

# Package ‘taxonomizr’

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**Maintainer** Scott Sherrill-Mix <shescott@upenn.edu>

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**Title** Functions to Work with NCBI Accessions and Taxonomy

**Type** Package

**LazyLoad** yes

**Author** Scott Sherrill-Mix [aut, cre]

**BugReports** <https://github.com/sherrillmix/taxonomizr/issues>

## Description

Functions for assigning taxonomy to NCBI accession numbers and taxon IDs based on NCBI's accession2taxid and taxdump files. This package allows the user to download NCBI data dumps and create a local database for fast and local taxonomic assignment.

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---

accessionToTaxa	<i>Convert accessions to taxa</i>
-----------------	-----------------------------------

---

## Description

Convert a vector of NCBI accession numbers to their assigned taxonomy

## Usage

```
accessionToTaxa(accessions, sqlFile, version = c("version", "base"))
```

## Arguments

accessions	a vector of NCBI accession strings to convert to taxa
sqlFile	a string giving the path to a SQLite file screated by <a href="#">read.accession2taxid</a>
version	either 'version' indicating that taxaids are versioned e.g. Z17427.1 or 'base' indicating that taxaids do not have version numbers e.g. Z17427

## Value

a vector of NCBI taxa ids

## References

<https://ftp.ncbi.nih.gov/pub/taxonomy/accession2taxid/>

**See Also**

[getTaxonomy](#), [read.accession2taxid](#)

**Examples**

```
taxa<-c(
  "accession\taccession.version\ttaxid\tgi",
  "Z17427\tZ17427.1\t3702\t16569",
  "Z17428\tZ17428.1\t3702\t16570",
  "Z17429\tZ17429.1\t3702\t16571",
  "Z17430\tZ17430.1\t3702\t16572",
  "X62402\tX62402.1\t9606\t30394"
)
inFile<-tempfile()
sqlFile<-tempfile()
writeLines(taxa,inFile)
read.accession2taxid(inFile,sqlFile,vocal=FALSE)
accessionToTaxa(c("Z17430.1","Z17429.1","X62402.1",'NOTREAL'),sqlFile)
```

---

condenseTaxa	<i>Condense multiple taxonomic assignments to their most recent common branch</i>
--------------	---

---

**Description**

Take a table of taxonomic assignments, e.g. assignments from hits to a read, and condense it to a single vector with NAs where there are disagreements between the hits.

**Usage**

```
condenseTaxa(taxaTable, groupings = rep(1, nrow(taxaTable)))
```

**Arguments**

taxaTable	a matrix or data.frame with hits on the rows and various levels of taxonomy in the columns
groupings	a vector of groups e.g. read queries to condense taxa within

**Value**

a matrix with `ncol(taxaTable)` taxonomy columns with a row for each unique id (labelled on `rownames`) with NAs where there was not complete agreement for an id

## Examples

```
taxas<-matrix(c(
  'a','b','c','e',
  'a','b','d','e'
),nrow=2,byrow=TRUE)
condenseTaxa(taxas)
condenseTaxa(taxas[c(1,2,2),],c(1,1,2))
```

---

getAccession2taxid      *Download accession2taxid files from NCBI*

---

## Description

Download a nucl\_xxx.accession2taxid.gz from NCBI servers. These can then be used to create a SQLite datanase with [read.accession2taxid](#). Note that if the files already exist in the target directory then this function will not redownload them. Delete the files if a fresh download is desired.

## Usage

```
getAccession2taxid(
  outDir = ".",
  baseUrl = "ftp://ftp.ncbi.nih.gov/pub/taxonomy/accession2taxid/",
  types = c("nucl_gb", "nucl_wgs")
)
```

## Arguments

outDir	the directory to put the accession2taxid.gz files in
baseUrl	the url of the directory where accession2taxid.gz files are located
types	the types if accession2taxid.gz files desired where type is the prefix of xxx.accession2taxid.gz. The default is to download all nucl_ accessions. For protein accessions, try types=c('prot').

## Value

a vector of file path strings of the locations of the output files

## References

<https://ftp.ncbi.nih.gov/pub/taxonomy/>, [https://www.ncbi.nlm.nih.gov/genbank/acc\\_prefix/](https://www.ncbi.nlm.nih.gov/genbank/acc_prefix/)

## See Also

[read.accession2taxid](#)

## Examples

```
## Not run:
if(readline(
  "This will download a lot data and take a while to process.
  Make sure you have space and bandwidth. Type y to continue: "
)!='y')
  stop('This is a stop to make sure no one downloads a bunch of data unintentionally')

getAccession2taxid()

## End(Not run)
```

---

getAccessions	<i>Find all accessions for a taxa</i>
---------------	---------------------------------------

---

## Description

Find accessions numbers for a given taxa ID the NCBI taxonomy. This will be pretty slow unless the database was built with `indexTaxa=TRUE` since the database would not have an index for `taxaId`.

## Usage

```
getAccessions(taxaId, sqlFile, version = c("version", "base"), limit = NULL)
```

## Arguments

<code>taxaId</code>	a vector of taxonomic IDs
<code>sqlFile</code>	a string giving the path to a SQLite file created by <a href="#">read.accession2taxid</a>
<code>version</code>	either 'version' indicating that taxoids are versioned e.g. Z17427.1 or 'base' indicating that taxoids do not have version numbers e.g. Z17427
<code>limit</code>	return only this number of accessions or NULL for no limits

## Value

a vector of character strings giving taxa IDs (potentially comma concatenated for any taxa with ambiguous names)

## See Also

[read.accession2taxid](#)

**Examples**

```

taxa<-c(
  "accession\taccession.version\ttaxid\tgi",
  "Z17427\tZ17427.1\t3702\t16569",
  "Z17428\tZ17428.1\t3702\t16570",
  "Z17429\tZ17429.1\t3702\t16571",
  "Z17430\tZ17430.1\t3702\t16572"
)
inFile<-tempfile()
sqlFile<-tempfile()
writeLines(taxa,inFile)
read.accession2taxid(inFile,sqlFile,vocal=FALSE)
getAccessions(3702,sqlFile)

```

---

getId

*Find a given taxa by name*


---

**Description**

Find a taxa by string in the NCBI taxonomy. Note that NCBI species are stored as Genus species e.g. "Bos taurus". Ambiguous taxa names will return a comma concatenated string e.g. "123,234" and generate a warning.

**Usage**

```
getId(taxa, sqlFile = "nameNode.sqlite", onlyScientific = TRUE)
```

**Arguments**

taxa	a vector of taxonomic names
sqlFile	a string giving the path to a SQLite file containing a names tables
onlyScientific	If TRUE then only match to scientific names. If FALSE use all names in database for matching (potentially increasing ambiguous matches).

**Value**

a vector of character strings giving taxa IDs (potentially comma concatenated for any taxa with ambiguous names)

**See Also**

[getTaxonomy](#), [read.names.sql](#)













```

)
writeLines(nodesText,tmpFile)
taxaNodes<-read.nodes.sql(tmpFile,sqlFile)
getTaxonomy(c(9606,9605),sqlFile)

```

---

getTaxonomy2

*Get taxonomic ranks for a taxa*


---

### Description

Take NCBI taxa IDs and get the corresponding taxa ranks from name and node data.tables. NOTE: This function is now deprecated for [getTaxonomy](#) (using SQLite rather than data.table).

### Usage

```

getTaxonomy2(
  ids,
  taxaNodes,
  taxaNames,
  desiredTaxa = c("superkingdom", "phylum", "class", "order", "family", "genus",
    "species"),
  mc.cores = 1,
  debug = FALSE
)

```

### Arguments

ids	a vector of ids to find taxonomy for
taxaNodes	a nodes data.table from <a href="#">read.nodes</a>
taxaNames	a names data.table from <a href="#">read.names</a>
desiredTaxa	a vector of strings giving the desired taxa levels
mc.cores	DEPRECATED the number of cores to use when processing. Note this option is now deprecated and has no effect. Please switch to <a href="#">getTaxonomy</a> (see <a href="#">taxonomizrSwitch</a> ) for much faster processing without requiring multiple cores.
debug	if TRUE output node and name vectors with dput for each id (probably useful only for development)

### Value

a matrix of taxonomic strings with a row for each id and a column for each desiredTaxa rank

### See Also

[read.nodes](#), [read.names](#), [getTaxonomy](#)



```

"314146\t|\t1437010\t|\tsuperorder", "1437010\t|\t9347\t|\tno rank",
"9347\t|\t32525\t|\tno rank", "32525\t|\t40674\t|\tno rank",
"40674\t|\t32524\t|\tclass", "32524\t|\t32523\t|\tno rank", "32523\t|\t1338369\t|\tno rank",
"1338369\t|\t8287\t|\tno rank", "8287\t|\t117571\t|\tno rank",
"117571\t|\t117570\t|\tno rank", "117570\t|\t7776\t|\tno rank",
"7776\t|\t7742\t|\tno rank", "7742\t|\t89593\t|\tno rank", "89593\t|\t7711\t|\tsubphylum",
"7711\t|\t33511\t|\tphylum", "33511\t|\t33213\t|\tno rank", "33213\t|\t6072\t|\tno rank",
"6072\t|\t33208\t|\tno rank", "33208\t|\t33154\t|\tkingdom",
"33154\t|\t2759\t|\tno rank", "2759\t|\t131567\t|\tsuperkingdom",
"131567\t|\t1\t|\tno rank"
)
writeLines(nodesText,tmpFile)
taxaNodes<-read.nodes(tmpFile)
getTaxonomy2(c(9606,9605),taxaNodes,taxaNames,mc.cores=1)

```

---

lastNotNa

*Return last not NA value*


---

## Description

A convenience function to return the last value which is not NA in a vector

## Usage

```
lastNotNa(x, default = "Unknown")
```

## Arguments

x                    a vector to look for the last value in  
default              a default value to use when all values are NA in a vector

## Value

a single element from the last non NA value in x (or the default)

## Examples

```

lastNotNa(c(1:4,NA,NA))
lastNotNa(c(letters[1:4],NA,'z',NA))
lastNotNa(c(NA,NA))

```

---

 makeNewick

 Create a Newick tree from taxonomy
 

---

## Description

Create a Newick formatted tree from a data.frame of taxonomic assignments

## Usage

```
makeNewick(
  taxa,
  naSub = "_",
  excludeTerminalNAs = FALSE,
  quote = NULL,
  terminator = ";"
)
```

## Arguments

taxa	a matrix with a row for each leaf of the tree and a column for each taxonomic classification e.g. the output from <code>getTaxonomy</code>
naSub	a character string to substitute in place of NAs in the taxonomy
excludeTerminalNAs	If TRUE then do not output nodes downstream of the last named taxonomic level in a row
quote	If not NULL then wrap all entries with this character
terminator	If not NULL then add this character to the end of the tree

## Value

a string giving a Newick formatted tree

## See Also

[getTaxonomy](#)

## Examples

```
taxa<-matrix(c('A','A','A','B','B','C','D','D','E','F','G','H'),nrow=3)
makeNewick(taxa)
taxa<-matrix(c('A','A','A','B',NA,'C','D','D',NA,'F','G',NA),nrow=3)
makeNewick(taxa)
makeNewick(taxa,excludeTerminalNAs=TRUE)
makeNewick(taxa,quote="")
```

---

`normalizeTaxa`*Bring multiple raw taxonomies into alignment*

---

### Description

Combine the raw taxonomy of several taxa into a single matrix where each row corresponds to a taxa and each column a taxonomic level. Named taxonomic levels are aligned between taxa then any unspecified clades are combined between the named levels. Taxonomic levels between named levels are arbitrarily combined from most generic to most specific. Working from the data provided in the NCBI taxonomy results in ambiguities so results should be used with care.

### Usage

```
normalizeTaxa(  
  rawTaxa,  
  cladeRegex = "^clade$|^clade\\.\\.[0-9]+$|^$|no rank",  
  rootFill = "_ROOT_",  
  lineageOrder = c()  
)
```

### Arguments

<code>rawTaxa</code>	A list of vectors with each vector containing a named character vector with entries specifying taxonomy for a clade and names giving the corresponding taxonomic levels e.g. the output from <a href="#">getRawTaxonomy</a>
<code>cladeRegex</code>	A regex to identify ambiguous taxonomic levels. In the case of NCBI taxonomy, these unidentified levels are all labelled "clade" and <a href="#">getRawTaxonomy</a> may attach a unique digit attach to the end for uniqueness.
<code>rootFill</code>	If a clade is upstream of the highest taxonomic level then it will be labeled with this prefix
<code>lineageOrder</code>	A vector giving an ordering for lineages from most specific to most generic. This should be unnecessary unless the taxonomy contains ambiguities e.g. one taxa goes from species to kingdom while another goes from genus to kingdom leaving it ambiguous whether genus or species is more specific

### Value

a matrix with a row for each taxa and a column for each taxonomic level

### See Also

[getRawTaxonomy](#)

**Examples**

```

rawTaxa<-list(
  '81907' = c(species = "Alectura lathamii", genus = "Alectura",
    family = "Megapodiidae", order = "Galliformes", superorder = "Galloanserae",
    infraclass = "Neognathae", class = "Aves", clade = "Coelurosauria",
    clade.1 = "Theropoda", clade.2 = "Saurischia", clade.3 = "Dinosauria",
    clade.4 = "Archosauria", clade.5 = "Archelosauria", clade.6 = "Sauria",
    clade.7 = "Sauropsida", clade.8 = "Amniota", clade.9 = "Tetrapoda",
    clade.10 = "Dipnotetrapodomorpha", superclass = "Sarcopterygii",
    clade.11 = "Euteleostomi", clade.12 = "Teleostomi", clade.13 = "Gnathostomata",
    clade.14 = "Vertebrata", subphylum = "Craniata", phylum = "Chordata",
    clade.15 = "Deuterostomia", clade.16 = "Bilateria", clade.17 = "Eumetazoa",
    kingdom = "Metazoa", clade.18 = "Opisthokonta", superkingdom = "Eukaryota",
    'no rank' = "cellular organisms"),
  '8496' = c(species = "Alligator mississippiensis",
    genus = "Alligator", subfamily = "Alligatorinae", family = "Alligatoridae",
    order = "Crocodylia", clade = "Archosauria", clade.1 = "Archelosauria",
    clade.2 = "Sauria", clade.3 = "Sauropsida", clade.4 = "Amniota",
    clade.5 = "Tetrapoda", clade.6 = "Dipnotetrapodomorpha", superclass = "Sarcopterygii",
    clade.7 = "Euteleostomi", clade.8 = "Teleostomi", clade.9 = "Gnathostomata",
    clade.10 = "Vertebrata", subphylum = "Craniata", phylum = "Chordata",
    clade.11 = "Deuterostomia", clade.12 = "Bilateria", clade.13 = "Eumetazoa",
    kingdom = "Metazoa", clade.14 = "Opisthokonta", superkingdom = "Eukaryota",
    'no rank' = "cellular organisms"),
  '38654' = c(species = "Alligator sinensis",
    genus = "Alligator", subfamily = "Alligatorinae", family = "Alligatoridae",
    order = "Crocodylia", clade = "Archosauria", clade.1 = "Archelosauria",
    clade.2 = "Sauria", clade.3 = "Sauropsida", clade.4 = "Amniota",
    clade.5 = "Tetrapoda", clade.6 = "Dipnotetrapodomorpha", superclass = "Sarcopterygii",
    clade.7 = "Euteleostomi", clade.8 = "Teleostomi", clade.9 = "Gnathostomata",
    clade.10 = "Vertebrata", subphylum = "Craniata", phylum = "Chordata",
    clade.11 = "Deuterostomia", clade.12 = "Bilateria", clade.13 = "Eumetazoa",
    kingdom = "Metazoa", clade.14 = "Opisthokonta", superkingdom = "Eukaryota",
    'no rank' = "cellular organisms")
)
normalizeTaxa(rawTaxa)

```

---

```
prepareDatabase
```

---

*Download data from NCBI and set up SQLite database*

---

**Description**

Convenience function to do all necessary preparations downloading names, nodes and accession2taxid data from NCBI and preprocessing into a SQLite database for downstream use.

**Usage**

```

prepareDatabase(
  sqlFile = "nameNode.sqlite",

```

```

    tmpDir = ".",
    getAccessions = TRUE,
    vocal = TRUE,
    ...
)

```

### Arguments

sqlFile	character string giving the file location to store the SQLite database
tmpDir	location for storing the downloaded files from NCBI. (Note that it may be useful to store these somewhere convenient to avoid re-downloading)
getAccessions	if TRUE download the very large accession2taxid files necessary to convert accessions to taxonomic IDs
vocal	if TRUE output messages describing progress
...	Arguments passed on to <a href="#">getNamesAndNodes</a> , <a href="#">getAccession2taxid</a> , <a href="#">read.accession2taxid</a>
url	the url where taxdump.tar.gz is located
fileNames	the filenames desired from the tar.gz file
baseUrl	the url of the directory where accession2taxid.gz files are located
types	the types of accession2taxid.gz files desired where type is the prefix of xxx.accession2taxid.gz. The default is to download all nucl_ accessions. For protein accessions, try types=c('prot').
extraSqlCommand	for advanced use. A string giving a command to be called on the SQLite database before loading data. A couple potential uses: <ul style="list-style-type: none"> <li>• "PRAGMA temp_store_directory = '/MY/TMP/DIR'" to store SQLite temporary files in directory /MY/TMP/DIR. Useful if the temporary directory used by SQLite (which is not necessarily in the same location as R's) is small on your system</li> <li>• "pragma temp_store = 2;" to keep all SQLite temp files in memory. Don't do this unless you have a lot (&gt;100 Gb) of RAM</li> </ul>
indexTaxa	if TRUE add an index for taxa ID. This would only be necessary if you want to look up accessions by taxa ID e.g. <a href="#">getAccessions</a>
overwrite	If TRUE, delete accessionTaxa table in database if present and re-generate

### Value

a vector of character string giving the path to the SQLite file

### See Also

[getNamesAndNodes](#), [getAccession2taxid](#), [read.accession2taxid](#), [read.nodes.sql](#), [read.names.sql](#)

### Examples

```

## Not run:
if(readline(
  "This will download a lot data and take a while to process.

```

```

    Make sure you have space and bandwidth. Type y to continue: "
  )!='y')
  stop('This is a stop to make sure no one downloads a bunch of data unintentionally')

  prepareDatabase()

## End(Not run)

```

---

read.accession2taxid *Read NCBI accession2taxid files*

---

## Description

Take NCBI accession2taxid files, keep only accession and taxa and save it as a SQLite database

## Usage

```

read.accession2taxid(
  taxaFiles,
  sqlFile,
  vocal = TRUE,
  extraSqlCommand = "",
  indexTaxa = FALSE,
  overwrite = FALSE
)

```

## Arguments

taxaFiles	a string or vector of strings giving the path(s) to files to be read in
sqlFile	a string giving the path where the output SQLite file should be saved
vocal	if TRUE output status messages
extraSqlCommand	for advanced use. A string giving a command to be called on the SQLite database before loading data. A couple potential uses: <ul style="list-style-type: none"> <li>• "PRAGMA temp_store_directory = '/MY/TMP/DIR'" to store SQLite temporary files in directory /MY/TMP/DIR. Useful if the temporary directory used by SQLite (which is not necessarily in the same location as R's) is small on your system</li> <li>• "pragma temp_store = 2;" to keep all SQLite temp files in memory. Don't do this unless you have a lot (&gt;100 Gb) of RAM</li> </ul>
indexTaxa	if TRUE add an index for taxa ID. This would only be necessary if you want to look up accessions by taxa ID e.g. <a href="#">getAccessions</a>
overwrite	If TRUE, delete accessionTaxa table in database if present and regenerate

## Value

TRUE if successful

**References**

<https://ftp.ncbi.nih.gov/pub/taxonomy/accession2taxid/>

**See Also**

[read.nodes.sql](#), [read.names.sql](#)

**Examples**

```
taxa<-c(
  "accession\taccession.version\ttaxid\tgi",
  "Z17427\tZ17427.1\t3702\t16569",
  "Z17428\tZ17428.1\t3702\t16570",
  "Z17429\tZ17429.1\t3702\t16571",
  "Z17430\tZ17430.1\t3702\t16572"
)
inFile<-tempfile()
sqlFile<-tempfile()
writeLines(taxa,inFile)
read.accession2taxid(inFile,sqlFile,vocal=FALSE)
db<-RSQLite::dbConnect(RSQLite::SQLite(),dbname=sqlFile)
RSQLite::dbGetQuery(db,'SELECT * FROM accessionTaxa')
RSQLite::dbDisconnect(db)
```

---

read.names

*Read NCBI names file*

---

**Description**

Take an NCBI names file, keep only scientific names and convert it to a `data.table`. NOTE: This function is now deprecated for [read.names.sql](#) (using SQLite rather than `data.table`).

**Usage**

```
read.names(nameFile, onlyScientific = TRUE)
```

**Arguments**

`nameFile` string giving the path to an NCBI name file to read from (both gzipped or uncompressed files are ok)

`onlyScientific` If TRUE, only store scientific names. If FALSE, synonyms and other types are included (increasing the potential for ambiguous taxonomic assignments).

**Value**

a `data.table` with columns `id` and `name` with a key on `id`









## Examples

```
tmpFile<-tempfile()
writeLines(LETTERS,tmpFile)
streamingRead(tmpFile,10,head,1)
writeLines(letters,tmpFile)
streamingRead(tmpFile,2,paste,collapse=' ',vocal=TRUE)
unlist(streamingRead(tmpFile,2,sample,1))
```

---

taxonomizrSwitch	<i>Switch from data.table to SQLite</i>
------------------	---

---

## Description

In version 0.5.0, taxonomizr switched from data.table to SQLite name and node lookups. See below for more details.

## Details

Version 0.5.0 marked a change for name and node lookups from using data.table to using SQLite. This was necessary to increase performance (10-100x speedup for [getTaxonomy](#)) and create a simpler interface (a single SQLite database contains all necessary data). Unfortunately, this switch requires a couple breaking changes:

- [getTaxonomy](#) changes from `getTaxonomy(ids, namesDT, nodesDT)` to `getTaxonomy(ids, sqlFile)`
- [getId](#) changes from `getId(taxa, namesDT)` to `getId(taxa, sqlFile)`
- [read.names](#) is deprecated, instead use [read.names.sql](#). For example, instead of calling `names<-read.names('names.dmp')` in every session, simply call `read.names.sql('names.dmp', 'accessionTaxa.')` once (or use the convenient [prepareDatabase](#)).
- [read.nodes](#) is deprecated, instead use [read.names.sql](#). For example, instead of calling `nodes<-read.names('nodes.dmp')` in every session, simply call `read.nodes.sql('nodes.dmp', 'accessionTaxa.')` once (or use the convenient [prepareDatabase](#)).

I've tried to ease any problems with this by overloading [getTaxonomy](#) and [getId](#) to still function (with a warning) if passed a data.table names and nodes argument and providing a simpler [prepareDatabase](#) function for completing all setup steps (hopefully avoiding direct calls to [read.names](#) and [read.nodes](#) for most users).

I plan to eventually remove data.table functionality to avoid a split codebase so please switch to the new SQLite format in all new code.

## See Also

[getTaxonomy](#), [read.names.sql](#), [read.nodes.sql](#), [prepareDatabase](#), [getId](#)

---

topoSort	<i>Combine multiple sorted vectors into a single sorted vector</i>
----------	--

---

**Description**

Combine multiple sorted vectors into a single vector assuming there are no cycles or weird topologies. Where a global position is ambiguous, the result is placed arbitrarily.

**Usage**

```
topoSort(vectors, maxIter = 1000, errorIfAmbiguous = FALSE)
```

**Arguments**

vectors	A list of vectors each vector containing sorted elements to be merged into a global sorted vector
maxIter	An integer specifying the maximum number of iterations before bailing out. This should be unnecessary and is just a safety feature in case of some unexpected input or bug.
errorIfAmbiguous	If TRUE then error if any ambiguities arise

**Value**

a vector with all unique elements sorted by the combined ordering provided by the input vectors

**See Also**

[normalizeTaxa](#)

**Examples**

```
topoSort(list(c('a', 'b', 'f', 'g'), c('b', 'e', 'g', 'y', 'z'), c('b', 'd', 'e', 'f', 'y')))
```

---

trimTaxa	<i>Trim columns from taxa file</i>
----------	------------------------------------

---

**Description**

A simple script to delete the first row and then delete the first and fourth column of a four column tab delimited file and write to another file.

**Usage**

```
trimTaxa(inFile, outFile, desiredCols = c(2, 3))
```

**Arguments**

<code>inFile</code>	a single string giving the 4 column tab separated file to read from
<code>outFile</code>	a single string giving the file path to write to
<code>desiredCols</code>	the integer IDs for columns to pull out from file

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