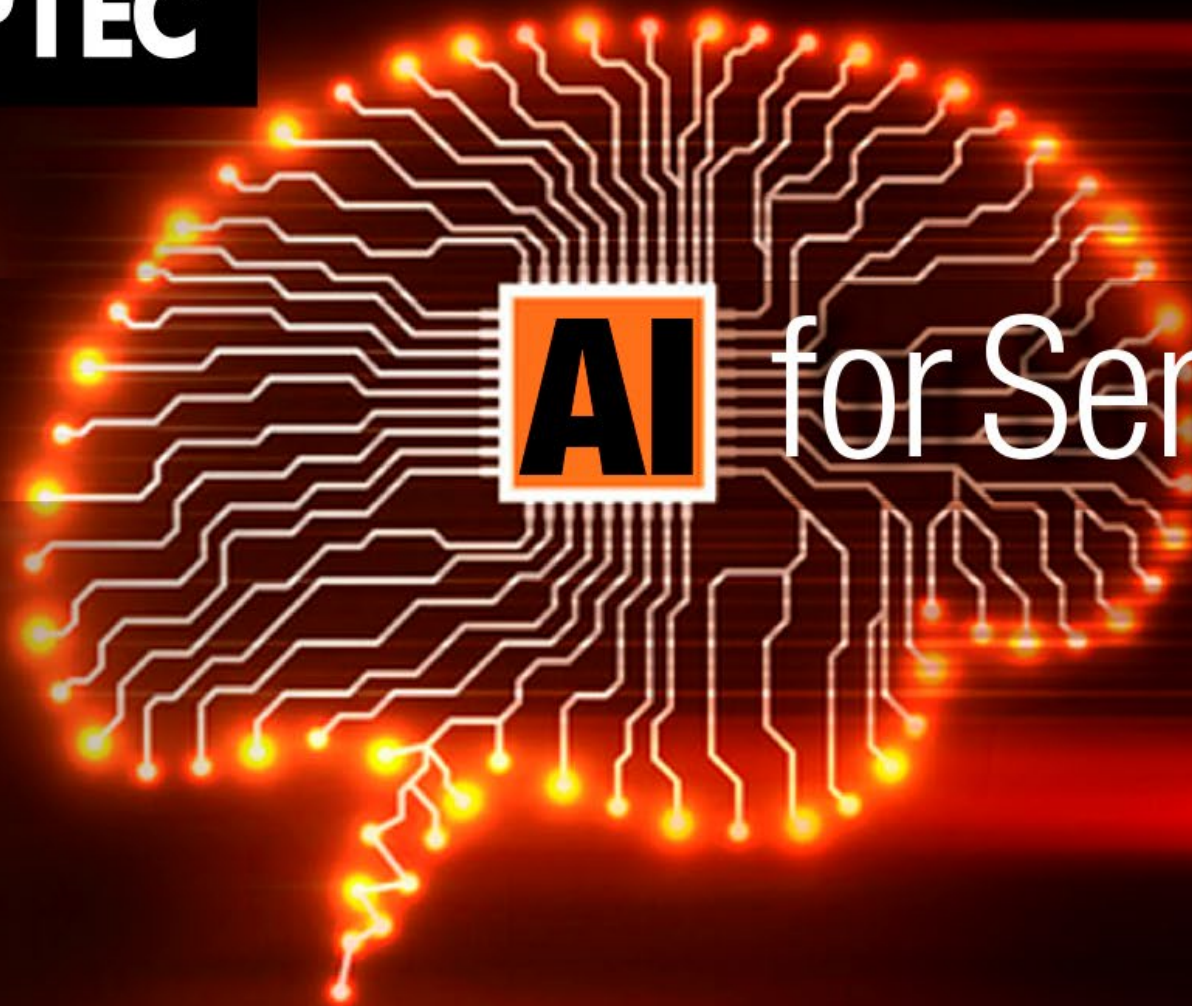




AI for Semiconductors

www.meptec.org



The background features a dark blue field with a faint hexagonal grid. Numerous translucent cubes in shades of cyan, blue, and red are scattered across the scene, some appearing to float or move. Mathematical formulas are visible on some of the grid cells, including $F(s) = -e^{-sT} \left(\frac{\alpha}{s+\alpha} \right)$, $f_m(t) = 1 - e^{-\beta t}$, and $\Gamma = m_0 \sqrt{2m - m_0^2}$. A small red horizontal line is positioned above the main title.

Accelerating PCB Design With AI

June 2024

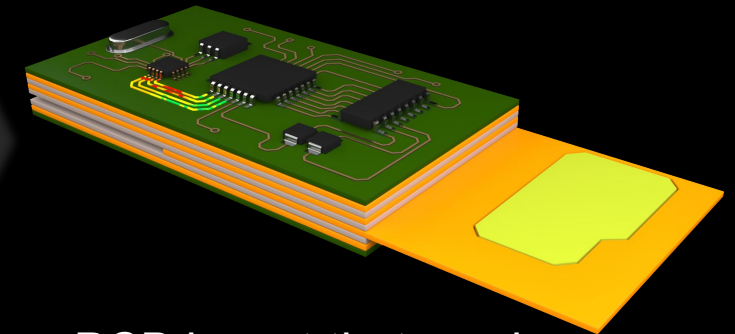
Taylor Hogan
Distinguished Engineer

cādence®

Allegro X AI Inputs and Outputs

Brings automation approach of IC digital design to PCB

Design Netlist
and
Constraints



PCB layout that can be
used as generated or
incrementally modified

AI In X AI

- Genetic Optimization
 - Chromosome contains “learned” good placement strategies
- Bayesian Optimization
 - Find the optimum set of hyper parameters used to guide automation
- Spectral Clustering
 - All AI Books contain k-means and other clustering techniques
- Monte Carlo Tree Search
 - Ala Alpha Go
- **Convolution Neural Net as a Proxy for a Router**
 - **Infers the probability of routing success given a placement**

Allegro X AI Placement Technologies Under the Covers

Extensive collection of AI and non-AI technologies powers X AI

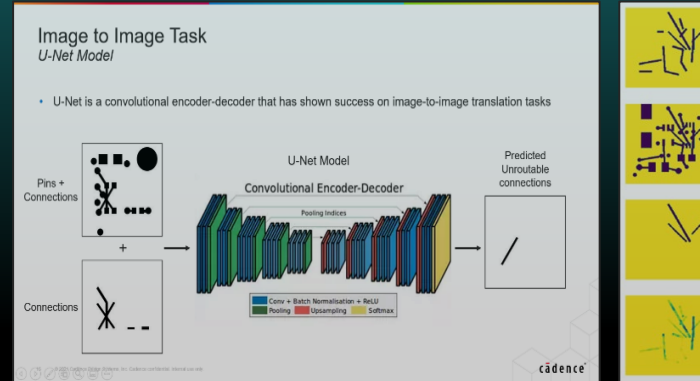
Monte Carlo Tree Search

Cloud Compute to Learn How to Incrementally Improve a Design



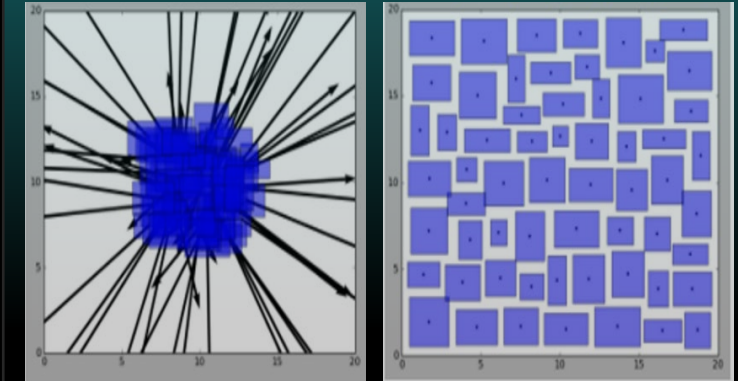
Convolutional Neural Net (CNN)

Predicts Routability to Guide Placement Refinement



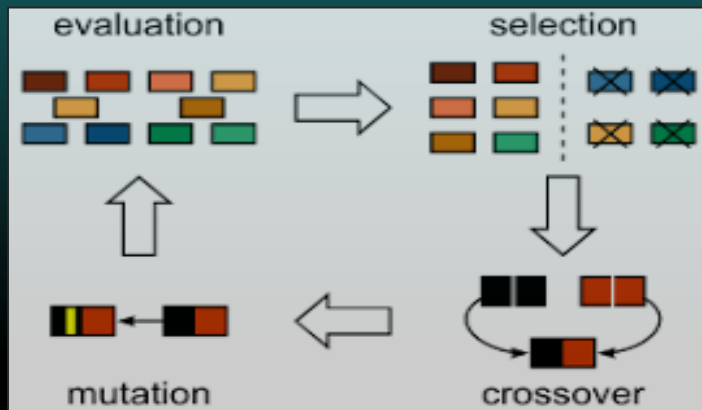
Force Directed Placement

Globally Optimizes Component Placement



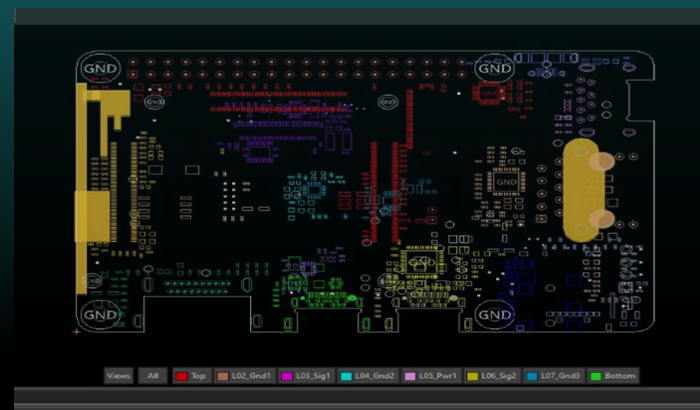
Distributed Genetic Optimization

Optimize Component Orientation/Rotation



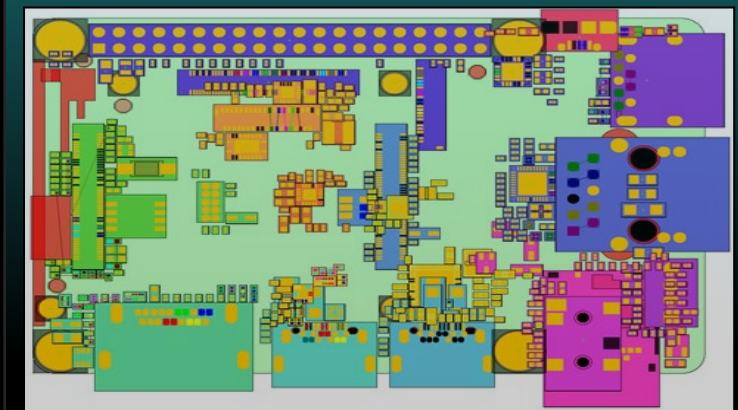
Spectral Clustering

Identifies Component Groupings

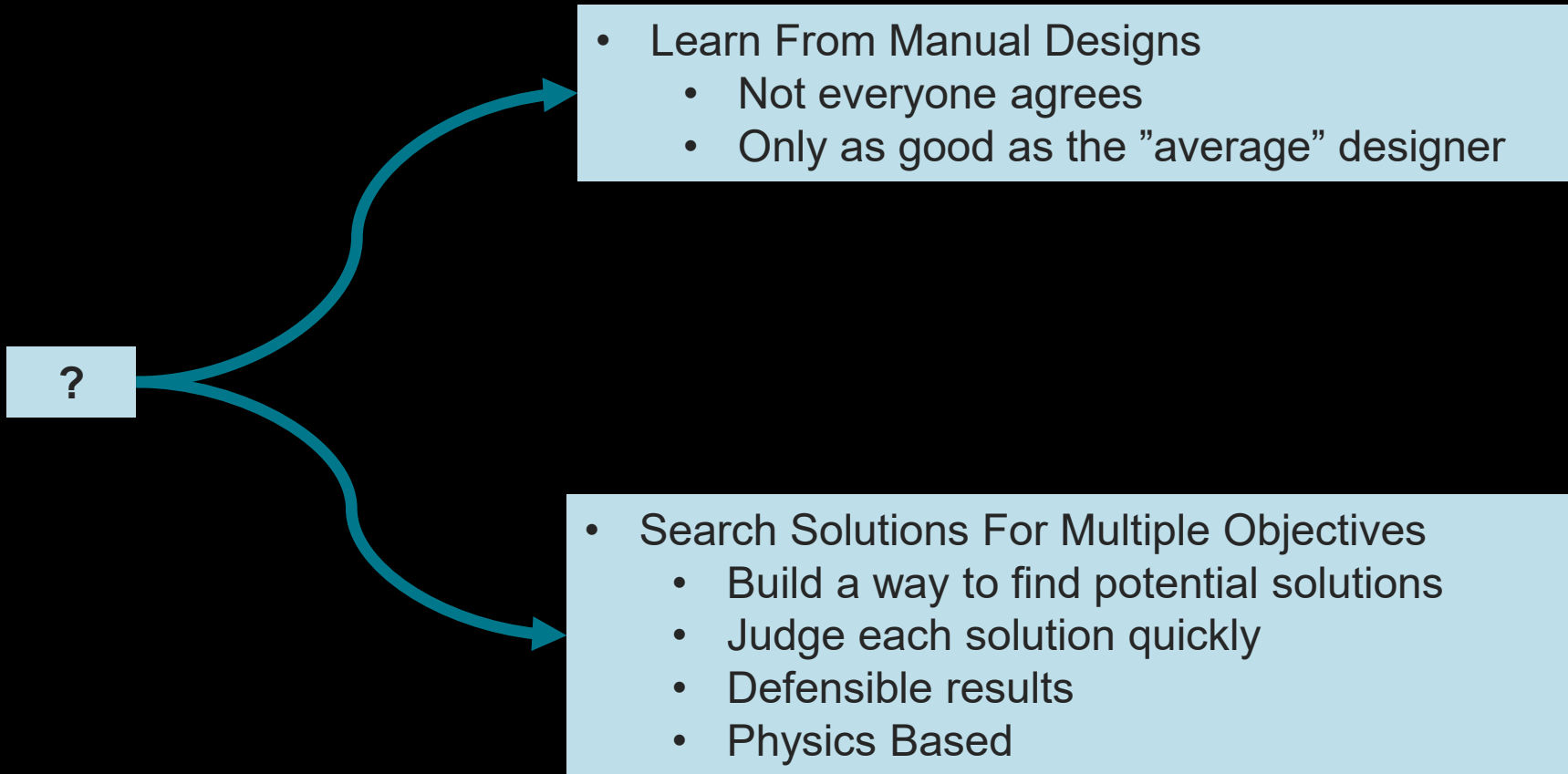


Route Aware Detailed Placement

Placement Legalization and Aesthetics



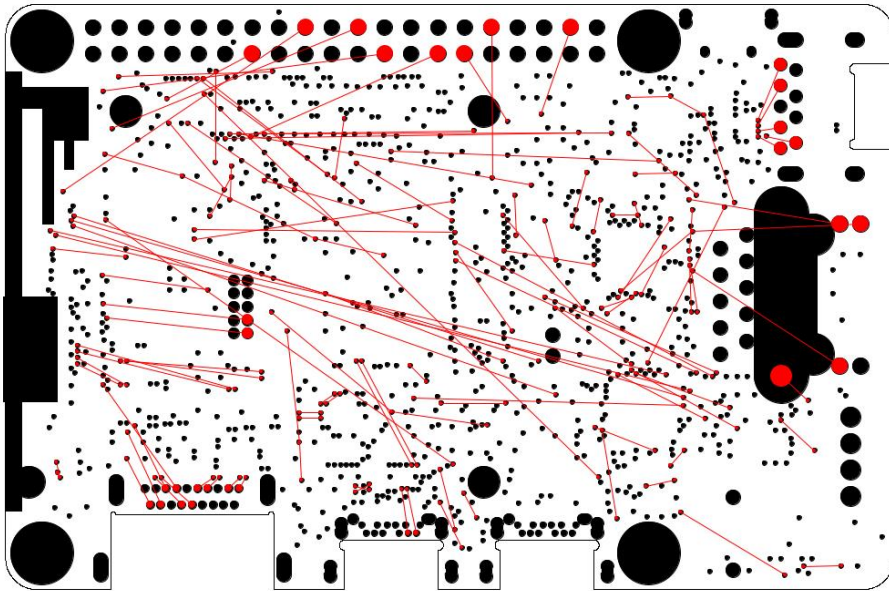
Automatic PCB Design...Which Strategy?



Route Prediction Problems

Can we predict the disconnects before we route?

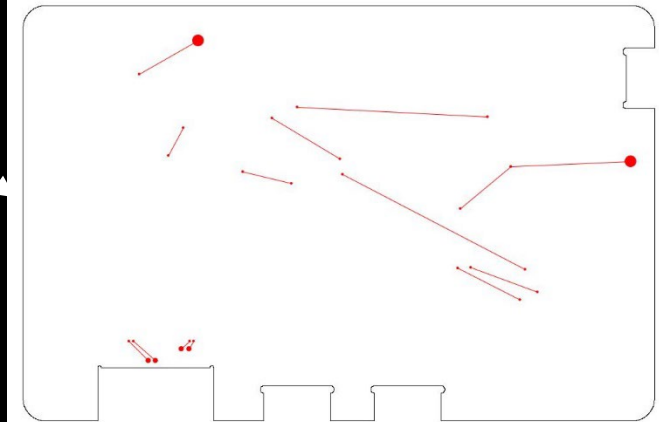
Connections



Model

Score: 97% Complete

Scores/Predictions

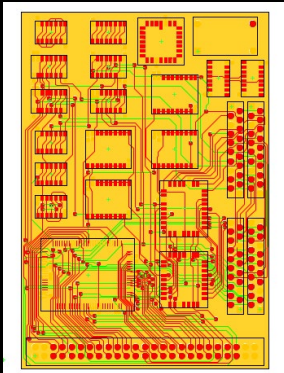


Route Prediction Problems

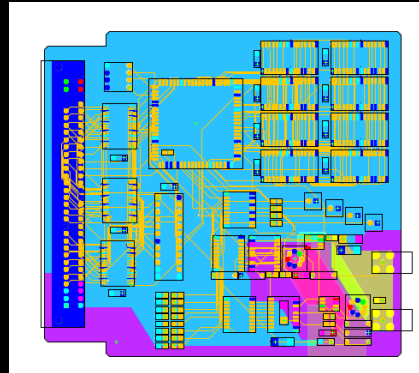
Building a Dataset

	Board 1	Board 2	Board 3	Board 4	Board 5	Board 6
Training Set Size	12,136	12,362	12,320	20,878	12,761	
Test Set Size	2,962	4,038	4,168	3,102	3,260	1,663

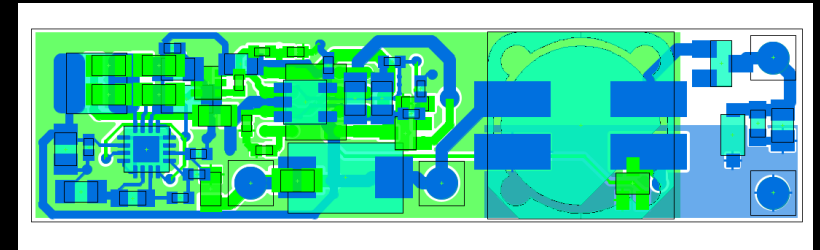
Simple



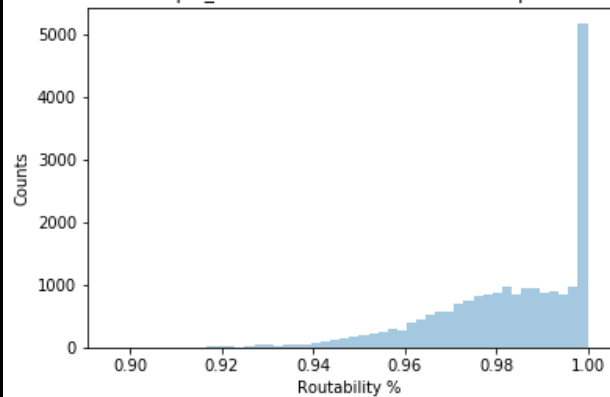
Test9



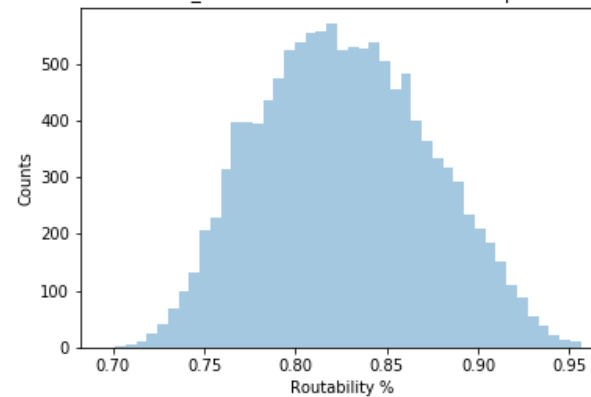
MFC_TI_Flyback_Rev2



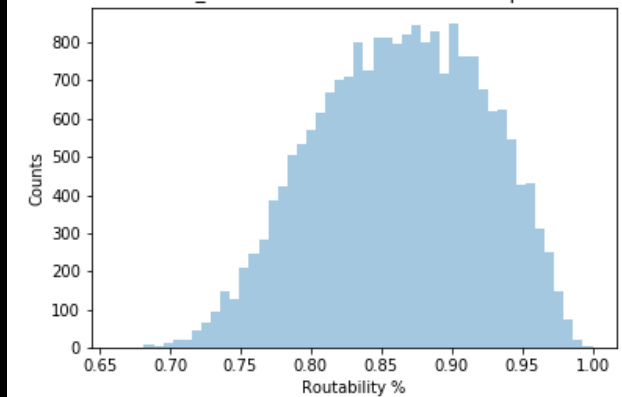
simple_dataset distribution: 21289 samples



test9_dataset distribution: 12362 samples



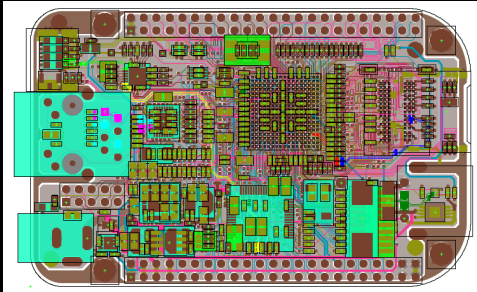
mfc_dataset distribution: 20878 samples



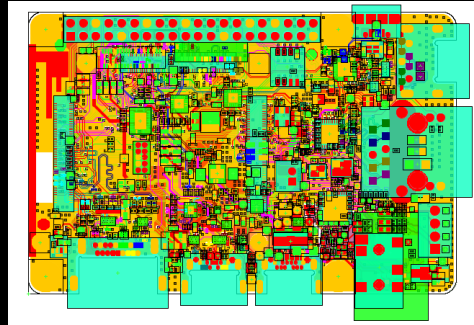
Route Prediction Problems

Quick turn around and Automatic Labeling

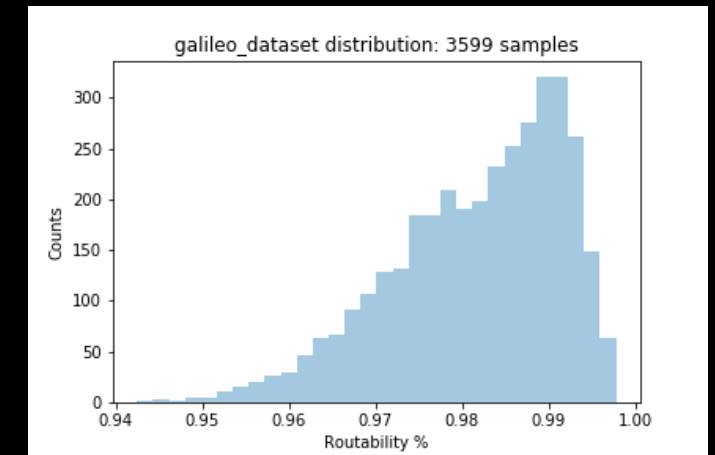
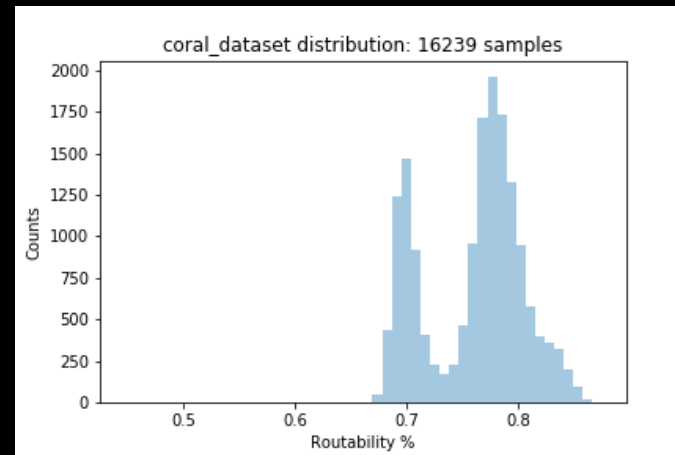
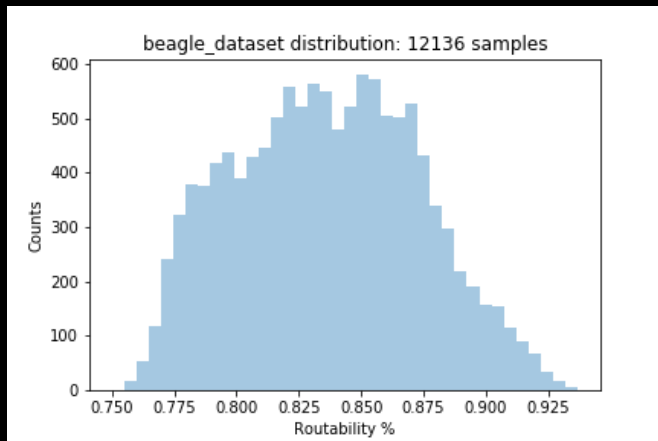
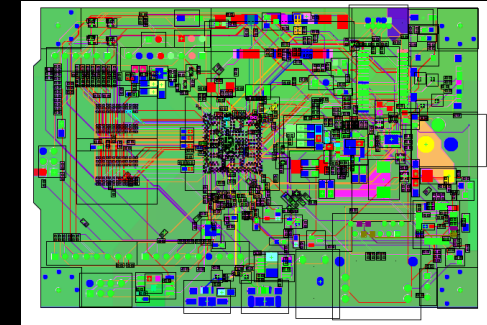
BeagleBone



Coral

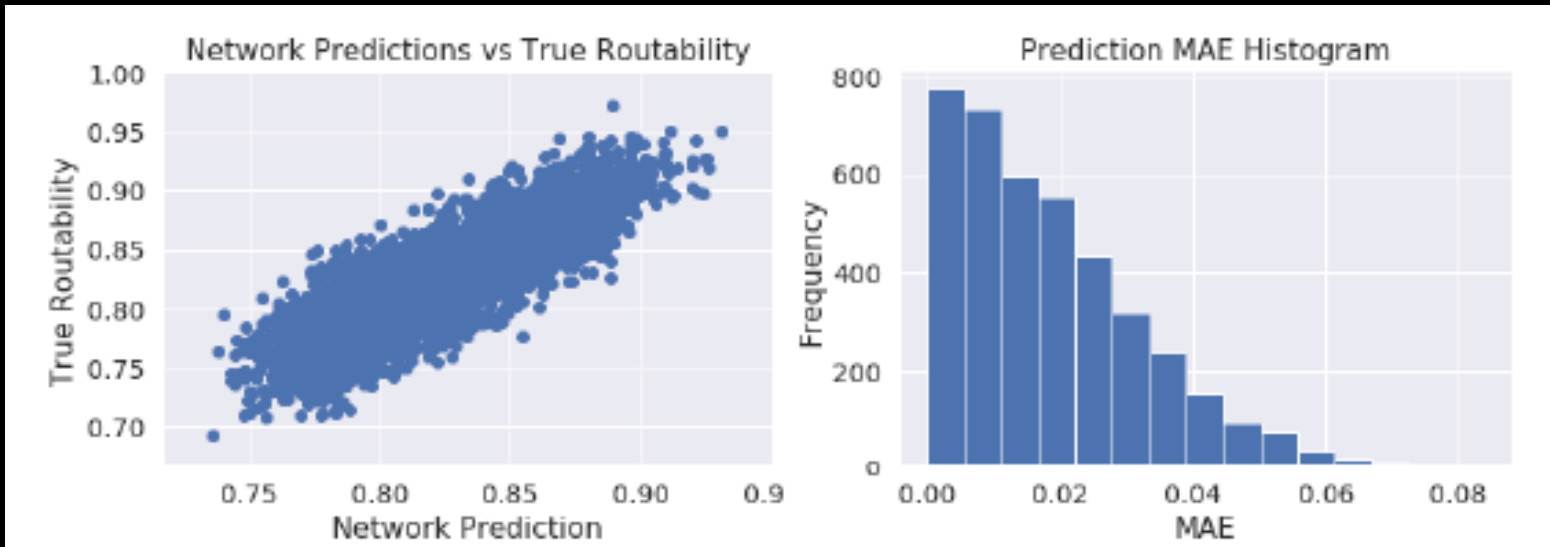
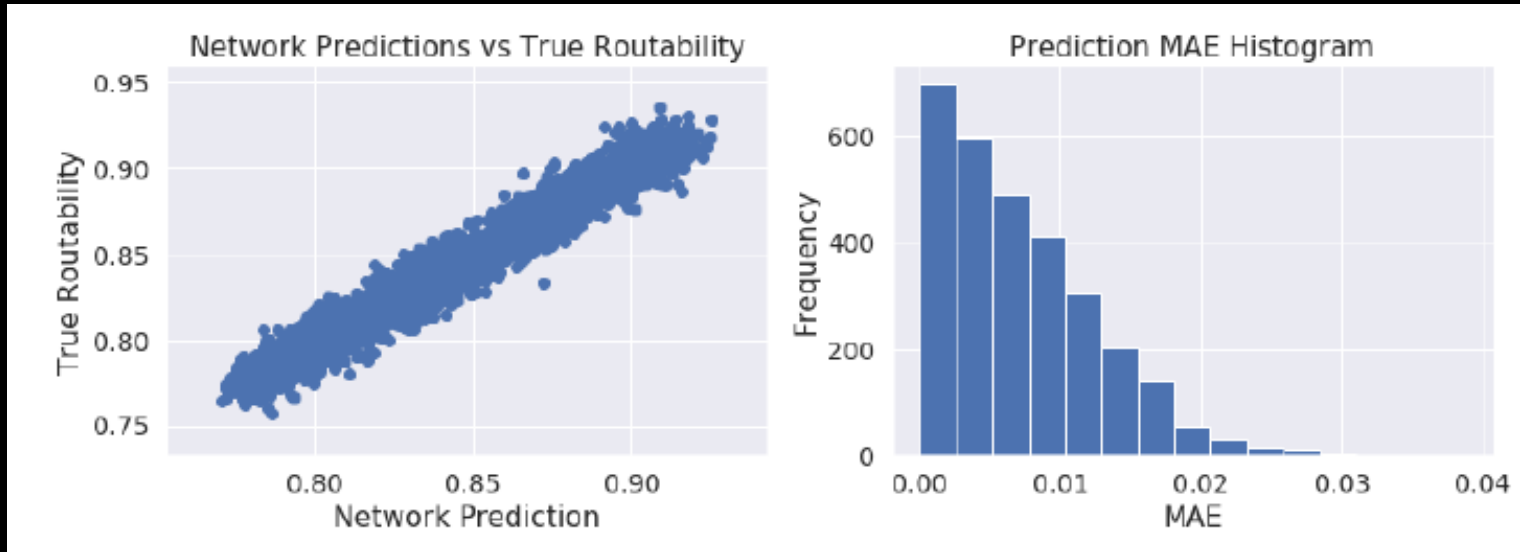


Galileo_G87173_204



Learning to Score Designs

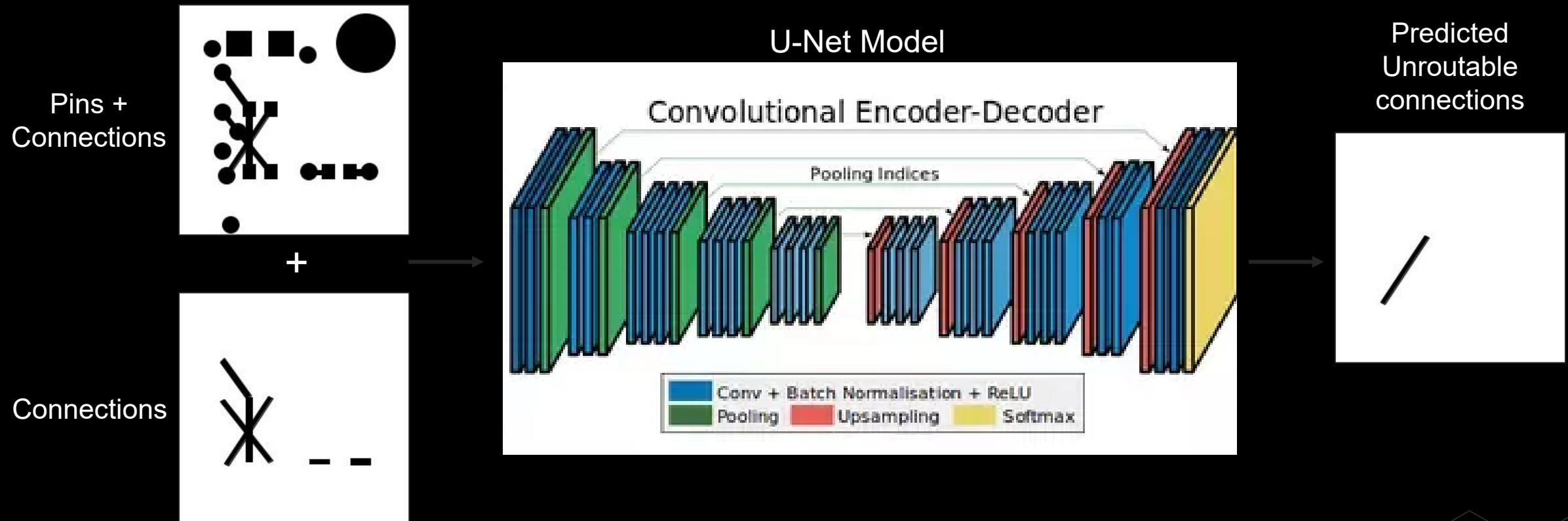
How do NNs correlate with Routability?



Disconnection Prediction Task – Via Patch Model

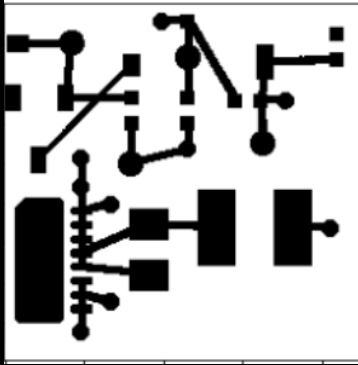
U-Net Model

- U-Net is a convolutional encoder-decoder that has shown success on image-to-image translation tasks

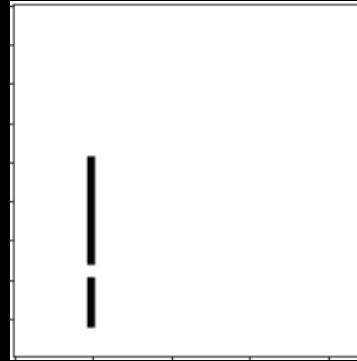


Disconnect Prediction Task

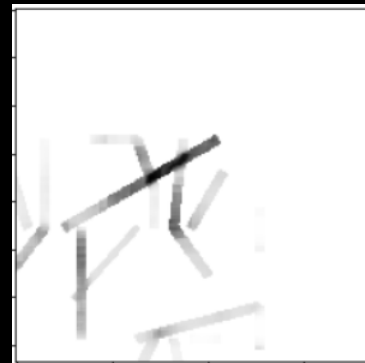
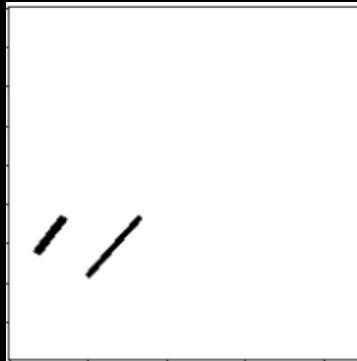
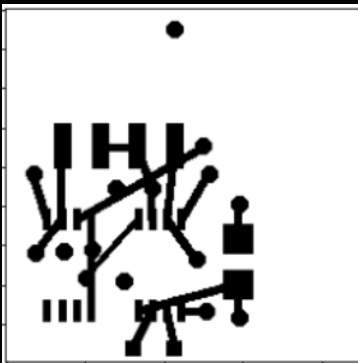
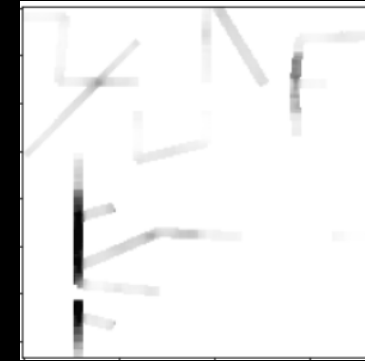
Input feature:



Label:



Prediction:



Allegro X AI Results

Transforming IC packaging and PCB

PLACEMENT

**3 days to
75 Minutes**

WIRELENGTH

**12%
Improved**

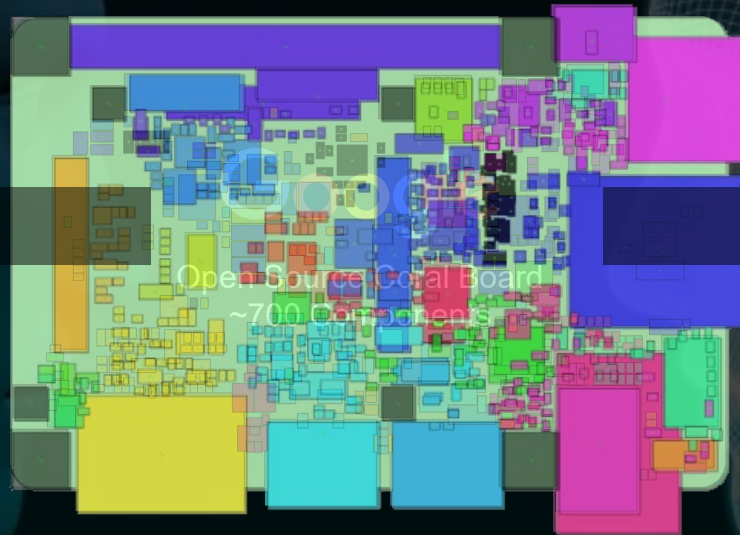
MANUFACTURING

**100%
Compliant**

ELECTRICAL
ANALYSIS

Optimized

Human



X AI

Leverages Cadence® OnCloud to
evaluate 1000s of alternatives

cadence

Allegro X AI

Transforming IC packaging and PCB

PLACEMENT

**4 days to
2 hours**

WIRELENGTH

**1%
Improved**

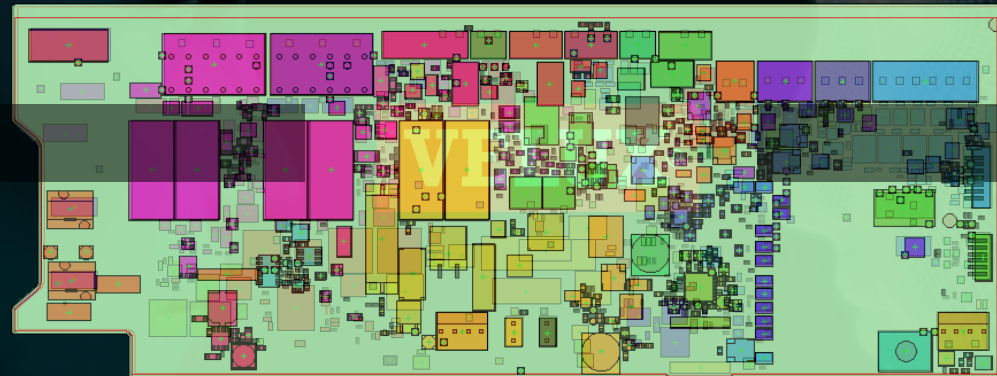
MANUFACTURING

**100%
Compliant**

ELECTRICAL
ANALYSIS

Optimized

Human



X AI

Leverages Cadence® OnCloud to
evaluate 1000s of alternatives

cadence

Allegro X AI

Transforming IC packaging and PCB

PLACEMENT

**22 hours to
34 minutes**

WIRELENGTH

**10%
Improved**

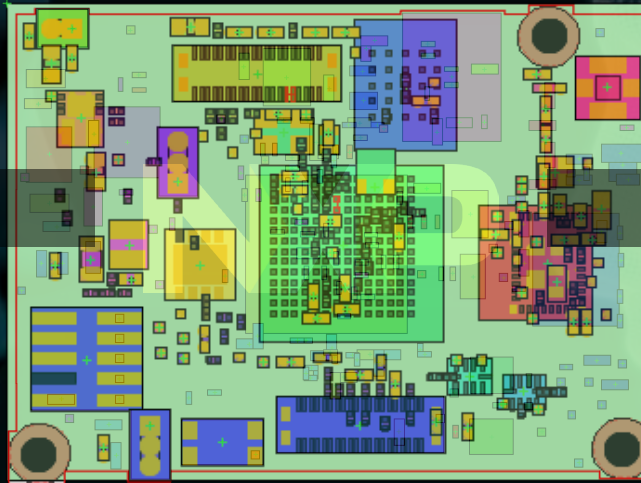
MANUFACTURING

**100%
Compliant**

ELECTRICAL
ANALYSIS

Optimized

Human



X AI

Leverages Cadence® OnCloud to
evaluate 1000s of alternatives

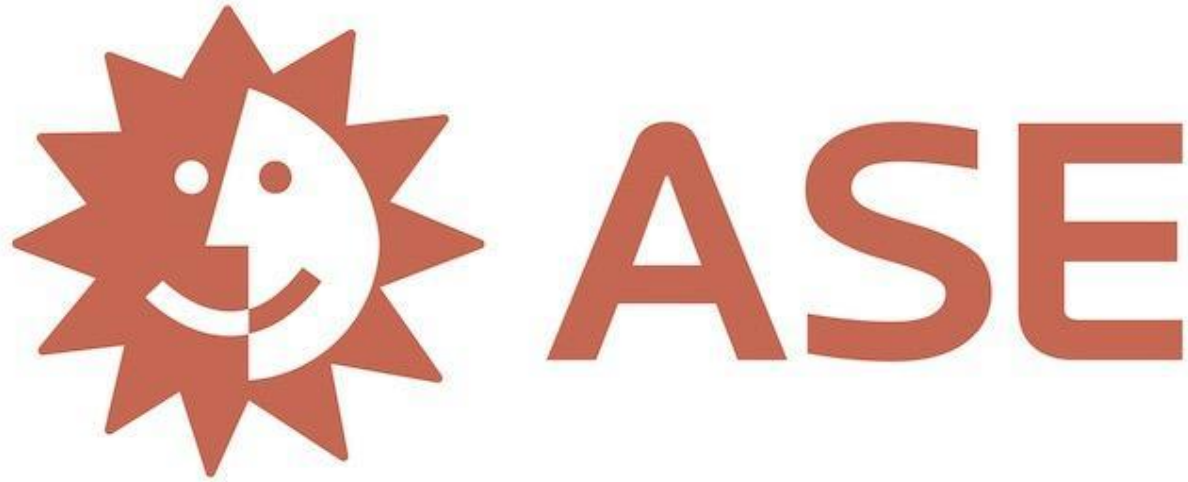
cadence

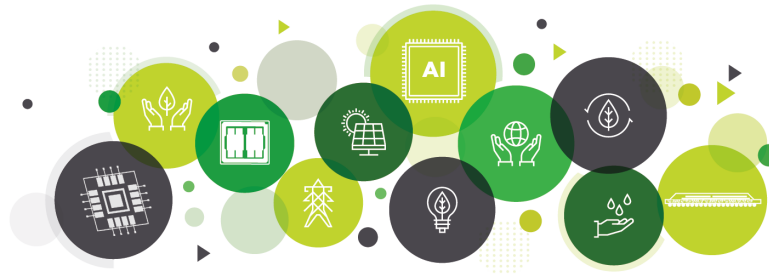


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