

**NANYANG
TECHNOLOGICAL
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SINGAPORE

Neural Network-Based Rule Model With Truth Tables

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ECAI23

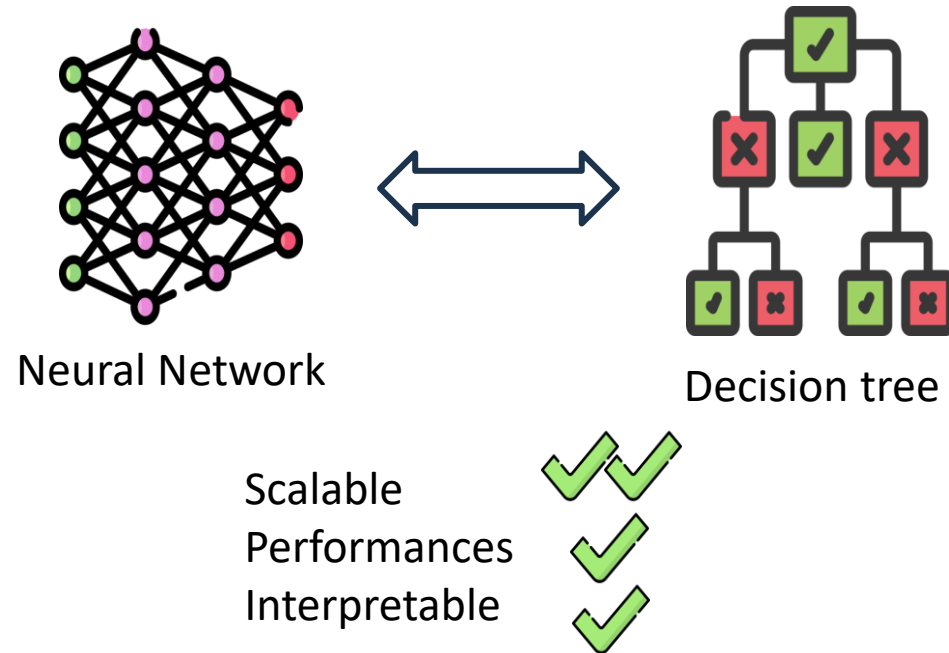
Nanyang Technological University

02/10/2023

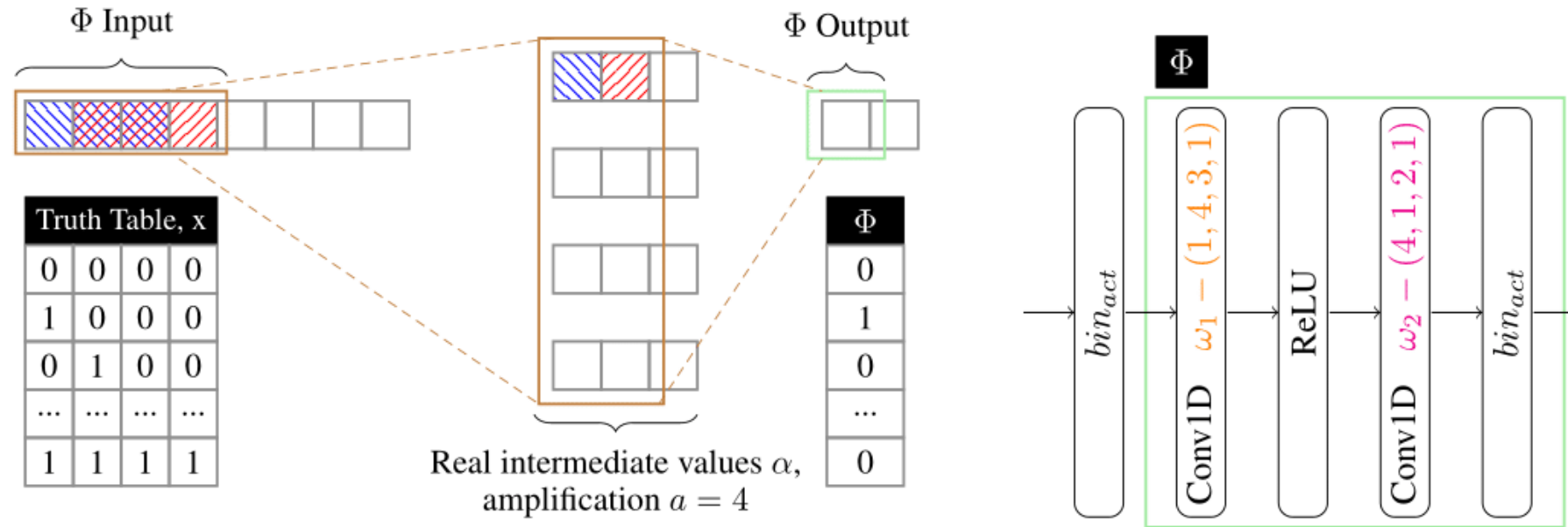
Presenter: **Tristan Guérand**



TTnet: From black box to truth tables

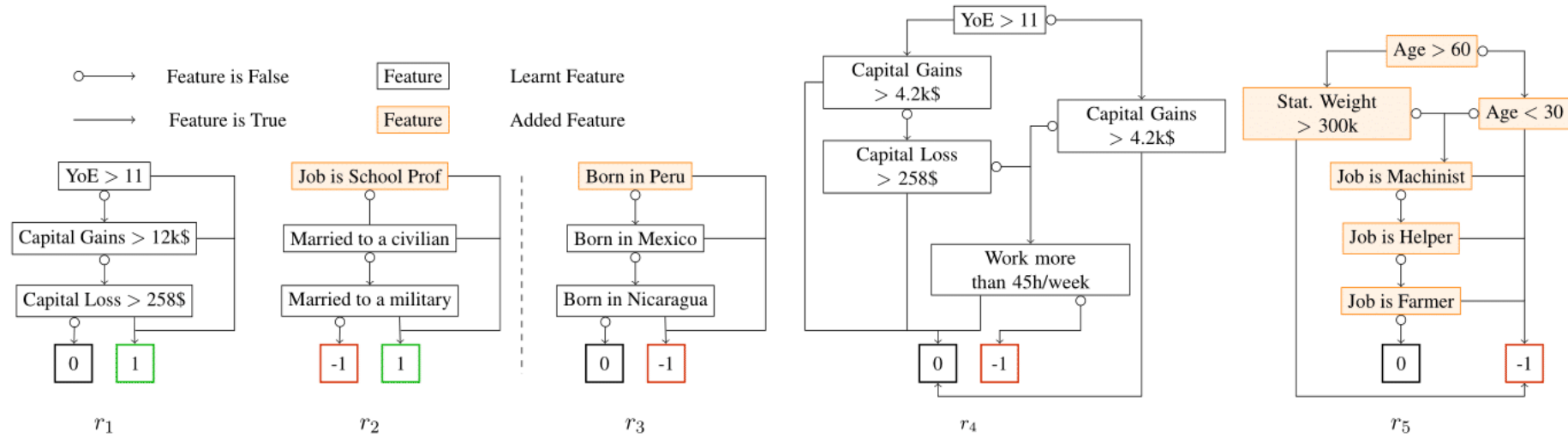


TTnet: From black box to truth tables



Convolution block \Leftrightarrow Truth Table

TTnet: From black box to truth tables



$$\text{Classifier}(\mathbf{I}, \mathcal{R}) = \begin{cases} 1 & \text{if } \sum_{r \in \mathcal{R}} r(\mathbf{I}) > 0 \\ 0 & \text{otherwise.} \end{cases}$$

Adult dataset – 5 rules – 84% Acc



TTnet: From black box to truth tables

	Regression (RMSE)	Binary classification (AUC)			Multi-classification (Accuracy)
continous/binary #	California Housing 8/144 features	Compas 9/17 features	Adult 14/100 features	HELOC 24/330 features	Diabetes 43/296 features
Linear/ log	0.728 ± 0.015	0.721 ± 0.010	0.883 ± 0.002	0.798 ± 0.013	0.581 ± 0.002
DT	0.514 ± 0.017	0.731 ± 0.020	0.872 ± 0.002	0.771 ± 0.012	0.572 ± 0.002
GL	0.425 ± 0.015	0.735 ± 0.013	0.904 ± 0.001	0.803 ± 0.001	NA
NAM	0.562 ± 0.007	0.739 ± 0.010	-	-	-
TT-rules (Ours)	0.394 ± 0.017	0.742 ± 0.007	0.906 ± 0.005	0.800 ± 0.001	0.584 ± 0.003
XGBoost	0.532 ± 0.014	0.736 ± 0.001	0.913 ± 0.002	0.802 ± 0.001	0.591 ± 0.001
DNNs	0.492 ± 0.009	0.732 ± 0.004	0.902 ± 0.002	0.800 ± 0.010	0.603 ± 0.004

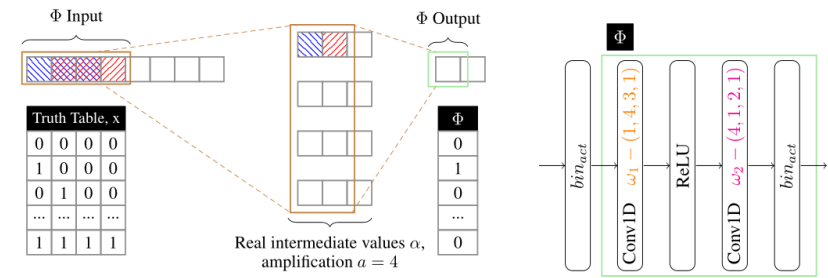
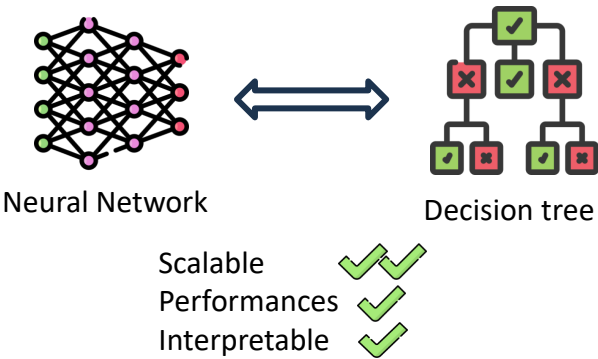
	Regression		Binary Classification	
	TCCA Cancer		Melanoma	
continous/binary #	0/20530		0/23689 features	
Metrics	RMSE	#Rules	Acc	#Rules
Linear/ log	0.092	-	0.833	-
TT-rules (Ours)	0.029	1064	0.835	9472
Random Forest	0.42	9259	0.729	13514
DNNs	0.028	-	0.725	-

**Scales to large datasets
(eg. Genetics)**

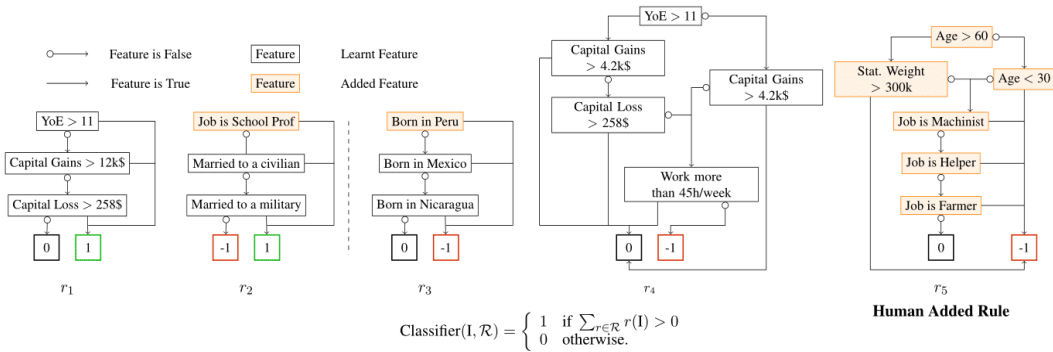


TTnet: From black box to truth tables

We want:



Convolution block ⇔ Truth Table



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Scales to large datasets
(eg. Genetics):

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	TCCA Cancer	Melanoma	
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