（三十一）Generative Adversarial Network. 生成对抗网络.

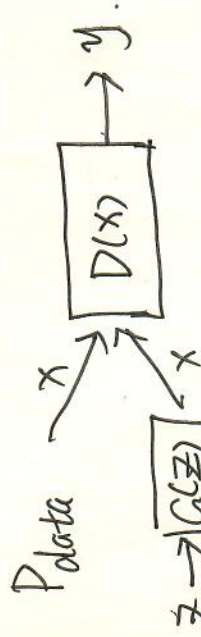背景 ⟶ 鉴定专家 ⟶ 真
                  ⟶ 假

工艺流程
工艺大师傅

固定: $P_{data}(x) = \{x_i\}_{i=1}^N$

工艺师: $P_g(x,\theta_g) = g(z,\theta_g)$: generator $(P_z(z) + C(z,\theta_g))$
大师傅 NN, 产生 x
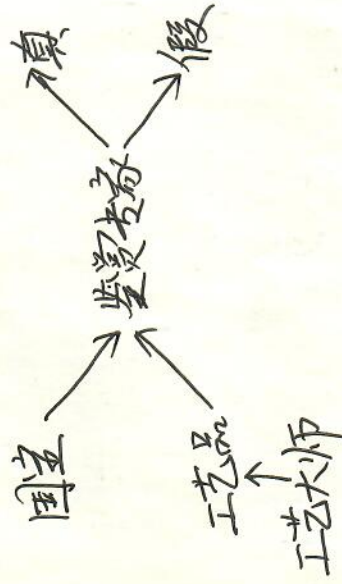
鉴定专家向: $y|x$ discriminator

$y|x$	1	0
P	$D(x)$	$1-D(x)$

目标: ① 鉴定家专家尽量引能乃5真. (手段)
② 工艺大师傅)造假的乃真 (图板)

$P_{data} \xrightarrow{x} \boxed{D(x)} \longrightarrow y$

$z \longrightarrow \boxed{G(z)} \xrightarrow{x}$

$$\min_G \max_D \; E_{x \sim P_{data}}[\log D(x)] + E_{z \sim P(z)}[1-\log D(C(z))]$$

记 $V(D,G) = E_{x \sim P_{data}}[\log D(x)] + E_{x \sim P_g}[1-\log D(x)]$

① for fixed G, 求 $\max V(D,G)$

$$\max_D V(D,G) = \int P_{data} \log D(x)\,dx + \int P_g(1-\log D(x))\,dx$$

$$= \int [P_d \log D(x) + P_g(1-\log D(x))]\,dx$$

$$\frac{\partial}{\partial D} = \int \frac{\partial}{\partial D}[P_d \log D(x) + P_g(1-\log D(x))]\,dx$$

$$= \int \left[P_d \frac{1}{D} + P_g \cdot \frac{1}{1-D} \right] dx = 0$$

$$\Rightarrow D_G^* = \frac{P_d}{P_d + P_g}$$

② 将 D_G^* 代入 $V(D,G)$

$$\min_G \max_D V(D,G) = \min_G V(D_G^*, G)$$