

# Dragon Phylogeny

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*GitHub* Username: RoshaelC Repository Link: <https://github.com/RoshaelC/DNAalignment.git>  
(<https://github.com/RoshaelC/DNAalignment.git>)

## Import Data

```
library(ape)
DragonNexus <- read.nexus.data("input/DragonMatrix.nex")
head(DragonNexus)
```

```

## $`0.1FishXXX`
## [1] "0" "0" "0" "0" "0" "0" "0" "0" "0" "0" "0" "0" "0" "0" "0" "0" "0" "0"
## [20] "0" "0" "0" "0" "0" "0" "0" "0" "0" "0" "0" "0" "0" "0" "0" "0" "0" "0"
## [39] "0" "0" "0" "0" "0" "0" "0" "0" "0" "0" "0" "0" "0" "0" "0" "0" "0" "0"
## [58] "0" "0" "0" "0" "0" "0" "0" "0" "0" "0" "0" "0" "0" "0" "0" "0" "0" "0"
## [77] "0" "0"
##
## $`0.2SnakeXX`
## [1] "1" "1" "1" "1" "0" "0" "0" "0" "1" "1" "1" "0" "0" "1" "1" "1" "0" "1" "1"
## [20] "0" "0" "0" "0" "0" "0" "0" "1" "1" "0" "0" "0" "0" "0" "1" "0" "0" "0"
## [39] "1" "0" "0" "0" "1" "0" "0" "0" "1" "0" "0" "0" "0" "0" "1" "1" "1" "1"
## [58] "1" "1" "0" "0" "0" "0" "0" "0" "0" "0" "1" "0" "0" "0" "0" "0" "0" "0"
## [77] "0" "0"
##
## $`0.3MammalX`
## [1] "1" "0" "0" "0" "0" "0" "0" "0" "0" "0" "1" "1" "1" "0" "0" "0" "0" "0"
## [20] "0" "0" "0" "1" "0" "0" "0" "1" "1" "1" "0" "0" "0" "0" "0" "1" "1" "0" "0"
## [39] "1" "1" "0" "0" "1" "1" "0" "0" "0" "0" "0" "0" "0" "0" "1" "0" "0" "0"
## [58] "0" "0" "0" "1" "1" "0" "0" "0" "0" "0" "1" "0" "0" "0" "0" "1" "0" "0"
## [77] "0" "0"
##
## $`1GermanXXX`
## [1] "0" "1" "0" "0" "1" "1" "1" "0" "0" "1" "1" "1" "1" "0" "0" "0" "0" "1" "1"
## [20] "0" "0" "0" "0" "1" "0" "1" "1" "1" "1" "1" "0" "0" "0" "0" "1" "1" "0" "1"
## [39] "0" "0" "0" "0" "1" "1" "0" "1" "1" "0" "0" "0" "0" "0" "0" "1" "1" "1" "0"
## [58] "0" "0" "0" "1" "0" "0" "0" "1" "0" "0" "1" "0" "0" "0" "0" "0" "0" "1"
## [77] "1" "1"
##
## $`2FrenchXXX`
## [1] "0" "1" "0" "0" "1" "1" "0" "1" "0" "1" "1" "0" "0" "1" "1" "1" "0" "1" "0"
## [20] "0" "0" "0" "0" "0" "0" "1" "1" "1" "1" "1" "0" "0" "0" "0" "1" "1" "0" "0"
## [39] "1" "0" "0" "0" "1" "1" "0" "0" "0" "0" "0" "0" "0" "0" "1" "1" "0" "0"
## [58] "0" "0" "1" "0" "0" "1" "0" "0" "0" "1" "1" "0" "0" "0" "1" "1" "0" "0"
## [77] "1" "0"
##
## $`3FrenchXXX`
## [1] "0" "1" "0" "0" "1" "1" "1" "0" "0" "0" "1" "1" "0" "0" "0" "0" "0" "0" "0"
## [20] "0" "0" "1" "0" "1" "0" "0" "1" "1" "1" "1" "0" "0" "0" "0" "1" "1" "0" "1"
## [39] "1" "1" "0" "1" "1" "1" "0" "1" "0" "0" "0" "0" "0" "0" "1" "1" "1" "0"
## [58] "0" "0" "0" "1" "0" "0" "0" "1" "0" "0" "1" "0" "0" "0" "1" "1" "0" "0"
## [77] "1" "1"

```

names(DragonNexus)

```
## [1] "0.1FishXXX" "0.2SnakeXX" "0.3MammalX" "1GermanXXX" "2FrenchXXX"
## [6] "3FrenchXXX" "4DutchXXXX" "5EnglishXX" "6AmericanX" "7FrenchXXX"
## [11] "8EnglishXX" "9FrenchXXX" "10FrenchXX" "11SpanishX" "12Japanese"
## [16] "13Japanese" "14Japanese" "15Japanese" "16Japanese" "17Japanese"
## [21] "18Japanese" "19Japanese" "20Japanese" "21Japanese" "22Japanese"
## [26] "23Japanese" "24Japanese" "25Japanese" "26Japanese" "27Japanese"
## [31] "28Japanese" "29Japanese" "30ItalianX" "31ItalianX" "32ItalianX"
## [36] "33XXXXXXXX" "34GermanXX" "35EnglishX" "36GermanXX" "37DutchXXX"
## [41] "38SpanishX" "39ItalianX" "40ItalianX" "41EnglishX" "42ItalianX"
## [46] "43SpanishX" "44ItalianX" "45ItalianX" "46EnglishX" "47ItalianX"
## [51] "48DutchXXX" "49IndianXX" "50Japanese" "51Japanese" "52Japanese"
## [56] "53Japanese" "54IranianX" "55IranianX" "56IranianX" "57IranianX"
## [61] "58TurkishX" "59IranianX" "60IranianX" "61TurkishX" "62TurkishX"
## [66] "63UkraineX" "64UkraineX" "65RussiaXX" "66UkraineX" "67RussiaXX"
## [71] "68GreeceXX" "69ItalianX" "70American" "71BritishX" "72BritishX"
## [76] "73BritishX" "74BritishX" "75Dragon1X" "76Dragon2X" "77Dragon3X"
```

```
DragonNexusDF <- data.frame(matrix(unlist(DragonNexus), ncol = 78, byrow = T))
row.names(DragonNexusDF) <- names(DragonNexus)
head(DragonNexusDF)
```

```
##           X1 X2 X3 X4 X5 X6 X7 X8 X9 X10 X11 X12 X13 X14 X15 X16 X17 X18 X19
## 0.1FishXXX 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
## 0.2SnakeXX 1 1 1 1 0 0 0 0 1 1 1 0 0 1 1 1 0 1 1
## 0.3MammalX 1 0 0 0 0 0 0 0 0 0 1 1 1 0 0 0 0 0 0
## 1GermanXXX 0 1 0 0 1 1 1 0 0 1 1 1 1 0 0 0 0 1 1
## 2FrenchXXX 0 1 0 0 1 1 0 1 0 1 1 0 0 1 1 1 0 1 0
## 3FrenchXXX 0 1 0 0 1 1 1 0 0 0 1 1 0 0 0 0 0 0 ?
##           X20 X21 X22 X23 X24 X25 X26 X27 X28 X29 X30 X31 X32 X33 X34 X35 X36
## 0.1FishXXX 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
## 0.2SnakeXX 0 0 0 0 0 0 0 0 1 1 0 0 0 0 0 0 1 0
## 0.3MammalX 0 0 0 1 0 0 0 0 1 1 1 0 0 0 0 0 1 1
## 1GermanXXX 0 0 0 0 1 0 1 1 1 1 1 0 0 0 0 0 1 1
## 2FrenchXXX 0 0 0 0 0 0 1 1 1 1 1 0 0 0 0 0 1 1
## 3FrenchXXX ? ? 1 0 1 0 0 1 1 1 1 0 0 0 0 0 1 1
##           X37 X38 X39 X40 X41 X42 X43 X44 X45 X46 X47 X48 X49 X50 X51 X52 X53
## 0.1FishXXX 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
## 0.2SnakeXX 0 0 1 0 0 0 0 1 0 0 0 1 0 0 0 0 0
## 0.3MammalX 0 0 1 1 0 0 0 1 1 0 0 0 0 0 0 0 0
## 1GermanXXX 0 1 0 0 0 0 0 1 1 0 1 1 0 0 0 0 0
## 2FrenchXXX 0 0 1 0 0 0 0 1 1 0 0 0 0 0 0 0 0
## 3FrenchXXX 0 1 1 1 0 1 1 1 0 1 0 0 0 0 0 0 0
##           X54 X55 X56 X57 X58 X59 X60 X61 X62 X63 X64 X65 X66 X67 X68 X69 X70
## 0.1FishXXX 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
## 0.2SnakeXX 1 1 1 1 1 1 0 0 0 0 0 0 0 0 0 1 0
## 0.3MammalX 1 0 0 0 0 0 0 0 1 1 0 0 0 0 0 1 0
## 1GermanXXX 1 1 1 0 0 0 0 0 1 0 0 0 1 0 0 1 0
## 2FrenchXXX 1 1 0 0 0 0 0 1 0 0 1 0 0 0 1 1 0
## 3FrenchXXX 1 1 1 0 0 0 0 0 1 0 0 0 1 0 0 1 0
##           X71 X72 X73 X74 X75 X76 X77 X78
## 0.1FishXXX 0 0 0 0 0 0 0 0
## 0.2SnakeXX 0 0 0 0 0 0 0 0
## 0.3MammalX 0 0 0 1 0 0 0 0
## 1GermanXXX ? ? ? 0 0 1 1 1
## 2FrenchXXX 0 1 1 0 0 1 1 0
## 3FrenchXXX 0 1 1 0 0 1 1 1
```

```
DragonDist <- dist(DragonNexusDF, method = "binary")
```

```
## Warning in dist(DragonNexusDF, method = "binary"): NAs introduced by coercion
```

```
DragonDistMat <- as.matrix(DragonDist)
```

## Visualizing the Matrix

```
library(reshape2)
PDat <- melt(DragonDistMat)
dim(DragonDistMat)
```

```
## [1] 80 80
```

```
head(DragonDistMat)
```

##	0.1FishXXX	0.2SnakeXX	0.3MammalX	1GermanXXX	2FrenchXXX	3FrenchXXX
##	0.1FishXXX	0	1.0000000	1.0000000	1.0000000	1.0000000
##	0.2SnakeXX	1	0.0000000	0.7428571	0.6744186	0.6250000
##	0.3MammalX	1	0.7428571	0.0000000	0.6578947	0.7105263
##	1GermanXXX	1	0.6744186	0.6578947	0.0000000	0.5000000
##	2FrenchXXX	1	0.6250000	0.7105263	0.5000000	0.0000000
##	3FrenchXXX	1	0.7555556	0.6216216	0.2571429	0.5238095
##	4DutchXXXX	5EnglishXX	6AmericanX	7FrenchXXX	8EnglishXX	9FrenchXXX
##	0.1FishXXX	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
##	0.2SnakeXX	0.7435897	0.6829268	0.3870968	0.6888889	0.7948718
##	0.3MammalX	0.7142857	0.7027027	0.7777778	0.7073171	0.9210526
##	1GermanXXX	0.5750000	0.3611111	0.6829268	0.4761905	0.7000000
##	2FrenchXXX	0.3750000	0.4736842	0.6904762	0.4390244	0.6666667
##	3FrenchXXX	0.5135135	0.3055556	0.6666667	0.4883721	0.6829268
##	10FrenchXX	11SpanishX	12Japanese	13Japanese	14Japanese	15Japanese
##	0.1FishXXX	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
##	0.2SnakeXX	0.6052632	0.7272727	0.6756757	0.6538462	0.4871795
##	0.3MammalX	0.6756757	0.6315789	0.5937500	0.5238095	0.7073171
##	1GermanXXX	0.4871795	0.3243243	0.6097561	0.5000000	0.5681818
##	2FrenchXXX	0.5128205	0.3947368	0.5945946	0.3809524	0.5909091
##	3FrenchXXX	0.4102564	0.2222222	0.6428571	0.4166667	0.5957447
##	16Japanese	17Japanese	18Japanese	19Japanese	20Japanese	21Japanese
##	0.1FishXXX	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
##	0.2SnakeXX	0.6590909	0.6904762	0.5925926	0.4722222	0.6470588
##	0.3MammalX	0.6052632	0.6923077	0.6400000	0.7435897	0.6000000
##	1GermanXXX	0.5333333	0.5348837	0.6363636	0.6046512	0.5405405
##	2FrenchXXX	0.6222222	0.6190476	0.5483871	0.6190476	0.6388889
##	3FrenchXXX	0.5454545	0.5909091	0.6060606	0.6222222	0.6153846
##	22Japanese	23Japanese	24Japanese	25Japanese	26Japanese	27Japanese
##	0.1FishXXX	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
##	0.2SnakeXX	0.7000000	0.7073171	0.6842105	0.6428571	0.6315789
##	0.3MammalX	0.7027027	0.6756757	0.6857143	0.6750000	0.6756757
##	1GermanXXX	0.5365854	0.5609756	0.5500000	0.5869565	0.5581395
##	2FrenchXXX	0.6250000	0.5853659	0.6410256	0.5714286	0.5500000
##	3FrenchXXX	0.5952381	0.6000000	0.6097561	0.6000000	0.5365854
##	28Japanese	29Japanese	30ItalianX	31ItalianX	32ItalianX	33XXXXXXXXX
##	0.1FishXXX	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
##	0.2SnakeXX	0.7021277	0.6829268	0.6666667	0.7073171	0.6000000
##	0.3MammalX	0.7500000	0.7027027	0.6666667	0.5757576	0.6486486
##	1GermanXXX	0.5555556	0.5952381	0.4871795	0.3611111	0.3947368
##	2FrenchXXX	0.5957447	0.5609756	0.4166667	0.5128205	0.4750000
##	3FrenchXXX	0.6041667	0.6136364	0.4615385	0.2857143	0.3243243
##	34GermanXX	35EnglishX	36GermanXX	37DutchXXX	38SpanishX	39ItalianX
##	0.1FishXXX	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
##	0.2SnakeXX	0.6666667	0.7446809	0.7826087	0.6739130	0.6666667
##	0.3MammalX	0.7142857	0.8222222	0.6842105	0.7209302	0.6829268
##	1GermanXXX	0.4146341	0.5116279	0.4750000	0.3902439	0.4523810
##	2FrenchXXX	0.4523810	0.4761905	0.4358974	0.5000000	0.4146341
##	3FrenchXXX	0.3902439	0.5555556	0.3684211	0.2564103	0.3500000
##	40ItalianX	41EnglishX	42ItalianX	43SpanishX	44ItalianX	45ItalianX
##	0.1FishXXX	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
##	0.2SnakeXX	0.6976744	0.7567568	0.7209302	0.7045455	0.6857143

## 0.3MammalX	0.6486486	0.6666667	0.6756757	0.6578947	0.6129032	0.6829268
## 1GermanXXX	0.3947368	0.5000000	0.3333333	0.4102564	0.4411765	0.3750000
## 2FrenchXXX	0.4750000	0.4545455	0.4210526	0.4500000	0.4411765	0.4883721
## 3FrenchXXX	0.3243243	0.4411765	0.2777778	0.3846154	0.4117647	0.2631579
##	46EnglishX	47ItalianX	48DutchXXX	49IndianXX	50Japanese	51Japanese
## 0.1FishXXX	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
## 0.2SnakeXX	0.7179487	0.7333333	0.7272727	0.5945946	0.6578947	0.6595745
## 0.3MammalX	0.6060606	0.6923077	0.6842105	0.6060606	0.6571429	0.7446809
## 1GermanXXX	0.5263158	0.4500000	0.5238095	0.5952381	0.5384615	0.4666667
## 2FrenchXXX	0.4722222	0.4500000	0.3947368	0.5526316	0.5263158	0.3414634
## 3FrenchXXX	0.3888889	0.3421053	0.4250000	0.6000000	0.5714286	0.4222222
##	52Japanese	53Japanese	54IranianX	55IranianX	56IranianX	57IranianX
## 0.1FishXXX	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
## 0.2SnakeXX	0.6176471	0.5862069	0.7073171	0.5789474	0.6875000	0.6511628
## 0.3MammalX	0.5666667	0.6206897	0.6756757	0.6111111	0.7333333	0.6315789
## 1GermanXXX	0.4722222	0.5714286	0.4736842	0.6046512	0.5531915	0.6000000
## 2FrenchXXX	0.5555556	0.4193548	0.4473684	0.5250000	0.4186047	0.5000000
## 3FrenchXXX	0.6000000	0.4857143	0.3421053	0.5238095	0.4666667	0.5777778
##	58TurkishX	59IranianX	60IranianX	61TurkishX	62TurkishX	63UkraineX
## 0.1FishXXX	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
## 0.2SnakeXX	0.4750000	0.6923077	0.6585366	0.6410256	0.5750000	0.6744186
## 0.3MammalX	0.6410256	0.7500000	0.6388889	0.6571429	0.6578947	0.5833333
## 1GermanXXX	0.6170213	0.6976744	0.6666667	0.6363636	0.5454545	0.5238095
## 2FrenchXXX	0.6086957	0.6341463	0.6363636	0.6000000	0.5365854	0.6222222
## 3FrenchXXX	0.5744681	0.6744186	0.5476190	0.6097561	0.5476190	0.5681818
##	64UkraineX	65RussiaXX	66UkraineX	67RussiaXX	68GreeceXX	69ItalianX
## 0.1FishXXX	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
## 0.2SnakeXX	0.6388889	0.6000000	0.7000000	0.5862069	0.6976744	0.7777778
## 0.3MammalX	0.5483871	0.6111111	0.6666667	0.5384615	0.6842105	0.7750000
## 1GermanXXX	0.6250000	0.5813953	0.4324324	0.5588235	0.5813953	0.6046512
## 2FrenchXXX	0.5789474	0.4358974	0.5384615	0.4516129	0.2571429	0.4615385
## 3FrenchXXX	0.5128205	0.5000000	0.3333333	0.5294118	0.4634146	0.5238095
##	70American	71BritishX	72BritishX	73BritishX	74BritishX	75Dragon1X
## 0.1FishXXX	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
## 0.2SnakeXX	0.6388889	0.7441860	0.6666667	0.6744186	0.7021277	0.7941176
## 0.3MammalX	0.5937500	0.7692308	0.8000000	0.7250000	0.7500000	0.7500000
## 1GermanXXX	0.4722222	0.4358974	0.5744681	0.5116279	0.4888889	0.7750000
## 2FrenchXXX	0.4571429	0.5000000	0.6000000	0.5000000	0.4761905	0.7368421
## 3FrenchXXX	0.4736842	0.4871795	0.5116279	0.4750000	0.4523810	0.8139535
##	76Dragon2X	77Dragon3X				
## 0.1FishXXX	1.0000000	1.0000000				
## 0.2SnakeXX	0.7750000	0.8055556				
## 0.3MammalX	0.8750000	0.8529412				
## 1GermanXXX	0.7209302	0.8478261				
## 2FrenchXXX	0.7441860	0.8372093				
## 3FrenchXXX	0.7500000	0.8444444				

dim(PDat)

## [1] 6400 3

```
head(PDat)
```

```
##          Var1          Var2 value
## 1 0.1FishXXX 0.1FishXXX      0
## 2 0.2SnakeXX 0.1FishXXX      1
## 3 0.3MammalX 0.1FishXXX      1
## 4 1GermanXXX 0.1FishXXX      1
## 5 2FrenchXXX 0.1FishXXX      1
## 6 3FrenchXXX 0.1FishXXX      1
```

## Weights

Setting up the weight distribution as done in Dragon Phylogeny Tutorial

```
WeightsDat <- read.csv("input/Weights.csv")

Weights <- paste0(WeightsDat$Weight, collapse = "")
Weights <- strsplit(Weights, split = "") [[1]]

WeightsNum <- rep(NA, length(Weights))

for (i in 1:length(WeightsNum)){
  if (Weights[i] %in% LETTERS){
    WeightsNum[i] <- which(LETTERS == Weights[i]) + 9
  } else {
    WeightsNum[i] <- Weights[i]
  }
}

WeightsNum <- as.numeric(WeightsNum)

length(WeightsNum)
```

```
## [1] 78
```

```
WtDragonNexus = DragonNexus

for (i in 1:length(DragonNexus)){
  RepWeight <- DragonNexus[[i]] == 1
  WtDragonNexus[[i]][RepWeight] <- WeightsNum[RepWeight]
  RepWeight <- NA
}
```

Calculate the distance matrix

```
WtDragonNexusDF <- data.frame(matrix(unlist(WtDragonNexus), ncol = 78, byrow = T))
row.names(WtDragonNexusDF) <- names(WtDragonNexus)
WtDragonDist <- dist(WtDragonNexusDF, method = 'euclidean')
```



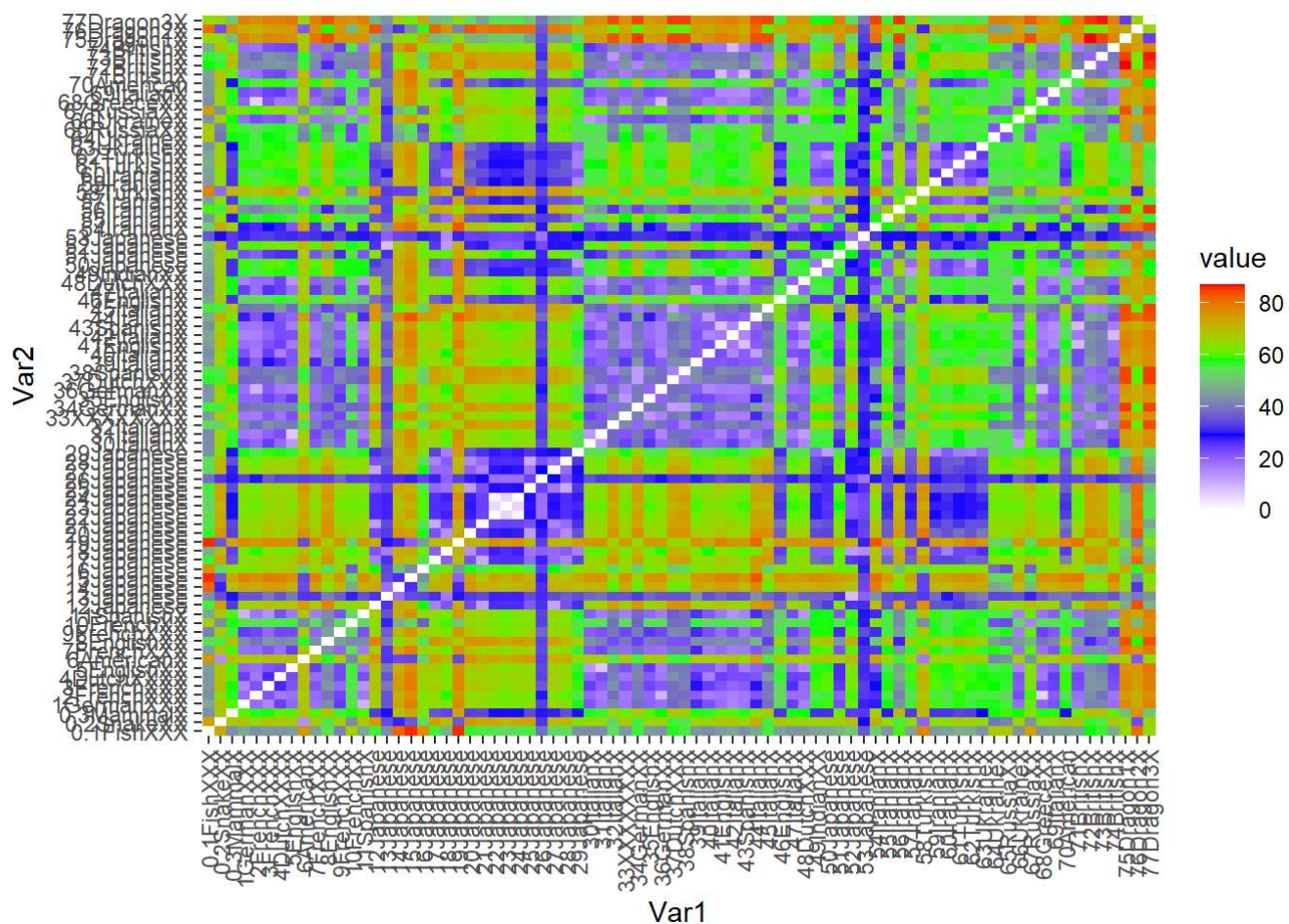
```
## Warning in dist(WtDragonNexusDF, method = "euclidean"): NAs introduced by
## coercion
```

```
WtDragonDistMat <- as.matrix(WtDragonDist)
```

```
library(ggplot2)
```

```
WtPDat <- melt(WtDragonDistMat)
```

```
ggplot(data = WtPDat, aes(x = Var1, y = Var2, fill = value)) +  
  geom_tile() + scale_fill_gradientn(colours = c("white", "blue", "green", "red")) +  
  theme(axis.text.x = element_text(angle = 90, hjust = 1, vjust = 0.5))
```



## Plotting the Tree

```
WtDragonTree<-fastme.bal(WtDragonDist)  
WtDragonTreeNJ<-nj(WtDragonDist)  
str(WtDragonTree)
```

```
## List of 4
## $ edge      : int [1:157, 1:2] 81 81 82 83 84 84 85 86 87 88 ...
## $ edge.length: num [1:157] 25.25 5.37 6.03 2.43 1.77 ...
## $ tip.label  : chr [1:80] "0.1FishXXX" "26Japanese" "0.2SnakeXX" "6AmericanX" ...
## $ Nnode      : int 78
## - attr(*, "class")= chr "phylo"
## - attr(*, "order")= chr "cladewise"
```

## Formatting the Tree

```
head(WtDragonTree$tip.label)
```

```
## [1] "0.1FishXXX" "26Japanese" "0.2SnakeXX" "6AmericanX" "76Dragon2X"
## [6] "58TurkishX"
```

```
Country <- gsub("[0-9\\.|]+(^[X]*).*", "\\1", WtDragonTree$tip.label)
```

```
Country
```

```
## [1] "Fish"      "Japanese" "Snake"    "American" "Dragon2"  "Turkish"
## [7] "Japanese" "Japanese" "Japanese" "Russia"   "Ukraine" "French"
## [13] "Russia"    "Japanese" "Japanese" "Mammal"   "Japanese" "Japanese"
## [19] "English"   "Iranian"  "Turkish"  "Japanese" "Japanese" "Indian"
## [25] "American" "Iranian"  "Iranian"  "Ukraine"  "Turkish"  "Iranian"
## [31] "Japanese" "Japanese" "Japanese" "Japanese" "Japanese" "Japanese"
## [37] "Japanese" "Japanese" "Japanese" "Japanese" "Japanese" "Dragon1"
## [43] "Dragon3"   "English"  "Italian"  "British"  "Dutch"    "Italian"
## [49] "German"    "Spanish"  "British"  "Iranian"  "French"   "Greece"
## [55] "German"    "Dutch"    "Italian"  "Italian"  "French"   "Italian"
## [61] "British"   "Japanese" ""          "English"  "German"   "Spanish"
## [67] "French"    "English"  "British"  "Spanish"  "Italian"  "English"
## [73] "Italian"   "Italian"  "Italian"  "Iranian"  "Italian"  "Ukraine"
## [79] "Dutch"     "French"
```

```
CountryGroups <- split(WtDragonTree$tip.label, Country)
CountryGroups
```

```
## [[1]]
## [1] "33XXXXXXXX"
##
## $American
## [1] "6AmericanX" "70American"
##
## $British
## [1] "73BritishX" "72BritishX" "74BritishX" "71BritishX"
##
## $Dragon1
## [1] "75Dragon1X"
##
## $Dragon2
## [1] "76Dragon2X"
##
## $Dragon3
## [1] "77Dragon3X"
##
## $Dutch
## [1] "37DutchXXX" "4DutchXXX" "48DutchXXX"
##
## $English
## [1] "46EnglishX" "8EnglishXX" "35EnglishX" "41EnglishX" "5EnglishXX"
##
## $Fish
## [1] "0.1FishXXX"
##
## $French
## [1] "10FrenchXX" "2FrenchXXX" "7FrenchXXX" "3FrenchXXX" "9FrenchXXX"
##
## $German
## [1] "34GermanXX" "36GermanXX" "1GermanXXX"
##
## $Greece
## [1] "68GreeceXX"
##
## $Indian
## [1] "49IndianXX"
##
## $Iranian
## [1] "55IranianX" "57IranianX" "59IranianX" "60IranianX" "56IranianX"
## [6] "54IranianX"
##
## $Italian
## [1] "32ItalianX" "45ItalianX" "40ItalianX" "44ItalianX" "42ItalianX"
## [6] "69ItalianX" "31ItalianX" "39ItalianX" "47ItalianX" "30ItalianX"
##
## $Japanese
## [1] "26Japanese" "14Japanese" "15Japanese" "19Japanese" "16Japanese"
## [6] "53Japanese" "13Japanese" "52Japanese" "50Japanese" "29Japanese"
## [11] "18Japanese" "22Japanese" "24Japanese" "23Japanese" "12Japanese"
## [16] "27Japanese" "17Japanese" "21Japanese" "20Japanese" "25Japanese"
```

```
## [21] "28Japanese" "51Japanese"
##
## $Mammal
## [1] "0.3MammalX"
##
## $Russia
## [1] "65RussiaXX" "67RussiaXX"
##
## $Snake
## [1] "0.2SnakeXX"
##
## $Spanish
## [1] "38SpanishX" "11SpanishX" "43SpanishX"
##
## $Turkish
## [1] "58TurkishX" "62TurkishX" "61TurkishX"
##
## $Ukraine
## [1] "64UkraineX" "63UkraineX" "66UkraineX"
```

```
library(ggtree)
```

```
## ggtree v3.2.1 For help: https://yulab-smu.top/treedata-book/
##
## If you use ggtree in published research, please cite the most appropriate paper(s):
##
## 1. Guangchuang Yu. Using ggtree to visualize data on tree-like structures. Current Protocols
in Bioinformatics. 2020, 69:e96. doi:10.1002/cpbi.96
## 2. Guangchuang Yu, Tommy Tsan-Yuk Lam, Huachen Zhu, Yi Guan. Two methods for mapping and visu
alizing associated data on phylogeny using ggtree. Molecular Biology and Evolution. 2018, 35(1
2):3041-3043. doi:10.1093/molbev/msy194
## 3. Guangchuang Yu, David Smith, Huachen Zhu, Yi Guan, Tommy Tsan-Yuk Lam. ggtree: an R packag
e for visualization and annotation of phylogenetic trees with their covariates and other associa
ted data. Methods in Ecology and Evolution. 2017, 8(1):28-36. doi:10.1111/2041-210X.12628
```

```
##
## Attaching package: 'ggtree'
```

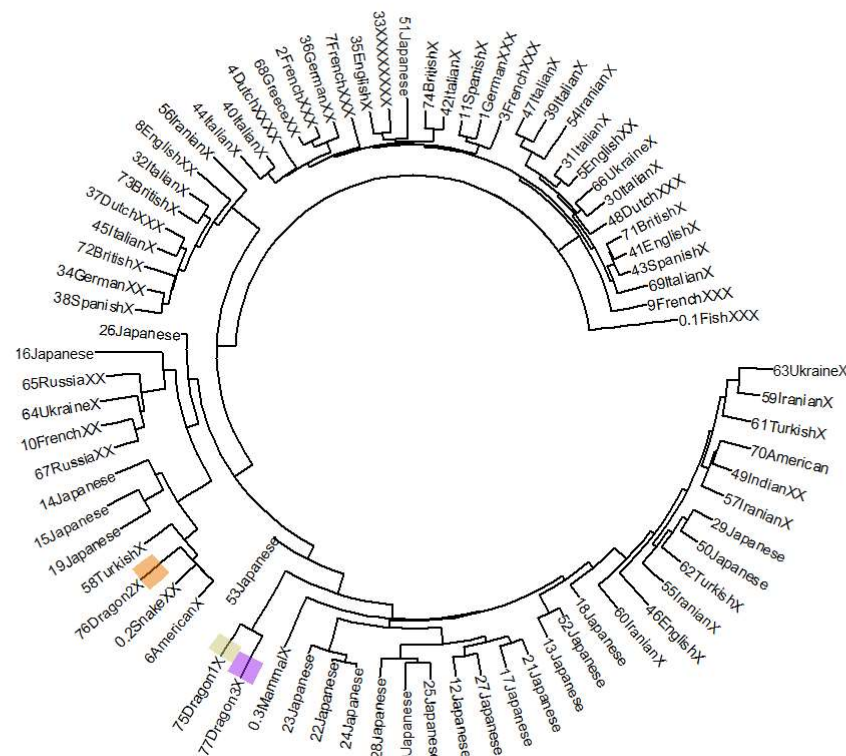
```
## The following object is masked from 'package:ape':
##
## rotate
```

```
WtDTcol <- group0TU(WtDragonTree, CountryGroups)
str(WtDTcol)
```

```
## List of 4
## $ edge      : int [1:157, 1:2] 81 81 82 83 84 84 85 86 87 88 ...
## $ edge.length: num [1:157] 25.25 5.37 6.03 2.43 1.77 ...
## $ tip.label  : chr [1:80] "0.1FishXXX" "26Japanese" "0.2SnakeXX" "6AmericanX" ...
## $ Nnode      : int 78
## - attr(*, "class")= chr "phylo"
## - attr(*, "order")= chr "cladewise"
## - attr(*, "group")= Factor w/ 22 levels "", "American",...: 9 16 19 2 5 21 16 16 16 18 ...
```

```
ggtree(WtDTcol, layout = "circular") + geom_tiplab(size = 2, aes(angle = angle)) + geom_highlight(
  node = 43, fill = "purple") + geom_highlight(node = 42, fill = "khaki3") + geom_highlight(node = 5,
  fill = "darkorange2") + xlim(-50, NA)
```

```
## Warning: The tree contained negative edge length. If you want to ignore the edge, you
## can set 'options(ignore.negative.edge=TRUE)', then re-run ggtree.
```



## Dragon Information





Dragon 1 (highlighted beige/khaki in phylogeny)



Dragon 2 (highlighted orange in phylogeny)



Dragon 3 (highlighted purple in phylogeny)