portal phylogenies.Rmd

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Add an intro to the newick format

A newick file is a text file that demonstrates a representation for a phylogenetic tree. This text file allows the easy accessibility and reading of the tree by the computer. An inner node is represented by a pair of paranthesis, a tip is represented by names or character strinngs, a lineage is represented by a comma which also allwos separation of the nodes and tups, and, finally, the semicolon is representative of the end of the tre; therefore, multiple semicolons in a newick file may represent multiple trees. This is useful as image files for the data are not able to be read by a cimputer, so a text file, such as the nwick file, is necessary for the computer to easily read the file

The package 'ape'

```
library(ape)
```

To read a newick tree from a local file:

```
portal_tree <- read.tree("../data-raw/portal-tree.tre")
portal_tree
```

```
##
## Phylogenetic tree with 43 tips and 345 internal nodes.
##
## Tip labels:
##   Sigmodon_ochrognathus, Sigmodon_hispidus, Sigmodon_fulviventer, Neotoma_albigula, Onychomys_leucoga
## Node labels:
##   Amniota, Mammalia, 'Theria (subclass in Deuterostomia)', 'Eutheria (in Deuterostomia)', Boreoeuther
##
## Rooted; no branch lengths.
```

Read a newick from a URL

```
small_tree <- read.tree(file = "http://ape-package.ird.fr/APER/APER2/primfive.tre")
small_tree
```

```
##
## Phylogenetic tree with 5 tips and 4 internal nodes.
##
## Tip labels:
##   Homo, Pongo, Macaca, Ateles, Galago
##
## Rooted; includes branch lengths.
```

The structure of a tree in R

```
surveys <- read.csv("../data-raw/surveys.csv")
class(portal_tree)
```

```
## [1] "phylo"
```

```
length(portal_tree)
```

```
## [1] 4
```

```
length(surveys)
```

```
## [1] 9
```

```
colnames(surveys)
```

```
## [1] "record_id"       "month"           "day"             "year"
## [5] "plot_id"         "species_id"      "sex"             "hindfoot_length"
## [9] "weight"
```

```
colnames(portal_tree)
```

```
## NULL
```

```
names(portal_tree)
```

```
## [1] "edge"       "Nnode"      "node.label" "tip.label"
```

```
portal_tree$Nnode
```

```
## [1] 345
```

```
portal_tree["tip.label"]
```

```
## $tip.label
##  [1] "Sigmodon_ochrognathus"           "Sigmodon_hispidus"
##  [3] "Sigmodon_fulviventer"            "Neotoma_albigula"
##  [5] "Onychomys_leucogaster"           "Onychomys_torridus"
##  [7] "Peromyscus_maniculatus"          "Peromyscus_leucopus"
##  [9] "Peromyscus_eremicus"             "Reithrodontomys_fulvescens"
## [11] "Reithrodontomys_montanus"        "Reithrodontomys_megalotis"
## [13] "Baiomys_taylori"                 "Chaetodipus_intermedius"
## [15] "Chaetodipus_penicillatus"        "Chaetodipus_baileyi"
## [17] "Chaetodipus_hispidus"            "Perognathus_flavus"
## [19] "Dipodomys_ordii"                 "Dipodomys_merriami"
## [21] "Dipodomys_spectabilis"           "Xerospermophilus_spilosoma"
## [23] "Xerospermophilus_tereticaudus"   "Ammospermophilus_harrisii"
## [25] "Sylvilagus_audubonii"            "Campylorhynchus_brunneicapillus"
## [27] "Ammodramus_savannarum"           "Kieneria_fusca"
## [29] "Pipilo_chlorurus"                "Pooecetes_gramineus"
## [31] "Zonotrichia_leucophrys"          "Spizella_breweri"
## [33] "Amphispiza_bilineata"            "Calamospiza_melanocorys"
## [35] "Zenaida_macroura"                "Callipepla_squamata"
## [37] "Crotalus_viridis"                "Crotalus_scutulatus"
## [39] "Sceloporus_undulatus"            "Sceloporus_clarkii"
## [41] "Gambelia_sila"                   "Aspidoscelis_uniparens"
## [43] "Aspidoscelis_tigris"
```

```
portal_tree[[3]]
```

```
##   [1] "Amniota"
##   [2] "Mammalia"
##   [3] "'Theria (subclass in Deuterostomia)'"
##   [4] "'Eutheria (in Deuterostomia)'"
##   [5] "Boreoeutheria"
##   [6] "Euarchontoglires"
##   [7] "mrcaott42ott30082"
##   [8] "Glires"
##   [9] "mrcaott42ott29157"
##  [10] "Rodentia"
##  [11] "mrcaott42ott10477"
##  [12] "mrcaott42ott38834"
##  [13] "mrcaott42ott48903"
##  [14] "mrcaott42ott254702"
##  [15] "Myomorpha"
##  [16] "Muroidea"
##  [17] "mrcaott42ott45197"
##  [18] "mrcaott42ott55942"
##  [19] "mrcaott42ott102"
##  [20] "mrcaott102ott739"
##  [21] "Cricetidae"
##  [22] "mrcaott739ott15637"
##  [23] "mrcaott739ott119008"
##  [24] "mrcaott739ott38053"
##  [25] "mrcaott38053ott39197"
##  [26] "Sigmodon"
##  [27] "mrcaott39197ott1067882"
##  [28] "mrcaott39197ott1067867"
```

```
##  [29] "mrcaott39197ott208424"
##  [30] "mrcaott39197ott208422"
##  [31] "mrcaott208424ott576098"
##  [32] "mrcaott208424ott1067878"
##  [33] "mrcaott1067867ott1067876"
##  [34] "Neotominae"
##  [35] "mrcaott15637ott15642"
##  [36] "Neotoma"
##  [37] "mrcaott15638ott5266793"
##  [38] "mrcaott15638ott83673"
##  [39] "mrcaott83673ott169825"
##  [40] "mrcaott169825ott690543"
##  [41] "mrcaott169825ott381420"
##  [42] "mrcaott18770ott5266794"
##  [43] "mrcaott18770ott39171"
##  [44] "mrcaott18770ott39181"
##  [45] "mrcaott18770ott76407"
##  [46] "mrcaott18770ott427266"
##  [47] "Onychomys"
##  [48] "mrcaott427266ott1004147"
##  [49] "mrcaott76407ott1024550"
##  [50] "mrcaott76407ott138845"
##  [51] "mrcaott76407ott319357"
##  [52] "mrcaott76407ott373073"
##  [53] "mrcaott76407ott576106"
##  [54] "mrcaott76407ott259483"
##  [55] "mrcaott259483ott1026151"
##  [56] "mrcaott259483ott259485"
##  [57] "mrcaott373073ott576104"
##  [58] "mrcaott138845ott162838"
##  [59] "mrcaott138845ott162828"
##  [60] "mrcaott162828ott343211"
##  [61] "mrcaott343211ott343214"
##  [62] "mrcaott343214ott576102"
##  [63] "mrcaott39181ott489149"
##  [64] "Reithrodontomys"
##  [65] "mrcaott39181ott208412"
##  [66] "mrcaott39181ott222510"
##  [67] "mrcaott208412ott208414"
##  [68] "mrcaott208412ott208418"
##  [69] "mrcaott208414ott208416"
##  [70] "mrcaott208416ott222512"
##  [71] "mrcaott208416ott770864"
##  [72] "mrcaott208416ott732037"
##  [73] "mrcaott39171ott91079"
##  [74] "Baiomys"
##  [75] "Castorimorpha"
##  [76] "mrcaott48903ott80974"
##  [77] "Heteromyidae"
##  [78] "mrcaott48903ott190180"
##  [79] "Perognathinae"
##  [80] "Chaetodipus"
##  [81] "mrcaott190180ott320777"
##  [82] "mrcaott190180ott190184"
```

```
##  [83] "mrcaott190180ott374303"
##  [84] "mrcaott374303ott764440"
##  [85] "mrcaott764440ott1004162"
##  [86] "mrcaott764440ott1004164"
##  [87] "mrcaott320777ott764435"
##  [88] "mrcaott427276ott1004150"
##  [89] "Perognathus"
##  [90] "mrcaott365546ott890372"
##  [91] "mrcaott365546ott943065"
##  [92] "mrcaott943065ott1004160"
##  [93] "Dipodomyinae"
##  [94] "Dipodomys"
##  [95] "mrcaott168145ott241218"
##  [96] "mrcaott168145ott241216"
##  [97] "mrcaott168145ott276776"
##  [98] "mrcaott276776ott844926"
##  [99] "mrcaott241216ott540773"
## [100] "mrcaott540773ott645721"
## [101] "mrcaott241218ott748116"
## [102] "Sciuromorpha"
## [103] "mrcaott10477ott829369"
## [104] "Sciuridae"
## [105] "mrcaott10477ott43435"
## [106] "mrcaott10477ott97818"
## [107] "mrcaott10477ott259084"
## [108] "mrcaott10477ott152097"
## [109] "Marmotini"
## [110] "mrcaott10477ott902084"
## [111] "mrcaott10477ott359117"
## [112] "mrcaott10477ott208064"
## [113] "mrcaott10477ott136299"
## [114] "mrcaott136299ott141507"
## [115] "mrcaott136299ott141525"
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## [117] "mrcaott141525ott580345"
## [118] "Xerospermophilus"
## [119] "mrcaott141525ott508648"
## [120] "mrcaott782266ott833672"
## [121] "mrcaott359117ott580339"
## [122] "Ammospermophilus"
## [123] "mrcaott580339ott632597"
## [124] "mrcaott580339ott580350"
## [125] "Lagomorpha"
## [126] "Leporidae"
## [127] "Sylvilagus"
## [128] "Sauropsida"
## [129] "Sauria"
## [130] "mrcaott246ott4128455"
## [131] "mrcaott246ott4127082"
## [132] "mrcaott246ott4129629"
## [133] "mrcaott246ott4142716"
## [134] "mrcaott246ott4126667"
## [135] "mrcaott246ott1662"
## [136] "mrcaott246ott2982"
```

```
## [137] "mrcaott246ott31216"
## [138] "mrcaott246ott4947920"
## [139] "mrcaott246ott4127428"
## [140] "mrcaott246ott4126230"
## [141] "mrcaott246ott4127421"
## [142] "mrcaott246ott664349"
## [143] "mrcaott246ott4126505"
## [144] "mrcaott246ott4127015"
## [145] "mrcaott246ott4129653"
## [146] "mrcaott246ott4127541"
## [147] "mrcaott246ott4946623"
## [148] "mrcaott246ott4126482"
## [149] "mrcaott246ott4128105"
## [150] "mrcaott246ott4127288"
## [151] "mrcaott246ott4132146"
## [152] "mrcaott246ott3602822"
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## [154] "mrcaott246ott3600976"
## [155] "mrcaott246ott4132107"
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## [157] "Neognathae"
## [158] "mrcaott246ott5481"
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## [160] "mrcaott246ott7145"
## [161] "mrcaott246ott5272"
## [162] "mrcaott246ott928360"
## [163] "mrcaott246ott1858"
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## [166] "mrcaott246ott47588"
## [167] "mrcaott246ott7113"
## [168] "Passeriformes"
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## [171] "mrcaott246ott44866"
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## [175] "mrcaott246ott22325"
## [176] "mrcaott246ott176461"
## [177] "mrcaott246ott10351"
## [178] "mrcaott246ott1488"
## [179] "mrcaott246ott3364"
## [180] "mrcaott246ott5934"
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## [182] "mrcaott246ott3599436"
## [183] "mrcaott246ott25638"
## [184] "mrcaott246ott157232"
## [185] "mrcaott246ott18313"
## [186] "Troglodytinae"
## [187] "mrcaott18313ott87938"
## [188] "Campylorhynchus"
## [189] "mrcaott87938ott800237"
## [190] "mrcaott3364ott73828"
```

```
## [191] "mrcaott3364ott4083"
## [192] "mrcaott4083ott35042"
## [193] "mrcaott4083ott370807"
## [194] "mrcaott4083ott469177"
## [195] "mrcaott4083ott4088"
## [196] "mrcaott4088ott95302"
## [197] "mrcaott4088ott9416"
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## [199] "mrcaott4088ott6366"
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## [202] "mrcaott5616ott28339"
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## [209] "mrcaott6023ott125079"
## [210] "mrcaott6023ott261498"
## [211] "mrcaott6023ott97318"
## [212] "mrcaott6023ott262696"
## [213] "mrcaott6023ott1027553"
## [214] "mrcaott6023ott97315"
## [215] "mrcaott97315ott463018"
## [216] "Kieneria"
## [217] "mrcaott97318ott408447"
## [218] "Pipilo"
## [219] "mrcaott261498ott292639"
## [220] "mrcaott261498ott934463"
## [221] "mrcaott261498ott292635"
## [222] "mrcaott292635ott765407"
## [223] "Pooecetes"
## [224] "mrcaott125079ott463026"
## [225] "mrcaott125079ott765405"
## [226] "'Zonotrichia (genus in domain Eukaryota)'"
## [227] "mrcaott125079ott265547"
## [228] "mrcaott125079ott265554"
## [229] "mrcaott243614ott292646"
## [230] "Spizella"
## [231] "mrcaott243614ott989506"
## [232] "mrcaott243614ott463036"
## [233] "mrcaott243614ott989508"
## [234] "mrcaott243614ott567431"
## [235] "mrcaott243614ott463034"
## [236] "mrcaott292646ott890355"
## [237] "mrcaott292646ott630695"
## [238] "Amphispiza"
## [239] "mrcaott890355ott948123"
## [240] "Calamospiza"
## [241] "mrcaott5021ott17146"
## [242] "mrcaott17146ott57819"
## [243] "Columbiformes"
## [244] "mrcaott17146ott45505"
```

```
## [245] "mrcaott45505ott50388"
## [246] "mrcaott50388ott120585"
## [247] "mrcaott120585ott189782"
## [248] "mrcaott120585ott244142"
## [249] "mrcaott120585ott183576"
## [250] "Zenaida"
## [251] "mrcaott183576ott329066"
## [252] "mrcaott183576ott329068"
## [253] "Galloanserae"
## [254] "Galliformes"
## [255] "mrcaott4765ott6520194"
## [256] "mrcaott4765ott109888"
## [257] "mrcaott4765ott75785"
## [258] "mrcaott4765ott104461"
## [259] "mrcaott4765ott151684"
## [260] "mrcaott204719ott554512"
## [261] "Odontophoridae"
## [262] "mrcaott204719ott329467"
## [263] "mrcaott204719ott5860929"
## [264] "mrcaott204719ott3596007"
## [265] "mrcaott204719ott3596012"
## [266] "mrcaott204719ott5860945"
## [267] "Callipepla"
## [268] "mrcaott204719ott5860923"
## [269] "mrcaott1662ott4947157"
## [270] "Lepidosauria"
## [271] "'Squamata (order in Deuterostomia)'"
## [272] "Bifurcata"
## [273] "Unidentata"
## [274] "Episquamata"
## [275] "mrcaott1662ott2417"
## [276] "mrcaott1662ott4126044"
## [277] "Serpentes"
## [278] "mrcaott1662ott20148"
## [279] "mrcaott1662ott4126085"
## [280] "mrcaott1662ott35603"
## [281] "mrcaott1662ott16254"
## [282] "mrcaott1662ott106872"
## [283] "mrcaott1662ott215727"
## [284] "mrcaott1662ott6519"
## [285] "Viperidae"
## [286] "mrcaott6519ott705289"
## [287] "Crotalinae"
## [288] "mrcaott6519ott26866"
## [289] "mrcaott6519ott6535"
## [290] "mrcaott6519ott11126"
## [291] "mrcaott6519ott27081"
## [292] "mrcaott6519ott125357"
## [293] "mrcaott6519ott130701"
## [294] "Crotalus"
## [295] "mrcaott6519ott21537"
## [296] "mrcaott21537ott27076"
## [297] "mrcaott27076ott373874"
## [298] "mrcaott27076ott29217"
```

```
## [299] "mrcaott29217ott123878"
## [300] "mrcaott29217ott600067"
## [301] "mrcaott29217ott29219"
## [302] "mrcaott2417ott97368"
## [303] "mrcaott2417ott4124528"
## [304] "Iguania"
## [305] "mrcaott3089ott4125746"
## [306] "mrcaott3089ott4125739"
## [307] "mrcaott3089ott9418"
## [308] "mrcaott3089ott53412"
## [309] "mrcaott3089ott6523"
## [310] "mrcaott3089ott15148"
## [311] "Phrynosomatidae"
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## [313] "mrcaott47621ott160827"
## [314] "mrcaott47621ott47629"
## [315] "Sceloporus"
## [316] "mrcaott47621ott47622"
## [317] "mrcaott47622ott342572"
## [318] "mrcaott47622ott47623"
## [319] "mrcaott47623ott51605"
## [320] "mrcaott51605ott265513"
## [321] "mrcaott51605ott795086"
## [322] "mrcaott51605ott656094"
## [323] "mrcaott51605ott51946"
## [324] "mrcaott51605ott57949"
## [325] "mrcaott51605ott624292"
## [326] "mrcaott51605ott96965"
## [327] "mrcaott51605ott917784"
## [328] "mrcaott51605ott608985"
## [329] "mrcaott51605ott917788"
## [330] "mrcaott51605ott80380"
## [331] "mrcaott80380ott265537"
## [332] "Crotaphytinae"
## [333] "'Gambelia (genus in Opisthokonta)'"
## [334] "mrcaott4987ott10058"
## [335] "mrcaott4987ott41163"
## [336] "mrcaott41163ott236051"
## [337] "mrcaott41163ott973821"
## [338] "mrcaott41163ott164954"
## [339] "mrcaott41163ott661799"
## [340] "mrcaott41163ott227429"
## [341] "mrcaott41163ott153490"
## [342] "mrcaott41163ott153486"
## [343] "Aspidoscelis"
## [344] "mrcaott348427ott498244"
## [345] "Aspidoscelis_tigris_group"
```

```
summary(portal_tree)
```

```
##
## Phylogenetic tree: portal_tree
##
##   Number of tips: 43
```

```
##   Number of nodes: 345
##   No branch lengths.
##   No root edge.
##   First ten tip labels: Sigmodon_ochrognathus
##                         Sigmodon_hispidus
##                         Sigmodon_fulviventer
##                         Neotoma_albigula
##                         Onychomys_leucogaster
##                         Onychomys_torridus
##                         Peromyscus_maniculatus
##                         Peromyscus_leucopus
##                         Peromyscus_eremicus
##                         Reithrodontomys_fulvescens
##   First ten node labels: Amniota
##                          Mammalia
##                          'Theria (subclass in Deuterostomia)'
##                          'Eutheria (in Deuterostomia)'
##                          Boreoeutheria
##                          Euarchontoglires
##                          mrcaott42ott30082
##                          Glires
##                          mrcaott42ott29157
##                          Rodentia
```

```
str(portal_tree)
```

```
## List of 4
##  $ edge      : int [1:387, 1:2] 44 45 46 47 48 49 50 51 52 53 ...
##  $ Nnode     : int 345
##  $ node.label: chr [1:345] "Amniota" "Mammalia" "'Theria (subclass in Deuterostomia)'" "'Eutheria (i
##  $ tip.label : chr [1:43] "Sigmodon_ochrognathus" "Sigmodon_hispidus" "Sigmodon_fulviventer" "Neotoma
##  - attr(*, "class")= chr "phylo"
##  - attr(*, "order")= chr "cladewise"
```

```
class(portal_tree$edge)
```

```
## [1] "matrix" "array"
```

```
portal_tree$edge
```

```
##        [,1] [,2]
##   [1,]   44   45
##   [2,]   45   46
##   [3,]   46   47
##   [4,]   47   48
##   [5,]   48   49
##   [6,]   49   50
##   [7,]   50   51
##   [8,]   51   52
##   [9,]   52   53
##  [10,]   53   54
##  [11,]   54   55
```

```
##  [12,]   55   56
##  [13,]   56   57
##  [14,]   57   58
##  [15,]   58   59
##  [16,]   59   60
##  [17,]   60   61
##  [18,]   61   62
##  [19,]   62   63
##  [20,]   63   64
##  [21,]   64   65
##  [22,]   65   66
##  [23,]   66   67
##  [24,]   67   68
##  [25,]   68   69
##  [26,]   69   70
##  [27,]   70   71
##  [28,]   71   72
##  [29,]   72   73
##  [30,]   73    1
##  [31,]   72   74
##  [32,]   74   75
##  [33,]   75    2
##  [34,]   71   76
##  [35,]   76    3
##  [36,]   65   77
##  [37,]   77   78
##  [38,]   78   79
##  [39,]   79   80
##  [40,]   80   81
##  [41,]   81   82
##  [42,]   82   83
##  [43,]   83   84
##  [44,]   84    4
##  [45,]   77   85
##  [46,]   85   86
##  [47,]   86   87
##  [48,]   87   88
##  [49,]   88   89
##  [50,]   89   90
##  [51,]   90   91
##  [52,]   91    5
##  [53,]   90    6
##  [54,]   88   92
##  [55,]   92   93
##  [56,]   93   94
##  [57,]   94   95
##  [58,]   95   96
##  [59,]   96   97
##  [60,]   97   98
##  [61,]   98   99
##  [62,]   99    7
##  [63,]   95  100
##  [64,]  100    8
##  [65,]   93  101
```

```
##  [66,]  101  102
##  [67,]  102  103
##  [68,]  103  104
##  [69,]  104  105
##  [70,]  105    9
##  [71,]   87  106
##  [72,]  106  107
##  [73,]  107  108
##  [74,]  108  109
##  [75,]  109   10
##  [76,]  108  110
##  [77,]  110  111
##  [78,]  111   11
##  [79,]  110  112
##  [80,]  112  113
##  [81,]  113  114
##  [82,]  114  115
##  [83,]  115   12
##  [84,]   86  116
##  [85,]  116  117
##  [86,]  117   13
##  [87,]   56  118
##  [88,]  118  119
##  [89,]  119  120
##  [90,]  120  121
##  [91,]  121  122
##  [92,]  122  123
##  [93,]  123  124
##  [94,]  124  125
##  [95,]  125  126
##  [96,]  126  127
##  [97,]  127   14
##  [98,]  127  128
##  [99,]  128  129
## [100,]  129   15
## [101,]  124  130
## [102,]  130   16
## [103,]  123  131
## [104,]  131   17
## [105,]  122  132
## [106,]  132  133
## [107,]  133  134
## [108,]  134  135
## [109,]  135   18
## [110,]  120  136
## [111,]  136  137
## [112,]  137  138
## [113,]  138  139
## [114,]  139  140
## [115,]  140  141
## [116,]  141   19
## [117,]  139  142
## [118,]  142  143
## [119,]  143   20
```

```
## [120,]  138  144
## [121,]  144   21
## [122,]   54  145
## [123,]  145  146
## [124,]  146  147
## [125,]  147  148
## [126,]  148  149
## [127,]  149  150
## [128,]  150  151
## [129,]  151  152
## [130,]  152  153
## [131,]  153  154
## [132,]  154  155
## [133,]  155  156
## [134,]  156  157
## [135,]  157  158
## [136,]  158  159
## [137,]  159  160
## [138,]  160  161
## [139,]  161  162
## [140,]  162   22
## [141,]  161  163
## [142,]  163   23
## [143,]  154  164
## [144,]  164  165
## [145,]  165  166
## [146,]  166  167
## [147,]  167   24
## [148,]   52  168
## [149,]  168  169
## [150,]  169  170
## [151,]  170   25
## [152,]   44  171
## [153,]  171  172
## [154,]  172  173
## [155,]  173  174
## [156,]  174  175
## [157,]  175  176
## [158,]  176  177
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## [167,]  185  186
## [168,]  186  187
## [169,]  187  188
## [170,]  188  189
## [171,]  189  190
## [172,]  190  191
## [173,]  191  192
```

```
## [174,]  192  193
## [175,]  193  194
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## [177,]  195  196
## [178,]  196  197
## [179,]  197  198
## [180,]  198  199
## [181,]  199  200
## [182,]  200  201
## [183,]  201  202
## [184,]  202  203
## [185,]  203  204
## [186,]  204  205
## [187,]  205  206
## [188,]  206  207
## [189,]  207  208
## [190,]  208  209
## [191,]  209  210
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## [193,]  211  212
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## [198,]  216  217
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## [201,]  219  220
## [202,]  220  221
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## [205,]  223  224
## [206,]  224  225
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## [208,]  226  227
## [209,]  227  228
## [210,]  228  229
## [211,]  229  230
## [212,]  230  231
## [213,]  231  232
## [214,]  232   26
## [215,]  222  233
## [216,]  233  234
## [217,]  234  235
## [218,]  235  236
## [219,]  236  237
## [220,]  237  238
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## [222,]  239  240
## [223,]  240  241
## [224,]  241  242
## [225,]  242  243
## [226,]  243  244
## [227,]  244  245
```

```
## [228,]  245  246
## [229,]  246  247
## [230,]  247  248
## [231,]  248  249
## [232,]  249   27
## [233,]  246  250
## [234,]  250  251
## [235,]  251  252
## [236,]  252  253
## [237,]  253  254
## [238,]  254  255
## [239,]  255  256
## [240,]  256  257
## [241,]  257  258
## [242,]  258  259
## [243,]  259   28
## [244,]  254  260
## [245,]  260  261
## [246,]  261   29
## [247,]  253  262
## [248,]  262  263
## [249,]  263  264
## [250,]  264  265
## [251,]  265  266
## [252,]  266   30
## [253,]  252  267
## [254,]  267  268
## [255,]  268  269
## [256,]  269  270
## [257,]  270  271
## [258,]  271   31
## [259,]  250  272
## [260,]  272  273
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## [264,]  276  277
## [265,]  277  278
## [266,]  278   32
## [267,]  272  279
## [268,]  279  280
## [269,]  280  281
## [270,]  281   33
## [271,]  279  282
## [272,]  282  283
## [273,]  283   34
## [274,]  202  284
## [275,]  284  285
## [276,]  285  286
## [277,]  286  287
## [278,]  287  288
## [279,]  288  289
## [280,]  289  290
## [281,]  290  291
```

```
## [282,]  291  292
## [283,]  292  293
## [284,]  293  294
## [285,]  294  295
## [286,]  295   35
## [287,]  200  296
## [288,]  296  297
## [289,]  297  298
## [290,]  298  299
## [291,]  299  300
## [292,]  300  301
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## [298,]  306  307
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## [301,]  309  310
## [302,]  310  311
## [303,]  311   36
## [304,]  178  312
## [305,]  312  313
## [306,]  313  314
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## [330,]  337  338
## [331,]  338  339
## [332,]  339  340
## [333,]  340  341
## [334,]  341  342
## [335,]  342  343
```

```
## [336,]  343  344
## [337,]  344   37
## [338,]  343   38
## [339,]  318  345
## [340,]  345  346
## [341,]  346  347
## [342,]  347  348
## [343,]  348  349
## [344,]  349  350
## [345,]  350  351
## [346,]  351  352
## [347,]  352  353
## [348,]  353  354
## [349,]  354  355
## [350,]  355  356
## [351,]  356  357
## [352,]  357  358
## [353,]  358  359
## [354,]  359  360
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## [363,]  368  369
## [364,]  369  370
## [365,]  370  371
## [366,]  371  372
## [367,]  372  373
## [368,]  373  374
## [369,]  374   39
## [370,]  368   40
## [371,]  351  375
## [372,]  375  376
## [373,]  376   41
## [374,]  317  377
## [375,]  377  378
## [376,]  378  379
## [377,]  379  380
## [378,]  380  381
## [379,]  381  382
## [380,]  382  383
## [381,]  383  384
## [382,]  384  385
## [383,]  385  386
## [384,]  386   42
## [385,]  386  387
## [386,]  387  388
## [387,]  388   43
```
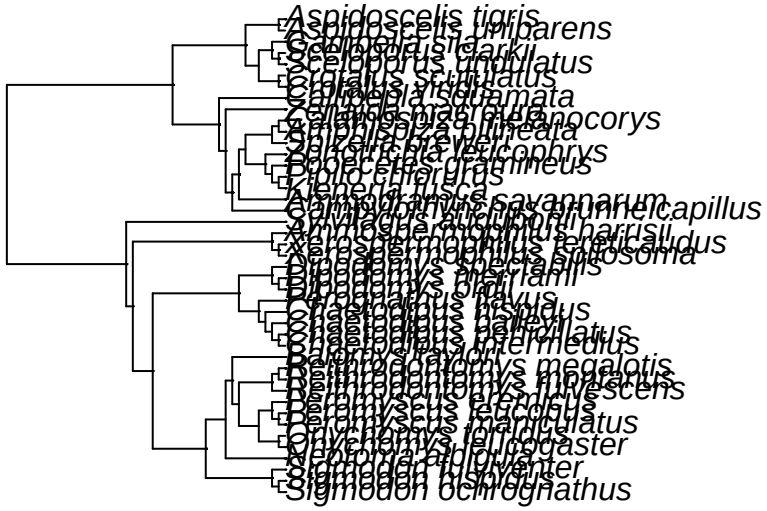

```
str(surveys)
```

```
## 'data.frame':    35549 obs. of  9 variables:
##  $ record_id      : int  1 2 3 4 5 6 7 8 9 10 ...
##  $ month          : int  7 7 7 7 7 7 7 7 7 7 ...
##  $ day            : int  16 16 16 16 16 16 16 16 16 16 ...
##  $ year           : int  1977 1977 1977 1977 1977 1977 1977 1977 1977 1977 ...
##  $ plot_id        : int  2 3 2 7 3 1 2 1 1 6 ...
##  $ species_id     : chr  "NL" "NL" "DM" "DM" ...
##  $ sex            : chr  "M" "M" "F" "M" ...
##  $ hindfoot_length: int  32 33 37 36 35 14 NA 37 34 20 ...
##  $ weight         : int  NA NA NA NA NA NA NA NA NA NA ...
```

```
plot.phylo(x = portal_tree)
```



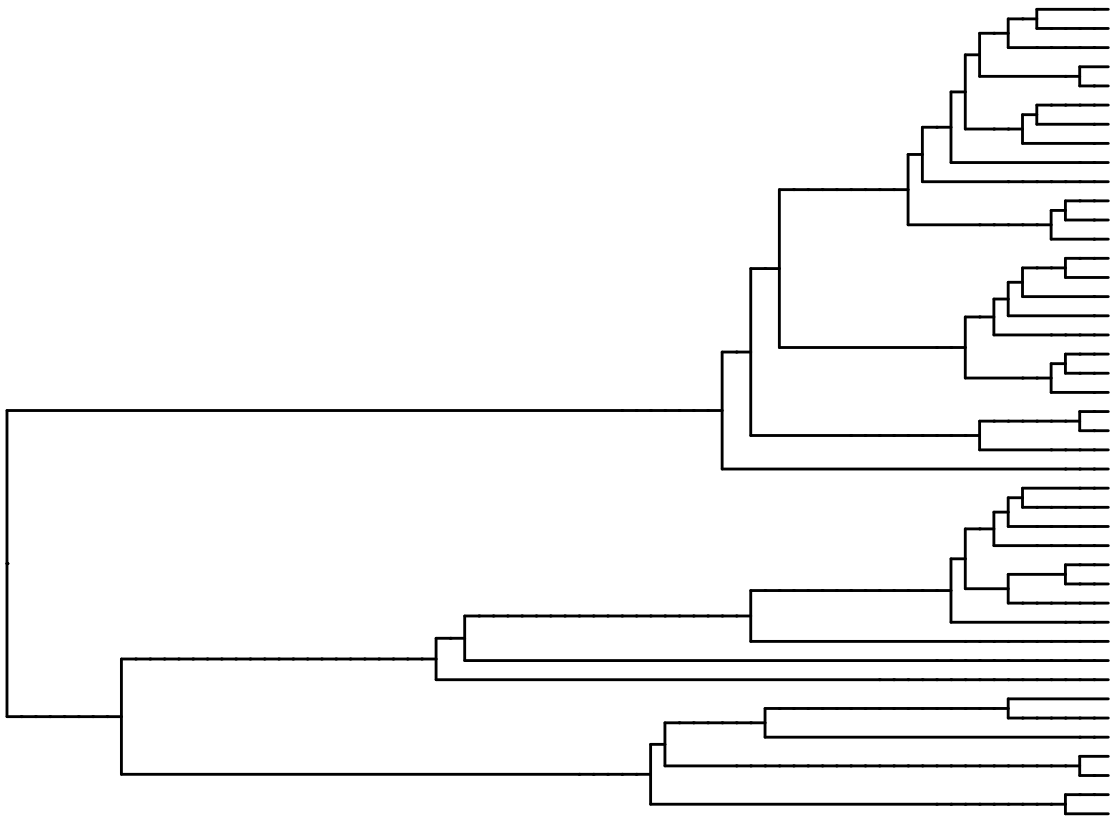
An extension of ggplot for phylogenetic visualization: `ggtree` To install packages from the Bioconductor repo, we need a CRAN package called BiocManager

```
library(BiocManager)
library(ggtree)
```

```
## ggtree v3.4.4 For help: https://yulab-smu.top/treedata-book/
##
## If you use the ggtree package suite in published research, please cite
```

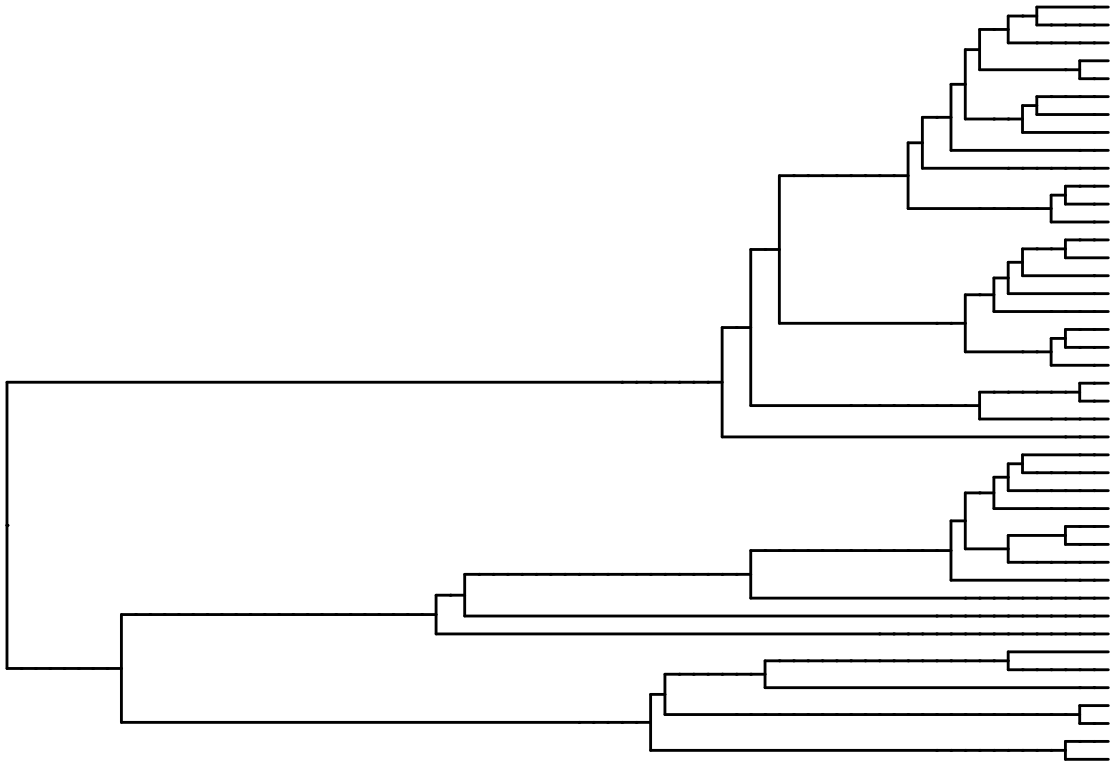
```
## the appropriate paper(s):
##
## Guangchuang Yu, David Smith, Huachen Zhu, Yi Guan, Tommy Tsan-Yuk Lam.
## ggtree: an R package for visualization and annotation of phylogenetic
## trees with their covariates and other associated data. Methods in
## Ecology and Evolution. 2017, 8(1):28-36. doi:10.1111/2041-210X.12628
##
## Guangchuang Yu, Tommy Tsan-Yuk Lam, Huachen Zhu, Yi Guan. Two methods
## for mapping and visualizing associated data on phylogeny using ggtree.
## Molecular Biology and Evolution. 2018, 35(12):3041-3043.
## doi:10.1093/molbev/msy194
##
## Guangchuang Yu.  Data Integration, Manipulation and Visualization of
## Phylogenetic Trees (1st edition). Chapman and Hall/CRC. 2022,
## doi:10.1201/9781003279242

##
## Attaching package: 'ggtree'

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

```
ggtree(portal_tree)
```



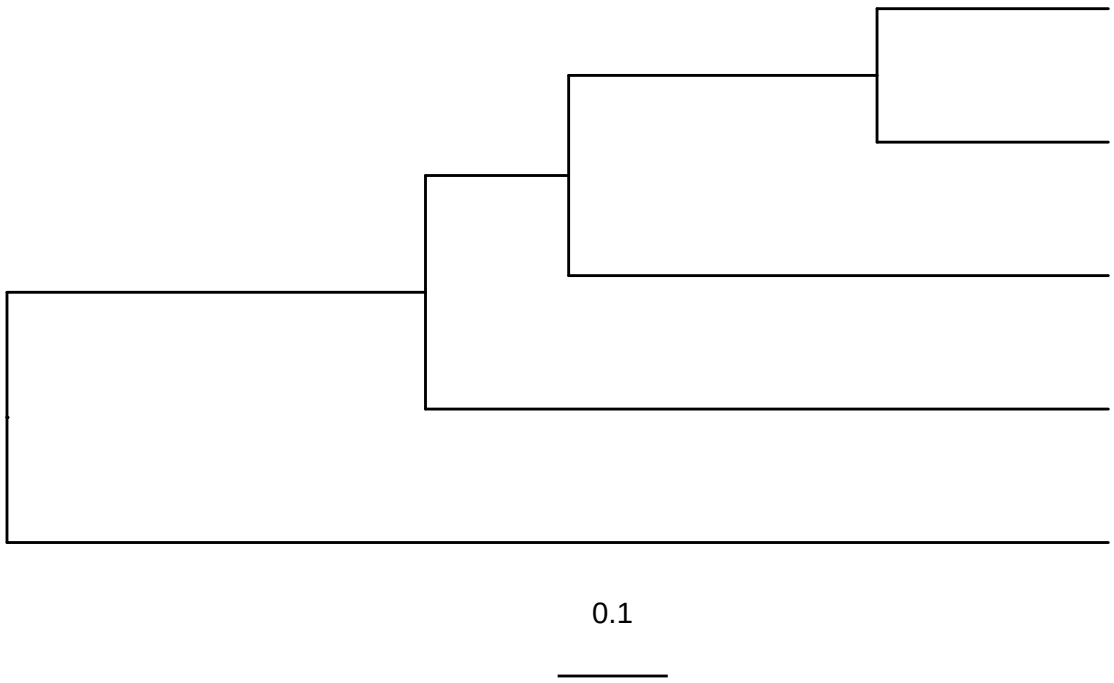
This is equivalent to:

```
ggplot(portal_tree, aes(x, y)) +
  geom_tree() +
  theme_tree()
```



Plot the small tree of five species of primates and include a scale what is the difference between the portal and the small tree

```
ggtree(small_tree) +
  geom_treescale()
```




```
class(small_tree)
```

```
## [1] "phylo"
```

```
length(small_tree) # gives the number of
```

```
## [1] 4
```

```
names(small_tree)
```

```
## [1] "edge"        "edge.length" "Nnode"       "tip.label"
```

```
small_tree$Nnode
```

```
## [1] 4
```

```
small_tree["tip.label"]
```

```
## $tip.label
## [1] "Homo"   "Pongo"  "Macaca" "Ateles" "Galago"
```

```
head(small_tree[[3]])
```

```
## [1] 4
```

```
summary(small_tree)
```

```
##
## Phylogenetic tree: small_tree
##
##   Number of tips: 5
##   Number of nodes: 4
##   Branch lengths:
##     mean: 0.415
##     variance: 0.08208571
##     distribution summary:
##    Min. 1st Qu.  Median 3rd Qu.    Max.
##  0.1300  0.2100  0.3300  0.5225  1.0000
##   No root edge.
##   Tip labels: Homo
##               Pongo
##               Macaca
##               Ateles
##               Galago
##   No node labels.
```

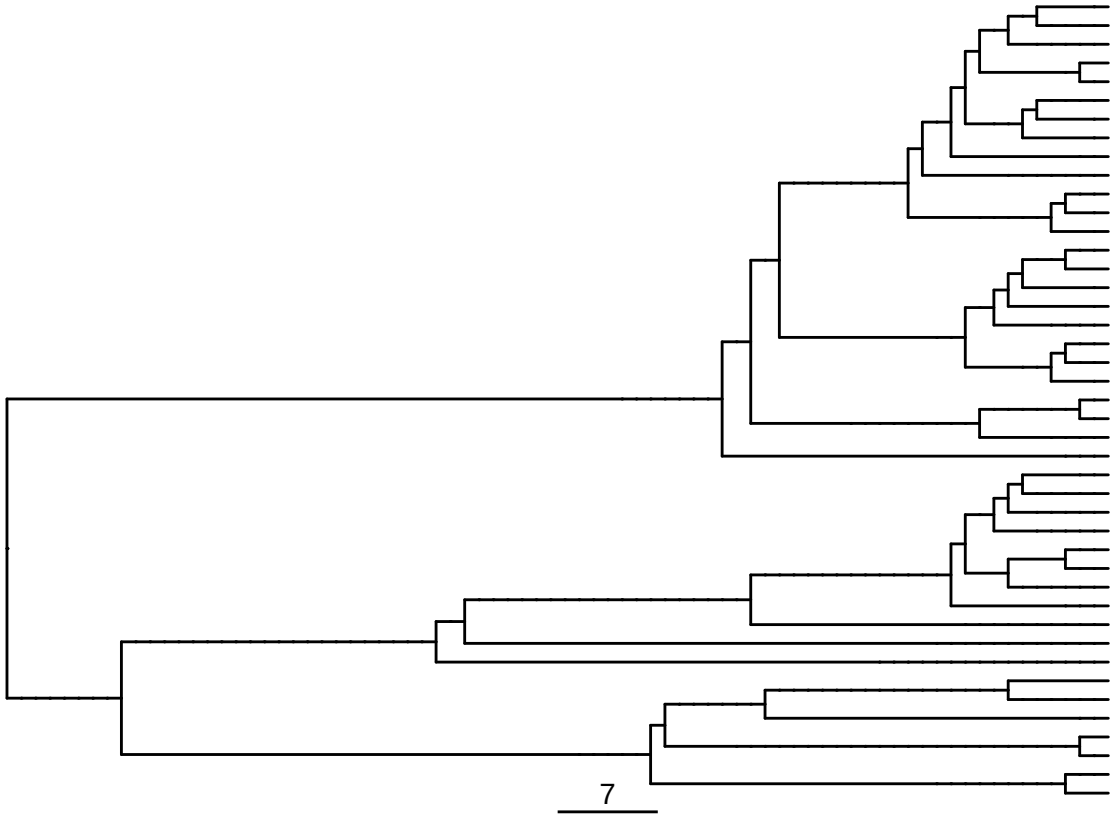
```
str(small_tree) # $ to access elements
```

```
## List of 4
##  $ edge       : int [1:8, 1:2] 6 7 8 9 9 8 7 6 7 8 ...
##  $ edge.length: num [1:8] 0.38 0.13 0.28 0.21 0.21 0.49 0.62 1
##  $ Nnode      : int 4
##  $ tip.label  : chr [1:5] "Homo" "Pongo" "Macaca" "Ateles" ...
##  - attr(*, "class")= chr "phylo"
##  - attr(*, "order")= chr "cladewise"
```

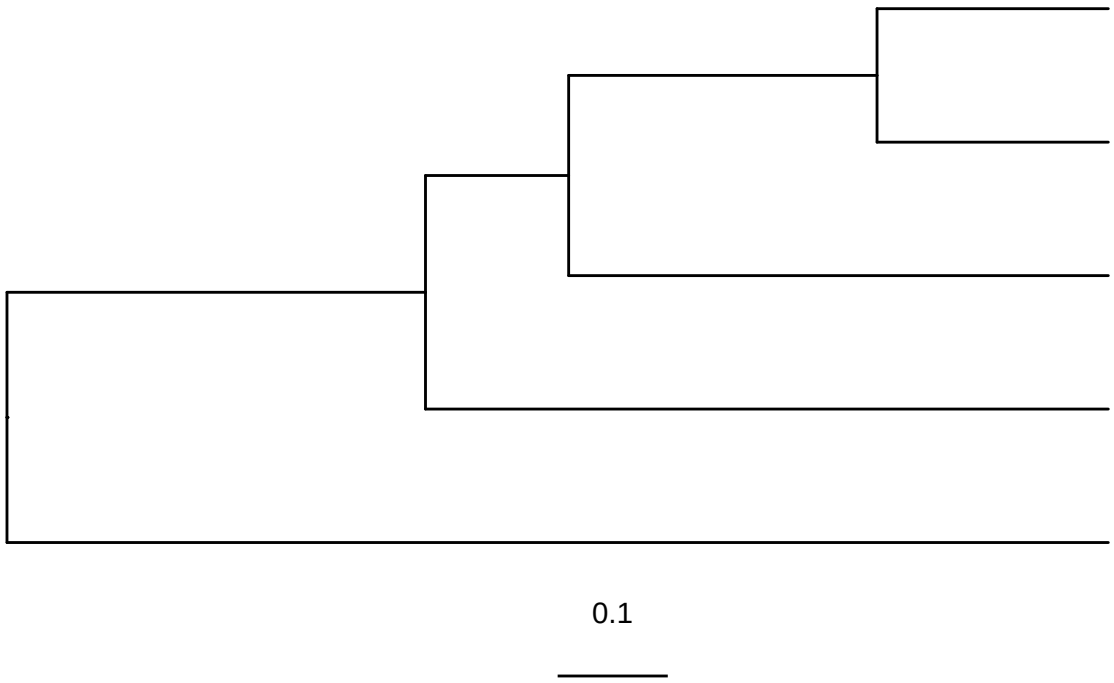
```
head(small_tree$edge)
```

```
##      [,1] [,2]
## [1,]    6    7
## [2,]    7    8
## [3,]    8    9
## [4,]    9    1
## [5,]    9    2
## [6,]    8    3
```

```
ggtree(portal_tree) +
geom_treescale()
```




```
ggtree(small_tree) +
geom_treescale()
```




```
names(small_tree)
```

```
## [1] "edge"        "edge.length" "Nnode"       "tip.label"
```

- a difference in number of tips (43 vs 5)
- an edge length in 'small_tree', but it has no node labels

```
small_tree$edge.length
```

```
## [1] 0.38 0.13 0.28 0.21 0.21 0.49 0.62 1.00
```

```
small_tree$node.label
```

```
## NULL
```

```
portal_tree$node.label
```

```
##   [1] "Amniota"
##   [2] "Mammalia"
##   [3] "'Theria (subclass in Deuterostomia)'"
##   [4] "'Eutheria (in Deuterostomia)'"
##   [5] "Boreoeutheria"
##   [6] "Euarchontoglires"
```

```
##   [7] "mrcaott42ott30082"
##   [8] "Glires"
##   [9] "mrcaott42ott29157"
##  [10] "Rodentia"
##  [11] "mrcaott42ott10477"
##  [12] "mrcaott42ott38834"
##  [13] "mrcaott42ott48903"
##  [14] "mrcaott42ott254702"
##  [15] "Myomorpha"
##  [16] "Muroidea"
##  [17] "mrcaott42ott45197"
##  [18] "mrcaott42ott55942"
##  [19] "mrcaott42ott102"
##  [20] "mrcaott102ott739"
##  [21] "Cricetidae"
##  [22] "mrcaott739ott15637"
##  [23] "mrcaott739ott119008"
##  [24] "mrcaott739ott38053"
##  [25] "mrcaott38053ott39197"
##  [26] "Sigmodon"
##  [27] "mrcaott39197ott1067882"
##  [28] "mrcaott39197ott1067867"
##  [29] "mrcaott39197ott208424"
##  [30] "mrcaott39197ott208422"
##  [31] "mrcaott208424ott576098"
##  [32] "mrcaott208424ott1067878"
##  [33] "mrcaott1067867ott1067876"
##  [34] "Neotominae"
##  [35] "mrcaott15637ott15642"
##  [36] "Neotoma"
##  [37] "mrcaott15638ott5266793"
##  [38] "mrcaott15638ott83673"
##  [39] "mrcaott83673ott169825"
##  [40] "mrcaott169825ott690543"
##  [41] "mrcaott169825ott381420"
##  [42] "mrcaott18770ott5266794"
##  [43] "mrcaott18770ott39171"
##  [44] "mrcaott18770ott39181"
##  [45] "mrcaott18770ott76407"
##  [46] "mrcaott18770ott427266"
##  [47] "Onychomys"
##  [48] "mrcaott427266ott1004147"
##  [49] "mrcaott76407ott1024550"
##  [50] "mrcaott76407ott138845"
##  [51] "mrcaott76407ott319357"
##  [52] "mrcaott76407ott373073"
##  [53] "mrcaott76407ott576106"
##  [54] "mrcaott76407ott259483"
##  [55] "mrcaott259483ott1026151"
##  [56] "mrcaott259483ott259485"
##  [57] "mrcaott373073ott576104"
##  [58] "mrcaott138845ott162838"
##  [59] "mrcaott138845ott162828"
##  [60] "mrcaott162828ott343211"
```

```
##  [61] "mrcaott343211ott343214"
##  [62] "mrcaott343214ott576102"
##  [63] "mrcaott39181ott489149"
##  [64] "Reithrodontomys"
##  [65] "mrcaott39181ott208412"
##  [66] "mrcaott39181ott222510"
##  [67] "mrcaott208412ott208414"
##  [68] "mrcaott208412ott208418"
##  [69] "mrcaott208414ott208416"
##  [70] "mrcaott208416ott222512"
##  [71] "mrcaott208416ott770864"
##  [72] "mrcaott208416ott732037"
##  [73] "mrcaott39171ott91079"
##  [74] "Baiomys"
##  [75] "Castorimorpha"
##  [76] "mrcaott48903ott80974"
##  [77] "Heteromyidae"
##  [78] "mrcaott48903ott190180"
##  [79] "Perognathinae"
##  [80] "Chaetodipus"
##  [81] "mrcaott190180ott320777"
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## [271] "'Squamata (order in Deuterostomia)'"
## [272] "Bifurcata"
## [273] "Unidentata"
## [274] "Episquamata"
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## [276] "mrcaott1662ott4126044"
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## [335] "mrcaott4987ott41163"
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## [344] "mrcaott348427ott498244"
## [345] "Aspidoscelis_tigris_group"
```
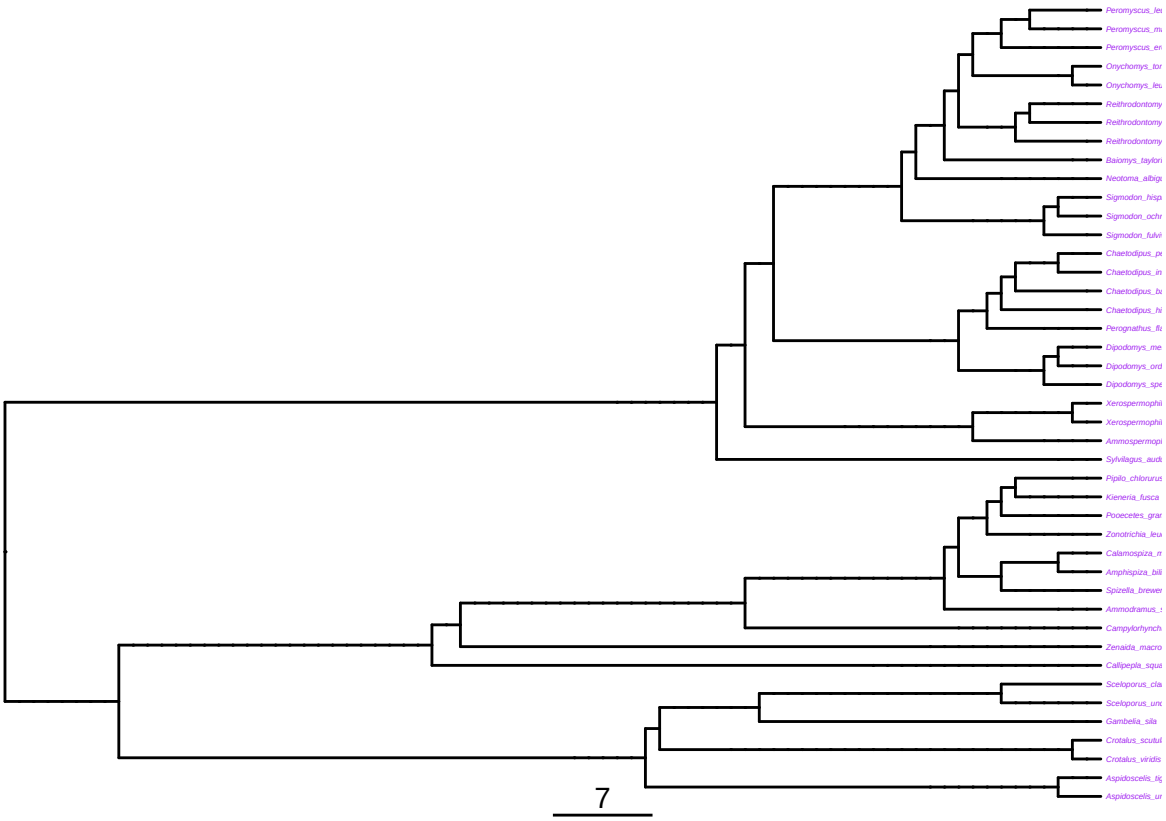

Add tip labels and node labels

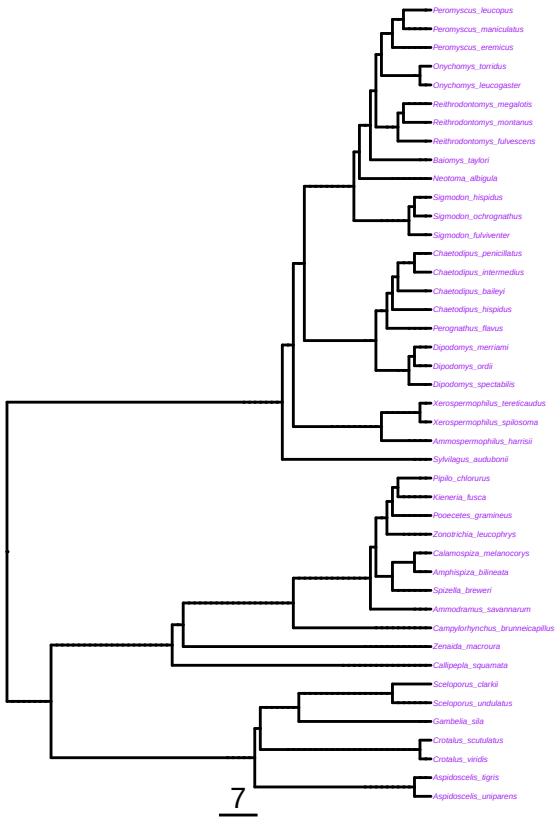
Because a plot is nothing with no labels:

```
ggtree(portal_tree) +
  geom_treescale() +
  geom_tiplab(size = 1, color = "purple", fontface = "italic")
```



Add a limit to the plot so we can see the labels fully:

```
ggtree(portal_tree) +
  geom_treescale() +
  geom_tiplab(size = 1, color = "purple", fontface = "italic") +
  xlim(NA,200)
```



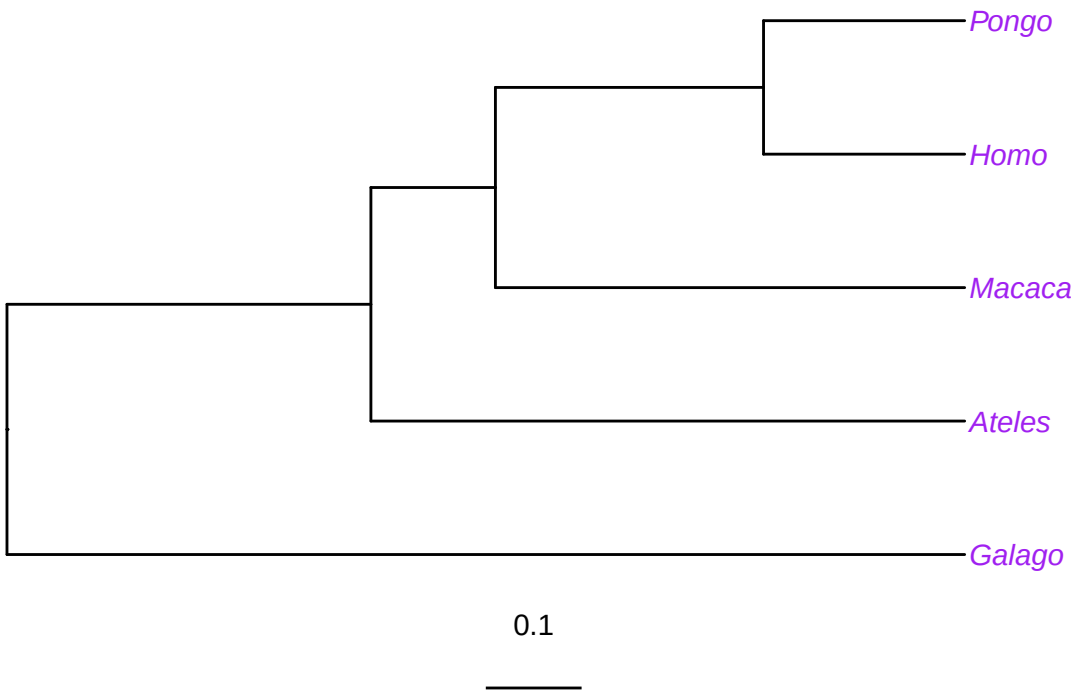
Do this for small_tree for homework

Get branch lengths

```
branching.times(small_tree)
```

```
##    6    7    8    9
## 1.00 0.62 0.49 0.21
```

```
ggtree(small_tree) +
  geom_treescale() +
  geom_tiplab(size = 4, color = "purple", fontface = "italic") +
  xlim(NA,1.15)
```


Pongo
Homo
Macaca
Ateles
Galago
0.1