Human Context Recognition:
A Controllable GAN Approach

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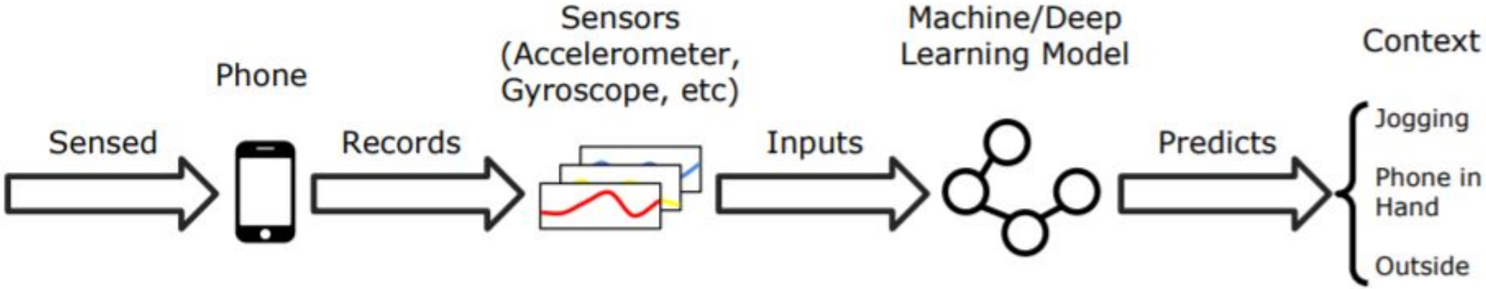
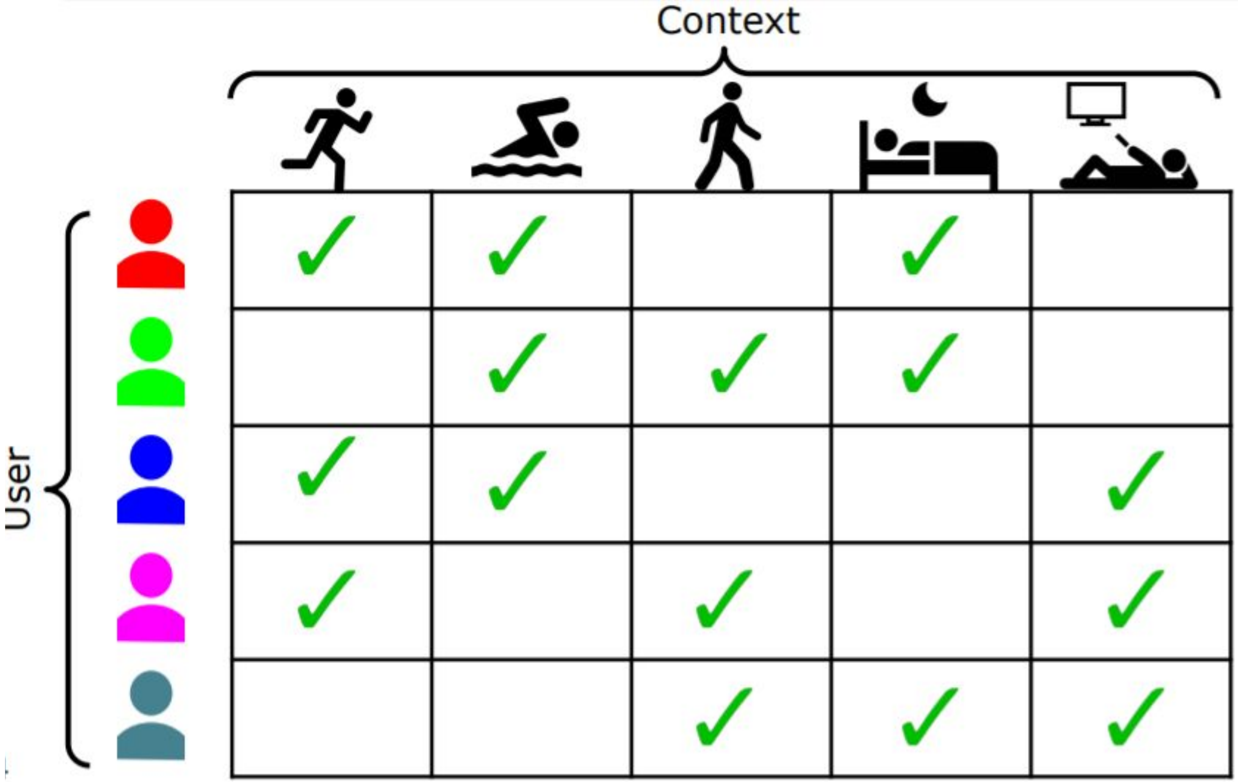
Project Overview



Use cases

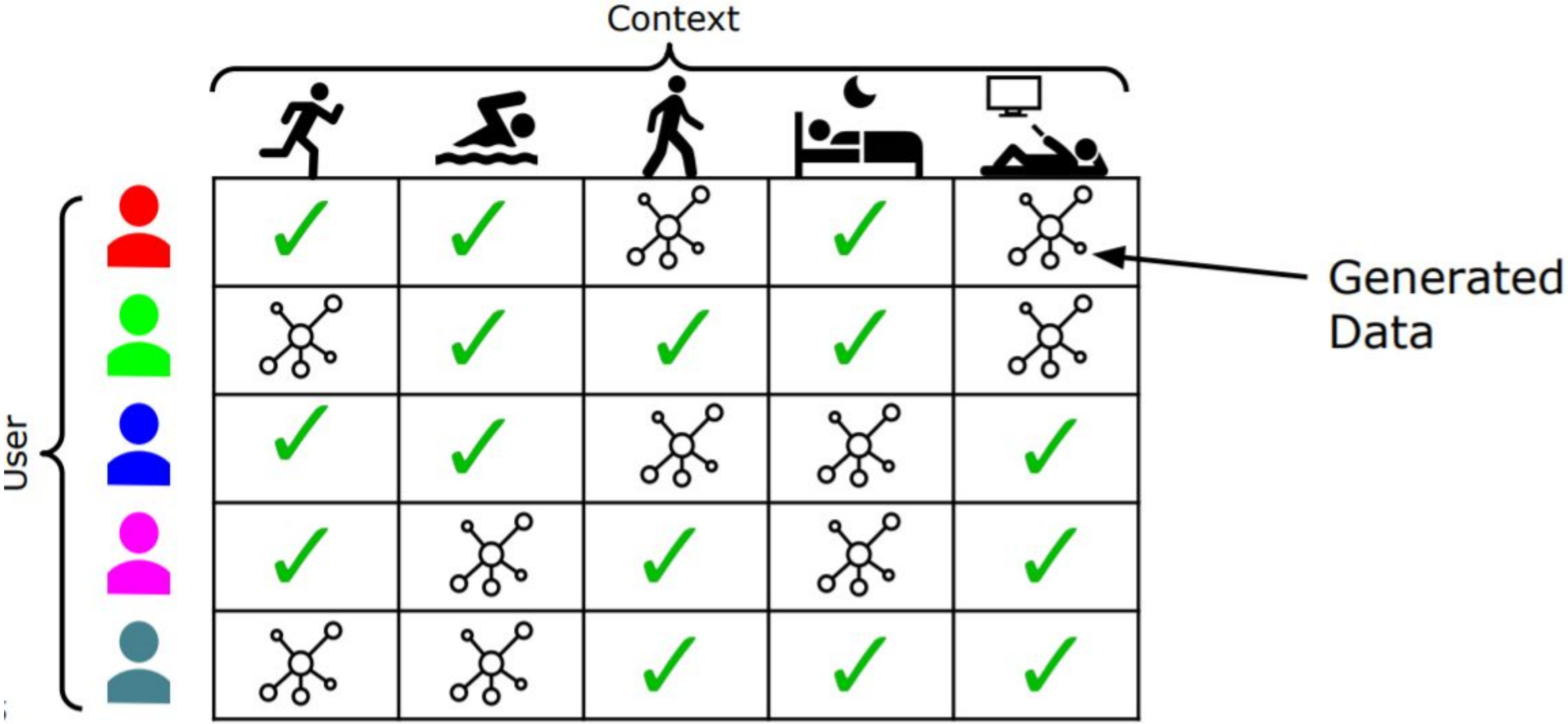
- Mobile healthcare
- Security/User Identification

Missing User-Context Pairs

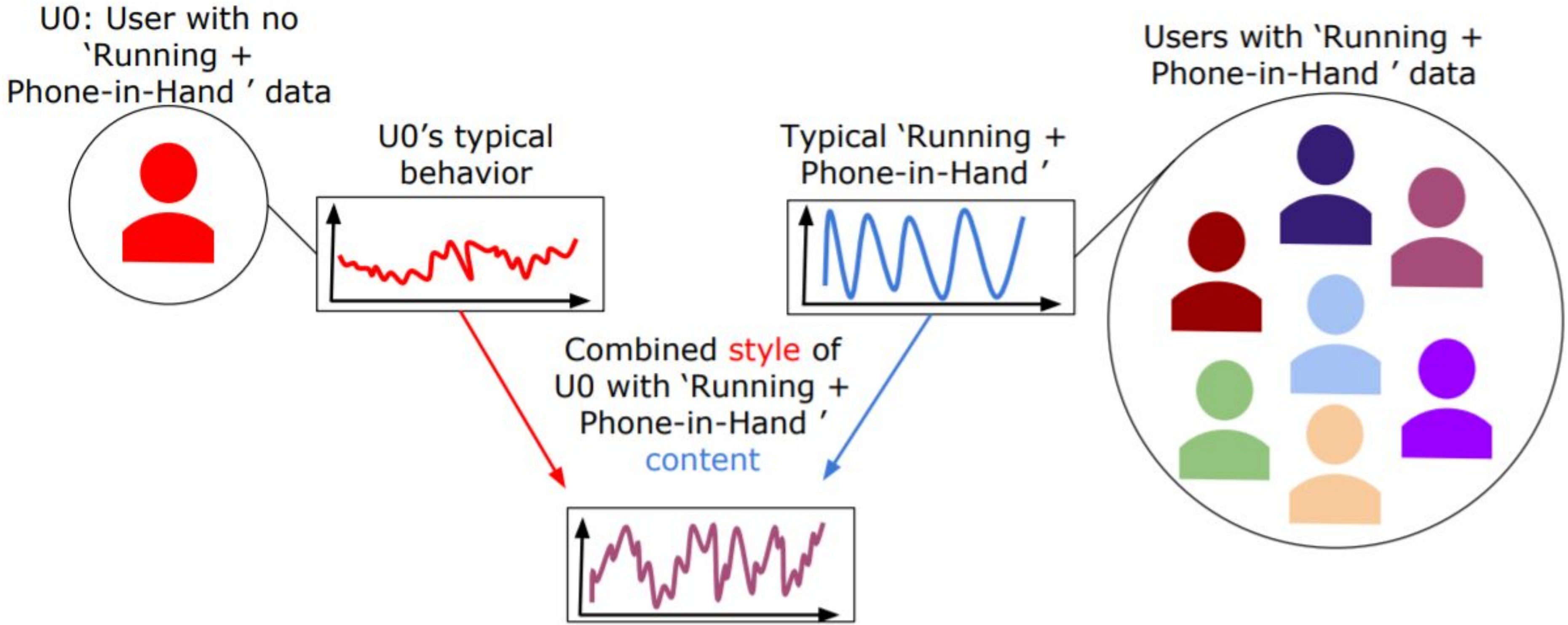


We do not have data for every context data for every user

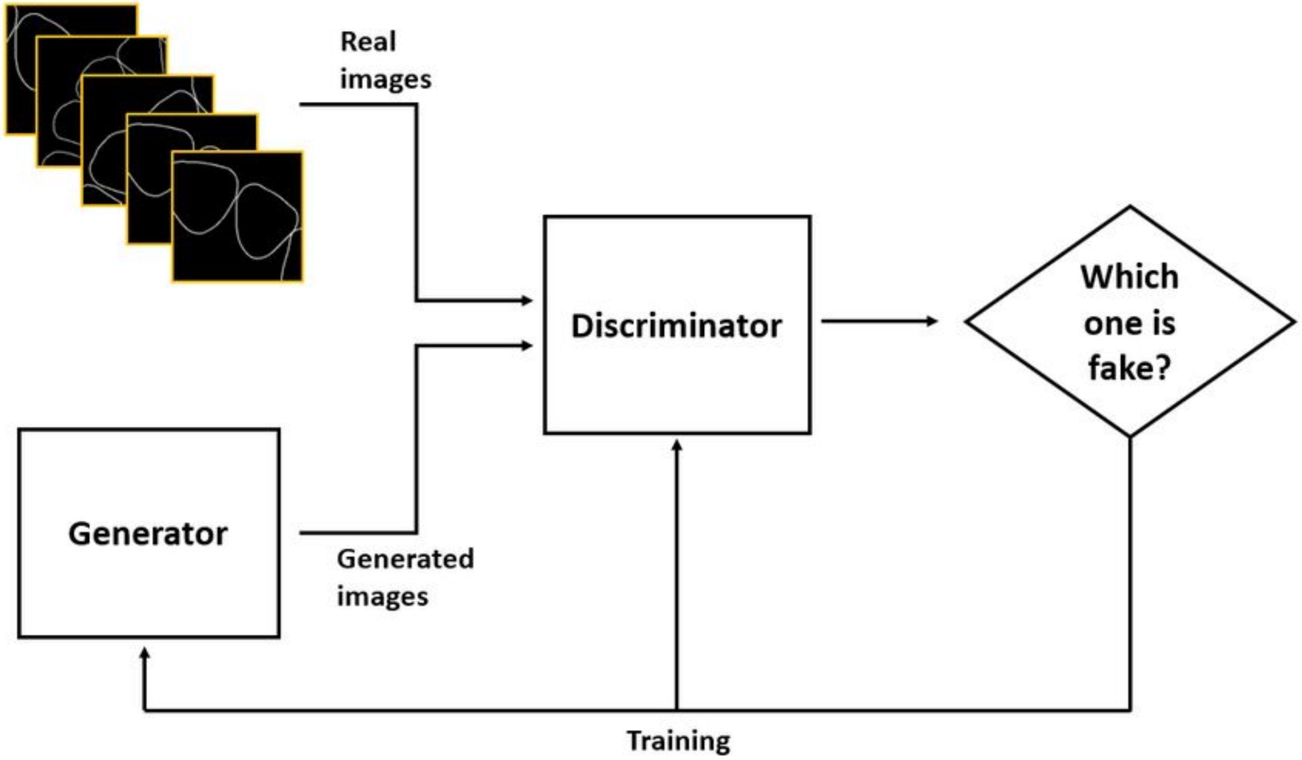
Missing User-Context Pairs



Idea: Generate Characteristic Data



Approach: Generative Adversarial Network (GAN)



 [1] Kim et al., “Overview of generative adversarial network (GAN).,” 2020

Simple GANs

- ***G*** learns a transformation *f(z)* = *x* such that all generated *x* converge towards the corpus.

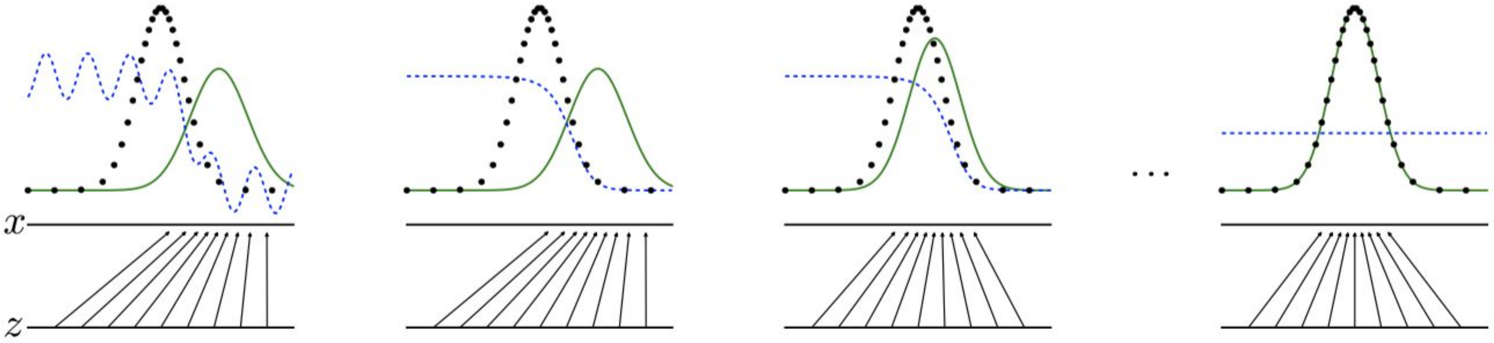
- ***D*** should no longer be able to discern between ***G***'s distribution and the corpus.

Legend:

Discriminative distribution:

Generative distribution:

Corpus distribution:



(a) (b) (c) (d)

[2] I. J. Goodfellow et al., "Generative adversarial nets," 2014.

Conditional GANs

- Forces ***G*** to generate with a specific class/feature
- Reduces class imbalance during ***G***'s training

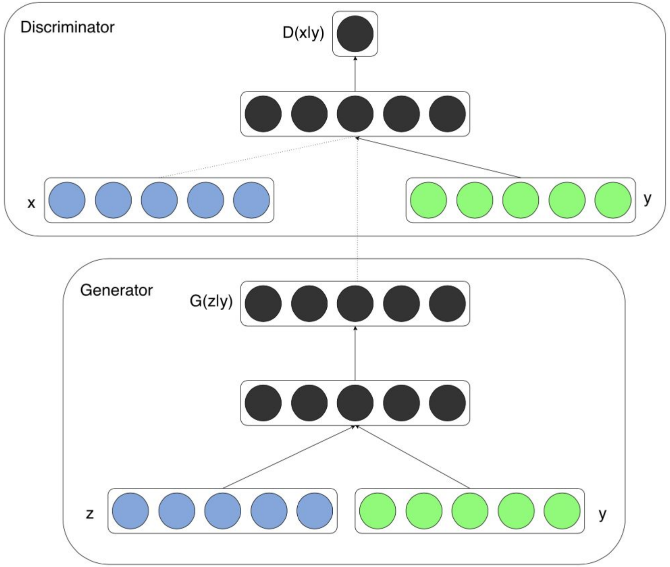
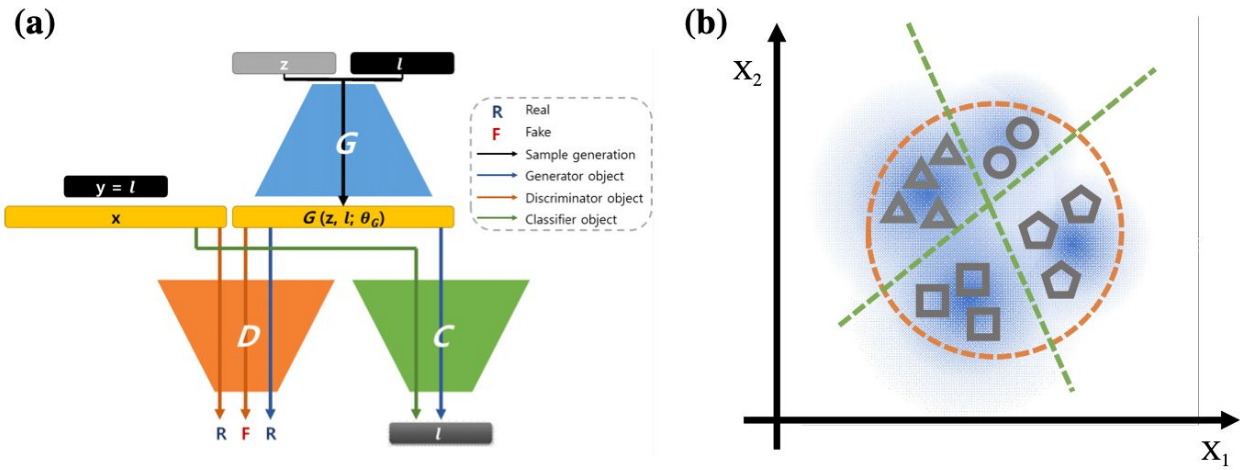


Figure 2: Generated MNIST digits, each row conditioned on one label

[3] M. Mirza and S. Osindero, "Conditional Generative Adversarial Nets," 2014.

Controllable GANs

- Addition of third machine, classifier
- Alters discrete features



Legend:

Classifier ***C***:

Discriminator ***D***:

Grey figures: corpus samples from different classes

Generator: blue region

[4] M. Lee and J. Seok, "Controllable Generative Adversarial Network," 2014.

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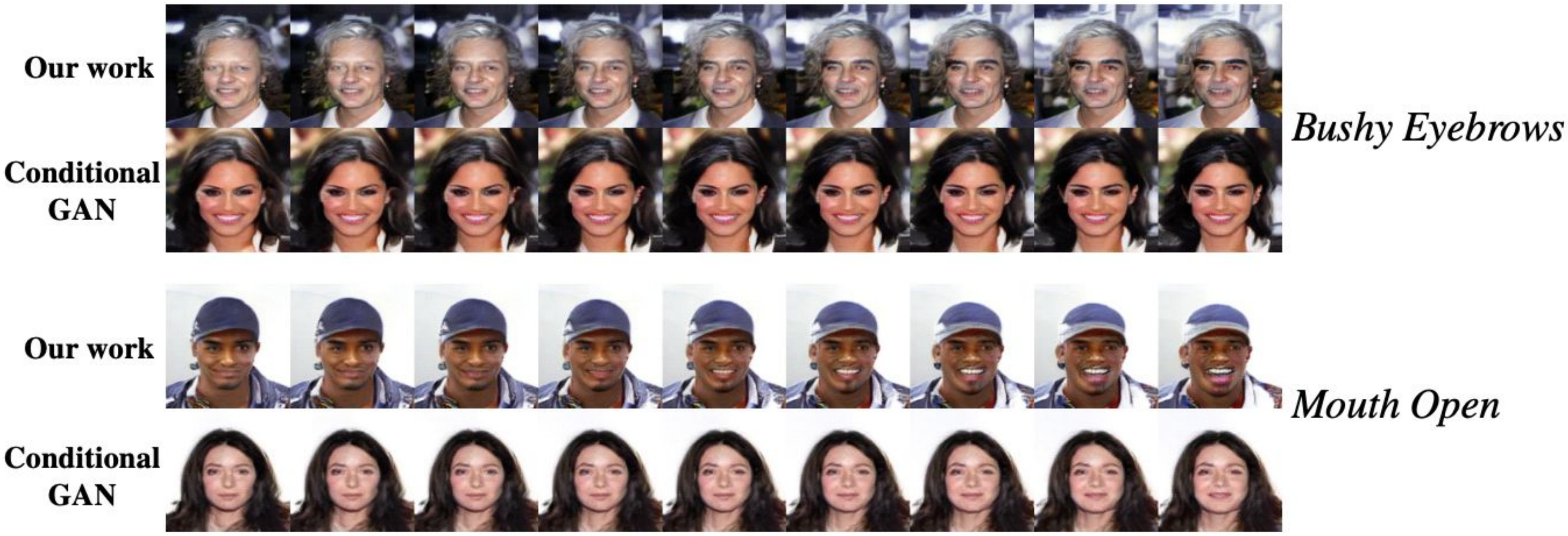
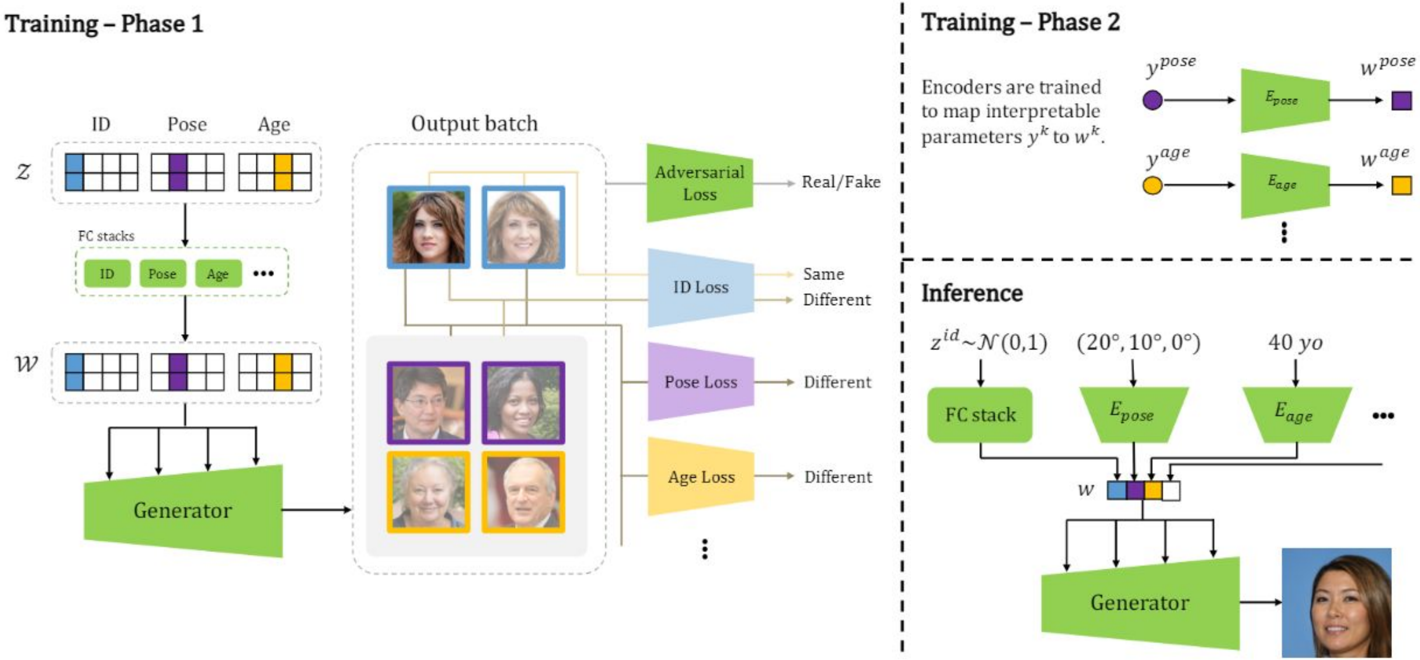


[4] M. Lee and J. Seok, “Controllable Generative Adversarial Network,” 2014.

Explicitly Controllable GANs

- Standard generator/discriminator models
- Alters a set of independent, continuous features



[5] A. Shoshan, N. Bhonker, I. Kviatkovsky, and G. Medioni, "GAN-Control: Explicitly Controllable GANs," 2021.

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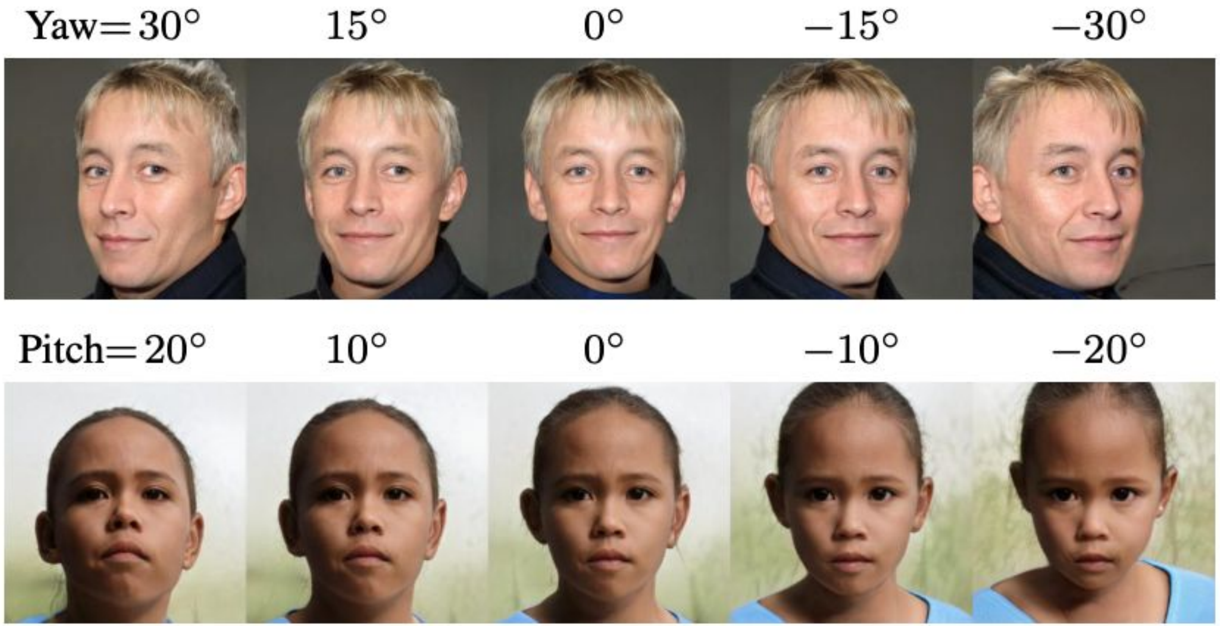
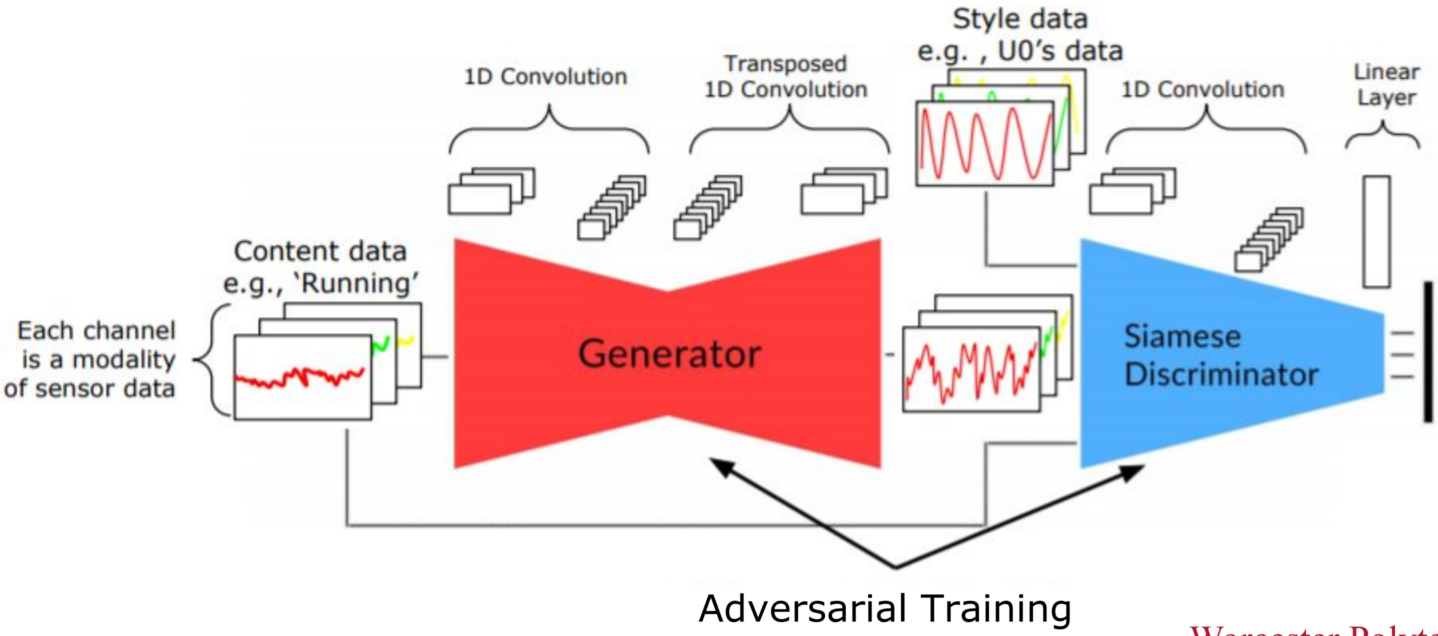


[5] A. Shoshan, N. Bhonker, I. Kviatkovsky, and G. Medioni, “GAN-Control: Explicitly Controllable GANs,” 2021.

Implementation for Mobile Sensor Data

- Smartphone data: 1D sequences with N channels
  - Channel: modality/sensor
- Generator: 1D convolution + transposed 1D convolution
  - Discriminator: 1D convolution + Linear



Completed Coding Tutorials

- Deep Learning With PyTorch: A 60 Minute Blitz
- Your First Machine Learning Project in Python Step-By-Step
- Introducing Scikit-Learn
- How to Develop a Conditional GAN (cGAN) From Scratch

Takeaways

1. Developed a basic understanding of the standard ML libraries and tools we’ll use throughout our research.

2. Read and analyzed the strengths and weaknesses of different GAN-based architectures rooted in image-based domains.

3. Began looking into how to apply these related works into the time-series-based domain of mobile sensor data.

References

[1] “Figure 3. Overview of generative adversarial network (GAN).,” ResearchGate. https://www.researchgate.net/figure/Overview-of-generative-adversarial-network-GAN_fig1_338509383 (accessed May 27, 2021).

[2] I. J. Goodfellow et al., “Generative adversarial nets,” in Proceedings of the 27th International Conference on Neural Information Processing Systems - Volume 2, Cambridge, MA, USA, Dec. 2014, pp. 2672–2680.

[3] M. Mirza and S. Osindero, “Conditional Generative Adversarial Nets,” ArXiv14111784 Cs Stat, Nov. 2014, Accessed: May 27, 2021. [Online]. Available: http://arxiv.org/abs/1411.1784

[4] M. Lee and J. Seok, “Controllable Generative Adversarial Network,” ArXiv170800598 Cs Stat, Mar. 2019, Accessed: May 27, 2021. [Online]. Available: http://arxiv.org/abs/1708.00598

[5] A. Shoshan, N. Bhonker, I. Kviatkovsky, and G. Medioni, “GAN-Control: Explicitly Controllable GANs,” ArXiv210102477 Cs, Jan. 2021, Accessed: May 27, 2021. [Online]. Available: http://arxiv.org/abs/2101.02477