

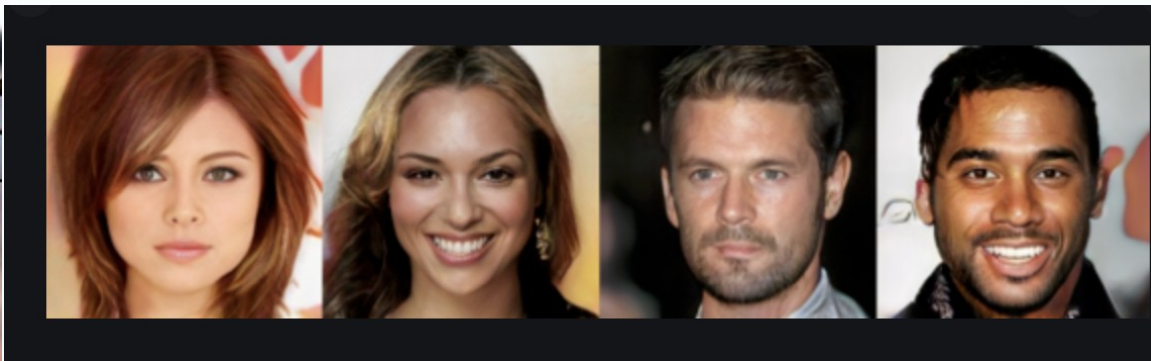
Generative AI, Causality and Game Theory

Game Theory & GAN

- Current Research in game theory for GAN
- My research target in generative AI
- Discussions: game theory for generative AI

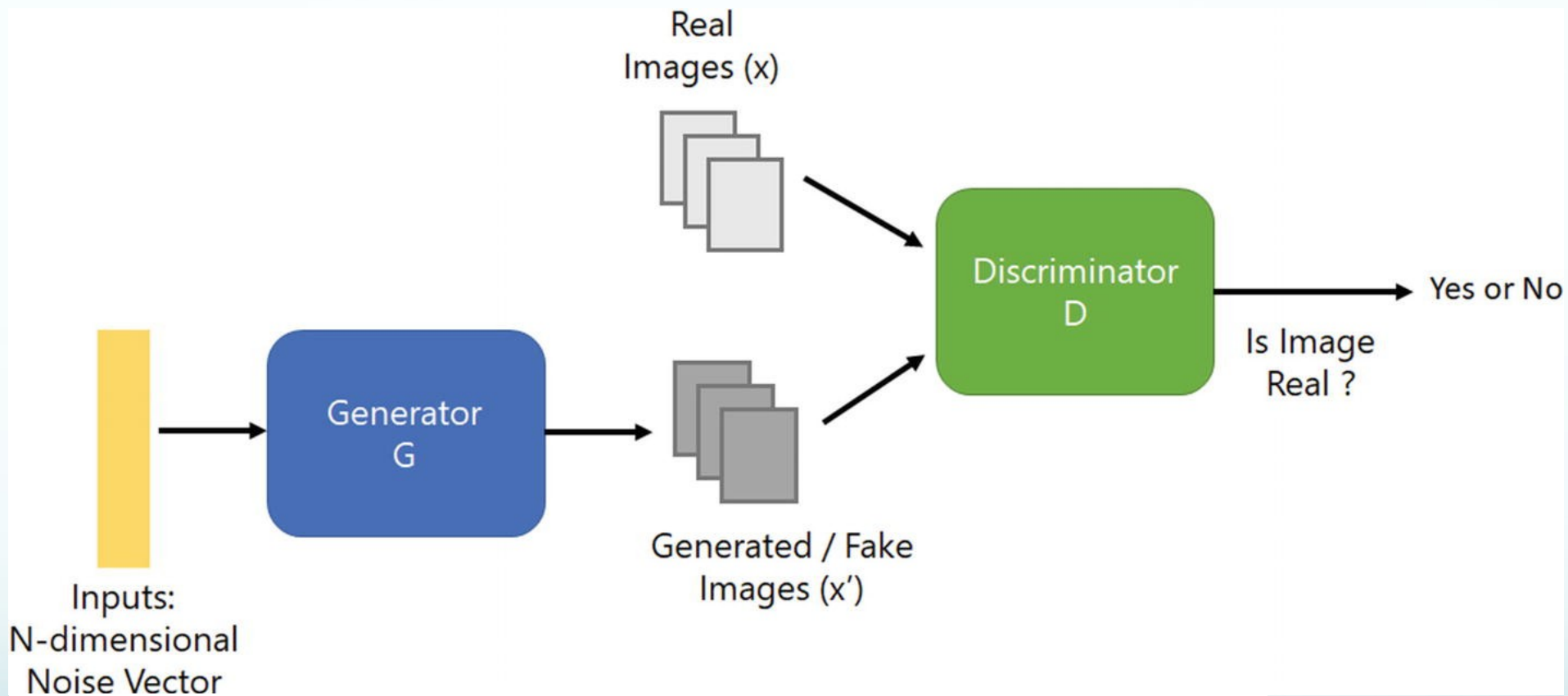
Generative approaches

- **Generative models:** to generate synthetic data with the same statistical distributions as the real world data



<https://www.youtube.com/watch?v=sucqskXRkss&t=2s>

https://www.youtube.com/watch?v=ClfsB_EYsVI

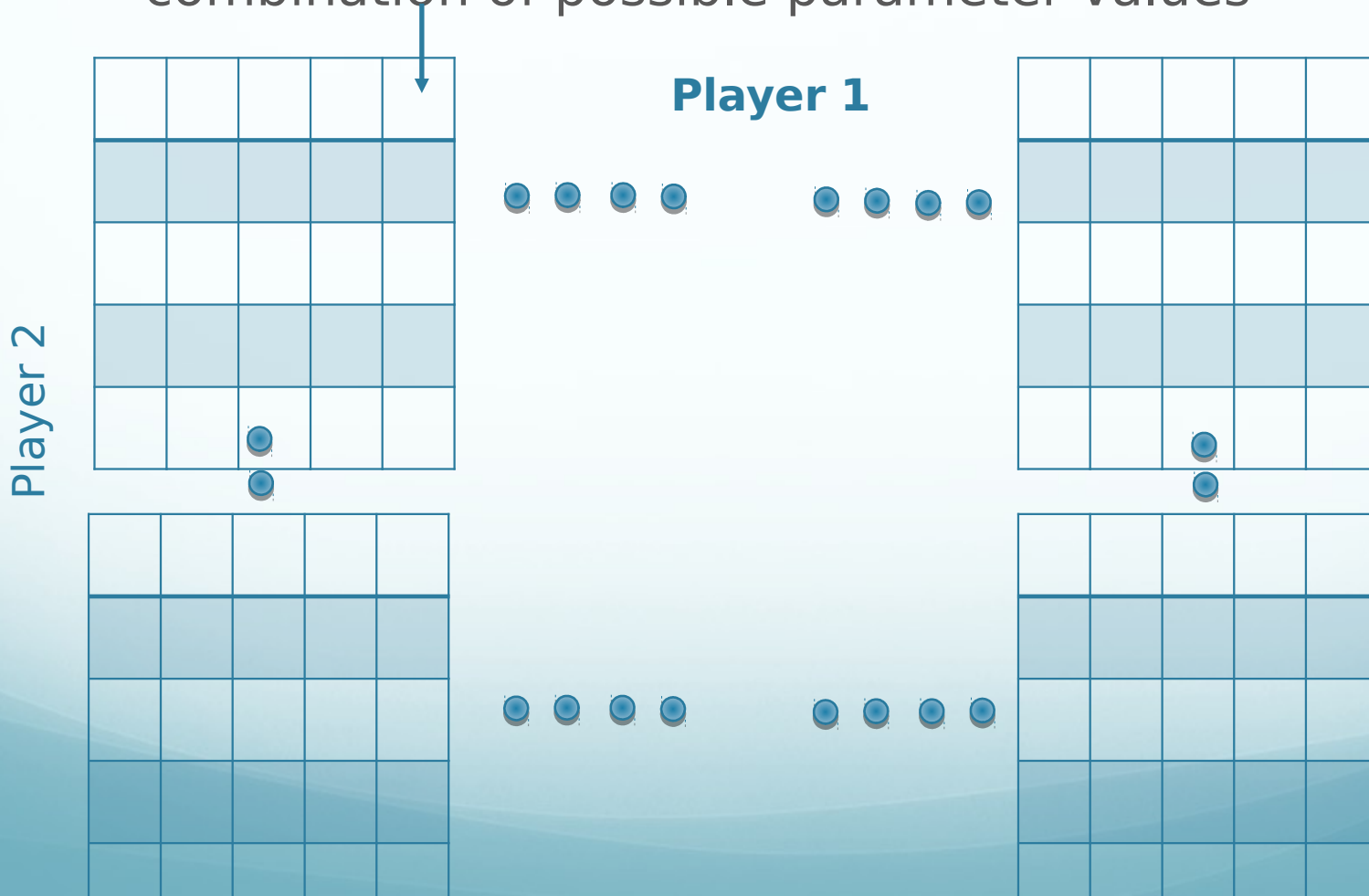


$$\min_G \max_D V(G, D) = \mathbb{E}_{\mathbf{x} \sim p_d(\mathbf{x})} \{\log D(\mathbf{x})\} + \mathbb{E}_{\mathbf{z} \sim p_z(\mathbf{z})} \{\log(1 - D(G(\mathbf{z})))\}.$$

$$\min_G \max_{D \in 1\text{-Lipschitz}} \{ \mathbb{E}_{\mathbf{x} \sim P_{data}} [D(\mathbf{x})] - \mathbb{E}_{\mathbf{x} \sim P_G} [D(\mathbf{x})] \}$$

The Challenge

- A huge utility table and discriminator and the combination of possible parameter values



Mixed Strategy Nash Equilibria (MNE)

- Wiatrak: Stabilizing Generative Adversarial Networks: A Survey, 2020
- Grnarova et al: An Online Learning Approach to Generative Adversarial Networks, 2017
- Ge et al: Fictitious GAN: Training GANs with Historical Models, 2018
- Oliehoek et al: GANGs: Generative Adversarial Network Games, 2017
- Oliehoek et al: Beyond Local Nash Equilibria for Adversarial Networks, 2018
- Hsieh et al: Finding Mixed Nash Equilibria of Generative Adversarial Networks, 2018
- Farnia et al: GANs May Have No Nash Equilibria, 2020

My Target



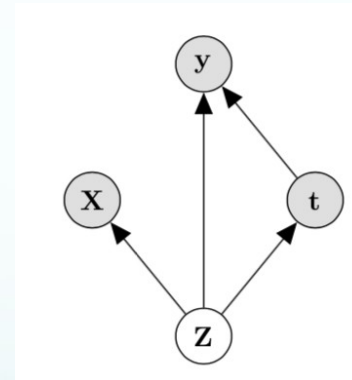
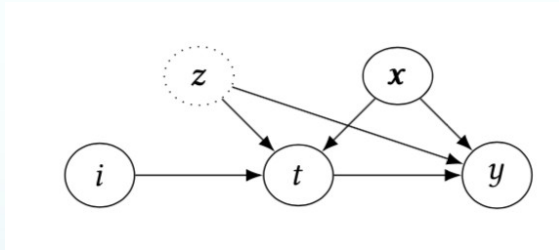
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0	39248	98530	143939	19/02/2104 17:04	05/02/2145 11:51	EMERGENCY	TRANSFER FROM HOSP/EXTRAM	HOME HEALTH CARE	Private	UNIT/ UNIVERS
1	26407	66452	182900	14/01/2172 07:15	18/12/2188 12:05	ELECTIVE	TRSF WITHIN THIS FACILITY	SNF	Self Pay	EPISCOF
2	7394	43138	123961	17/01/2149 16:49	20/03/2159 13:20	URGENT	TRANSFER FROM HOSP/EXTRAM	HOSPICE-HOME	Medicare	UNIT/ UNIVERS
3	55859	19461	111428	29/08/2155 20:08	25/08/2174 15:30	EMERGENCY	TRANSFER FROM HOSP/EXTRAM	HOME WITH HOME IV PROVIDR	Medicaid	CHR SCIE
4	16907	18867	181741	11/06/2132 13:34	25/08/2155 13:55	ELECTIVE	PHYS REFERRAL/NORMAL DELI	HOME HEALTH CARE	Medicaid	UNOBTAI
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995	29272	21340	159596	19/11/2183 08:00	23/07/2122 04:00	URGENT	CLINIC REFERRAL/PREMATURE	HOME HEALTH CARE	Medicaid	UNIT/ UNIVERS
996	53730	11855	116458	01/05/2136 05:22	16/01/2136 17:33	URGENT	PHYS REFERRAL/NORMAL DELI	HOME	Government	(
997	16715	641	141687	17/11/2117 17:19	16/09/2134 14:42	ELECTIVE	TRSF WITHIN THIS FACILITY	DISC-TRAN CANCER/CHLDRN H	Medicare	JEHC WT
998	35094	42819	113534	18/07/2132 11:45	29/05/2140 16:50	ELECTIVE	TRANSFER FROM OTHER HEALT	LEFT AGAINST MEDICAL ADVI	Private	NOT SPE
999	44810	77794	168321	10/07/2141 16:26	31/10/2121 15:35	EMERGENCY	PHYS REFERRAL/NORMAL DELI	LONG TERM CARE HOSPITAL	Medicare	UNOBTAI

Why Generative?

- “What I cannot create, I do not understand”
- A new way for simulation via statistics
- Learn causality through generation

Causal inference & Generative approaches

- **Causal Inference:** to discover causality between data variables without making assumptions of data sufficiency.



Game Theory & Generative AI

- Multiple generators
- Casual relations between the generators
- Multiple discriminators (critics)

- N-player Games
- Sequential Games