Shine Bright Like a Diamond

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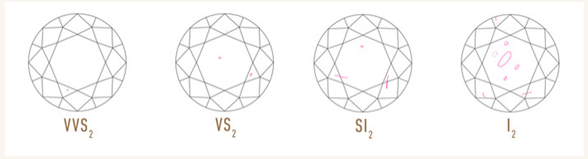
BROWN

Motivation

Grading diamonds by clarity–the quality of a diamond, which is determined by its lack of inclusions or imperfections–is typically an intensive process of the diamond supply chain, unlike cut, color and carat, which are the other metrics used to determine a diamond's price and use case. This is because it has historically relied upon human graders and expensive machinery. Inspired by the ongoing area of research conducted by the GIA-IBM partnership to automate diamond grading by clarity, we decided to attempt clarity grading using both conventional image processing techniques and also more modern deep learning techniques learned in class.

Define the problem

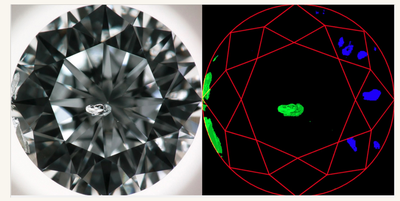
The GIA scale for diamond clarity is based on the number of inclusions that can be observed at 10x magnification. The grades are FL (Flawless), IF (Internally Flawless), VVS (Very Very Slightly Included), SI (Slightly Included) and I (Included).



[1]

Goal

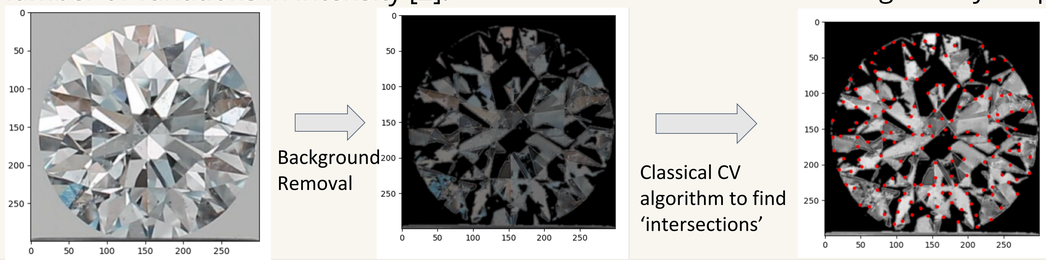
1. Use traditional CV strategies to extract inclusions
2. Create a neural network that consistently correctly classifies images of diamonds based on clarity



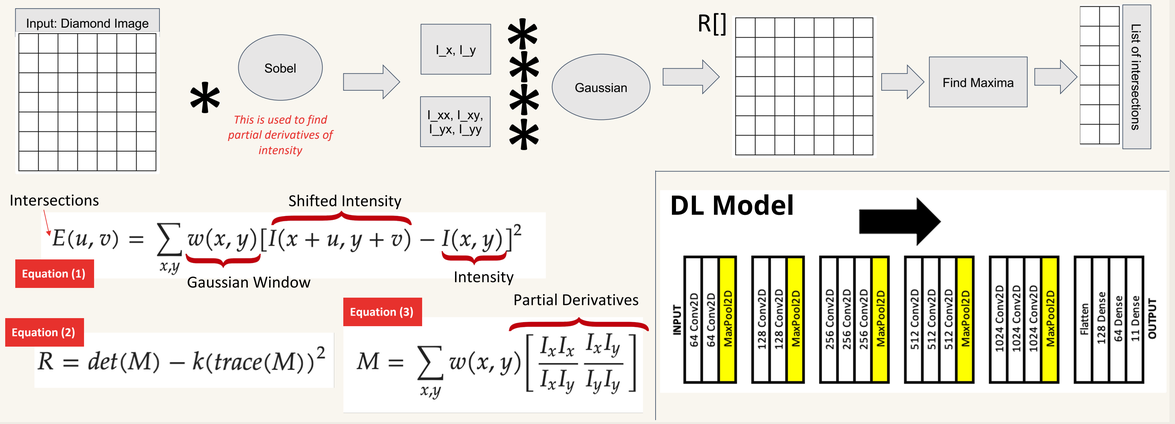
What is the insight into the problem that leads to the solution?

Classical methods: Reflections and facets are structurally different from inclusions. Specifically, regions of reflection contain a small number of variations in intensity in all directions, whereas regions of inclusions contain a large number of variations in intensity [2].

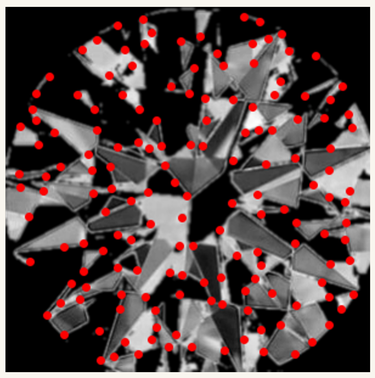
DL methods
VGGs are designed for complex classification problems, thus this is a good use case for them. The threat of overfitting can be mitigated by dropout layers.



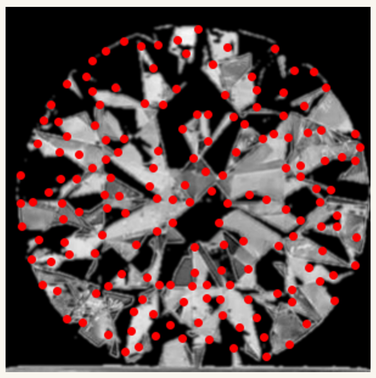
More details. Explain how it works.



Results (images/figures)

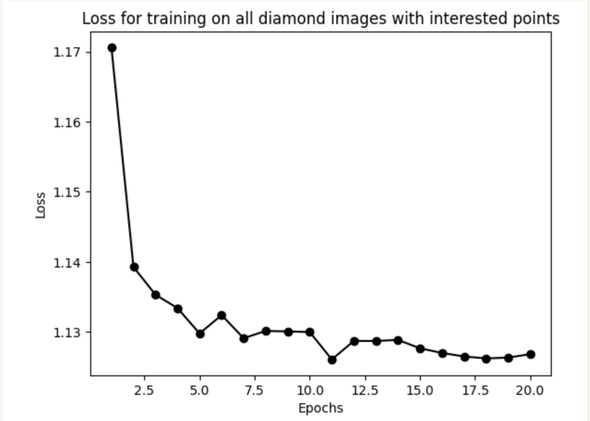


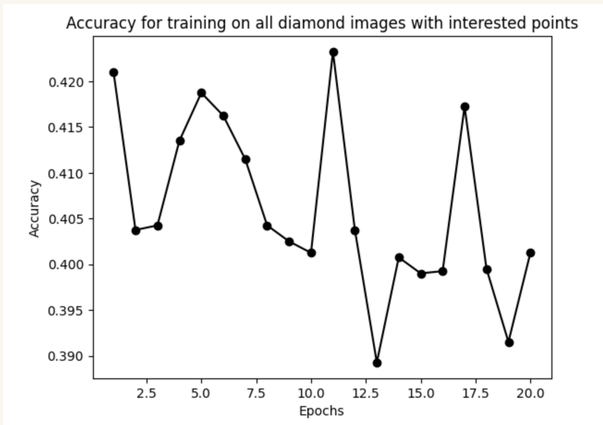
IF: Number of extracted points: 157



I1: Number of extracted points: 166

More Results





References

[1] GIA. What is diamond clarity: The 4cs of diamond quality, Dec 2019
[2] Wenjing Wang and Lilong Cai, "Inclusion extraction from diamond clarity images based on the analysis of diamond optical properties," Opt. Express 27, 27242-27255 (2019)

Acknowledgements

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