1. Covid19 Audio Cough Classification
   Emma Conti - econti2020@my.fit.edu
   Lamine Deen - ldeen2016@my.fit.edu
   Rodrigo Alarcon - ralarcon2019@my.fit.edu
2. Faculty Advisor: Dr. Nematzadeh Zahra znematzadeh@fit.edu
3. Client: Dr. Nematzadeh Zahra, professor at Florida Tech

4. Milestone 1 Matrix

Task	***Completion %***	***Rodrigo***	***Emma***	***Lamine***	***To Do***
1. Pick web framework	100%	60%	20%	20%	Continue working with Django
2. Pick ML framework	100%	25%	25%	50%	
3. Become familiar with ML	90%	33%	33%	33%	Continue research
4. Become familiar with web-dev	90%	60%	20%	20%	Continue working with Django
5. Research sound classification	90%	40%	40%	20%	Continue research, test alternate methods
6. Required research	90%	20%	60%	20%	Continue research
7. Design ML workflow (beginning to end)	100%	15%	60%	25%	
8. User interaction (SSD)	100%	15%	15%	70%	
9. Develop a testing plan for ML	100%	33%	33%	33%	
10. Develop a testing plan for Web	90%	60%	20%	20%	Finalize testing plan
11. Requirements Gathering	90%	10%	10%	80%	

5. Discussion (at least a few sentences, ie a paragraph) of each accomplished task (and obstacles) for the current Milestone:

- Task 1: Rodrigo
    - ❖ Django was selected as the backend framework, but will also provide frontend support. The Django documentation and rapid development process made it the optimal choice. A comparison with other frameworks such as rails ensured that Django fit the technical and developmental requirements needed for this project. Further work will focus on refining the MVC architecture as well as furthering the web-dev progress with the integration of a ML model.
- Task 2: Lamine
    - ❖ During Milestone 1, we selected PyTorch as the machine learning framework for developing our custom Convolutional Neural Network (CNN). This decision was driven by PyTorch's dynamic computation graph and its ease of use for building and modifying neural network architectures. PyTorch also offers robust support for GPU acceleration, which is essential for training deep learning models efficiently. An obstacle we encountered was the initial consideration between PyTorch and other frameworks like TensorFlow and Keras. We had to evaluate factors such as ease of use, library functionalities, and compatibility with our project's requirements. Ultimately, PyTorch's flexibility and extensive documentation made it the ideal choice for our project.
- Task 3: Emma
    - ○ During Milestone 1, each team member took time to review research on machine learning, specifically neural networks and how they are composed in order to be better suited to meet the goals of the research project. Throughout the research alternative neural networks and forms of sound classification were discussed and considered. Further research will be gathered on convolutional neural networks to ensure the project is progressing as it should. This is also essential in determining the best way to compose the final ML workflow.
- Task 4: Rodrigo
    - ❖ Progress has been made with the selection of a web framework, specifically using Django as the backend framework. To become familiar with this framework, the documentation is being reviewed and a variety of demo websites are being created to further understand the inner workings. Further work needs to be done to understand the integration between back-end and front-end components. Additionally, the integration of Django with a ML model also needs to be understood.
- Task 5: Emma
    - ○ The importance of researching a variety of types of sound classification is to allow our group to determine the one best suited to our particular project. Linear predictive coding and wavelet decomposition are suitable alternatives, but it was ultimately decided that spectrograms will be the best way to analyze sound given the requirements of our project. Due to this, we will not be continuing research into other types of sound classification, and alternative methods will not be discussed in more detail. CNNs in particular are well suited for classifying speech

and speech patterns, which will assist in the cough classification required for the project.

- Task 6: Emma
    - In researching various types of sound classification, Convolutional Neural Networks were repeatedly discussed. Additionally, Recurrent Neural Networks were frequently mentioned. This project was originally intended to be a CNN, but RNN's were determined to be worth researching as a possible alternative. RNNs specifically are particularly useful when working on audio classification and segmentation, which would fit well within the requirements of our project. There is also the possibility of using a hybrid RNN-CNN model, which would allow for the combined benefits of these learning models to be capitalized upon. For the time being a CNN is the best option due to how well suited it is to our project. Further research may be conducted into the possibility of an RNN-CNN model and its feasibility for this project though.
- Task 7: Lamine
    - ❖ We have outlined the complete machine learning workflow for our project, starting from data collection to model evaluation. The workflow begins with collecting cough audio samples, followed by preprocessing steps where we will use libraries like LibROSA and Pandas to convert audio files into mel spectrogram images suitable for CNN input. We will incorporate simple data augmentation techniques such as noise addition, pitch shifting, and time-stretching to enhance the diversity of our dataset. The preprocessed data is then fed into our custom CNN built with PyTorch for training. To evaluate our model's performance, we planned to compare it against three benchmark pretrained models. One challenge we faced was ensuring seamless integration between each stage of the workflow, particularly in automating the preprocessing steps to handle large volumes of data efficiently.
- Task 8: Lamine
    - ❖ We began designing the user interaction flow for the web application by creating a System Sequence Diagram (SSD). The SSD maps out the sequence of interactions between the user and the system, including recording a cough, submitting the audio, receiving a health prediction, and viewing historical data for health progression tracking. An obstacle we encountered was translating complex backend processes into a simple and intuitive user interface. We needed to ensure that users could easily navigate through the application without being overwhelmed by technical details. Balancing the display of essential information, such as prediction confidence metrics, while maintaining a user-friendly interface required careful consideration and iterative design.
- Task 9: Emma
    - The ML workflow has been designed and mapped out. All audio recordings will be transformed into a mel spectrogram. This allows for the data to be properly formatted to be run through the CNN. In order to properly run a CNN and get usable results it was determined that our initial workflow will include three sequential layers before any testing is completed on the data. Three is ideal

because it will allow for the necessary data to be kept, while background noise may be lost. This is especially useful in our case with the inconsistency of how the audio recordings may be taken. Once testing has been completed the evaluation metrics will focus on the accuracy and specificity of the model and its ability to identify and produce the correct output. Our project will only have three classifications for all output: Healthy, Symptomatic, and Has COVID-19.

- Task 10: Rodrigo
    - ❖ A detailed web testing plan is being established to ensure the expected functionality, usability, and security of the web app. The primary focus is on verifying the key components such as user authentication, audio recording, and submission. Usability testing has also been outlined to assess the users experience across different systems and devices ensuring seamless navigation and interaction. The plan also includes compatibility testing, performance testing, and security testing to guarantee proper data handling.
- Task 11: Lamine
    - ❖ In Milestone 1, we conducted comprehensive requirements gathering to establish a clear understanding of the project's scope and objectives. We identified key stakeholders, including end-users, the sponsoring professor, medical professionals, and the development team. We defined business requirements that focus on providing real-time health predictions and tracking user health progression over time. Functional requirements were specified, detailing features like audio recording, prediction generation, and progress visualization. Non-functional requirements, such as performance goals, security measures, and scalability needs, were also documented. One of the obstacles we faced was ensuring compliance with legal regulations related to health data privacy, such as HIPAA. This required us to consider additional security features and data handling protocols, which added complexity to the requirements.

6. Discussion (at least a few sentences, ie a paragraph) of contribution of each team member to the current Milestone:

Rodrigo Alarcon

For this milestone, my contributions have been primarily focused on the selection and implementation of the Django framework, which was chosen for its extensive documentation and support for both backend and frontend development. This will enable us to streamline the web development process while also making sure scalability will not be a concern. I have been familiarizing myself with the core functionalities of Django, including the MVC architecture, by reviewing the documentation, following guides, and developing simple web applications to understand its workflow. Additionally, I have researched sound classification, focusing on the different methods of audio preprocessing such as converting audio into mel spectrograms, to be used as input for ML models.

Emma Conti

For this Milestone, my contributions have been focused primarily on gathering and assessing research related to CNNs and sound classification in order to determine if the current plan for the project is the choice that will provide the best results. RNNs are another usable possibility, and would have applications for our type of project, especially with the type of sound classification we are attempting to accomplish. Ultimately it would not perform better than a CNN. A possibility that may be ideal would be a hybrid RNN-CNN model, which I will be researching more in depth prior to Milestone 2. Sound classification specifically is something that the group had not encountered in any previous ML research. Milestone has determined that a spectrogram is the ideal type of file we should use to analyze the sound recordings for our project, but others were considered.

Once the ML Model was researched, the workflow was developed. I have finalized and put together a graphic to outline what this will look like as we progress. We, as a group, determined that our first model should have three sequential layers, and that more can be added later if it is determined that we need more to achieve more accurate results.

Along with ML, CNN, and sound classification research, I have been familiarizing myself with web design, so as we move towards further development of the webapp for Milestone 2, I will be better suited and capable of assisting in its development.

Lamine Deen

In Milestone 1, we accomplished several foundational tasks for our real-time audio cough classification project. I selected PyTorch as our machine learning framework due to its dynamic computation graph, ease of building custom CNN architectures, and strong community support, overcoming the initial challenge of choosing between PyTorch, TensorFlow, and Keras. I designed the basic ML workflow from data collection to model evaluation, incorporating preprocessing steps with Pandas to convert audio data into mel spectrograms suitable for our custom CNN, and applying simple data augmentation techniques like noise addition, pitch shifting, and time-stretching to enhance the dataset. To assess our model's performance, we planned to compare it against three benchmark pretrained models. I also worked on the design of user interaction by creating a System Sequence Diagram (SSD) that maps out the user journey—from recording a cough to receiving health predictions and tracking progression—while ensuring the interface remains intuitive. Lastly, I conducted comprehensive requirements gathering, identifying key stakeholders and specifying business, functional, and non-functional requirements, while addressing obstacles such as ensuring compliance with health data privacy laws like HIPAA and GDPR, which added complexity to our security measures and data handling protocols.

7. Plan for the next Milestone (task matrix)

Task	Rodrigo	Emma	Lamine
1. Refine ML Workflow	Finalize research to determine best path forward	Finalize research to determine best path forward	Finalize research to determine best path forward
2. Begin Feature Engineering on Dataset	Learn about selected features	Learn about selected features	Determine feature engineering on dataset
3. Begin Working on WebFramework Frontend	Integrate and test necessary front end components	Integrate and test necessary front end components	Familiarize with web dev
4. Begin Working on Web Framework Back End	Design 50%	Design 30%	Design 20%
5. Pick 3 benchmark models	Familiarize and select benchmark CNN models	Familiarize and select benchmark CNN models	Familiarize and select benchmark CNN models

8. Discussion (at least a few sentences, ie a paragraph) of each planned task for the next Milestone or

- Task 1: We will work on refining the machine learning workflow to enhance efficiency and effectiveness. We plan to optimize each stage of the workflow, from data preprocessing to model evaluation. This includes streamlining the conversion of audio data into mel spectrograms using Pandas or similar tools, and integrating data augmentation techniques more seamlessly to enrich the dataset. We will also focus on fine-tuning our custom CNN model built with PyTorch by adjusting hyperparameters and improving training procedures. Additionally, we will establish a systematic approach to compare our model's performance against three benchmark pretrained models. We aim to achieve higher accuracy and reliability in our predictions for our cough classification system.
- Task 2: We will begin feature engineering on the dataset to enhance our model's performance. We will extract meaningful features from the audio data, such as mel-frequency cepstral coefficients (MFCCs), spectral roll-off, and zero-crossing rates, which are crucial for distinguishing between different cough sounds. Additionally, we will experiment with advanced preprocessing techniques to improve the quality of the mel spectrograms used as input for our custom CNN. By focusing on feature

engineering, we aim to provide the model with richer information, thereby increasing its accuracy in classifying coughs as healthy, symptomatic, or indicative of COVID-19.

- Task 3: Focus on integrating and testing necessary frontend components, specifically user interactions. This includes user authentication and other user functions such as recording and submitting. Ensure the design is responsive across various devices. Initial tests will also be conducted to ensure frontend elements are user-friendly easy to navigate
- Task 4: Continue working with Django to develop web app prototype with a focus on handling user data. The backend will also need to be set up to store user data and prepare for future integration with a ML model. This will include a database schema for any user data.
- Task 5: This part will be about exploring and choosing 3 useful and widely used CNN to use as our benchmark models to compare and assess the performance of our custom CNN. The goal will be to have similar or better results than pretrained models by the end of this project.

9. Meeting Date: September 30th

10. See Faculty Advisor Feedback Below

11. Meeting Date: September 30th

12. Faculty Advisor feedback on each task for the current Milestone 1

- Task 1: ...
- Task 2: ...
- Task 3: ...
- Task 4: …
- Task 5: …

Faculty Advisor Signature: _____ Date: _____