Milestone 4 Progress Evaluation

1) **Project Title:** Tomographic Medical Image Reconstruction using Federated Learning
   Members: Joshua Sheldon ((jsheldon2022@my.fit.edu), Yash Jani (vjani2023@my.fit.edu), Tanuj Kancharla (tkancharla2022@my.fit.edu), and Izzy MacDonald (imacdonald2022@my.fit.edu)
2) **Faculty Advisor:** Dr. Debasis Mitra (dmitra@fit.edu)
3) **Client:** Same as advisor
4) **Progress Matrix**

Task	Completion	Josh	Izzy	Tanuj	Yash	To Do
Refactor data synthesis pipeline	90%	100%	0%	0%	0%	Write supervisor script
Begin writing Flower framework code	100%	0%	0%	0%	100%	
Develop a UI for the contributor application	100%	0%	100%	0%	0%	
Update the ML model to reflect data dimensionality	100%	0%	0%	100%	0%	
Connect orchestrator application frontend and backend	100%	0%	50%	50%	0%	
Fix FL daemon secure communications	100%	0%	0%	100%	0%	
Attempt to leverage A.I Panther for Data Synthesis	90%	100%	0%	0%	0%	Deploy refactored pipeline on AI.Panther.

5) **Task Discussion**

a) Due to maintainability and portability issues with the data synthesis pipeline, I decided to refactor it, drastically improving its comprehensibility, configurability, and efficiency. Additionally, the pipeline now stores more metadata and intermediary artifacts, making it easier to change the pipeline without restarting all our data generation from scratch and enabling us to determine the characteristics of the artificial patient that a given simple came from (sex, diseased, etc.)
b) Implemented initial Flower integration: defined the model, client selection, and data loading; began wiring our model into Flower's client/server; added start/stop orchestration hooks; and reviewed Flower architecture to align with our project goals.
c) I was able to create the UI for the contributor application. The frontend is not functional in a way where it connects to the backend, however, there is dummy information filled in for it at the moment. The frontend is ready to sync with the backend once we decide to connect the two.
d) I updated the model's input/output dimensionality to 64 × 80 × 80 and refined the smoothing techniques to better preserve fine details in the predictions. I also enabled AMP, which mixes 16- and 32-bit operations to improve training speed and reduce GPU memory usage without sacrificing accuracy.
e) I connected the frontend to the backend in the orchestrator application. I added selection bars, status bar updates, and a connectivity test button. Contributors, orchestration, and model data load automatically—no extra clicks—backed by a regular polling interval to keep the UI in sync with backend. On the UX side, users can now choose a specific contributor and model.
f) Fixed contributor detection: reproduced the HTTPS registration failure. Added a connectivity check and verified end-to-end connection; contributors now register, appear in the UI, and can be re-selected.
g) I confirmed that Gate 10 can be installed and run on AI.Panther, and developed a script to automatically install Gate 10 on AI.Panther. Once the refactored data synthesis pipeline is complete, I can deploy it on AI.Panther to increase the amount of compute we leverage for data synthesis.

6) Member Contributions

Joshua:

- Refactored data synthesis pipeline.
- Revised data synthesis plan.
- Determined reasonable bounds of a cropped XCAT to be 64 slices of 80x80, meaning we can reduce output dimensionality, meaning downstream positive impacts on model weight count and training time.
- Tested Gate 10 on AI.Panther.
- Managed the project.

Izzy:

- Developed UI for contributor application
- Worked on the data generation pipeline
- Began the generation on the 20 standard patients

Yash:

- Began writing Flower framework code to define model, client selection, and data loading for federated learning.
- Started integrating the ML model with the Flower framework.
- Contributed to connecting federated learning applications with the Flower framework, focusing on orchestrating start/stop functionality.
- Researched federated learning operations and Flower architecture to align implementation with project goals.

Tanuj:

- Connected the frontend with the orchestrator daemon backend APIs.
  Implemented and tested API routes
- Enabled choosing a specific contributor and model.
- Fixed bug where selections were previously locked — users can now re-select or update contributors/models after submitting.
- Added selection bars, status bar updates, and a connectivity test button.
- Handled model ingestion, renaming, and deletion via the daemon API.
- Models, contributors, and orchestration data should load automatically without requiring button clicks.
- Data refresh is designed to occur on a regular polling interval, keeping the UI synced with backend state.
- Updated the ML model to reflect new input dimensionality: 64 × 80 × 80 (down from 128 × 128 × 120).
- Added MSE loss and a hybrid loss function.
- Enhanced smoothing of outputs
- Integrated Automatic Mixed Precision (AMP) for faster training and reduced GPU memory usage.

7) **Next Milestone Plan(5):**

Task	Josh	Izzy	Tanuj	Yash
Finish the Flower framework code	0%	0%	0%	100%
Continually improve ML model accuracy	0%	0%	100%	0%
Connect the Flower framework code and the federated learning applications	50%	0%	0%	50%
Connect the contributor's frontend to the backend	50%	50%	0%	0%

8) **Task Discussion**
   a) The Flower framework code defines the model that will be used for federated learning, how clients will be selected, how data will be loaded, and other federated learning operations concerns. Completing this code is vital to the functionality of our project.
   b) We are continually revising our machine learning model to improve accuracy. During this milestone, we'll have more by way of data to test the updated model and glean insights into how we can improve accuracy.
   c) The existing federated learning applications need to be able to start and stop software components of the Flower framework to start and stop the federated learning process. We need to implement this connection between our applications and those of the Flower framework.
   d) Last milestone, we developed a UI for the contributor application. This milestone, we need to connect it to the backend.
9) **Meeting Dates with Client:** See Meeting Dates with Advisor
10) **Client Feedback:** See Faculty Advisor Feedback below
11) **Meeting Dates with Advisor:** 9/24 12:30pm-1:30pm
12) **Faculty Advisor Feedback:** I expect the training phase to start as soon as possible.

Faculty Advisor Signature: _____ Date: _____

Evaluation by Faculty Advisor

- Faculty Advisor: detach and return this page to Dr. Chan (HC 209) or email the scores to pkc@cs.fit.edu
- Score (0-10) for each member: circle a score (or circle two adjacent scores for .25 or write down a real number between 0 and 10)

Joshua Sheldon	0	1	2	3	4	5	5.5	6	6.5	7	7.5	8	8.5	9	9.5	10
Yash Jani	0	1	2	3	4	5	5.5	6	6.5	7	7.5	8	8.5	9	9.5	10
Tanuj Kancharla	0	1	2	3	4	5	5.5	6	6.5	7	7.5	8	8.5	9	9.5	10
Izzy MacDonald	0	1	2	3	4	5	5.5	6	6.5	7	7.5	8	8.5	9	9.5	10

Faculty Advisor Signature: _____ Date: _____