

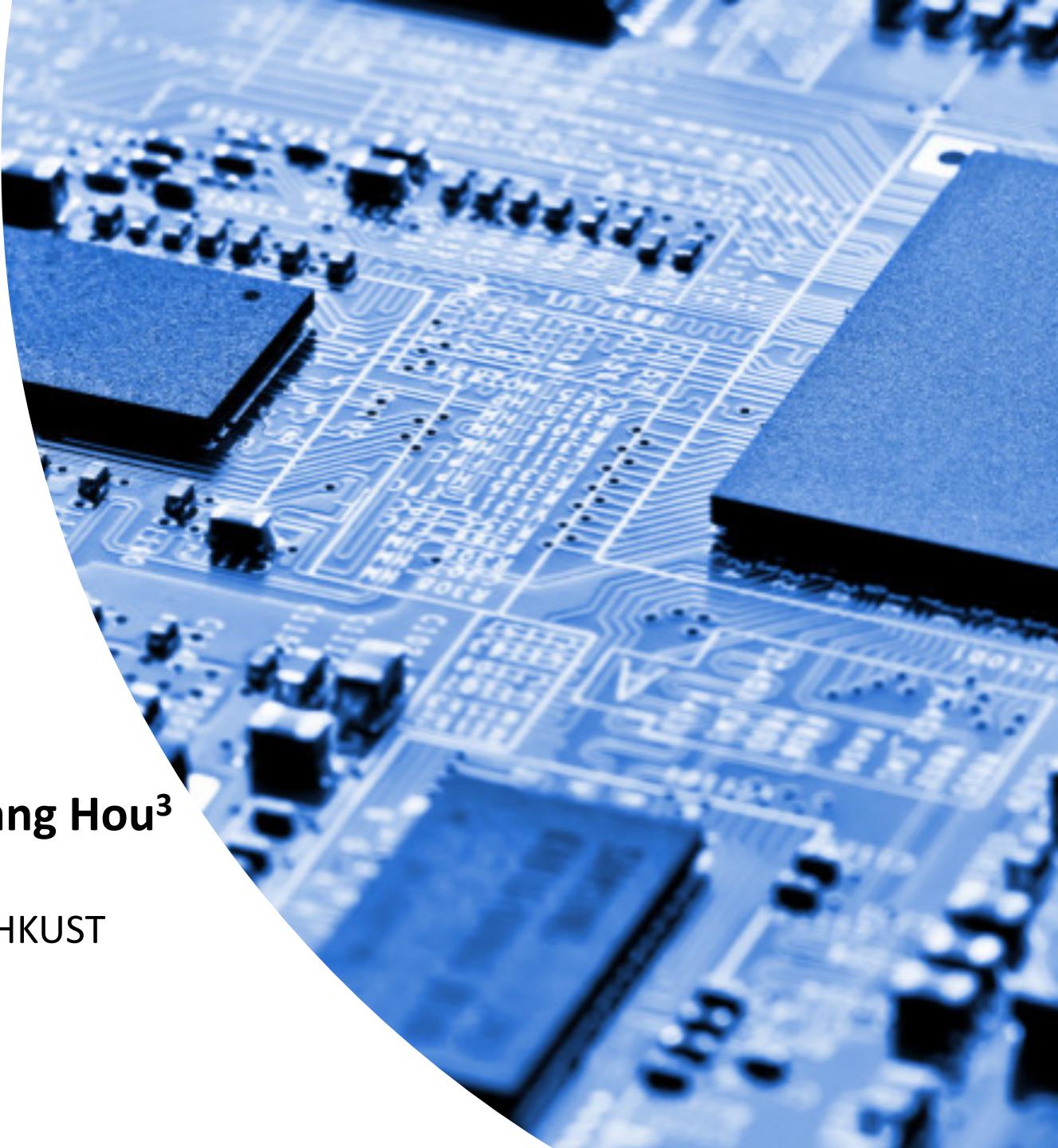
MATH 6380o Final Project: Defects Recognition on Nexperia's Semi-Conductors

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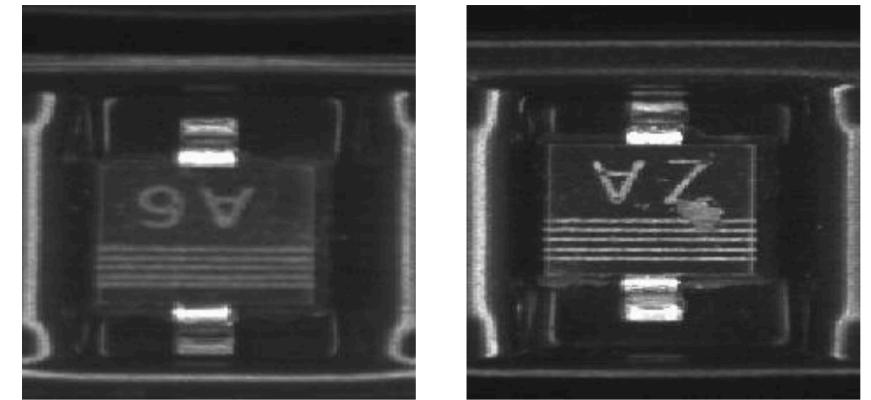
Introduction

Billions of semi-conductors are produced by
Nexperia every year



Products Applications Packages Quality Support Careers About News

The screenshot shows the Nexperia website homepage. At the top, there's a navigation bar with links for Products, Applications, Packages, Quality, Support, Careers, About, and News. Below the navigation is a large search bar with the placeholder "I'm searching for...". To the right of the search bar are buttons for "Search", "Parametric search", "Cross reference", and "Packages". A red "EFFICIENCY WINS" banner on the right side contains the text "Browse, select and get your products for your designs." and a "Buy newest products" button. At the bottom, there are category links for Bipolar transistors, Diodes, ESD protection, TVS, signal, MOSFETs, GaN FETs, and Analog & Logic. A feedback button is also visible.



Anomaly detection (e.g. defects identification) is a hard problem and mainly depends on human power

Data Description

- Training samples: 29K images
2.9K bad & 26.1K good
- 1K validation
100 bad & 900 good
- Testing sets: 3K images

The screenshot shows a competition page for "InClass Prediction Competition". The main title is "Semi-conductor Image Classification (first stage)" with the subtitle "Dataset are from Nexperia". It indicates "14 teams · 6 months to go". The navigation bar includes "Overview", "Data" (which is active), "Notebooks", "Discussion", "Leaderboard", and "Rules". A prominent blue button on the right says "Join Competition". Below the navigation, a section titled "Data Description" contains a heading "File descriptions" followed by a bulleted list of file types and their descriptions.

Semi-conductor Image Classification (first stage)
Dataset are from Nexperia
14 teams · 6 months to go

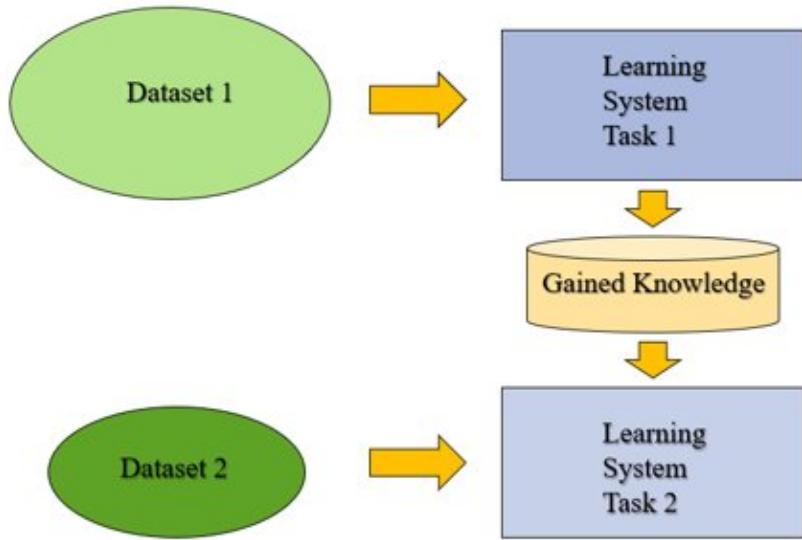
Overview **Data** Notebooks Discussion Leaderboard Rules [Join Competition](#)

Data Description

File descriptions

- **train.tar.gz** - the training data: bad_1 folder contains 3000 bad semi-conductor images and the label is 1, good_0 folder contains 27000 good semi-conductor images and the label is 0.
- **test.tar.gz** - the test data
- **sampleSubmission.csv** - a sample submission file in the correct format. The id column is the test image name and the label column is the corresponding score which is between 0 and 1.

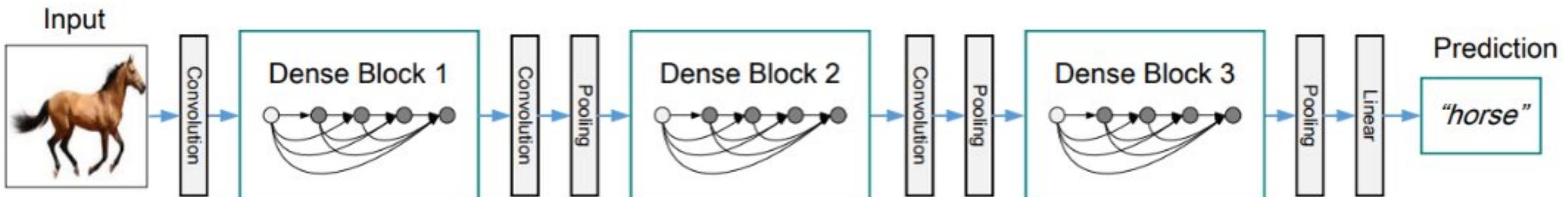
Transfer Learning



DenseNet-121

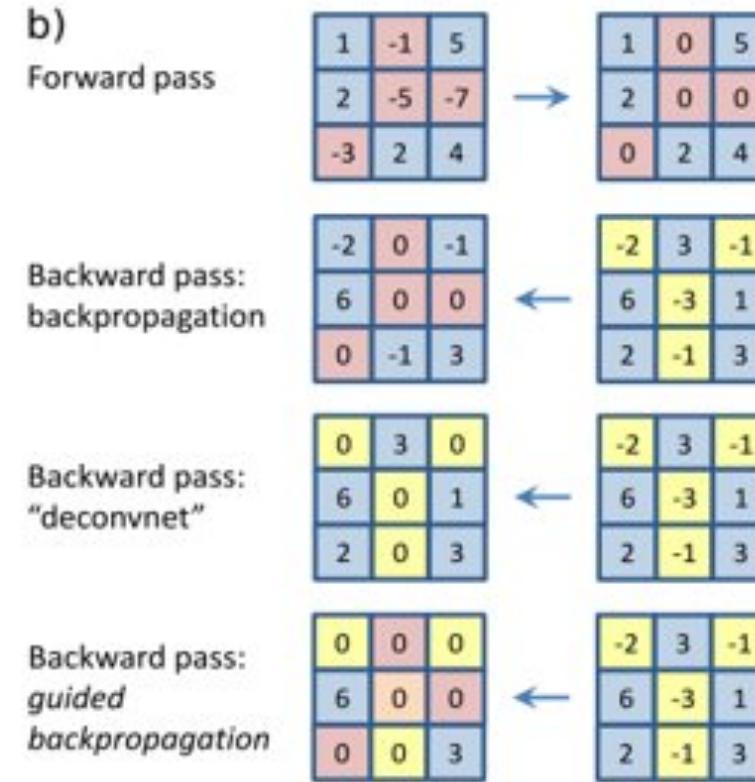
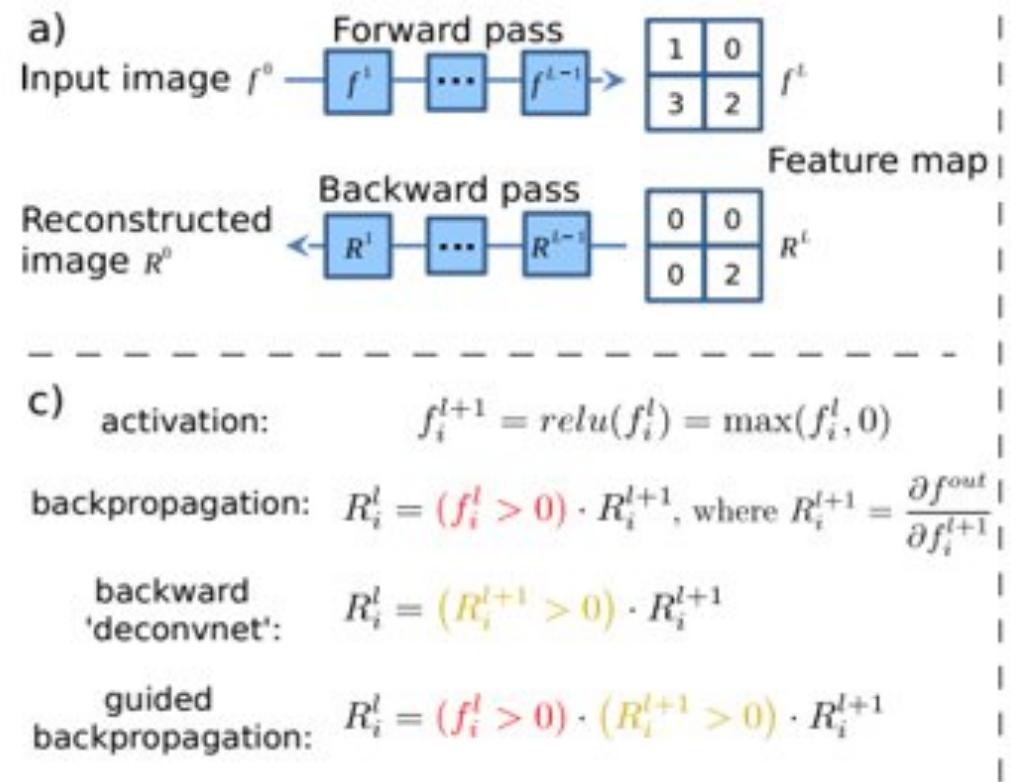
Advantages of DenseNet-121

- Alleviates the vanishing-gradient problem;
- Feature propagation can be strengthened;
- DenseNet encourages feature reuse;
- Significantly reduces the number of parameters.

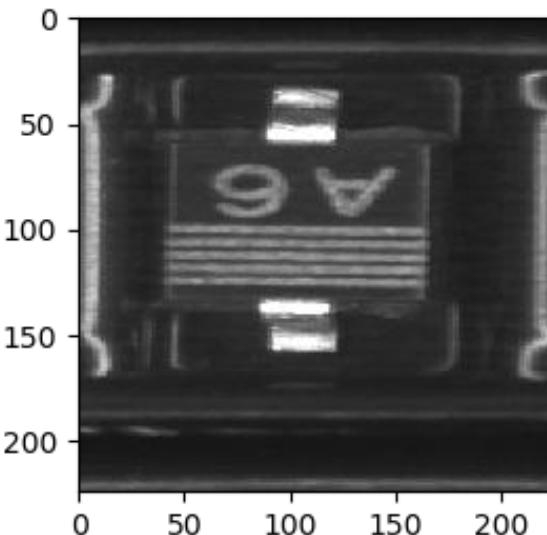
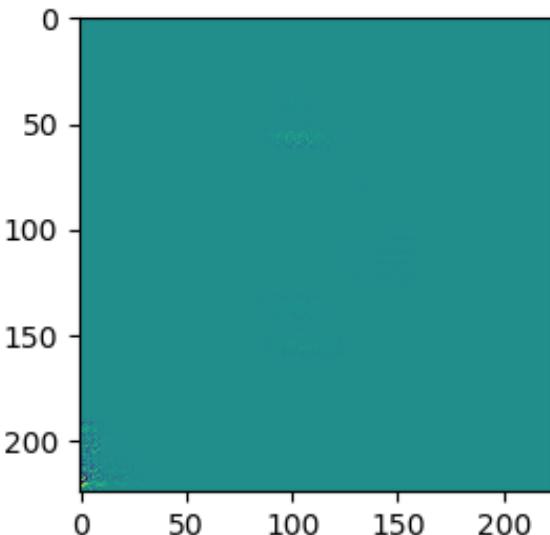


Feature Visualization

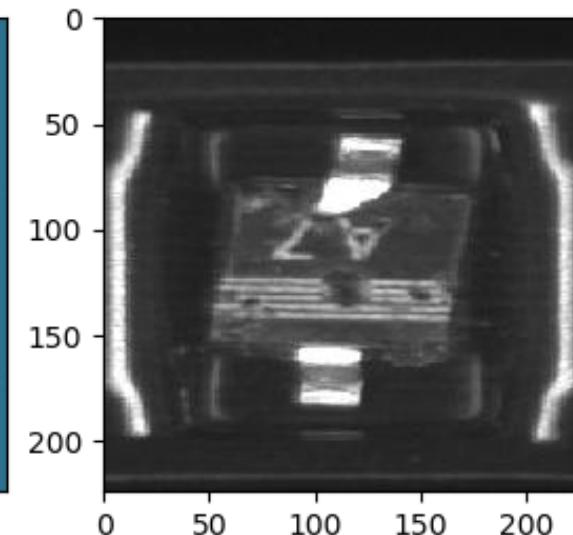
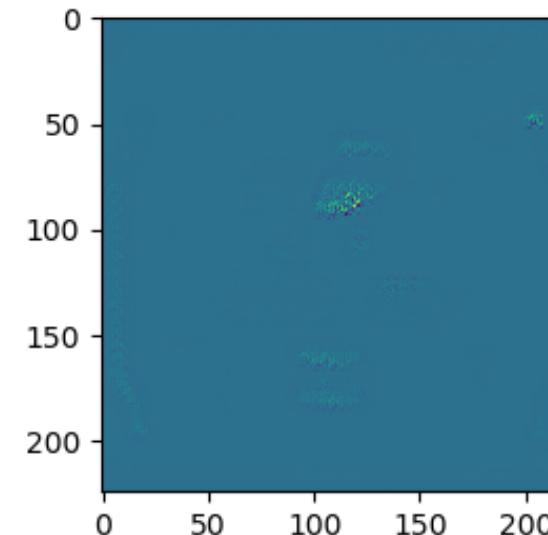
Deconvolution network approach



Feature Visualization

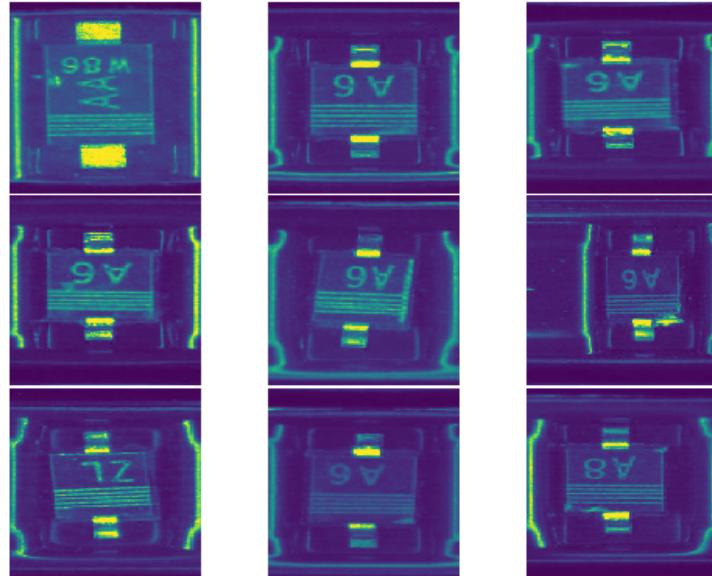


Saliency map of a good semi-conductor and the original image of a semi-conductor without defect

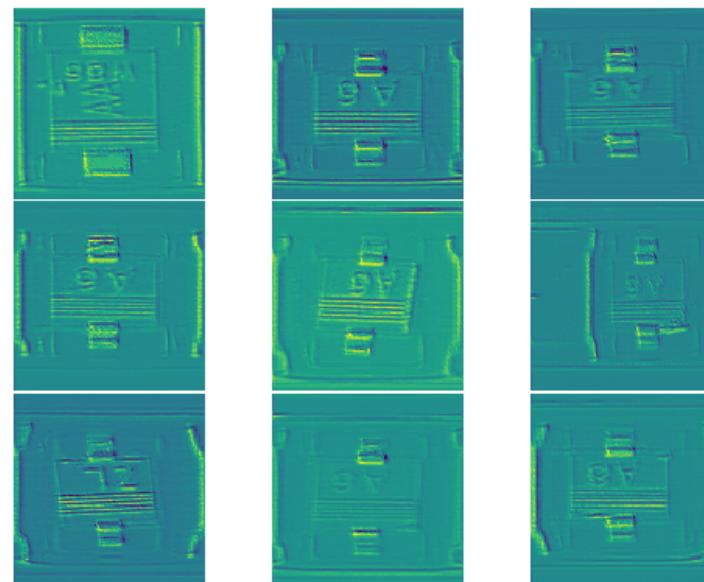


Saliency map of a defective semi-conductor and the original image of a semi-conductor with defect

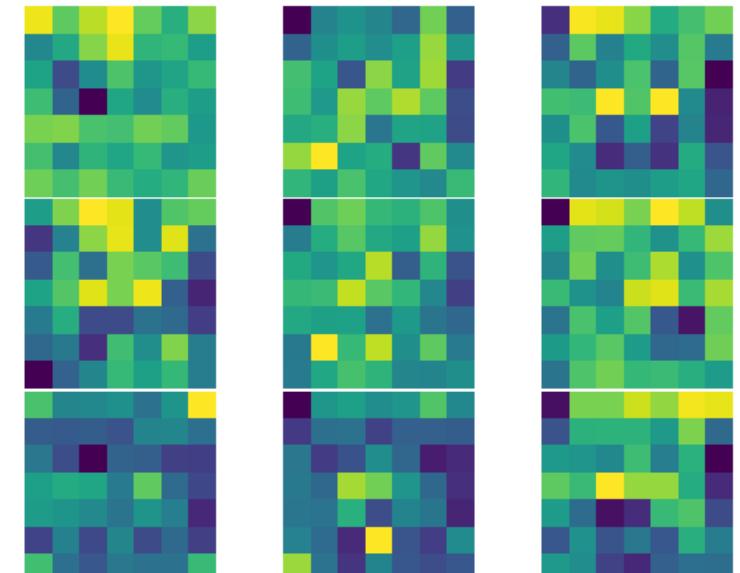
Feature Visualization



Original images with changed channel



Post first convolution layer



Post last convolution layer

Results

DenseNet-121

Training Results

Precision	Recall	Accuracy	F1-Measure
1.0000	1.0000	0.9999	1.0000

Validation Results

Precision	Recall	Accuracy	F1-Measure
0.9857	0.9933	0.9810	0.9895

Results

InClass Prediction Competition

Semi-conductor Image Classification (first stage)

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14 teams · 6 months to go

Overview Data Notebooks Discussion Leaderboard Rules [Join Competition](#)

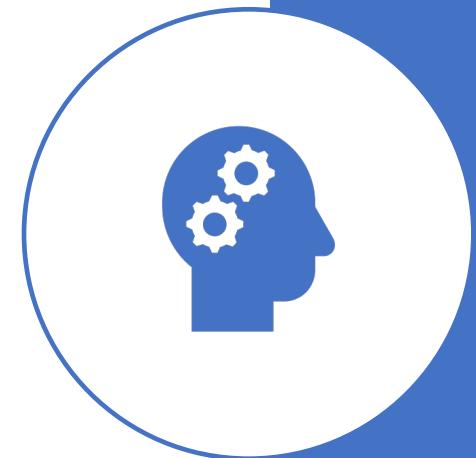
[Public Leaderboard](#) [Private Leaderboard](#)

This leaderboard is calculated with all of the test data. [Raw Data](#) [Refresh](#)

#	Team Name	Notebook	Team Members	Score	Entries	Last
6	hemuttiann			0.92537	2	2d

Contribution

- Mutian He: Transfer learning using DenseNet-121, Feature visualization using FlashTorch, Binary classification on testing datasets
- Yuxin Tong: Feature visualization using FlashTorch & Poster
- Qing Yang: Results analysis & Poster
- Ruoyang Hou: Transfer learning & Slides



References

- [1] Huang, G., Liu, Z., Van Der Maaten, L., & Weinberger, K. Q. (2017). Densely connected convolutional networks. In Proceedings of the IEEE conference on computer vision and pattern recognition (pp. 4700-4708).
- [2] Springenberg, J., Dosovitskiy, A., Brox, T., & Riedmiller, M. (n.d.). STRIVING FOR SIMPLICITY: THE ALL CONVOLUTIONAL NET. Posted on Arxiv., 2015 <https://arxiv.org/pdf/1412.6806.pdf>