Human Context Recognition:
A Controllable GAN Approach

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Progress Summary

1. Cleaned our existing codebase by making our programs more modular.

2. Began implementing a Controllable GAN by building user and activity classifiers (explained later).

3. Established a third metric for evaluating the performance of our GAN architectures.

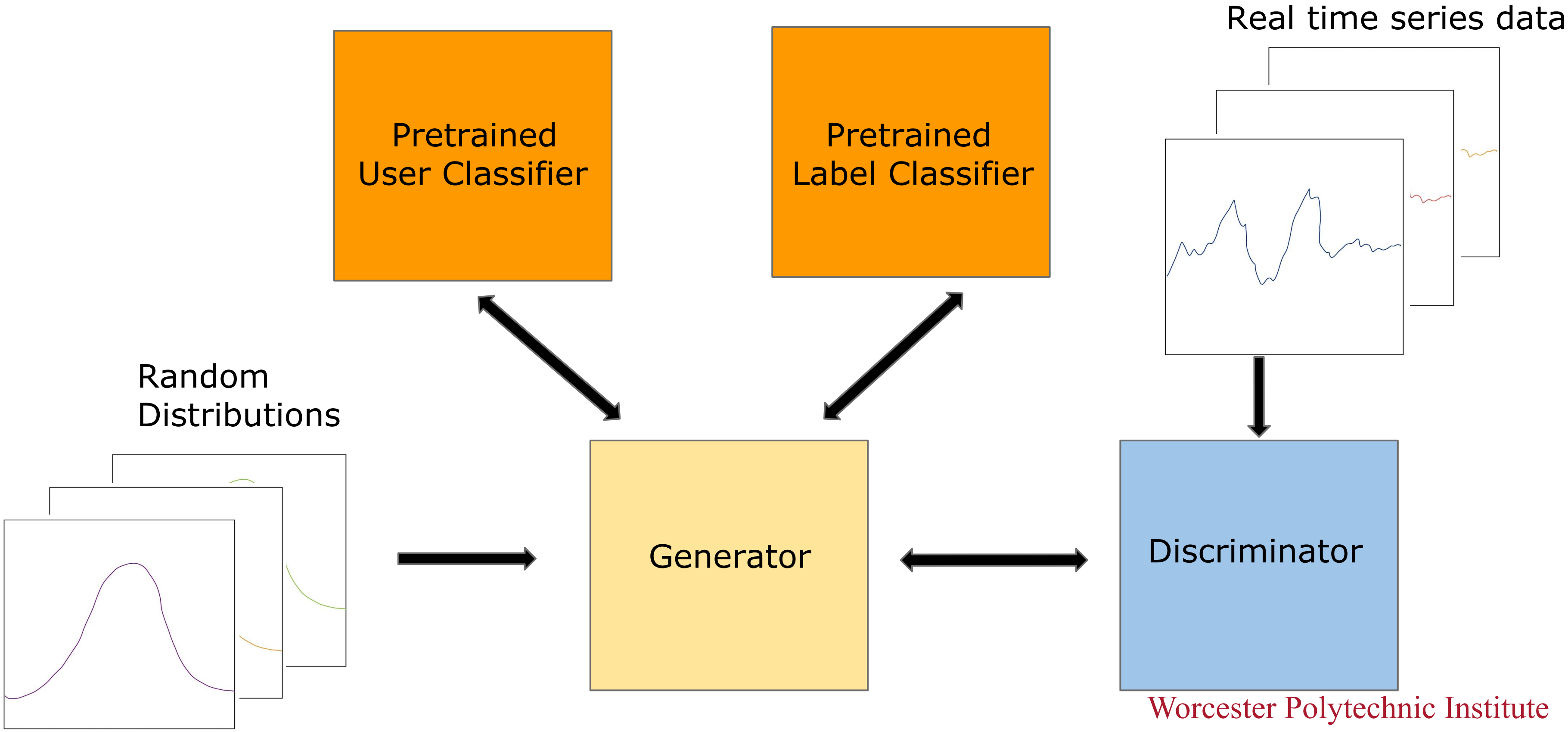
4. Continued exploring our novel methodology for training simple GANs by tuning hyperparameters.

5. Gathered preliminary results demonstrating the benefits of our training methodology over existing practices.

Modularization of Vanilla GAN

- Broke GAN up into functions
- Added comments to specify parameters and return values
- GAN runs in 3 lines with easy specification of parameters

Controllable GAN



Controllable GAN Activity Classifier

Standard Classifier

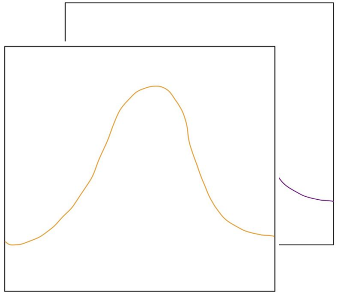
	precision	recall	f1-score	support
0	0.916	0.960	0.938	682
1	0.948	0.906	0.926	319
2	0.723	0.515	0.602	66
accuracy			0.917	1067
macro avg	0.862	0.794	0.822	1067
weighted avg	0.914	0.917	0.914	1067

SMOTE-Augmented Classifier

	precision	recall	f1-score	support
0	0.929	0.853	0.889	659
1	0.939	0.955	0.947	627
2	0.897	0.961	0.928	595
accuracy			0.921	1881
macro avg	0.921	0.923	0.921	1881
weighted avg	0.922	0.921	0.921	1881

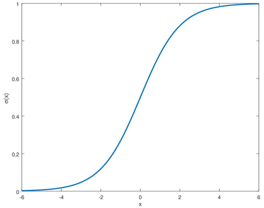
Evaluating Our GAN Architectures

Real & Fake Data



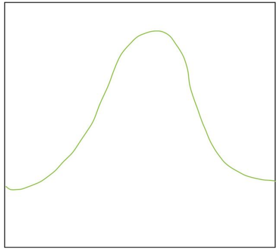
Logistic Regression

Train

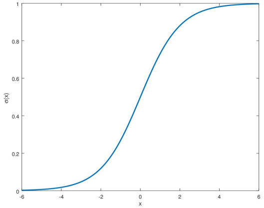


Compare Performance
on Real Test Data

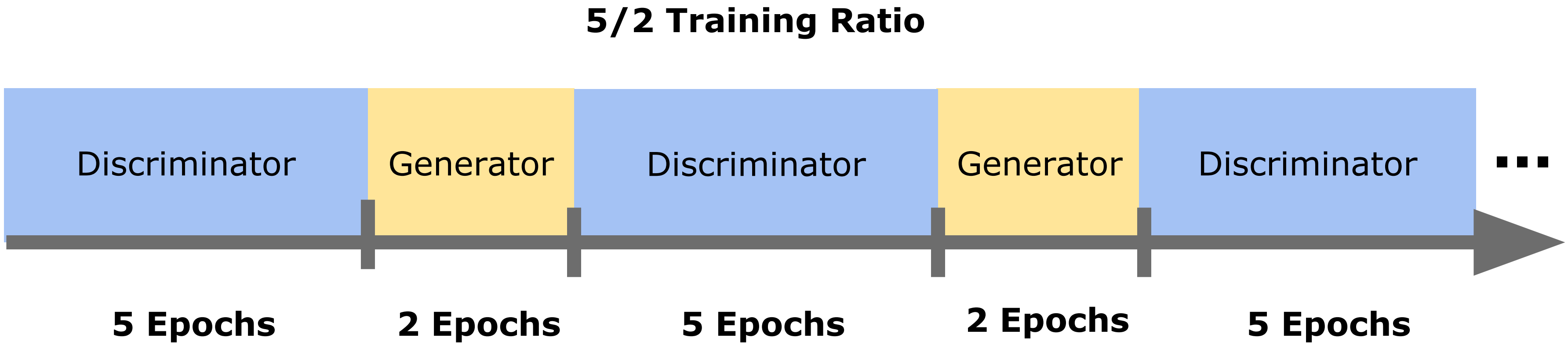
Only Real Data



Train



Conventional GAN Training Methodology



[1] Lim et al. "Geometric GAN"
[2] Lin, Muyang et. al "GAN Compression: Efficient Architectures for Interactive Conditional GANs"
[3] Lei, Kai et. al "GCN-GAN: A Non-linear Temporal Link Prediction Model for Weighted Dynamic Networks"
[4] Lee, Hyeungill et. al "Generative Adversarial Trainer: Defense to Adversarial Perturbations with GAN"
[5] Mescheder, Lars et. al "Which Training Methods for GANs do actually Converge?"
[6] Gao, Lianli et. al "Lightweight dynamic conditional GAN with pyramid attention for text-to-image synthesis"
[7] Mirza Mehdi, "Conditional Generative Adversarial Nets"
[8] Lee, Minhyeok et. al, "Controllable Generative Adversarial Network"
[9] Goodfellow et. al, "Generative Adversarial Nets"
[10] Shoshan et. al , "GAN-Control: Explicitly Controllable GANs"

Conventional GAN Training Methodology

Original Motivation

- Stable training is an open problem
- Alternates training
- Simple to implement
- Involves only 2 hyper-parameters
- Ensures ***D*** is always better than ***G***

Flaws

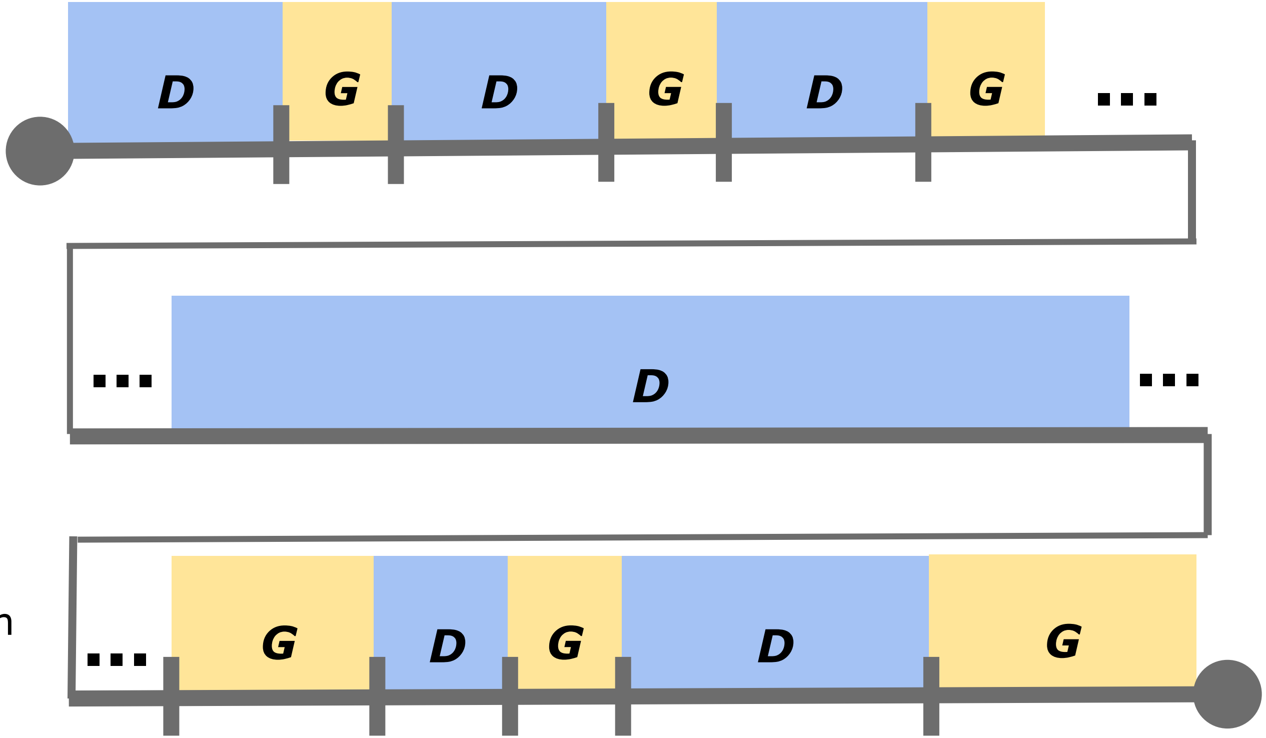
- ***D*** can be overtrained
- Leads to inefficient computation
- Minority of epochs spent training ***G***
- Doesn’t maintain a sense of fair competition between machines

Proposed Methodology: Dynamic Training

Phase 1: Conventional training for first *T* epochs

Phase 2: Train ***D*** until model yields minimum recall *R*

Phase 3: Switch which machine to train based on fpR



How Does Dynamic Training Add Value?

Assumptions:

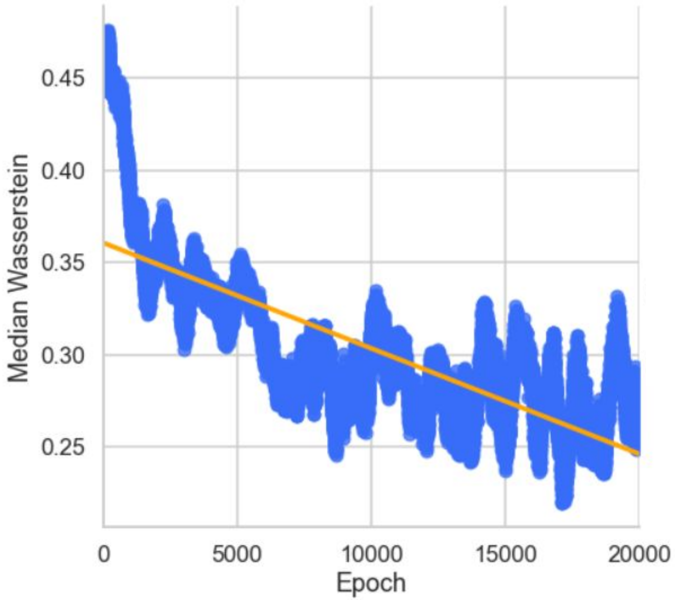
1. Similar runtime for training each machine for an epoch
2. Limited time and/or resources

Improvements on Conventional Training:

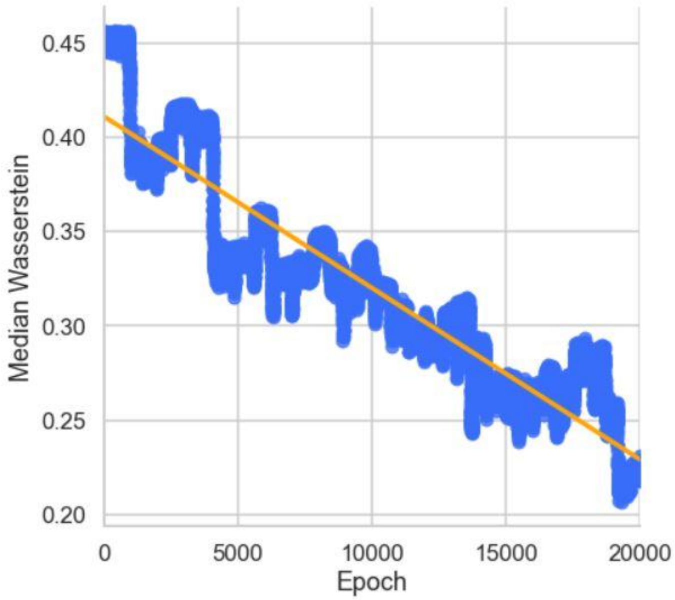
1. Improves training stability
2. Reduces frequency of redundant/inefficient epochs
3. Leads to equal to or quicker convergence
4. Maximizes training of ***G***
5. Negligibly additional computation

Preliminary Results: Median Wasserstein

Conventional Training

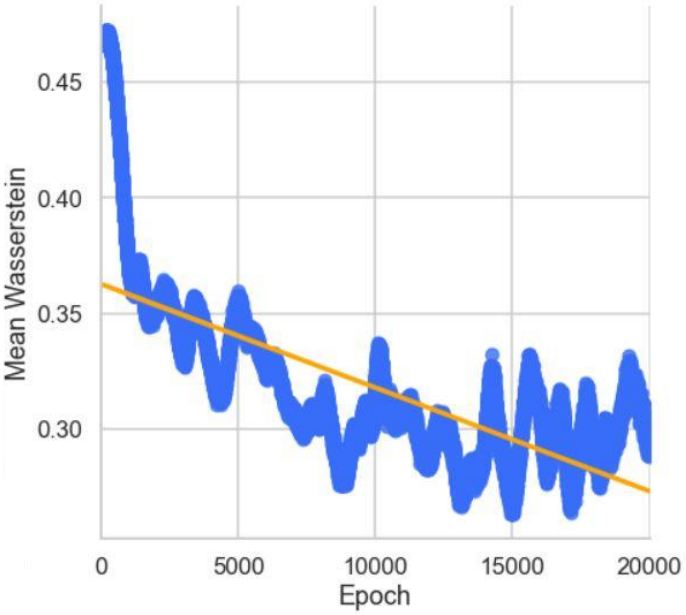


Dynamic Training

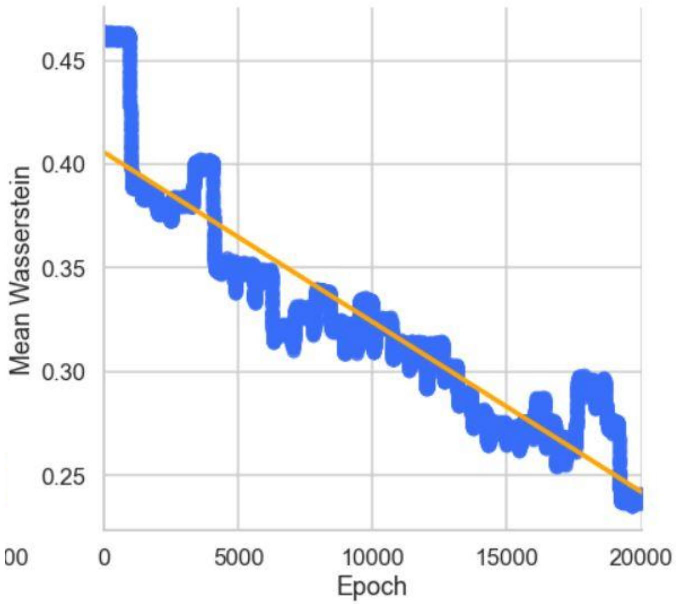


Preliminary Results: Mean Wasserstein

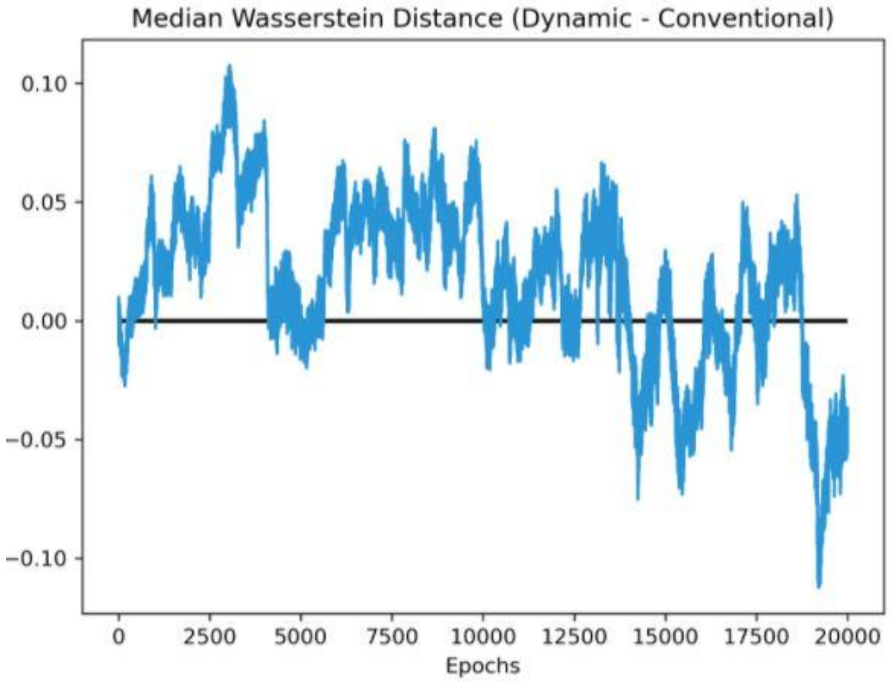
Conventional Training

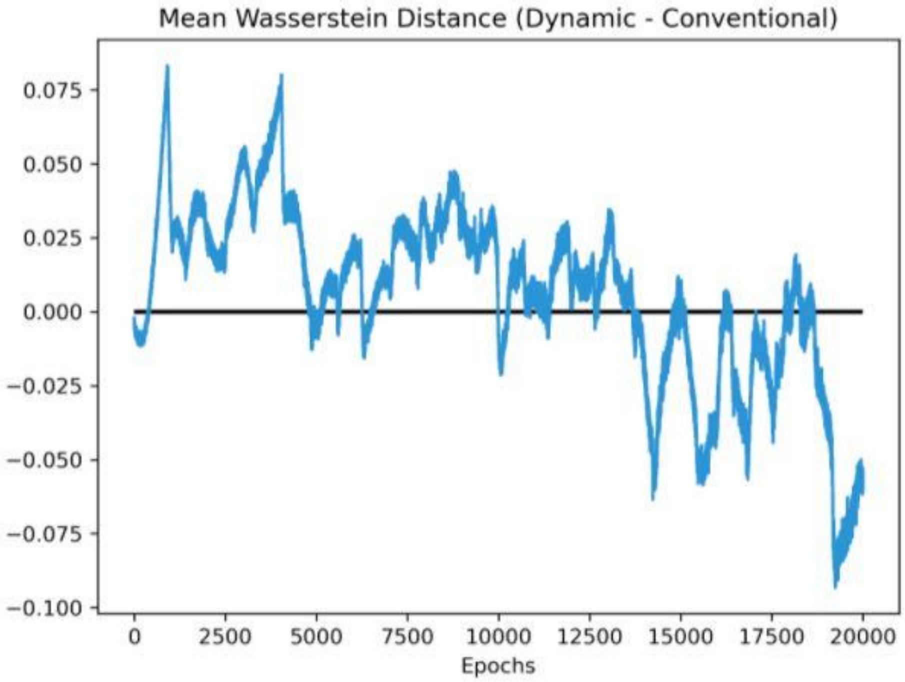


Dynamic Training



Preliminary Results: Wasserstein Difference

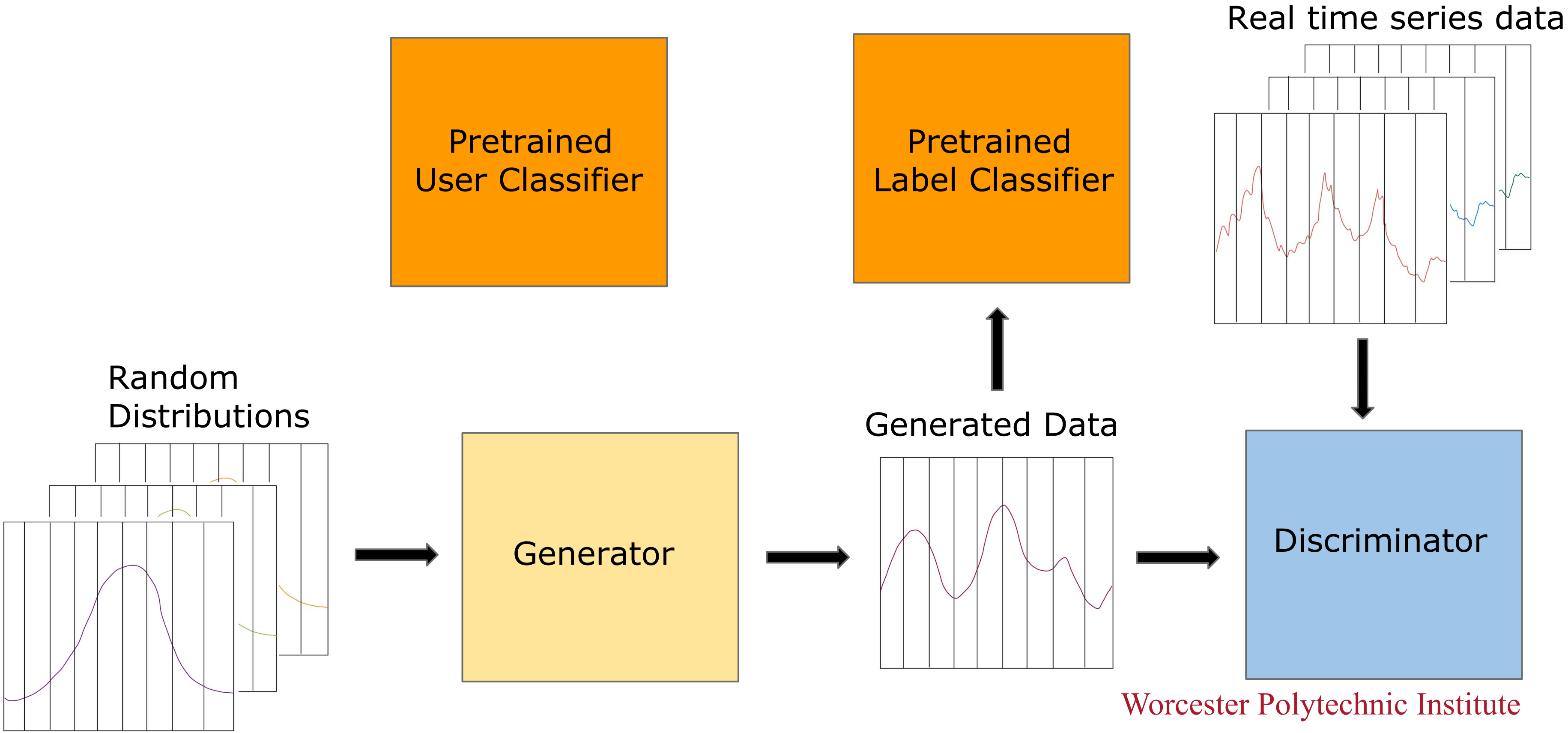


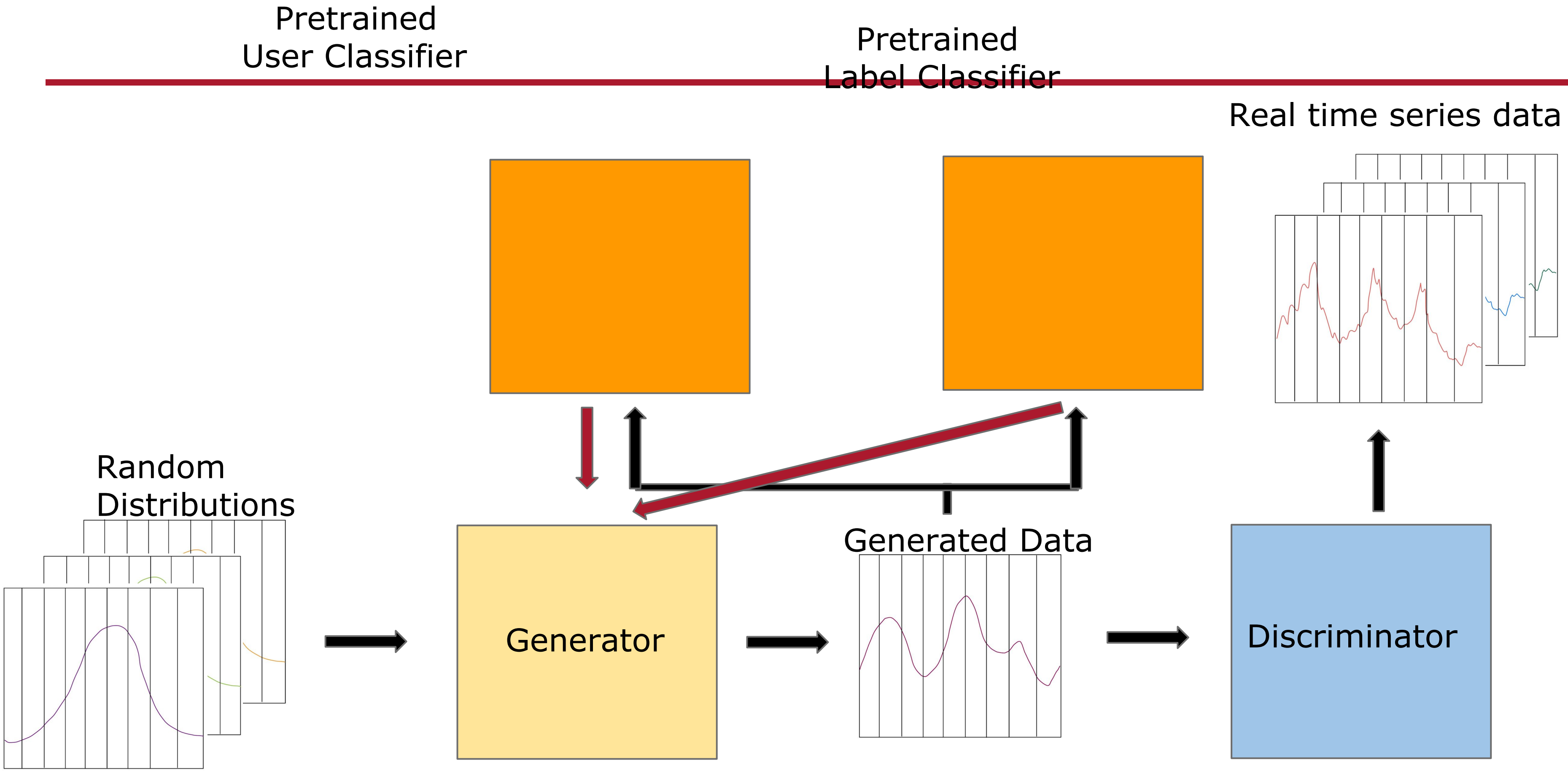


Next Steps

1. Integrate user and activity classifiers into the main Controllable GAN architecture.
2. Train a Controllable GAN to generate 3 different types of activities undertaken by 3 users.
3. Expand the GAN to generate n different types of activities undertaken by m users.
4. Begin updating the GAN for time-series data generation.

Controllable GAN




Pretrained
User Classifier
Pretrained
Label Classifier
Real time series data
Random
Distributions
Generator
Generated Data
Discriminator