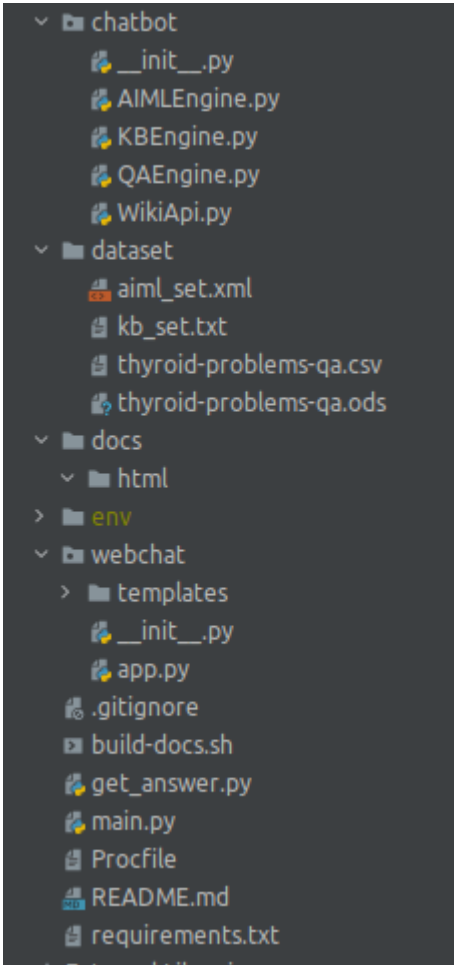


ISYS30221 Artificial Intelligence 2021-22

Coursework Documentation Template

1- About this submission

Student Name	Ivica Matic
Student ID	n0781349
Chatbot Topic	Thyroid Issues Chat Bot
Tasks implemented in this submission (a,b,c,or d)	a,b
Files inventory (excluding this file)	<div></div> <ul style="list-style-type: none">• All chatbot functionalities implemented in chatbot module<ul style="list-style-type: none">◦ AIMLEngine.py◦ KBEngine.py◦ QAEEngine.py◦ WikiApi.py• Dataset for the chatbot stored in the dataset folder<ul style="list-style-type: none">◦ aimpl_set.xml - for AIML functionalities

	<ul style="list-style-type: none"> ○ kb_set.xml - for Knowledge Based reasoning ○ thyroid-problems-qa.csv - for Bag Of Words/ cosine similarity lookup ○ thyroid-problems-qa.ods - same as above, but in LibreOffice Calc format ● Autobuild documentation using pdoc3 in the docs folder, both pdf and HTML version ● Additional web chat module used for web application ● build-docs.sh script for building documentation ● get_answer.py function file ● main.py file as chatbot entry point ● Procfile for hosting the chatbot on Heroku platform (https://thyroid-chat-bot.herokuapp.com/ , allow up-to a minute for initial load as it is hosted on free tier package) ● requirements.txt file for managing dependencies using python venv
Demo video URL	https://youtu.be/N5vcxdgHYK4
Checklist	<p>x I will submit this file separately (without compression) into DropBox</p> <p>x All other files are zipped and will be submitted into DropBox</p> <p>x The demo video is recorded as instructed, and the sharing link is inserted above</p> <p>x I have made sure that the demo video is shared according to the instructions so that I allowed everybody in the university to view it.</p> <p>x All the sections below are populated accordingly.</p>

2- Design notes (shrink/grow as needed, add images where applicable)

<p>General explanations of the system and its goals</p>	<p>The system described here is used to provide the users with support regarding their questions about thyroid and thyroid-related issues.</p> <p>The system takes the user's input and runs it through the AIMLEngine. If the match is found within the AIML responses it is returned back to the user. In case the input requires obtaining the data from Wikipedia, the Wikipedia API (WikiAPI) is called and the data is returned to the user. In case the input requires logical reasoning, the KBEngine module is used to process the user query with the help of AIML templating. And finally, if the user query is not suitable either for AIML, KB or Wikipedia it is passed to QAEngine where the cosine similarity and bag of words approach is used to return the most appropriate answer. However, if even that answer does not surpass the pre-set similarity index score, the user is prompted to be more clear with their question.</p>
<p>System requirements, i.e., the list of what the system should do/have from a user's perspective</p>	<ul style="list-style-type: none">• System must greet the user• System must reply to the user greeting it• System must reply to the user asking a question for which the system has the knowledge to respond accordingly• System must prompt the user to be more precise with the question in case it can't find the appropriate answer• System could pull information from other services such as Wikipedia• System could allow users to expand the system's knowledge in other ways rather than expanding the dataset files• System won't speak any other language other than English

The employed AI techniques, and the explanation of program codes and the supplied files.

The AIML functionalities of the chatbot are implemented in the chatbot module in the AIMLEngine.py file. It works by loading in the AIML .xml file on the chatbot initialization and provides the lookup capabilities.

If lookup queries require additional modules to fulfil the wanted task, they are indicated in the XML using # symbols.

```
<!-- Wikipedia API -->
<category>
  <pattern>TELL ME ABOUT */pattern>
  <template>wikishort#
    <star index="1"/>
  </template>
</category>

<category>
  <pattern>TELL ME MORE ABOUT */pattern>
  <template>wikilong#
    <star index="1"/>
  </template>
</category>

<category>
  <pattern>MORE ABOUT */pattern>
  <template>
    <srai>TELL ME MORE ABOUT
      <star/>
    </srai>
  </template>
</category>
```

For example, in the snippet above, Wikipedia API is used to obtain the response.

Similarly, if logical reasoning is needed:

```
<!-- Reactions for KB engine -->
<category>
  <pattern>* PRODUCES */pattern>
  <template>
    <star index="1"/>
    #PRODUCES#
    <star index="2"/>
  </template>
</category>

<category>
  <pattern>* CAUSES */pattern>
  <template>
    <star index="1"/>
    #CAUSES#
    <star index="2"/>
  </template>
</category>
```

	<p>The QAEngine module is used to perform similarity-based question lookup to provide the user with the best possible answer. The similarity-based functionality is based on a set of pre-defined Q/As in a CSV file. The similarity-based component is based on the bag-of-words model, tf/idf, and cosine similarity.</p> <p>The QA Pairs are loaded on the chatbot initialization from the QA CSV file.</p> <p>The KBEngine module is used to provide logical reasoning capabilities with the help of the NLTK library. Initial logic is loaded into the chatbot from the Knowledge base txt file.</p> <p>The extra features for this submission are as follows:</p> <ul style="list-style-type: none"> ● Wikipedia Integration with WikiAPI ● Speelproffing on user queries ● Logging using python logging module ● Automatic documentation provided with doc build script ● Dependencies managed with venv, listed in requirements.txt file ● Chatbot hosted online on Heroku platform (together with HTML version of documentation too). <ul style="list-style-type: none"> ○ Allow up to a minute for the initial load as the chatbot is hosted on a free tier instance. <ul style="list-style-type: none"> ■ https://thyroid-chat-bot.herokuapp.com/ ■ https://thyroid-chat-bot.herokuapp.com/docs/index.html

3- Conversation log (insert text, screenshots and/or images as required)

10 conversation pairs for each task are enough)

Task 1. Greetings / AIML functionalities

Chat

Thyroid Bot
Hi, welcome to Thyroid Chat Bot! Go ahead and send me a message. 😊
Check out documentation at: [Docs](#)

You 14:13
Hi

Thyroid Bot 14:13
Hello! How are you?

You 14:13
Hi

Thyroid Bot 14:13
Hello

You 14:13
Hi

Thyroid Bot 14:13
Hello! How are you?

You 14:13
Hi

Thyroid Bot 14:13
Hi :)

You 14:13
Hi

Thyroid Bot 14:13
Hello

Send

Chat

Thyroid Bot

Hi, welcome to Thyroid Chat Bot! Go ahead and send me a message. 😊

Check out documentation at: [Docs](#)

You 14:14

Hi

Thyroid Bot 14:14

Hi :)

You 14:14

Hello

Thyroid Bot 14:14

Hi

You 14:14

Hey there

Thyroid Bot 14:14

Hello

You 14:15

Hey

Thyroid Bot 14:15

Hi there

You 14:15

How are you

Thyroid Bot

14:15

I'm functioning within normal parameters, thanks for asking.

Send

Chat

Thyroid Bot

Hi, welcome to Thyroid Chat Bot! Go ahead and send me a message. 😊

Check out documentation at: [Docs](#)

You 14:18

Thanks

Thyroid Bot 14:18

You are welcome.

You 14:18

Cheers

Thyroid Bot 14:18

Sure mate.

You 14:18

Cheers mate

Thyroid Bot 14:18

Sure mate.

Send

Task 1. QA Based lookup, Bag Of words + cosine similarity

Chat

Thyroid Bot

Hi, welcome to Thyroid Chat Bot! Go ahead and send me a message. 😊

Check out documentation at: [Docs](#)

You14:28

What is thyroid gland?

Thyroid Bot14:28

The thyroid gland is an endocrine gland in your neck. It makes two hormones that are secreted into the blood: thyroxine (T4) and triiodothyronine (T3). These hormones are necessary for all the cells in your body to work normally.

Thyroid Bot14:28

The thyroid makes two hormones that it secretes into the bloodstream. One is called thyroxine; this hormone contains four atoms of iodine and is often called T4. The other is called triiodothyronine, which contains three atoms of iodine and is often called T3.

Thyroid Bot14:28

The T4, or rather the T3 derived from it, and the T3 secreted directly by the thyroid gland influence the metabolism of your body cells. In other words, it regulates the speed with which your body cells work. I

Thyroid Bot14:29

Thyroid disorders are very common and tend mainly to occur in women, although anybody - men, teenagers, children, and babies, too - can be affected.

Enter your message...

Send

Chat

Thyroid Bot

Hi, welcome to Thyroid Chat Bot! Go ahead and send me a message. 😊

Check out documentation at: [Docs](#)

You

14:33

What are the most common disorder symptoms?

Thyroid Bot

14:33

Hypothyroidism: tiredness, feeling cold, weight gain, poor concentration, depression. Hyperthyroidism: weight loss, heat intolerance, anxiety, and, sometimes, sore and gritty eyes. Sometimes there are very few symptoms. A blood test from your doctor will confirm whether or not you have a thyroid disorder.

You

14:33

What other disorders can occur?

Thyroid Bot

14:33

Thyroid eye disease, Nodules or swellings, Thyroid cancer.

You

14:33

How common is cancer?

Thyroid Bot

14:33

Very rare, but it is important to ask your doctor to check any lump in your neck.

Chat

Hi, welcome to Thyroid Chat Bot! Go ahead and send me a message. 😊

Check out documentation at: [Docs](#)

You

14:39

What is causing a thyroid disorder?

Thyroid Bot

14:39

There are many different causes of the different thyroid disorders. Most commonly the cause is due to autoimmune thyroid disease - a self-destructive process in which the body's immune system attacks the thyroid cells as though they were foreign cells.

You

14:39

How are disorders diagnosed?

Thyroid Bot

14:39

Your doctor will be able to get a good idea about the activity of your thyroid gland by listening to your symptoms, asking you some questions, and by examining your neck. However, by taking a small sample of your blood he or she can assess exactly your thyroid secretory state. A single blood test will normally confirm the diagnosis, but sometimes other tests are required.

You

14:39

Can disorders be treated?

Thyroid Bot

14:39

Yes - your thyroid disorder and many of the symptoms, too, can be treated. Most thyroid disorders are treated with daily medication. There are other treatments for those thyroid disorders that cannot be controlled with medication.

You

14:40

At what age problems start?

Thyroid Bot

14:40

The disease is hereditary and may develop at any age in men or women, but it's much more common in women ages 20 to 30

Send

Chat

Thyroid Bot

Hi, welcome to Thyroid Chat Bot! Go ahead and send me a message. 😊

Check out documentation at: [Docs](#)

Thyroid Bot

14:42

First look in the mirror. And tip your head back second drink some water swallow. And watch your thyroid move up and down.

Thyroid Bot

14:42

Gastrointestinal problems, Mood changes, Weight changes, Skin problems, Sensitivity to temperature changes, Vision changes (occurs more often with hyperthyroidism), Hair thinning or hair loss (hyperthyroidism), Memory problems (both hyperthyroidism and hypothyroidism).

Thyroid Bot

14:42

Both hypothyroidism and hyperthyroidism have been linked toÂ erectile dysfunctionÂ (ED) for men, painful intercourse for women, and low libido for both genders

Thyroid Bot

14:43

Roasted seaweed, Salted nuts. Brazil nuts, macadamia nuts, hazelnuts, Baked fish, Dairy, Fresh eggs.

You

14:42

How can I check my thyroid at home?

You

14:42

What are early signs of problems?

You

14:42

Do problems affect sex life?

You

14:43

What foods help heal thyroid?

Enter your message...

Send

Task 1. Logging / spellchecking

```
(env) ivica@icepad:~/Coding/uni-chat-bot$ python3 main.py
Loading ./dataset/aiml_set.xml...done (0.00 seconds)
Kernel bootstrap completed in 0.00 seconds
>>Hi
Hi
>>Hello
Hi
>>What is tyroid?
INFO:root:Corrected what is tyroid? into what is thyroid?
INFO:root:Corrected what is tyroid? into what is thyroid?
[0.3825811 0.29945032 0.25894507 0.3825811 0.25178503 0.31715108
 0.31715108 0.14968377 0. 0. 0. 0.25178503
 0. 0.230121 0.26479762 0.26479762 0.21341389 0.
 0.17461451 0.230121 0.18957362 0.230121 0.230121 0.230121
 0.17461451]
The thyroid gland is an endocrine gland in your neck. It makes two hormones that are secreted into
the blood: thyroxine (T4) and triiodothyronine (T3). These hormones are necessary for all the cel
ls in your body to work normally.
```

```
(env) ivica@icepad:~/Coding/uni-chat-bot$ python3 main.py
Loading ./dataset/aiml_set.xml...done (0.00 seconds)
Kernel bootstrap completed in 0.00 seconds
>>Can thyroid disorders be treathed?
INFO:root:Corrected can thyroid disorders be treathed? into can thyroid disorders be treated?
INFO:root:Corrected can thyroid disorders be treathed? into can thyroid disorders be treated?
[0.11115362 0.4279945 0.07523289 0.11115362 0.07315264 0.09214384
 0.09214384 0.21015215 0.56668469 0. 0. 0.07315264
 0. 0.06685846 0.37648248 1. 0.06200444 0.
 0.05073182 0.06685846 0.05507798 0.06685846 0.06685846 0.06685846
 0.05073182]
Yes - your thyroid disorder and many of the symptoms, too, can be treated. Most thyroid disorders
are treated with daily medication. There are other treatments for those thyroid disorders that can
not be controlled with medication.
>>
```

Task 1. Wikipedia API

Chat

Thyroid Bot

Hi, welcome to Thyroid Chat Bot! Go ahead and send me a message. 😊

Check out documentation at: [Docs](#)

You

14:45

Tell me about thyroid hormones

Thyroid Bot

14:45

Thyroid hormones are two hormones produced and released by the thyroid gland, namely triiodothyronine (T3) and thyroxine (T4). They are tyrosine-based hormones that are primarily responsible for regulation of metabolism. T3 and T4 are partially composed of iodine.

You

14:45

Tell me more about thyroid hormones

Thyroid Bot

14:45

Thyroid hormones are two hormones produced and released by the thyroid gland, namely triiodothyronine (T3) and thyroxine (T4). They are tyrosine-based hormones that are primarily responsible for regulation of metabolism. T3 and T4 are partially composed of iodine. A deficiency of iodine leads to decreased production of T3 and T4, enlarges the thyroid tissue and will cause the disease known as simple goitre. The major form of thyroid hormone in the blood is thyroxine (T4), which has a longer half-life than T3. In humans, the ratio of T4 to T3 released into the blood is approximately 14:1. T4 is converted to the active T3 (three to four times more potent than T4) within cells by deiodinases (5'-deiodinase). These are further processed by decarboxylation and deiodination to produce iodothyronamine (T1a) and thyronamine (T0a). All three isoforms of the deiodinases are selenium-containing enzymes, thus dietary selenium is essential for T3 production. American chemist Edward Calvin Kendall was responsible for the isolation of thyroxine in 1915.

Enter your message...

Send

You

14:51

Tell me about Hypothyroidism

Thyroid Bot

14:51

Hypothyroidism (also called underactive thyroid, low thyroid or hypothyreosis) is a disorder of the endocrine system in which the thyroid gland does not produce enough thyroid hormone. It can cause a number of symptoms, such as poor ability to tolerate cold, a feeling of tiredness, constipation, slow heart rate, depression, and weight gain. Occasionally there may be swelling of the front part of the neck due to goiter.

You

14:51

Tell me more about thyroid disease

Thyroid Bot

14:51

Thyroid disease is a medical condition that affects the function of the thyroid gland. The thyroid gland is located at the front of the neck and produces thyroid hormones that travel through the blood to help regulate many other organs, meaning that it is an endocrine organ. These hormones normally act in the body to regulate energy use, infant development, and childhood development. There are five general types of thyroid disease, each with their own symptoms. A person may have one or several different types at the same time. The five groups are:

- Hypothyroidism (low function) caused by not having enough free thyroid hormones
- Hyperthyroidism (high function) caused by having too many free thyroid hormones
- Structural abnormalities, most commonly a goiter (enlargement of the thyroid gland)
- Tumors which can be benign (not cancerous) or cancerous
- Abnormal thyroid function tests without any clinical symptoms (subclinical hypothyroidism or subclinical hyperthyroidism).

In some types, such as subacute thyroiditis or postpartum thyroiditis, symptoms may go away after a few months and laboratory tests may return to normal. However most types of thyroid disease do not resolve on their own. Common hypothyroid symptoms include fatigue, low energy, weight gain, inability to tolerate the cold, slow heart rate, dry skin and constipation. Common hyperthyroid symptoms include irritability, anxiety, weight loss, fast heartbeat, inability to tolerate the heat, diarrhea, and enlargement of the thyroid. Structural abnormalities may not produce symptoms, however some people may have hyperthyroid or hypothyroid symptoms related to the structural abnormality or notice swelling of the neck. Rarely goiters can cause compression of the airway, compression of the vessels in the neck, or difficulty swallowing.

Enter your message...

Send

Task 2

Chat

Thyroid Bot
Hi, welcome to Thyroid Chat Bot! Go ahead and send me a message. 😊
Check out documentation at: [Docs](#)

You 10:41
Thyroid produces hormones

Thyroid Bot 10:41
True

You 10:41
Thyroid produces enzymes

Thyroid Bot 10:41
False

Chat

Thyroid Bot
Hi, welcome to Thyroid Chat Bot! Go ahead and send me a message. 😊
Check out documentation at: [Docs](#)

You 10:42
Coffee helps thyroid

Thyroid Bot 10:42
True

You 10:43
Issues include hypothyroidism

Thyroid Bot 10:43
True

You 10:43
Issues include hyperthyroidism

Thyroid Bot 10:43
True

(no word count is necessary)

References and Acknowledgments:

Webchat application adapted and inspired by:

<https://codepen.io/sajadhsm/pen/odaBdd>

<https://codeburst.io/building-your-first-chat-application-using-flask-in-7-minutes-f98de4adfa5d>