

Project of Advanced Machine Learning : Neural Networks Fail to Learn Periodic Functions and How to Fix It

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Fonction d'activation snake

$$\text{snake}_a(x) = x + \frac{1}{a} \sin^2(ax)$$

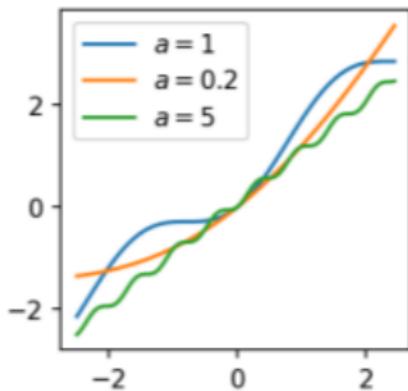
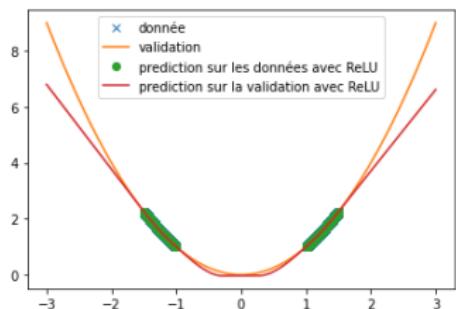
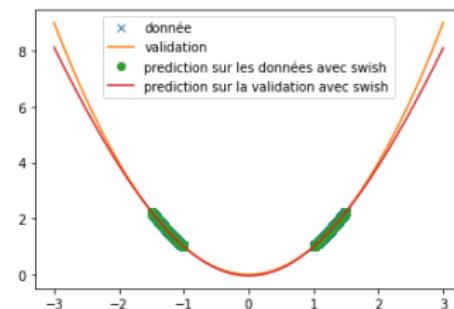


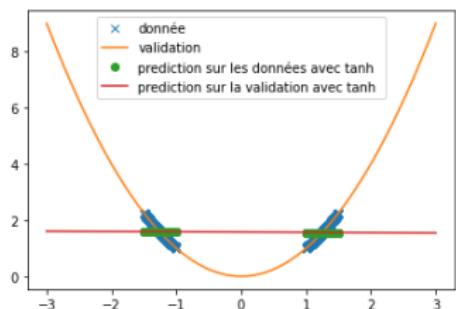
Figure: Tracé des fonctions Snake



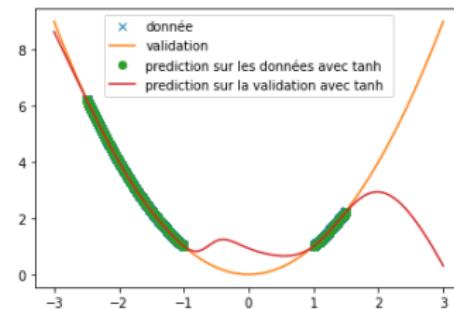
(a) ReLU



(b) swish

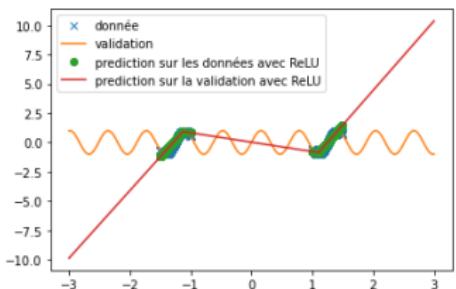


(c) tanh

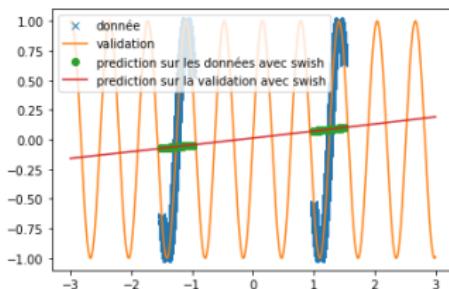


(d) tanh avec base de données asymétrique

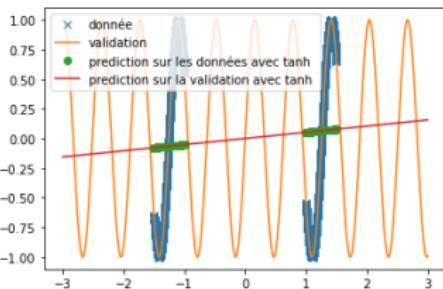
Figure: Prediction d'un signal carré avec différentes fonctions d'activations



(a) ReLU



(b) swish



(c) tanh

Figure: Prediction d'un signal sinus avec différentes fonctions d'activations

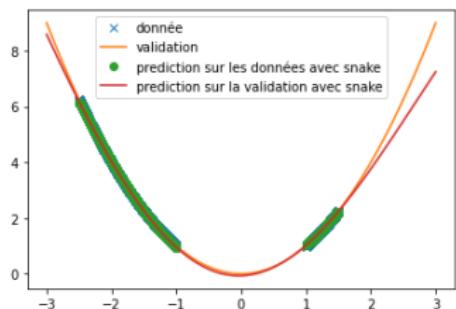
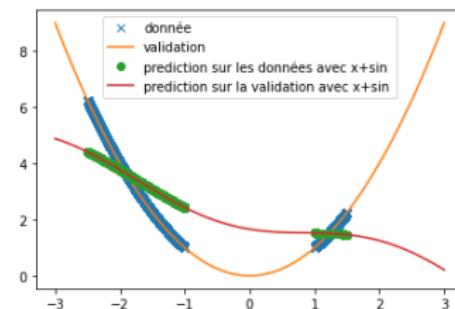
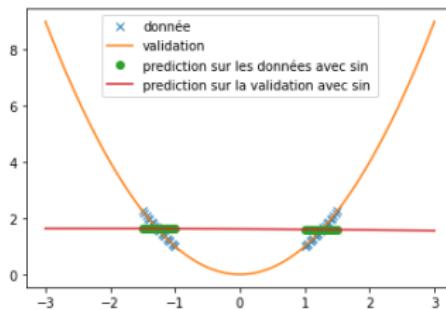
(a) $\text{snake}(x)$ (b) $x + \sin(x)$ (c) $\sin(x)$

Figure: Prediction d'un signal carré avec différentes fonctions d'activations

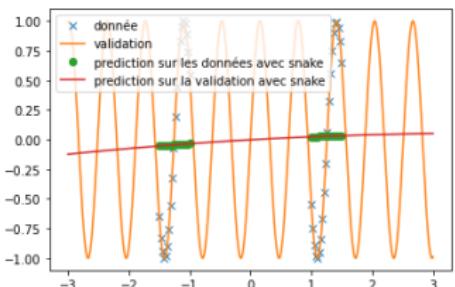
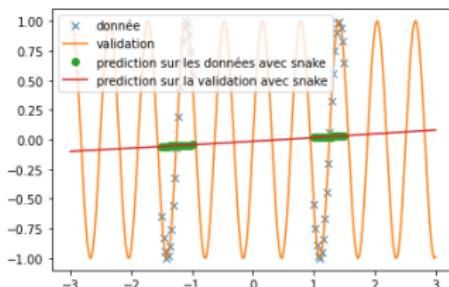
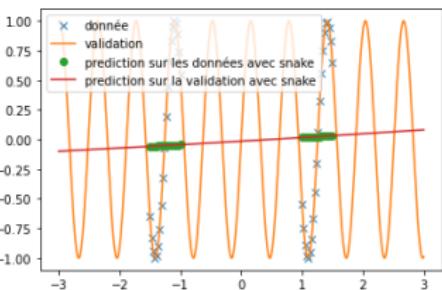
(a) $\text{snake}(x)$ (b) $x + \sin(x)$ (c) $\sin(x)$

Figure: Prédiction d'un signal sinus avec les différentes fonctions d'activations

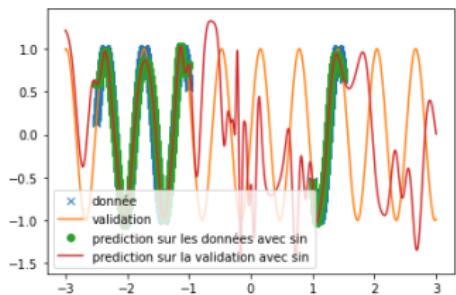
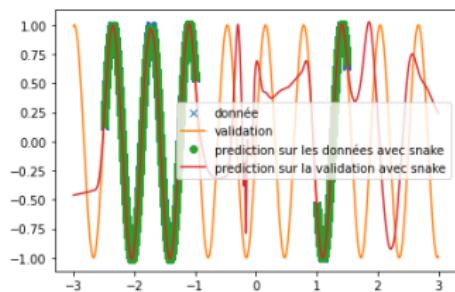
(a) $\sin(x)$ (b) $\text{snake}(x)$

Figure: Prédiction par des réseaux de neurones avec des fonctions d'activations périodiques ou pseudo-périodique

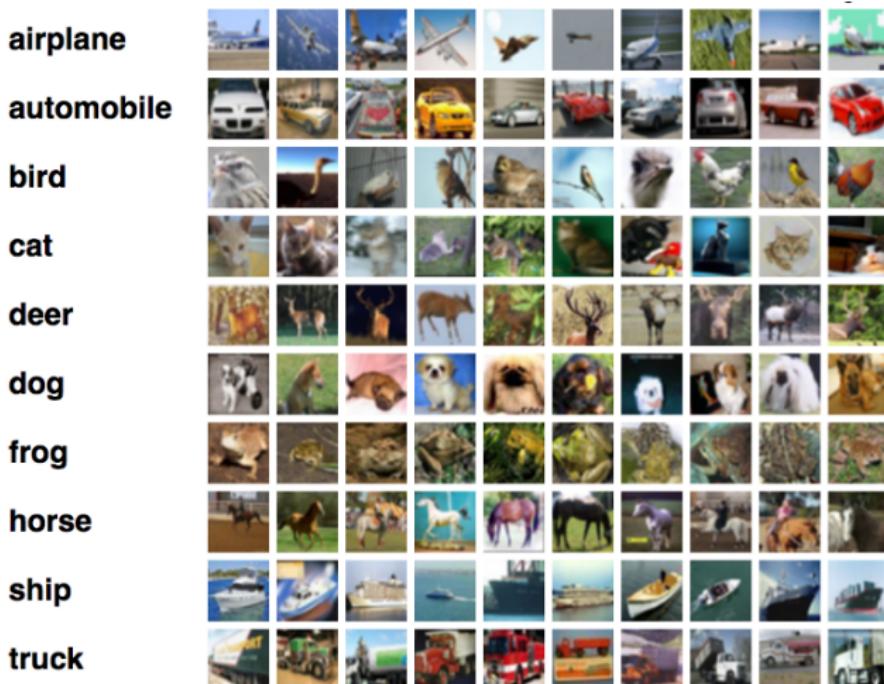


Figure: Exemple de la base de données cipher-10

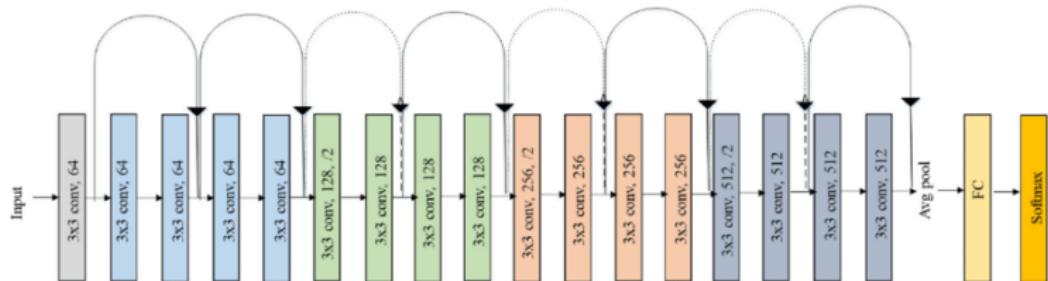
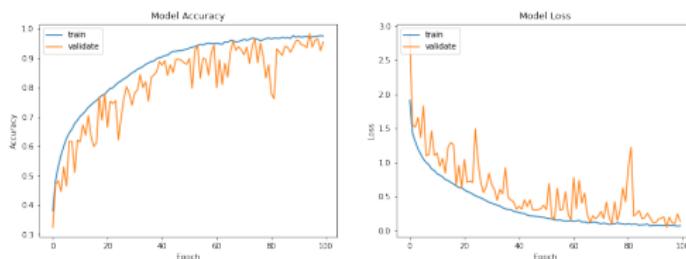
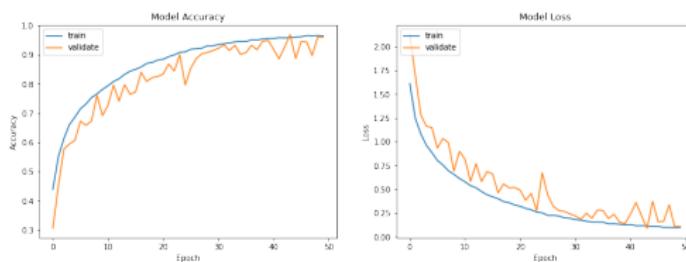


Figure: Architecture du réseau de neurone convolutionnel ResNet-18



(a) Prédiction de snake ($a = 1$) sur la base de données Cipher-10



(b) Prédiction de ReLu sur la base de données Cipher-10

Figure: Comparaison de l'efficacité de Snake par rapport à ReLu sur un tache de classification d'image

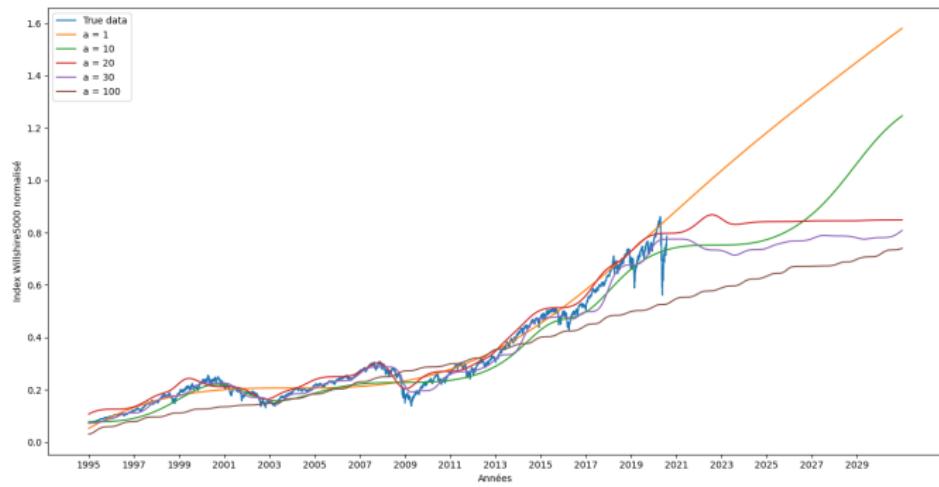


Figure: Prédictions pour différentes valeurs de a

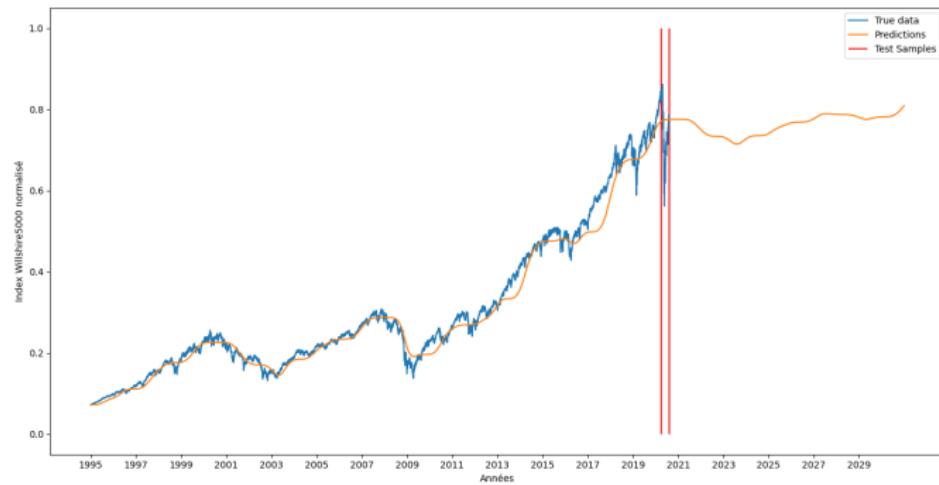
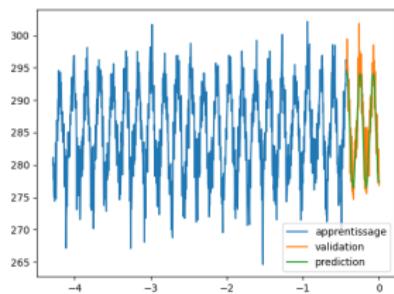
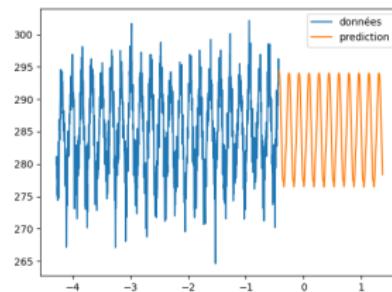


Figure: Prédiction pour $a = 30$



(a) Prédiction des températures par réseau récurrent



(b) Vérification de la stabilité de la prédiction

Figure: Prédiction par des réseaux utilisant des couches LSTM

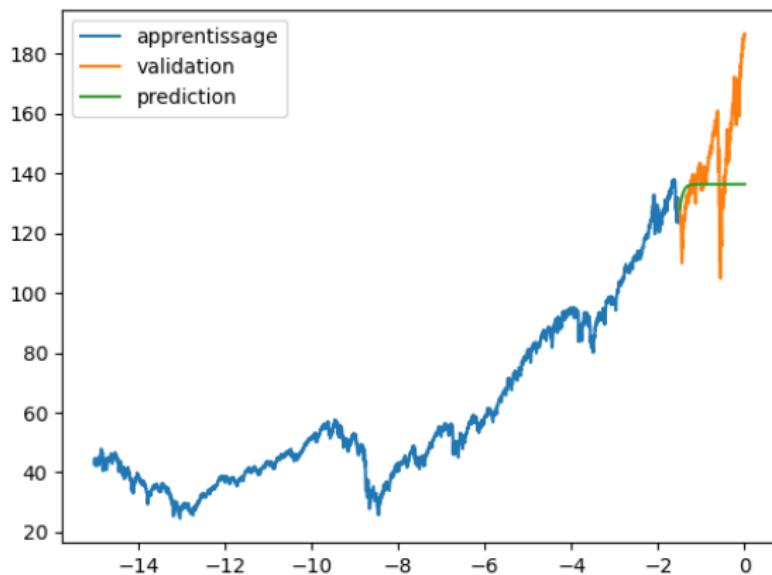


Figure: Prédiction de l'évolution du wilshire5000

Merci pour votre attention !