

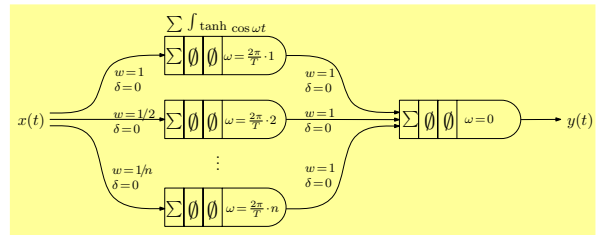
Neural Networks and Continuous Time

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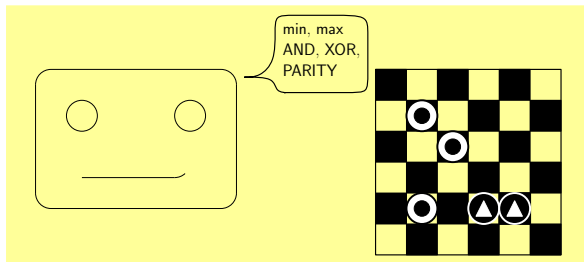
Goal

simulate structure and functional aspects of biological networks, i.e. find computational model for technical, physical, and cognitive processes, which evolve continuously in time

Continuous Neural Networks



Scenario 1: deductive reasoning



Neural Network Unit

1. summation with *time delay* :

$$y_1(t) = \sum_{i=1}^n w_i \cdot x_i(t - \delta_i)$$

2. *integration* (average signal power):

$$y_2(t) = \sqrt{\frac{1}{\tau} \int_{t-\tau}^t y_1(u)^2 du}$$

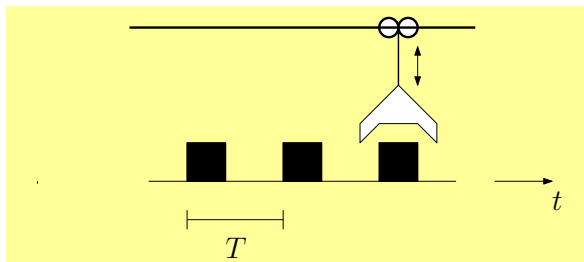
3. nonlinear activation:

$$y_3(t) = \frac{\tanh(\alpha y_2(t))}{\alpha}$$

4. *oscillation* (amplitude modulation):

$$y_4(t) = y_3(t) \cdot \cos(\omega t)$$

Scenario 2: behavior generation



Summary

CNNs can express deductive reasoning, robot behavior, and analysis of environment

Scenario 3: periodicity analysis

