Continuant	<b>x</b> Velar Pulmonic Fricative Obstruent Continuant
<b>β</b> Bilabial Voiced Pulmonic Fricative Obstruent Continuant	<b>ɛ̃</b> Mid Front Vowel Diphthong
<b>ʃ</b> Palatal Voiced Pulmonic Stop Occlusive	<b>ð</b> Dental Voiced Pulmonic Fricative Obstruent Continuant
<b>y</b> Close Front Rounded Vowel Continuant	<b>ʀ</b> Uvular Pulmonic Trill Rhotic Vibrant Liquid
<b>õ</b> Mid Front Vowel Diphthong	<b>ɥ</b> Labial-Palatal Vowel Semivowel Voiced Approximant Continuant
<b>c</b> Palatal Pulmonic Stop Occlusive	<b>ts</b> Alveolar Pulmonic Sibilant Affricate Occlusive Strident
<b>ɭ</b> Alveolar Voiced Velarized Pulmonic Lateral Approximant	<b>ɛj</b> Mid Front Vowel Diphthong

## Appendix 4 - Segment Groups

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**f** Labio-Dental Pulmonic Fricative Strident  
Obstruent Continuant

**g** Labial-Velar Voiced Pulmonic Stop  
Occlusive

**ẽ** Mid Front Vowel Diphthong

## Appendix 5 - International Phonetic Alphabet

### IPA Segments

ẽ	θ	β	ʈʂ
1EBD Close Back Nasal Vowel	03B8 Dental Pulmonic Fricative Obstruent Continuant	03B2 Bilabial Voiced Pulmonic Fricative Obstruent Continuant	02A7 Palato-Alveolar Pulmonic Sibilant Affricate
ts	ɖʒ	j	ʒ
02A6 Alveolar Pulmonic Sibilant Affricate Occlusive Strident	02A4 Palato-Alveolar Voiced Sibilant Affricate	029D Palatal Voiced Pulmonic Fricative Obstruent Continuant	0292 Post-Alveolar Voiced Pulmonic Sibilant Fricative Strident Obstruent Continuant
ʎ	ʃ	ʁ	ʀ
028E Palatal Vocoid Voiced Pulmonic Lateral Approximant Rhotic Liquid	0283 Post-Alveolar Pulmonic Sibilant Fricative Strident Obstruent Continuant	0281 Uvular Voiced Pulmonic Fricative Rhotic Strident Obstruent Continuant Liquid	0280 Uvular Pulmonic Trill Rhotic Vibrant Liquid
ɾ	ɳ	ɭ	ɪ
027E Alveolar Voiced Pulmonic Tap/Flap Rhotic Vibrant Liquid	0272 Palatal Voiced Pulmonic Nasal Occlusive	026B Alveolar Voiced Velarized Pulmonic Lateral Approximant	026A Near-close Near-Front Vowel

## Appendix 5 - International Phonetic Alphabet

<p style="text-align: center; font-size: 2em;">i</p> <p style="text-align: center;">0268</p> <p style="text-align: center;">Close Central Vowel</p>	<p style="text-align: center; font-size: 2em;">ɥ</p> <p style="text-align: center;">0265</p> <p style="text-align: center;">Labial-Palatal Vocoid Semivowel Voiced Approximant Continuant</p>	<p style="text-align: center; font-size: 2em;">ʏ</p> <p style="text-align: center;">0263</p> <p style="text-align: center;">Velar Voiced Pulmonic Fricative Obstruent Continuant</p>	<p style="text-align: center; font-size: 2em;">ɡ</p> <p style="text-align: center;">0261</p> <p style="text-align: center;">Velar Voiced Pulmonic Stop Occlusive</p>
<p style="text-align: center; font-size: 2em;">ʃ</p> <p style="text-align: center;">025F</p> <p style="text-align: center;">Palatal Voiced Pulmonic Stop Occlusive</p>	<p style="text-align: center; font-size: 2em;">ɛ</p> <p style="text-align: center;">025B</p> <p style="text-align: center;">Open-mid Near-Front Vocoid Vowel Continuant</p>	<p style="text-align: center; font-size: 2em;">ə</p> <p style="text-align: center;">0259</p> <p style="text-align: center;">Close-mid Central Vowel</p>	<p style="text-align: center; font-size: 2em;">ɔ</p> <p style="text-align: center;">0254</p> <p style="text-align: center;">Open-mid Back Rounded Vocoid Vowel Continuant</p>
<p style="text-align: center; font-size: 2em;">ɑ</p> <p style="text-align: center;">0251</p> <p style="text-align: center;">Open Back Vocoid Vowel Continuant</p>	<p style="text-align: center; font-size: 2em;">æ</p> <p style="text-align: center;">0250</p> <p style="text-align: center;">Near-open Central Rounded Vowel</p>	<p style="text-align: center; font-size: 2em;">ũ</p> <p style="text-align: center;">0169</p> <p style="text-align: center;">Open Back Nasal Vowel</p>	<p style="text-align: center; font-size: 2em;">ŋ</p> <p style="text-align: center;">014B</p> <p style="text-align: center;">Velar Voiced Pulmonic Nasal Occlusive</p>
<p style="text-align: center; font-size: 2em;">ĩ</p> <p style="text-align: center;">0129</p> <p style="text-align: center;">Close Front Nasal Vowel</p>	<p style="text-align: center; font-size: 2em;">ø</p> <p style="text-align: center;">00F8</p> <p style="text-align: center;">Close-mid Front Rounded Vocoid Vowel Continuant</p>	<p style="text-align: center; font-size: 2em;">õ</p> <p style="text-align: center;">00F5</p> <p style="text-align: center;">Close-mid Back Rounded Nasal Vowel</p>	<p style="text-align: center; font-size: 2em;">ð</p> <p style="text-align: center;">00F0</p> <p style="text-align: center;">Dental Voiced Pulmonic Fricative Obstruent Continuant</p>
<p style="text-align: center; font-size: 2em;">ã</p> <p style="text-align: center;">00E3</p> <p style="text-align: center;">Near-open Central Nasal Vowel</p>	<p style="text-align: center; font-size: 2em;">z</p> <p style="text-align: center;">007A</p> <p style="text-align: center;">Alveolar Voiced Pulmonic Sibilant Fricative Strident Obstruent Continuant</p>	<p style="text-align: center; font-size: 2em;">y</p> <p style="text-align: center;">0079</p> <p style="text-align: center;">Close Front Rounded Vocoid Vowel Continuant</p>	<p style="text-align: center; font-size: 2em;">x</p> <p style="text-align: center;">0078</p> <p style="text-align: center;">Velar Pulmonic Fricative Obstruent Continuant</p>



## Appendix 5 - International Phonetic Alphabet

<b>w</b>	<b>v</b>	<b>u</b>	<b>t</b>
0077	0076	0075	0074
Labial-Velar Vocoid Semivowel Voiced Approximant Continuant	Labio-Dental Voiced Pulmonic Fricative Strident Obstruent Continuant	Close Back Rounded Vocoid Vowel Continuant	Alveolar Pulmonic Stop Occlusive
<b>s</b>	<b>r</b>	<b>p</b>	<b>o</b>
0073	0072	0070	006F
Alveolar Pulmonic Sibilant Fricative Strident Obstruent Continuant	Alveolar Voiced Pulmonic Trill Rhotic Vibrant Liquid	Bilabial Pulmonic Stop Occlusive	Close-mid Back Rounded Vocoid Vowel Continuant
<b>n</b>	<b>m</b>	<b>l</b>	<b>k</b>
006E	006D	006C	006B
Alveolar Voiced Pulmonic Nasal Occlusive	Bilabial Voiced Pulmonic Nasal Occlusive	Alveolar Vocoid Voiced Pulmonic Lateral Approximant Rhotic Liquid	Velar Pulmonic Stop Occlusive
<b>j</b>	<b>i</b>	<b>h</b>	<b>g</b>
006A	0069	0068	0067
Palatal Vocoid Semivowel Voiced Pulmonic Approximant Continuant	Close Front Vocoid Vowel Continuant	Glottal Pulmonic Fricative	Velar Voiced Pulmonic Stop Occlusive

## Appendix 5 - International Phonetic Alphabet

f	e	d	c
0066 Labio-Dental Pulmonic Fricative Strident Obstruent Continuant	0065 Close-mid Front Vocoid Vowel Continuant	0064 Alveolar Voiced Pulmonic Stop Occlusive	0063 Palatal Pulmonic Stop Occlusive
b	a	g <sup>w</sup>	ẽ
0062 Bilabial Voiced Pulmonic Stop Occlusive	0061 Open Near-Front Vocoid Vowel Continuant	0261, 02B7 Labial-Velar Voiced Pulmonic Stop Occlusive	025B, 0303 Open-mid Near-Front Nasal Vowel
ɛː	ɛj	õ	ã
025B, 02D0 Open-mid Near-Front Vocoid Long Vowel Continuant	025B, 006A Mid Front Vowel Diphthong	0254, 0303 Open-mid Back Rounded Nasal Vowel	0251, 0303 Near-close Back Nasal Vowel
ẽ	əj	œ	øː
0250, 0303 Near-open Central Rounded Nasal Vowel	0250, 006A Mid Front Vowel Diphthong	0153, 0303 Open-mid Near-Front Rounded Nasal Vowel Diphthong	00F8, 02D0 Open Front Rounded Vocoid Long Vowel
uː	oː	oj	k <sup>w</sup>
0075, 02D0 Close Back Rounded Long Vowel	006F, 02D0 Mid Back Rounded Vocoid Long Vowel Continuant	006F, 006A Mid Front Vowel Diphthong	006B, 02B7 Labial-Velar Pulmonic Stop Occlusive

## Appendix 5 - International Phonetic Alphabet

<p style="text-align: center; font-size: 2em;">iː</p> <p style="text-align: center;">0069, 02D0</p> <p style="text-align: center;">Close Front Vocoid Long Vowel Continuant</p>	<p style="text-align: center; font-size: 2em;">eː</p> <p style="text-align: center;">0065, 02D0</p> <p style="text-align: center;">Mid Front Vocoid Long Vowel Continuant</p>	<p style="text-align: center; font-size: 2em;">ej</p> <p style="text-align: center;">0065, 006A</p> <p style="text-align: center;">Mid Front Vowel Diphthong</p>	<p style="text-align: center; font-size: 2em;">aː</p> <p style="text-align: center;">0061, 02D0</p> <p style="text-align: center;">Open Central Vocoid Long Vowel Continuant</p>
<p style="text-align: center; font-size: 2em;">aj</p> <p style="text-align: center;">0061, 006A</p> <p style="text-align: center;">Mid Front Vowel Diphthong</p>	<p style="text-align: center; font-size: 2em;">ẽu</p> <p style="text-align: center;">1EBD, 0075, 032F</p> <p style="text-align: center;">Mid Front Vowel Diphthong</p>	<p style="text-align: center; font-size: 2em;">ẽj</p> <p style="text-align: center;">1EBD, 006A, 0303</p> <p style="text-align: center;">Mid Front Vowel Diphthong</p>	<p style="text-align: center; font-size: 2em;">tʃ</p> <p style="text-align: center;">0074, 0361, 0283</p> <p style="text-align: center;">Alveolo-Palatal Pulmonic Sibilant Affricate</p>
<p style="text-align: center; font-size: 2em;">o̞a</p> <p style="text-align: center;">006F, 032F, 0061</p> <p style="text-align: center;">Mid Front Vowel Diphthong</p>	<p style="text-align: center; font-size: 2em;">e̞a</p> <p style="text-align: center;">0065, 032F, 0061</p> <p style="text-align: center;">Mid Front Vowel Diphthong</p>	<p style="text-align: center; font-size: 2em;">ẽj̃</p> <p style="text-align: center;">0250, 0303, 006A, 0303</p> <p style="text-align: center;">Mid Front Vowel Diphthong</p>	

## Appendix 6 - Languages

### LATIN

A classical language belonging to the Italic branch of the Indo-European languages. Latin was originally spoken in the area around Rome, known as Latium. Through the power of the Roman Republic, it became the dominant language in Italy, and subsequently throughout the western Roman Empire, before eventually becoming a dead language. Latin has contributed many words to the English language. In particular, Latin (and Ancient Greek) roots are used in English descriptions of theology, the sciences, medicine, and law.

By the late Roman Republic (75 BC), Old Latin had been standardised into Classical Latin. Vulgar Latin was the colloquial form spoken at that time and attested in inscriptions and the works of comic playwrights like Plautus and Terence[3] and author Petronius. Late Latin is the written language from the 3rd century; its colloquial form Vulgar Latin developed in the 6th to 9th centuries into the Romance languages, such as Italian, Sardinian, Venetian, Neapolitan, Sicilian, Piedmontese, Lombard, French, Franco-Provençal, Occitan, Corsican, Ladin, Friulan, Romansh, Catalan/Valencian, Aragonese, Spanish, Asturian, Galician, and Portuguese. Medieval Latin was used as a literary language from the 9th century to the Renaissance which used Renaissance Latin. Later, Early Modern Latin and New Latin evolved. Latin was the language of international communication, scholarship and science until well into the 18th century, when vernaculars (including the Romance languages) supplanted it. Ecclesiastical Latin remains the official language of the Holy See and the Roman Rite of the Catholic Church. Latin is a highly inflected language, with three distinct genders, six or seven noun cases, five declensions, four verb conjugations, six tenses, three persons, three moods, two voices, two or three aspects, and two numbers. The Latin alphabet is derived from the Etruscan and Greek alphabets and ultimately from the Phoenician alphabet.



## Appendix 6 - Languages

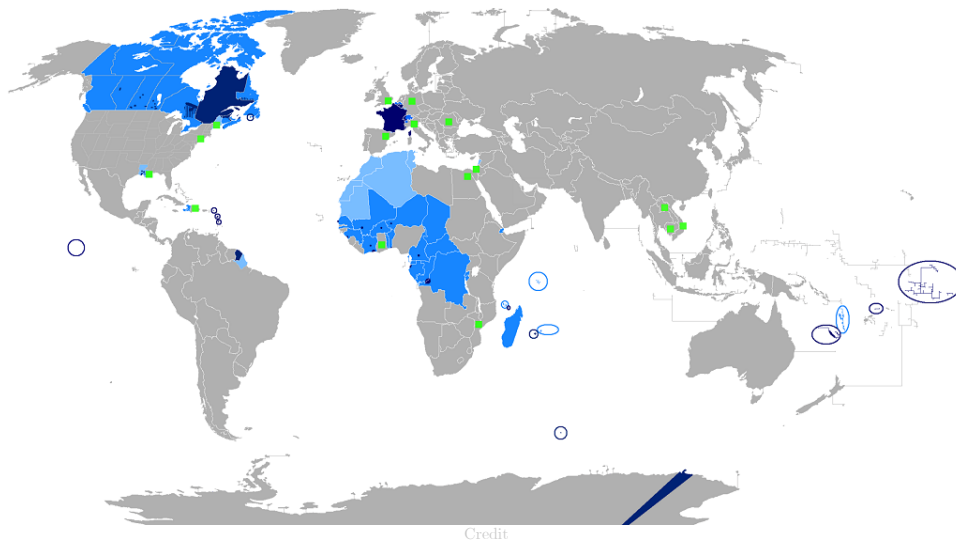
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### FRENCH

A Romance language of the Indo-European family. It descended from the Vulgar Latin of the Roman Empire, as did all Romance languages. French evolved from Gallo-Romance, the Latin spoken in Gaul, and more specifically in Northern Gaul. Its closest relatives are the other langues d'oïl—languages historically spoken in northern France and in southern Belgium, which French (Francien) largely supplanted.

French was also influenced by native Celtic languages of Northern Roman Gaul like Gallia Belgica and by the (Germanic) Frankish language of the post-Roman Frankish invaders. Today, owing to France's past overseas expansion, there are numerous French-based creole languages, most notably Haitian Creole. A French-speaking person or nation may be referred to as Francophone in both English and French.

French is an official language in 29 countries across multiple continents, most of which are members of the Organisation internationale de la Francophonie (OIF), the community of 84 countries which share the official use or teaching of French. French is also one of six official languages used in the United Nations. It is spoken as a first language (in descending order of the number of speakers) in France; the Democratic Republic of Congo; Algeria; Morocco; Canada (provinces of Quebec, Ontario and New Brunswick as well as other Francophone regions); Cameroon; Belgium (Wallonia and the Brussels-Capital Region); Ivory Coast; Tunisia; western Switzerland (Romandy—all or part of the cantons of Bern, Fribourg, Geneva, Jura, Neuchâtel, Vaud, Valais); Monaco; parts of Luxembourg; parts of the United States (the states of Louisiana, Maine, New Hampshire and Vermont); northwestern Italy (autonomous region of Aosta Valley); and various communities elsewhere.



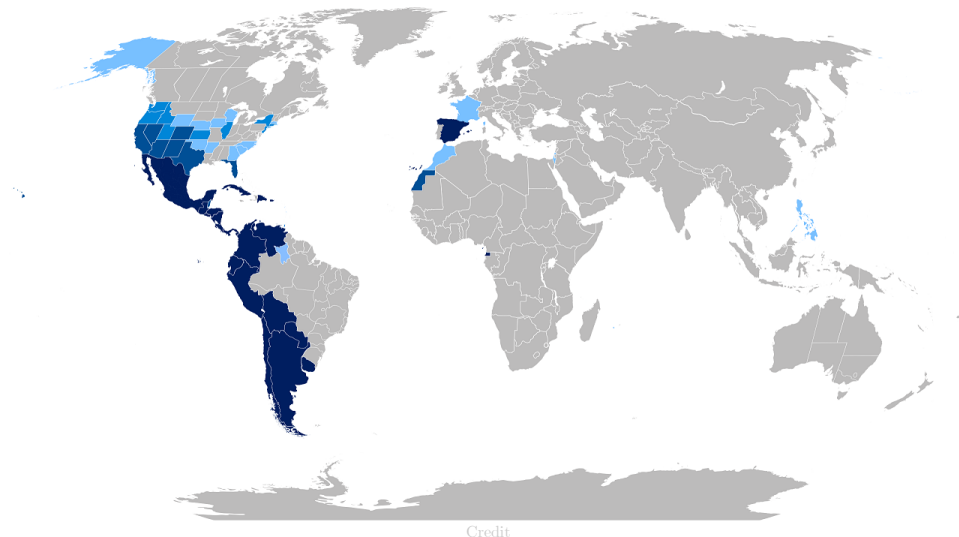
### SPANISH

A Romance language that originated in the Iberian Peninsula of Europe. Today, it is a global

## Appendix 6 - Languages

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language with nearly 500 million native speakers, mainly in Spain and the Americas. It is the world's second-most spoken native language after Mandarin Chinese, and the world's fourth-most spoken language overall after English, Mandarin Chinese, and Hindi.



### ITALIAN

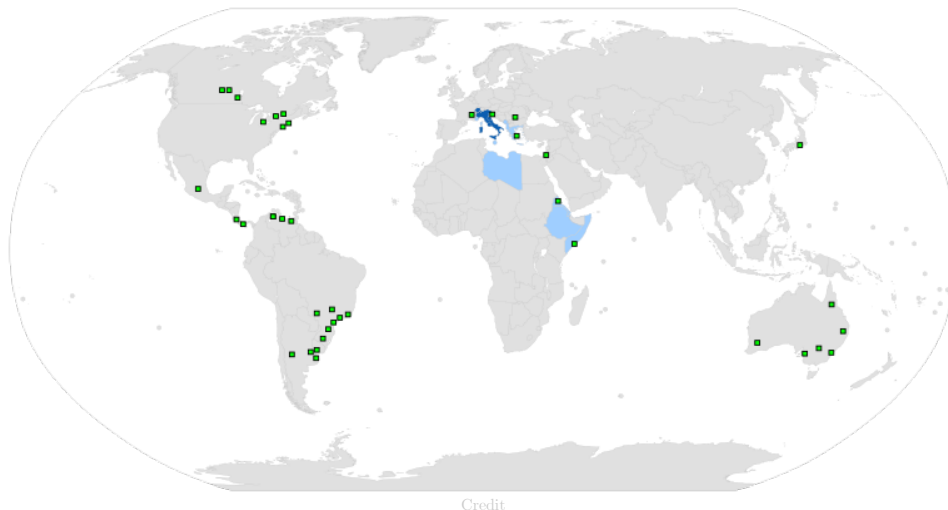
A Romance language of the Indo-European language family. Italian is the closest national language to Latin, from which it descends via vulgar Latin of the Roman Empire. Taking into account both national and regional languages, it is seen that Italian and Sardinian are together the least differentiated from Latin. Italian is an official language in Italy, Switzerland (Ticino and the Grisons), San Marino, and Vatican City. It has an official minority status in western Istria (Croatia and Slovenia).

It formerly had official status in Albania, Malta, Monaco, Montenegro (Kotor), Greece (Ionian Islands and Dodecanese), and is generally understood in Corsica by Corsican speakers (many linguists classify Corsican as an Italian dialect). It used to be an official language in the former colonial areas of Italian East Africa and Italian North Africa, where it still has a significant role in various sectors.

Italian is also spoken by large immigrant and expatriate communities in the Americas and Australia. Italian is included under the languages covered by the European Charter for Regional or Minority languages in Bosnia and Herzegovina and in Romania, although Italian is neither a co-official nor a protected language in these countries. Many speakers of Italian are native bilinguals of both Italian (either in its standard form or regional varieties) and another regional language of Italy.

## Appendix 6 - Languages

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### BRAZILIAN PORTUGUESE

The set of dialects of the Portuguese language native to Brazil and the most influential form of Portuguese worldwide. It is spoken by almost all of the 200 million inhabitants of Brazil and spoken widely across the Brazilian diaspora, today consisting of about two million Brazilians who have emigrated to other countries. With a population of over 205 million, Brazil is by far the world's largest Portuguese-speaking nation and the only one in the Americas.



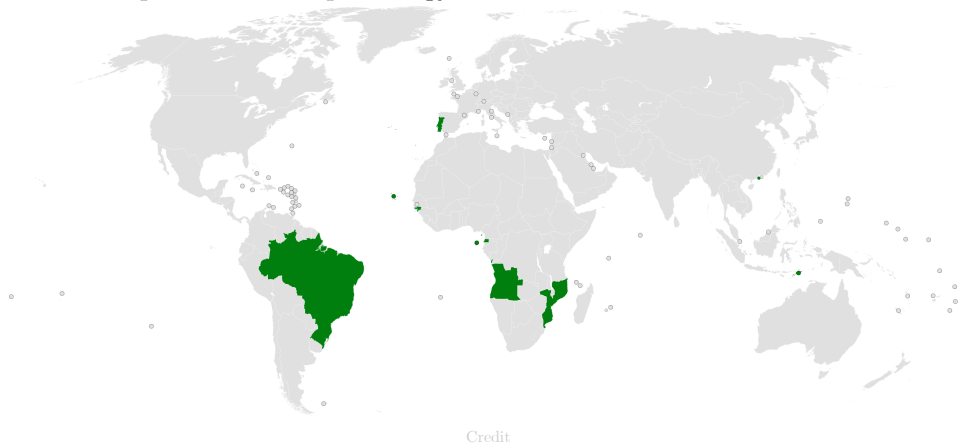
### PORTUGUESE

A Romance language originating in the Iberian Peninsula of Europe. It is the sole official language of Portugal, Angola, Mozambique, Guinea-Bissau, Cape Verde, São Tomé and Príncipe, and Brazil,

## Appendix 6 - Languages

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while having co-official language status in East Timor, Equatorial Guinea, and Macau. A Portuguese-speaking person or nation is referred to as "Lusophone" (lusófono). As the result of expansion during colonial times, a cultural presence of Portuguese and Portuguese creole speakers are also found around the world. Portuguese is part of the Ibero-Romance group that evolved from several dialects of Vulgar Latin in the medieval Kingdom of Galicia and the County of Portugal, and has kept some Celtic phonology and its lexicon.



### CATALAN

Catalan (/ˈkætələn, -æn, ˌkætəˈlæn/; autonym: català or llengua catalana; Eastern Catalan: [kətəˈla]), known in the Valencian Community and Carche as Valencian, is a Western Romance language derived from Vulgar Latin. It is the official language of Andorra, and a co-official language of three autonomous communities in eastern Spain: Catalonia, the Valencian Community and the Balearic Islands. It also has semi-official status in the Italian comune of Alghero. It is also spoken in the Pyrénées-Orientales department of France and in two further areas in eastern Spain: the eastern strip of Aragon and the Carche area in the Region of Murcia. The Catalan-speaking territories are often called the Països Catalans or "Catalan Countries".

The language evolved from Vulgar Latin in the Middle Ages around the eastern Pyrenees. Nineteenth-century Spain saw a Catalan literary revival, culminating in the early 1900s.



## Appendix 6 - Languages

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### WALLOON

A Romance language that is spoken in much of Wallonia and (to small extent) in Brussels, Belgium; some villages near Givet, northern France; a clutch of communities in northeastern Wisconsin, U.S.; and in some parts of Canada. It belongs to the langue d'oïl language family, the most prominent member of which is the French language. The historical background of its formation was the territorial extension since 980 of the Principality of Liège to the south and west.

Despite its rich literature, beginning anonymously in the 16th century and with well-known authors since 1756, the use of Walloon has decreased markedly since France's annexation of Wallonia in 1795. This period definitively established French as the language of social promotion, far more than it was before. After World War I, public schools provided French-speaking education to all children, inducing a denigration of Walloon, especially when accompanied by official orders in 1952 to punish its use in schools. Subsequently, since the middle of the 20th century, generational transmission of the language has decreased, resulting in Walloon almost becoming a dead language. Today it is scarcely spoken among younger people, with vast majority of its native speakers being the elderly (aged 65 and over). In 2007, the number of people with knowledge of the language was estimated at 600,000.

## Appendix 6 - Languages

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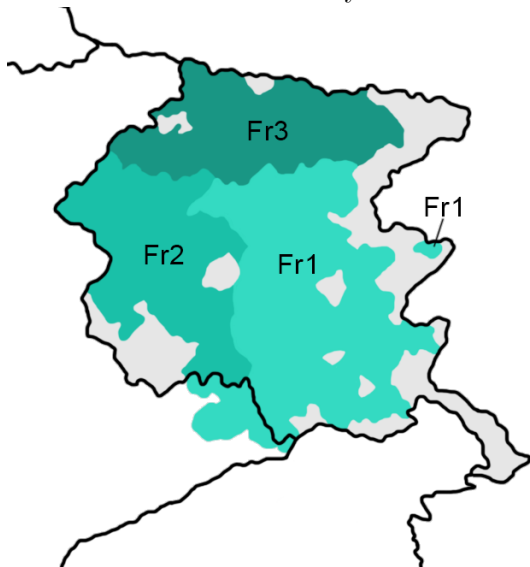


Credit

### FRIULIAN

Friulian (/friːˈuːliən/ free-00-lee-ən) or Friulan (natively About this soundfurlan or marilenghe; Italian: friulano; German: Furlanisch; Slovene: furlanščina) is a Romance language belonging to the Rhaeto-Romance family, spoken in the Friuli region of northeastern Italy. Friulian has around 600,000 speakers, the vast majority of whom also speak Italian.

It is sometimes called Eastern Ladin since it shares the same roots as Ladin, but over the centuries, it has diverged under the influence of surrounding languages, including German, Italian, Venetian, and Slovene. Documents in Friulian are attested from the 11th century and poetry and literature date as far back as 1300. By the 20th century, there was a revival of interest in the language.



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## Appendix 6 - Languages

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### ROMANIAN

Romanian (obsolete spellings: Rumanian or Roumanian; autonym: *limba română* ['limba ro'mɨnə] (About this soundlisten), or *românește*, lit. 'in Romanian') is a Balkan Romance language spoken by approximately 24–26 million people as a native language, primarily in Romania and Moldova, and by another 4 million people as a second language. According to another estimate, there are about 34 million people worldwide who can speak Romanian, of whom 30 million speak it as a native language. It is an official and national language of both Romania and Moldova and is one of the official languages of the European Union.

Romanian is a part of the Eastern Romance sub-branch of Romance languages, a linguistic group that evolved from several dialects of Vulgar Latin which separated from the Western Romance languages in the course of the period from the 5th to the 8th centuries. To distinguish it within the Eastern Romance languages, in comparative linguistics it is called Daco-Romanian as opposed to its closest relatives, Aromanian, Megleno-Romanian and Istro-Romanian. Romanian is also known as Moldovan in Moldova, although the Constitutional Court of Moldova ruled in 2013 that "the official language of the republic is Romanian".



## Appendix 7 - Symbols

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$\Psi$	<b>Phylogeny</b> The (possibly unknown) relationship between entities resulting from an evolutionary tree
$\tau$	<b>Tree topology</b> Information on the relationships of the languages
$\mu$	<b>Substitution rate</b> the rate at which the language changes
$N$	<b>Sampled languages</b> The number of languages in a sample
$\nu$	<b>Expected events</b> The expected number of evolutionary events that occurred between two languages
$t$	<b>Past times</b> Times of branch events
$B$	<b>Possible rooted trees</b>
$A$	<b>Segmental alignment</b> Constructed by combining the word segment information for the languages of interest with information on the homology of the segments
$S$	<b>Segmental information</b> Information on the homology of the segments
$s$	<b>Segment</b> Linguistic segment
$s_i$	<b>ith segment</b>
$H$	<b>Homology map</b> The map describing the alignment of the segments
$Q$	<b>Rate Matrix</b>
$\beta$	<b>Rate matrix scaling factor</b> Scales the rate matrix such that the average rate of segmental substitution is one

## Appendix 7 - Symbols

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<b>P</b>	<b>Probability</b> The probability the process ends in certain state
<b>P</b>	<b>Marginal Likelihood</b>
$\pi$	<b>Equilibrium distribution</b>
$\lambda$	<b>Rate of segment insertion</b>
$\mu$	<b>Rate of segment deletion</b>
$n$	<b>Word length</b> Number of segments in a word
$r$	<b>Rate parameter</b>
$\vartheta$	<b>Rate parameters</b> Parameters associated with the rate matrix
$\vartheta'$	<b>Proposal</b> New value proposal
$q$	<b>Proposal probability</b> Probability of new proposal
$u$	<b>Random number</b>
$R$	<b>Acceptance probability</b> Probability of accepting a proposed value
$M$	<b>Model</b> Mathematical model for linguistic parameters
$BF$	<b>Bayes Factor</b> A numerical factor related to the quality of the model fit
$X$	<b>Unknown</b>