ECE59500CV Lecture 3: Automatic Differentiation—II

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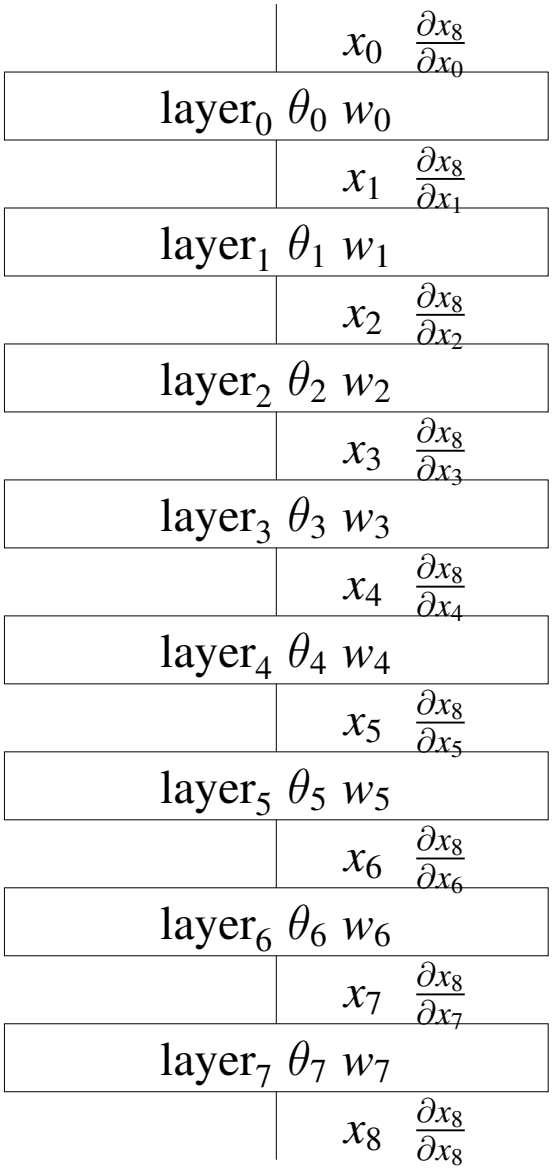
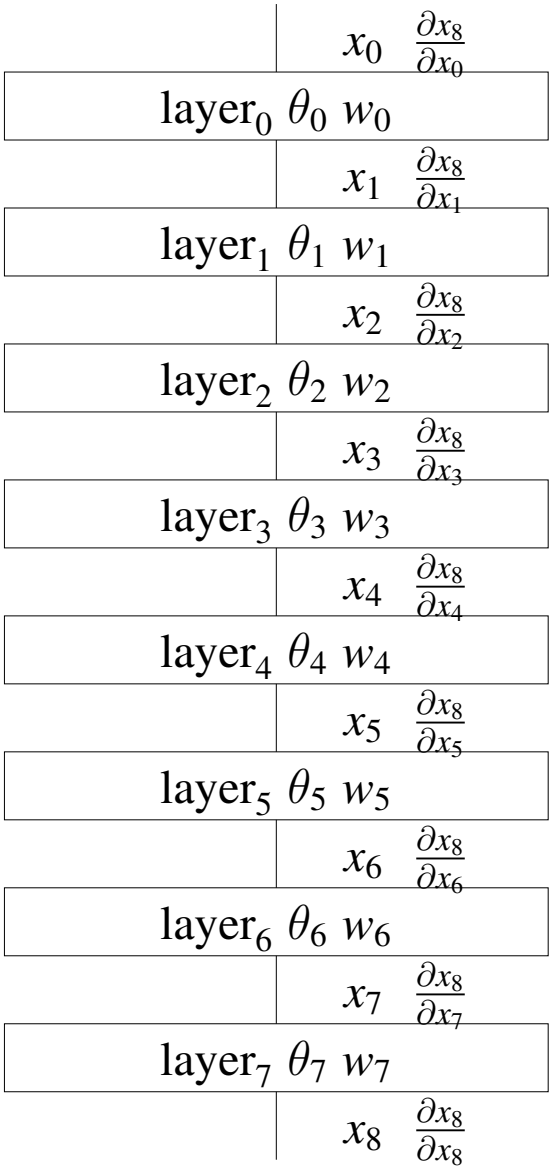
Elmore Family School of Electrical and Computer Engineering

Fall 2021

A Neural Network



A Neural Network is a (Functional) Program



$$
\begin{aligned}
&\text{net}\ [\theta_0,\ldots,\theta_7]\ [w_0,\ldots,w_7]\ x_0 \triangleq \\
&\quad \textbf{let}\quad x_1 = \text{layer}_0\ \theta_0\ w_0\ x_0 \\
&\qquad\quad x_2 = \text{layer}_1\ \theta_1\ w_1\ x_1 \\
&\qquad\quad x_3 = \text{layer}_2\ \theta_2\ w_2\ x_2 \\
&\qquad\quad x_4 = \text{layer}_3\ \theta_3\ w_3\ x_3 \\
&\qquad\quad x_5 = \text{layer}_4\ \theta_4\ w_4\ x_4 \\
&\qquad\quad x_6 = \text{layer}_5\ \theta_5\ w_5\ x_5 \\
&\qquad\quad x_7 = \text{layer}_6\ \theta_6\ w_6\ x_6 \\
&\qquad\quad x_8 = \text{layer}_7\ \theta_7\ w_7\ x_7 \\
&\quad \textbf{in}\ x_8
\end{aligned}
$$

A (Functional) Program

$$
\begin{aligned}
&f\ [w_0, w_1]\ [x_0, x_1] \triangleq \\
&\quad \textbf{let} \quad t_0 = w_0 \times x_0 \\
&\qquad\quad\ \ t_1 = w_1 \times x_1 \\
&\qquad\quad\ \ y = t_0 + t_1 \\
&\quad \textbf{in}\ y
\end{aligned}
$$

A (Functional) Program is a (Neural) Network

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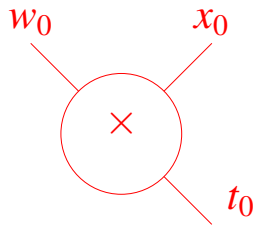

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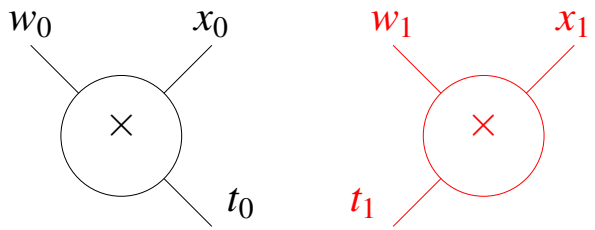

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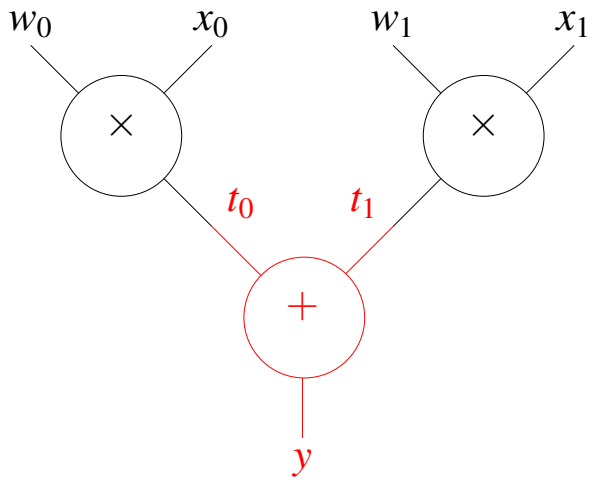

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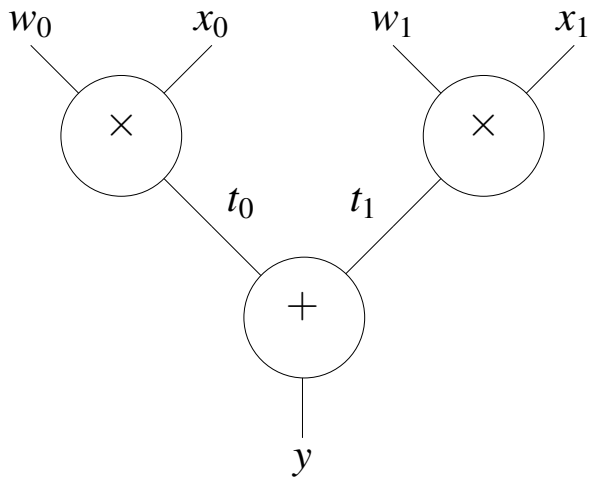
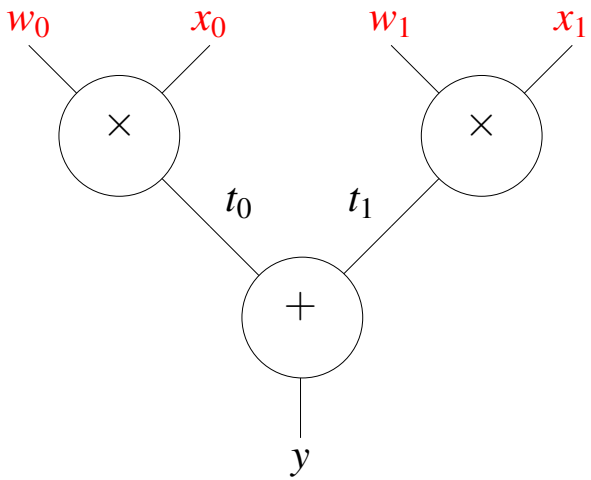


Evaluating a Network



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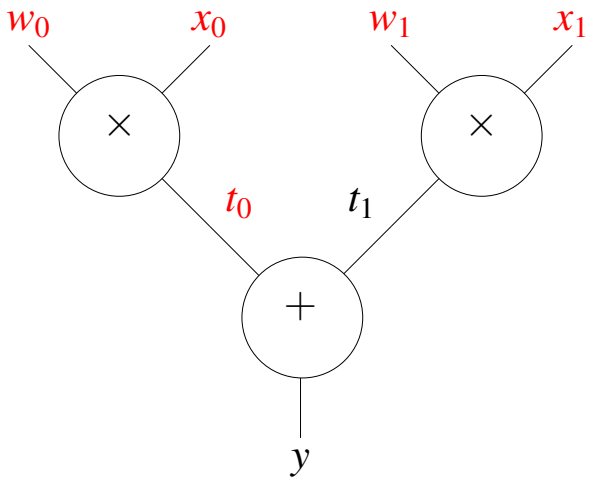

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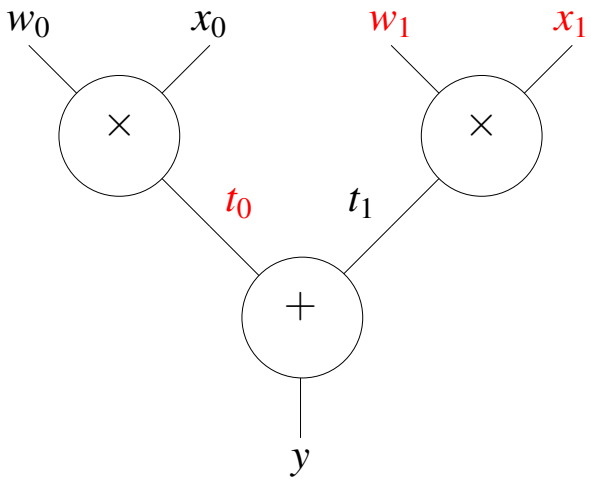

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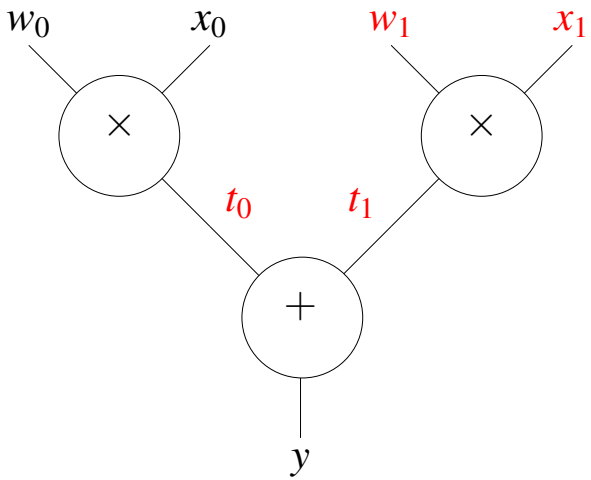

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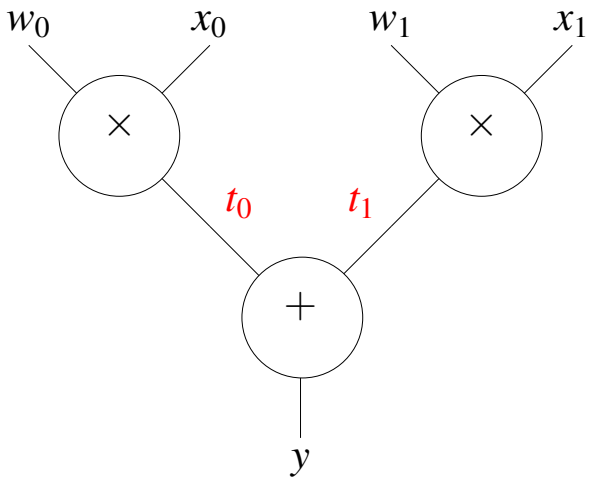

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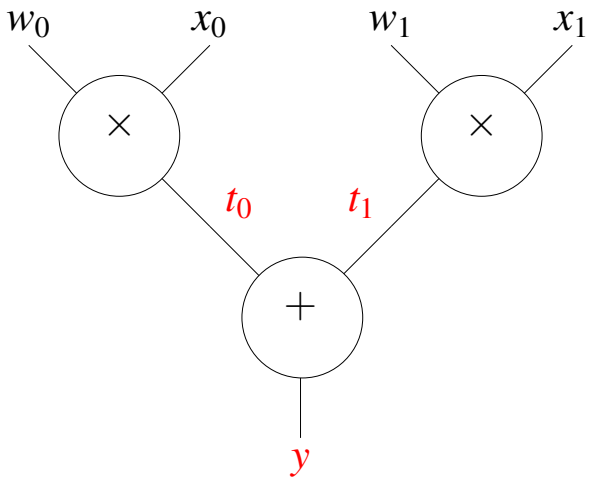

Evaluating a Network