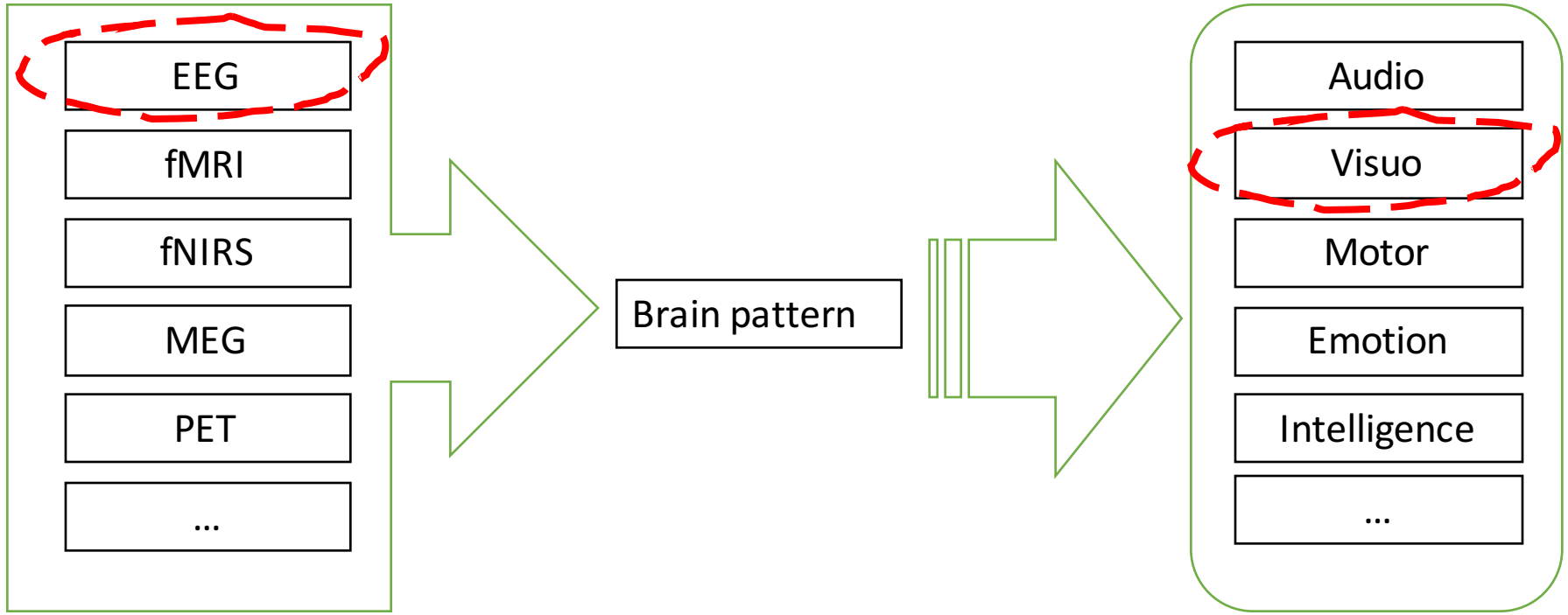
# Brain2Image: Converting Brain Signals into Images

Kavasidis, Isaak, et al. "Brain2Image: Converting Brain Signals into Images." *Proceedings of the 2017 ACM on Multimedia Conference*. ACM, 2017.

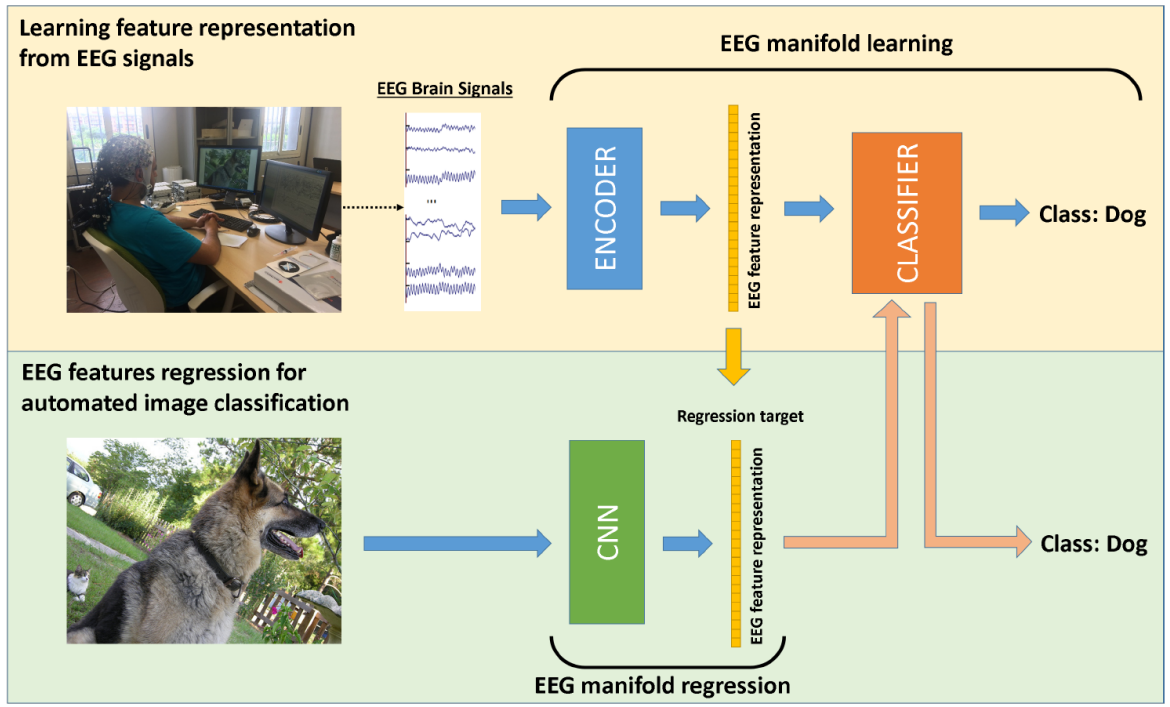
# Background

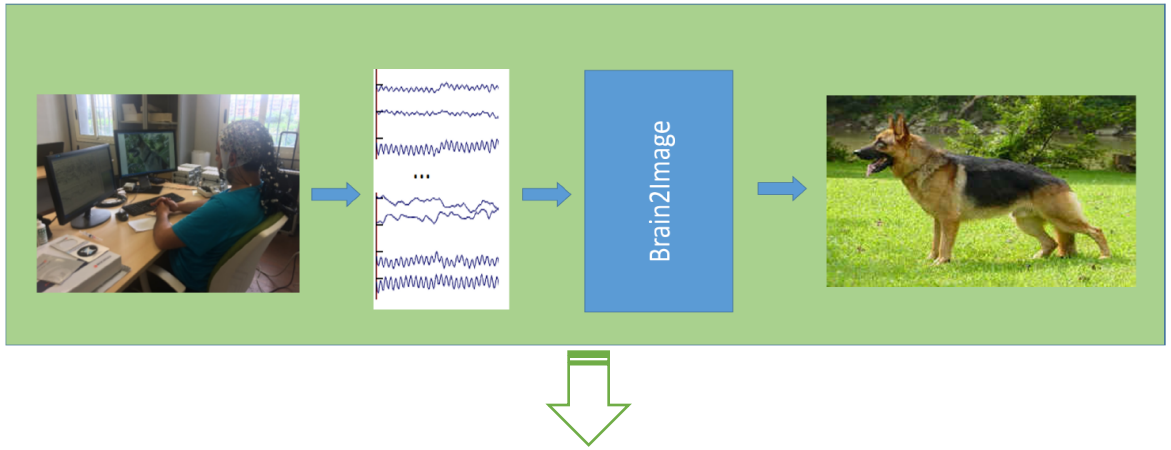
- Read minds
- Brain-Computer Interface (BCI)



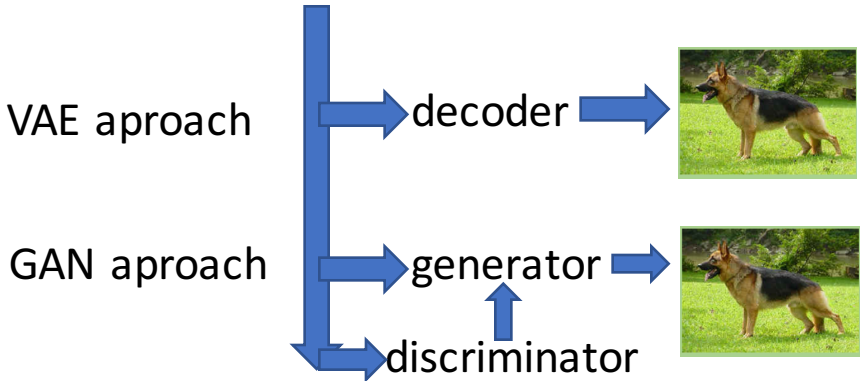
# Aims

- Move forward from classification of visually seen figures to generation of the figures;

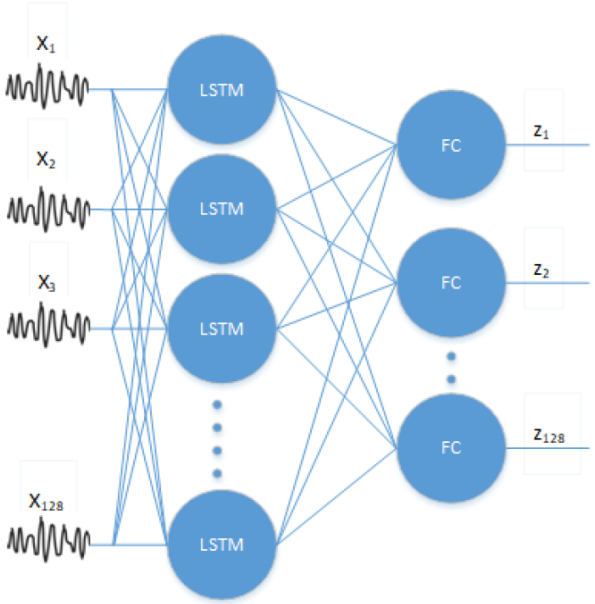



- Spampinato, Concetto, et al. "Deep learning human mind for automated visual classification." *Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition*. 2017.

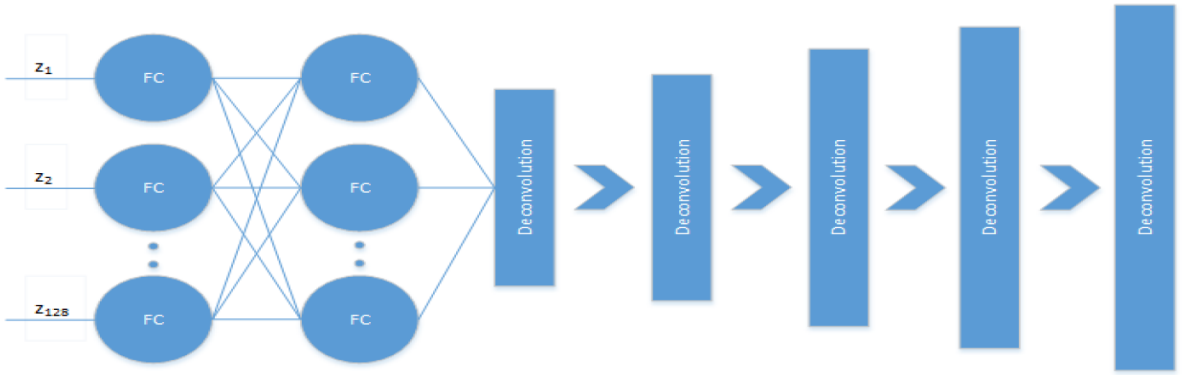


# Methods:



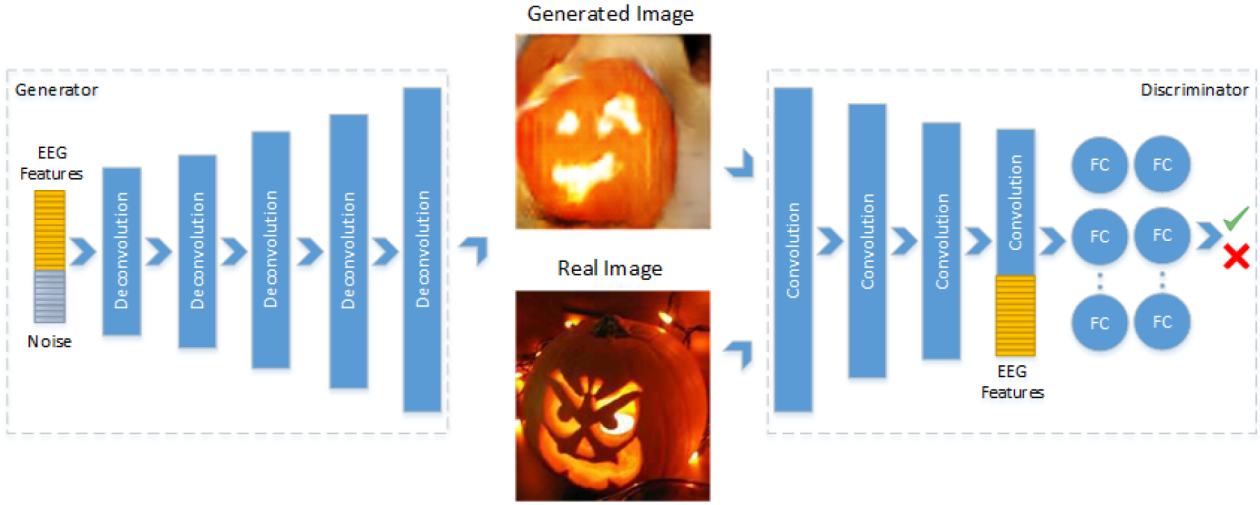

EEG LSTM encoder

VAE approach:




$$L = D_{KL}(E(z|x_I)|\left|D(\hat{I}|z)\right) + MSE(\hat{I}, I)$$

GAN approach:




$$\min_G \max_D V(D,G) = \mathrm{E}_{x \in p_{data}}(x)[\log D(x|y)] + \mathrm{E}_{z \in p_z(z)}[\log(1 - D(G(z|y)|y))]$$

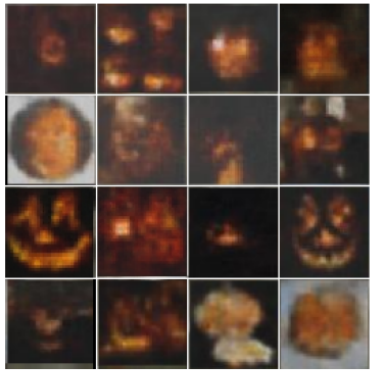
$$L_D = -\log D(x_t|y_t) - \log\left(1 - D(x_c|y_w)\right) - \log(1 - D(x_w|y_w))$$

$$L_G = -\log D(x_w|y_w)$$

# Results:

(1) Visually check

(a) Airliner



(b) Jack-o'-Lantern

(c) Panda

ure 7: VAE results in terms of generated images

(a) Airliner

(b) Jack-o'-Lantern

(c) Panda

Figure 8: GAN results in terms of generated images

(2) Inception score:

$$\mathrm{IS}(G) = \exp(E_{x\sim p_g} D_{KL}(p(y|x)||p(y)))$$

(3) Inception classification accuracy:

To assess this capability, we employ the generated image samples (by the two approaches) and compute the class probability distribution of Inception, with the softmax layer changed for a 40-class classification task.

| Generative method | VAE | | GAN | |
|---|---|---|---|---|
| Class | IS | IC | IS | IC |
| *All* | *4.49* | *0.35* | *5.07* | *0.43* |