

# How to use LexMapr

For people who have  
**little to no experience with command line**

*and*

**For macOS and Linux users only**

Note: this tutorial shows you how to use LexMapr through the command-line, but a web application is currently in development

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# Open up your terminal

## macOs:

*cmd* + *space* to open spotlight search

type terminal

hit *return*

## Linux:

*ctrl* + *alt* + *t*

# Terminal tutorial

The terminal opens in your Home (also known as ~) directory

Type the following command into your terminal:

```
ls
```

This will print out all the sub-directories and files in your home directory

# Terminal tutorial

You can change terminal directories with the `cd` command:

<code>cd Desktop</code>	Navigate to your Desktop subdirectory
<code>ls</code>	View the contents of your Desktop
<code>cd ..</code>	Navigate to the parent directory
<code>ls</code>	View the contents of your Home again

If you ever get lost, you can return Home with `cd ~`

# Do you have Conda?

In your terminal, type:

```
conda -V
```

**If you have Conda**, the terminal will tell you your Conda version number

**If you do not have Conda**, the terminal will tell you the `conda` command was not found

# Install Conda

Go to <https://docs.conda.io/en/latest/miniconda.html>

Install the appropriate **64-bit bash installer** for **Python 3.7**

In your terminal, navigate to the folder containing the installer

Assuming this was the Downloads folder:

```
cd ~
```

```
cd Downloads
```

# Install Conda

In this folder, we run the installer through a terminal command

**macOS:**

```
bash Miniconda3-latest-MacOSX-x86_64.sh
```

**Linux:**

```
bash Miniconda3-latest-Linux-x86_64.sh
```

Follow the prompts to completion



# Bioconda

Bioconda is a channel that allows users to easily install various bioinformatic packages, including LexMapr

Run the following terminal commands to set up Bioconda:

```
conda config --add channels default
```

```
conda config --add channels bioconda
```

```
conda config --add channels conda-forge
```

**RUN THESE COMMANDS IN ORDER**

# Install LexMapr into a Conda environment

Enter the following command from any directory:

```
conda create -n LexMapr python=3.6 lexmapr
```

Follow the prompts to completion

This creates a Conda environment called “LexMapr”, that contains a Bioconda installation of LexMapr

# Running LexMapr

Whenever you want to run LexMapr, all you have to do is:

Start the terminal

Activate your LexMapr Conda environment:

```
conda activate LexMapr
```

Run LexMapr commands

```
lexmapr --help
```

# LexMapr input files

LexMapr takes input csv files with the following format:

SampleId,Sample

1,Chicken Breast

2,Baked Potato

3,Canned Corn

4,Frozen Yogurt

5,Apple Pie

# LexMapr input files

Open up Microsoft Excel, Apple Numbers or LibreOffice Calc  
Create a spreadsheet like so:

	A	B
1	SampleId	Sample
2	1	Chicken Breast
3	2	Baked Potato
4	3	Canned Corn
5	4	Frozen Yogurt
6	5	Apple Pie

Save as “small\_simple.csv”

# Running LexMapr

In the terminal, `cd` to the folder containing `small_simple.csv`

**With the LexMapr Conda environment activated, try:**

```
lexmapr small_simple.csv
```

# Taking a while?

The first run will be slow

LexMapr caches a lookup table on the first run

LexMapr uses this table to make subsequent runs much faster

# Running LexMapr

Output:

Sample_Id	Sample_Desc	Cleaned_Sample	Matched_Components
small_simple1	Chicken Breast	chicken breast	['breast:uberon_0000310']
small_simple2	Baked Potato	baked potato	[]
small_simple3	Canned Corn	canned corn	[]
small_simple4	Frozen Yogurt	frozen yogurt	['frozen:pato_0001985']
small_simple5	Apple Pie	apple pie	[]



# Running LexMapr

You can specify an “output” tsv file for your results to be written to

Saves your results ✓

tsv files can be opened in Excel, Numbers or Calc for easier viewing ✓

Try:

```
lexmapr small_simple.csv -o small_simple_output.tsv
```

# Running LexMapr

`small_simple_output.tsv` was created in the directory

Open it up in Excel, Numbers or Calc for easy viewing of your output, separated into columns

# A problem

Output:

Sample_Id	Sample_Desc	Cleaned_Sample	Matched_Components
small_simple1	Chicken Breast	chicken breast	['breast:uberon_0000310']
small_simple2	Baked Potato	baked potato	[] ←
small_simple3	Canned Corn	canned corn	[] ←
small_simple4	Frozen Yogurt	frozen yogurt	['frozen:pato_0001985']
small_simple5	Apple Pie	apple pie	[] ←

**Missing matches**

# Mapping samples against online ontologies

Unless told otherwise, LexMapr maps samples against a highly limited collection of pre-defined resources → missed matches

You should instead map samples against terms of your own choosing

You can do this by supplying LexMapr with a **config file**

# Config files

When running LexMapr, use a config file that specifies the online ontology terms you want to map your samples against

e.g., we could create a config file that tells LexMapr to map against terms belonging to the Food ontology “Foodon”, and use it whenever we run LexMapr on a collection of food samples

Config files can specify terms from:

- Entire ontologies

- Subsets of ontologies

- Multiple ontologies

You re-use config files for multiple runs, or create new config files when you want to switch things up, but you can only provide one config file each time you run LexMapr

# Config file format

```
[  
  { "ONTOLOGY_IRI_1" : "ROOT_IRI_1" },  
  { "ONTOLOGY_IRI_2" : "ROOT_IRI_2" },  
  . . . ,  
]
```

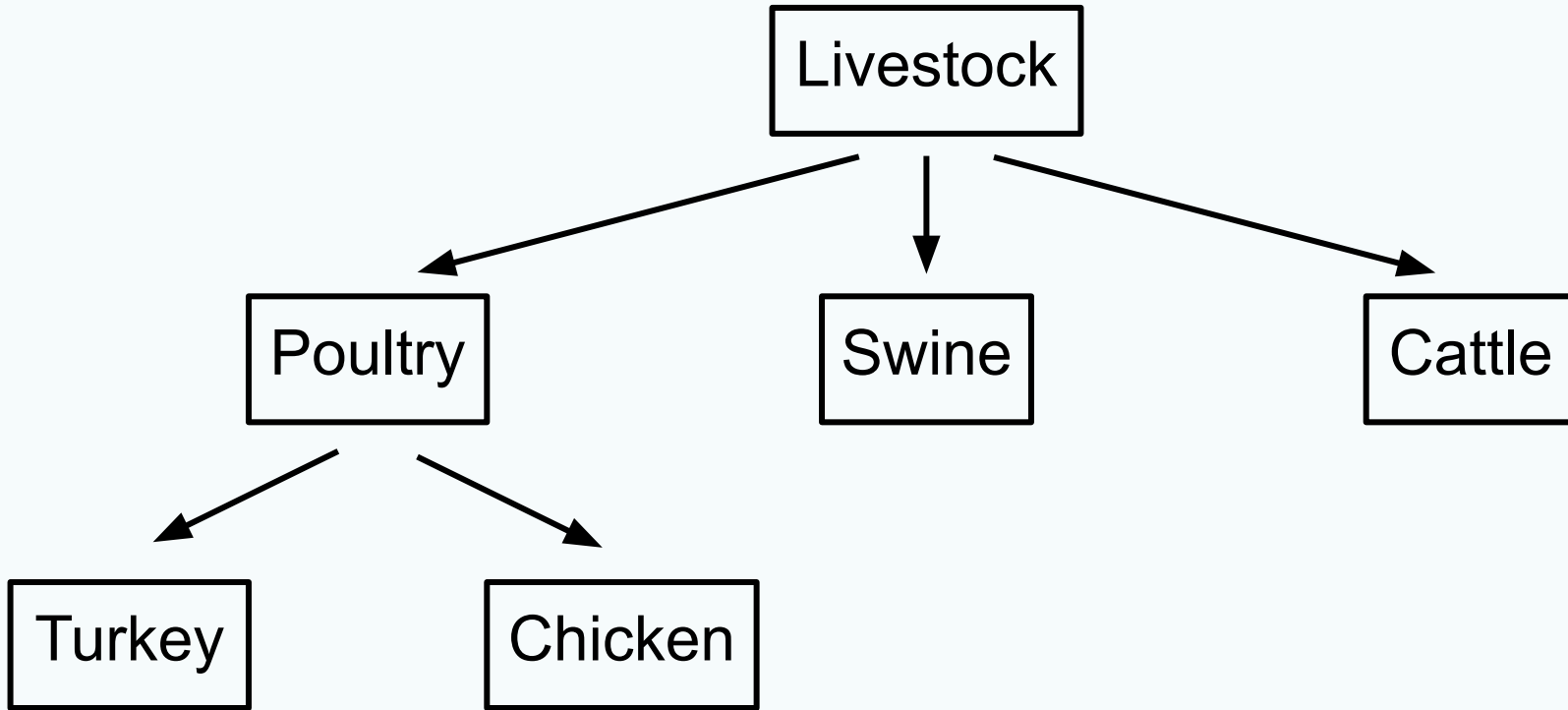
# Config file format

```
[  
  { "ONTOLOGY_IRI_1" : "ROOT_IRI_1" },  
  { "ONTOLOGY_IRI_2" : "ROOT_IRI_2" },  
  . . . ,  
]
```

IRI of ontology you want to map your samples against

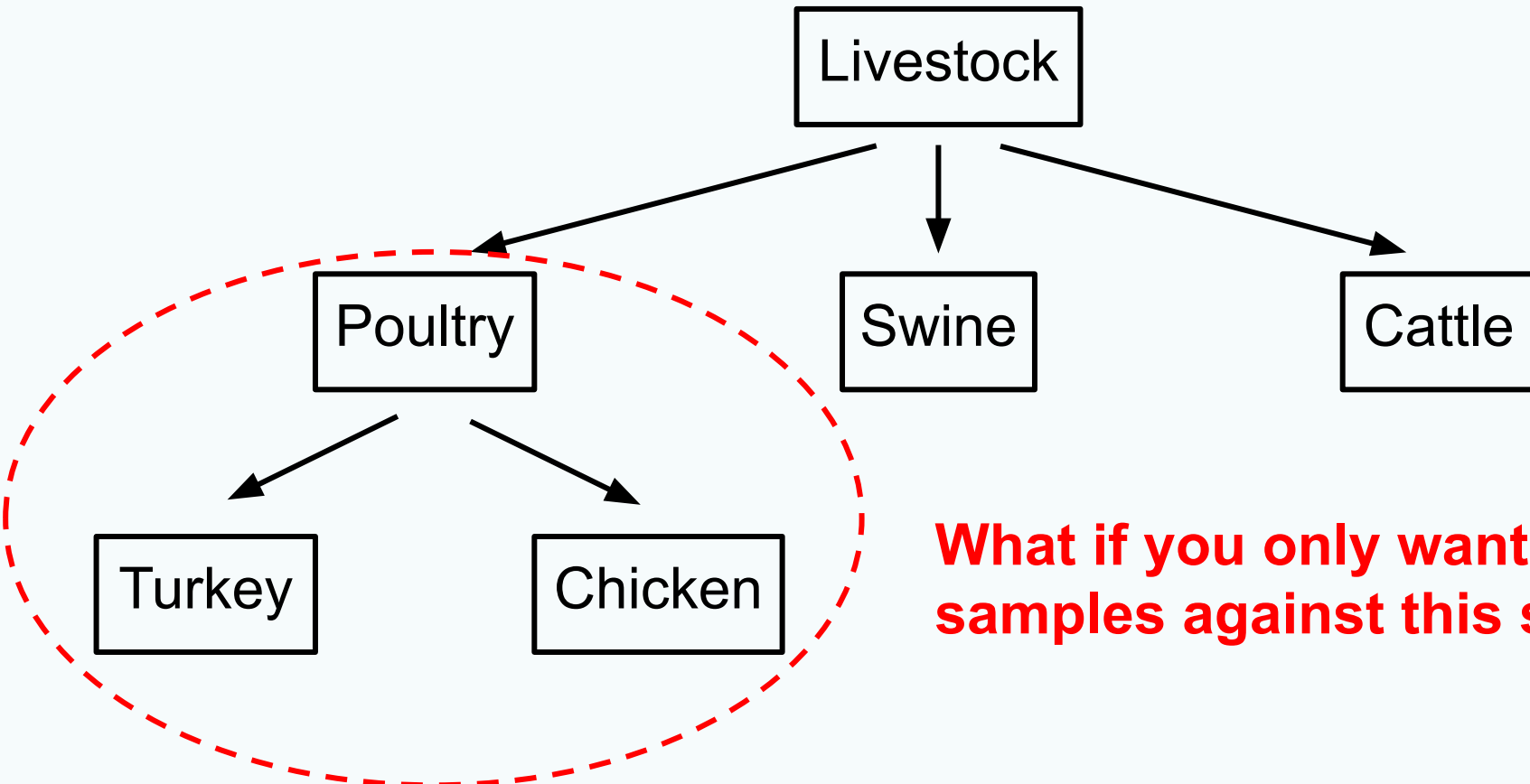
e.g., `"http://purl.obolibrary.org/obo/foodon.owl"`

# Ontology refresher





# Ontology refresher



**What if you only want to match samples against this sub-tree?**

# Config file format

```
[  
  { "ONTOLOGY_IRI_1": "ROOT_IRI_1" },  
  { "ONTOLOGY_IRI_2": "ROOT_IRI_2" },  
  . . . ,  
]
```

IRI of the “top” of the sub-tree, within the specified ontology

e.g., the IRI for “poultry or game bird” within FOODON:

`"http://purl.obolibrary.org/obo/FOODON_03411563"`

## Create a config file

We're going to map our `small_simple.csv` file against everything under “plant food product” in FOODON

# Create a config file

We need IRI values

Go to <https://www.ebi.ac.uk/ols/ontologies>

Search up “foodon”

The screenshot shows the EBI OLS search interface. The search bar at the top contains 'Foodon'. Below the search bar, there are filters for 'Exact match' and 'Obsolete terms'. The 'Filters' section on the left shows 'Term type' set to 'Ontology' and 'Ontologies' set to 'FOODON'. The search results section on the right is titled 'Search results for Foodon' and shows 'Showing 1 to 1 of 1 results'. A red box highlights the first result, 'Food Ontology FOODON', which includes the IRI 'http://purl.obolibrary.org/obo/foodon.owl' and a description of the FoodOn project. A red arrow points from the text 'Jump to the ontology page when located' to the highlighted result.

Foodon

☐ Exact match ☐ Obsolete terms

Filters

Term type

ontology 1

Ontologies

Filter by ontology

FOODON 1

Clear filters

Search results for **Foodon**

Previous Showing 1 to 1 of 1 results Next

**Food Ontology** **FOODON**

<http://purl.obolibrary.org/obo/foodon.owl>

FoodOn (<http://foodon.org>) is a consortium-driven project to build a comprehensive and easily accessible global farm-to-fork ontology about food, that accurately and consistently describes foods commonly known in cultures from around the world.

Previous Showing 1 to 1 of 1 results Next

**Jump to the ontology page when located**

# Create a config file

Under the box titled “Ontology info” on the Foodon ontology page, note the Ontology IRI:

The screenshot shows the Food Ontology website. At the top, the title "Food Ontology" is displayed. Below it, a description states: "FoodOn (<http://foodon.org>) is a consortium-driven project to build a comprehensive and easily accessible global farm-to-fork ontology about food, that accurately and consistently describes foods commonly known in cultures from around the world." A search bar labeled "Search FOODON" is present. Below the search bar are three buttons: "Terms", "Download", and "Ontology Homepage".

At the bottom of the page, there are two main sections. On the left, a sidebar contains links: "Browse Terms", "Browse Properties", "Ontology history", "Obsolete Class", and "entity". On the right, the "Ontology info" section is highlighted with a blue header. It contains the following information:

- Ontology IRI:** <http://purl.obolibrary.org/obo/foodon.owl> (This line is highlighted with a red box in the original image)
- Version IRI:** <http://purl.obolibrary.org/obo/foodon/releases/2019-09-01/foodon.owl>
- Ontology id:** foodon
- Version:** 2019-09-01
- Number of terms:** 27879

## Create a config file

Under the box titled “Ontology info” on the Foodon ontology page, note the Ontology IRI:

<http://purl.obolibrary.org/obo/foodon.owl>

This is your **ONTOLOGY\_IRI**

# Create a config file

You can then use the “browse terms” tab, or the search bar, to locate the OLS page for “plant food product”

The screenshot displays the Food Ontology web interface. At the top, the title "Food Ontology" is followed by a description: "FoodOn (<http://foodon.org>) is a consortium-driven project to build a comprehensive and easily accessible global farm-to-fork ontology about food, that accurately and consistently describes foods commonly known in cultures from around the world." Below this is a search bar labeled "Search FOODON" with a magnifying glass icon, which is highlighted with a red rectangle. Under the search bar are three buttons: "Terms", "Download", and "Ontology Homepage". At the bottom left, a navigation menu is shown with tabs for "Browse Terms", "Browse Properties", and "Ontology history". The "Browse Terms" tab is selected and highlighted with a red rectangle, showing a list of terms including "Obsolete Class" and "entity". On the right side, there is a section titled "Ontology info" containing details such as "Ontology IRI", "Version IRI", "Ontology id", "Version", and "Number of terms".

**Food Ontology**

FoodOn (<http://foodon.org>) is a consortium-driven project to build a comprehensive and easily accessible global farm-to-fork ontology about food, that accurately and consistently describes foods commonly known in cultures from around the world.

Search FOODON

Terms Download Ontology Homepage

Browse Terms Browse Properties Ontology history

Obsolete Class  
entity

**Ontology info**

**Ontology IRI:** <http://purl.obolibrary.org/obo/foodon.owl>  
**Version IRI:** <http://purl.obolibrary.org/obo/foodon/releases/2019-09-01/foodon.owl>  
**Ontology id:** foodon  
**Version:** 2019-09-01  
**Number of terms:** 27879

# Create a config file

The IRI for “plant food product” is under the title of its OLS page:

## plant food product



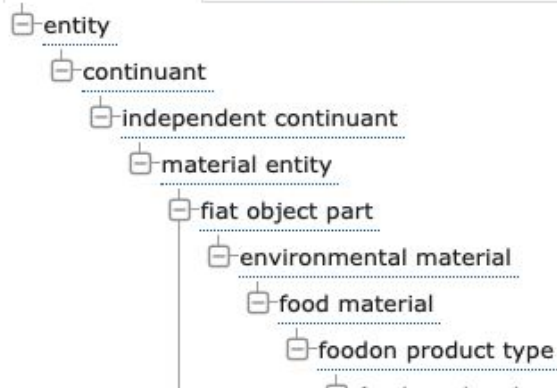
[http://purl.obolibrary.org/obo/FOODON\\_00001015](http://purl.obolibrary.org/obo/FOODON_00001015)



This food product type includes food products which are derived from or produced by a plant.

Tree view

Term history



Graph view

Reset tree

Show all siblings

### Term info

has curation status

[http://purl.obolibrary.org/obo/IAO\\_0000428](http://purl.obolibrary.org/obo/IAO_0000428)

### Term relations

#### Equivalent to:

- [food product by organism](#) and [derives from](#) [some plant](#)



## Create a config file

The IRI for “plant food product” is under the title of its OLS page:

[http://purl.obolibrary.org/obo/FOODON\\_00001015](http://purl.obolibrary.org/obo/FOODON_00001015)

This is your **ROOT\_IRI**

# Create a config file

Open a text editor, and write the following:

```
[  
{ "http://purl.obolibrary.org/obo/foodon.owl": "http://purl.obolibrary.org/obo/FOODON_00001015" }  
]
```

Save the file as `small_simple_config.json`, in the same folder as `small_simple.csv`

**Notice that we're using the IRI values we just searched for**

So you now have a config file that tells LexMapr to map samples against everything under “plant food product” in Foodon

## Create a config file

Note for macOS users:

TextEdit may not allow you to save JSON files

You can use another text editor, or google for an online JSON editor

# Mapping samples against online ontologies

In terminal:

Navigate to the folder with `small_simple.csv` and `small_simple_config.json`

With your LexMapr conda environment activated, try:

```
lexmapr small_simple.csv -c small_simple_config.json -o small_simple_output.tsv
```

This may take a while, as lexmapr creates a lookup table for each config file (to speed up subsequent runs)

# Mapping samples against online ontologies

Output:

Sample_Id	Sample_Desc	Cleaned_Sample	Matched_Components
small_simple1	Chicken Breast	chicken breast	['breast:uberon_0000310']
small_simple2	Baked Potato	baked potato	['potato (whole, baked):foodon_03302196']
small_simple3	Canned Corn	canned corn	['corn (canned):foodon_03302665']
small_simple4	Frozen Yogurt	frozen yogurt	['frozen:pato_0001985']
small_simple5	Apple Pie	apple pie	['apple pie:foodon_00002475']

That's better!

But `small_simple1` and `small_simple4` could be better.

# Create a config file

Fetch the IRI values for “meat food product” and “dairy food product” under Foodon the same way, and extend your config file:

```
[  
{"http://purl.obolibrary.org/obo/foodon.owl": "http://purl.obolibrary.org/obo/FOODON_00001015"},  
{"http://purl.obolibrary.org/obo/foodon.owl": "http://purl.obolibrary.org/obo/FOODON_00001006"},  
{"http://purl.obolibrary.org/obo/foodon.owl": "http://purl.obolibrary.org/obo/FOODON_00001256"}  
]
```

**Note the commas**

Save the file

Your config file now tells LexMapr to map samples against everything under “plant food product”, “meat food product” and “dairy food product” in Foodon

# Mapping samples against online ontologies

Run:

```
lexmapr small_simple.csv -c small_simple_config.json -o small_simple_output.tsv --no-cache
```

The `--no-cache` flag is needed whenever you update a config file, so LexMapr can update the corresponding lookup table

Output:

Sample_Id	Sample_Desc	Cleaned_Sample	Matched_Components
small_simple1	Chicken Breast	chicken breast	['chicken breast:foodon_00002703']
small_simple2	Baked Potato	baked potato	['potato (whole, baked):foodon_03302196']
small_simple3	Canned Corn	canned corn	['corn (canned):foodon_03302665']
small_simple4	Frozen Yogurt	frozen yogurt	['frozen yogurt:foodon_03307445']
small_simple5	Apple Pie	apple pie	['apple pie:foodon_00002475']

Perfect

# Third-party classification schemes

Try:

```
lexmapr small_simple.csv -c small_simple_config.json -o small_simple_output.tsv -b
```

The `-b` flag classifies all samples into broad categories:

Sample_Id	Sample_Desc	Cleaned_Sample	Matched_Components	Third Party Classification
small_simple1	Chicken Breast	chicken breast	['chicken breast:foodon_00002703']	['chicken']
small_simple2	Baked Potato	baked potato	['potato (whole, baked):foodon_03302196']	['root/underground (tubers)']
small_simple3	Canned Corn	canned corn	['corn (canned):foodon_03302665']	['seeded vegetables (other)']
small_simple4	Frozen Yogurt	frozen yogurt	['frozen yogurt:foodon_03307445']	['dairy']
small_simple5	Apple Pie	apple pie	['apple pie:foodon_00002475']	['pome fruit']

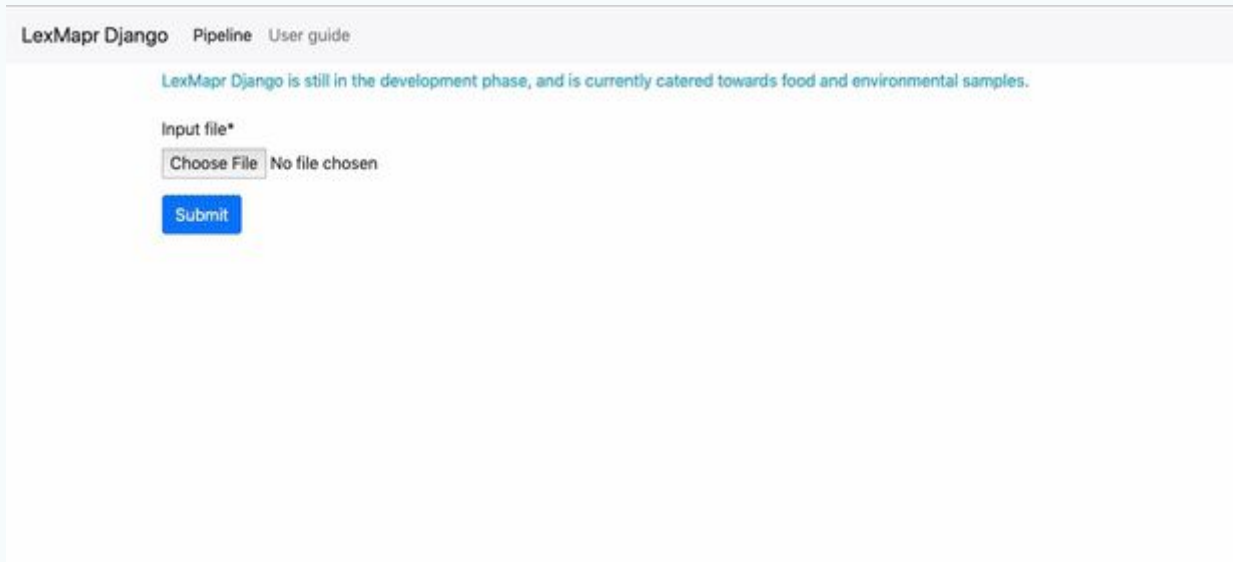
The categories were selected by a third-party, and follow their highly specific classification scheme, which is geared towards food

In the future, LexMapr will allow you to introduce classification schemes of your own



# LexMapr Django

<https://watson.bccdc.med.ubc.ca/lexmapr/>



The screenshot shows the LexMapr Django web interface. At the top, there are navigation links: "LexMapr Django", "Pipeline", and "User guide". Below these, a teal-colored message states: "LexMapr Django is still in the development phase, and is currently catered towards food and environmental samples." The main section is titled "Input file\*" and contains a file selection interface with a "Choose File" button and the text "No file chosen". Below this is a blue "Submit" button.

Django-powered web interface, that allows you to run LexMapr from your browser

# LexMapr Django

Not as powerful as the command-line tool yet

Built-in config file specialized for food and environment samples

Cannot specify your own config file

Highly specific third-party classification scheme always used

Will become more powerful in the future