1. Reread in the csv file using genename as the index column. Remove the Unnamed column and the WormBase\_ID column from the data frame using drop or a similar method. Alternatively, specify that these columns shouldn’t be read in by the read\_csv command. Repeat some of the examples from the lecture with genename being the index.
2. Gamma-aminobutyric acid (GABA) is an amino acid that serves as the primary inhibitory neurotransmitter between nerve cells in the brain and spinal cord. Its natural function is binding to receptors GABA-A and GABA-B on the neurons to modulate and block impulses between nerve cells.

It plays a role in how people experience anxiety, fear, and stress. GABA acts to slow or block certain nerve signals in the brain, sometimes reducing feelings of anxiety. Without the right level of GABA activity in the body, nerve cells can be activated in ways that exacerbate certain conditions, like anxiety disorders.

In C. elegans, the gene unc-25 encodes glutamic acid decarboxylase (GAD), the GABA biosynthetic enzyme. This gene is expressed exclusively in GABAergic neurons. Based upon this information, what are the GABA releasing neurons in C. elegans? Create a list of neurons that are GABAergic.

1. Now create a function that takes in a dataframe and a genename, and returns all of the neurons that the gene is expressed in.
2. Run this function on the entire set of genes to find all of the genes that have the exact same expression pattern as unc-25
3. The GABAA receptor and the GABA-gated cation channel are the two primary receptors for GABA. They are encoded by the unc-49 and exp-1 genes. What are the neurons that these two receptors are expressed in? Do they overlap with each other?
4. Identify all of the genes that are only expressed in a single neuron class. How many are there? Does each neuron class have a gene that is only expressed in that class? Why are these genes useful as reagents to manipulate individual neurons through transgenics approaches?
5. cat-2 and tph-1 encode genes necessary for synthesizing dopamine and serotonin, respectively. What are the neurons that express these genes?
6. The srg family of genes express pheromone receptors, G-protein coupled receptors that are expressed in ciliated neurons that are exposed to the environment. Pheromones are used for communication between animals: each animal releases dozens of individual pheromones that communicate information about the themselves.
   1. How many srg genes are encoded in the genome? For this problem you need to filter on the index values, which is a little bit trickier. One way to do this is to access the index using dt.index and then using the str collection of functions:

>>> dir(dt.index.str)

['\_\_annotations\_\_', '\_\_class\_\_', '\_\_delattr\_\_', '\_\_dict\_\_', '\_\_dir\_\_', '\_\_doc\_\_', '\_\_eq\_\_', '\_\_format\_\_', '\_\_frozen', '\_\_ge\_\_', '\_\_getattribute\_\_', '\_\_getitem\_\_', '\_\_gt\_\_', '\_\_hash\_\_', '\_\_init\_\_', '\_\_init\_subclass\_\_', '\_\_iter\_\_', '\_\_le\_\_', '\_\_lt\_\_', '\_\_module\_\_', '\_\_ne\_\_', '\_\_new\_\_', '\_\_reduce\_\_', '\_\_reduce\_ex\_\_', '\_\_repr\_\_', '\_\_setattr\_\_', '\_\_sizeof\_\_', '\_\_str\_\_', '\_\_subclasshook\_\_', '\_\_weakref\_\_', '\_data', '\_doc\_args', '\_freeze', '\_get\_series\_list', '\_index', '\_inferred\_dtype', '\_is\_categorical', '\_is\_string', '\_name', '\_orig', '\_parent', '\_validate', '\_wrap\_result', 'capitalize', 'casefold', 'cat', 'center', 'contains', 'count', 'decode', 'encode', 'endswith', 'extract', 'extractall', 'find', 'findall', 'fullmatch', 'get', 'get\_dummies', 'index', 'isalnum', 'isalpha', 'isdecimal', 'isdigit', 'islower', 'isnumeric', 'isspace', 'istitle', 'isupper', 'join', 'len', 'ljust', 'lower', 'lstrip', 'match', 'normalize', 'pad', 'partition', 'repeat', 'replace', 'rfind', 'rindex', 'rjust', 'rpartition', 'rsplit', 'rstrip', 'slice', 'slice\_replace', 'split', 'startswith', 'strip', 'swapcase', 'title', 'translate', 'upper', 'wrap', 'zfill']

Which function would be useful for determining if the index contains the letters ‘srg-‘?

* 1. Now for each srg gene, determine which neurons it is expressed in. What are the three neuron classes that express the most chemoreceptors? How many do each express?