# CVCHESS: A DEEP LEARNING FRAMEWORK FOR CONVERTING CHESSBOARD IMAGES TO FORSYTH–EDWARDS NOTATION

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## 1 INDIVIDUAL CONTRIBUTIONS

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|---|---|---|---|
| 30% | 23.3% | 23.3% | 23.3% |

## 2 COMPLETED TASKS (10 SUBSTANTIAL TASKS)

- Designed the full system pipeline diagram outlining each stage from image capture to best-move recommendation, including preprocessing, classification, FEN generation, and chess engine integration.
- Researched and evaluated potential baseline models for piece classification, including tiny CNNs, k-Nearest Neighbors (k-NN), and Support Vector Machines (SVM), assessing trade-offs in accuracy, training requirements, and inference speed.
- Implemented the chosen baseline SVM model using HOG features, PCA for dimensionality reduction, and an RBF kernel, achieving 68% tile-level accuracy.
- Developed a robust board corner detection pipeline using grayscale conversion, Gaussian blur, Canny edge detection, and morphological operations to handle imperfect real-world images.
- Wrote a script to apply the Hough Line Transform to detect and align grid lines, ensuring accurate segmentation despite perspective distortions.
- Wrote a script to apply a perspective transformation to warp images into a standardized top-down $400\times400$ chessboard view for consistent model input.
- Implemented square slicing to divide the aligned chessboard into 64 equal patches, each representing a single board square (was not used for final model).
- Parsed and expanded FEN strings into 64-element arrays of labeled classes (13 categories) for supervised training.
- Investigated Vision Transformer (ViT) architectures for the main model, comparing performance against the baseline and other candidates.
- Wrote a script to map captured images from new dataset to ground-truth FEN strings from PGN files for labeling.

## 3 ASSIGNED UNCOMPLETED TASKS (5 TASKS)

- Conduct a more in-depth review of background literature and past research on chessboard and piece recognition to identify potential improvements in methodology.
- Allocate more time to refining and supporting the residual CNN architecture, including extended training and hyperparameter optimization.
- Implement and evaluate a full end-to-end CNN model for direct FEN generation from raw images to assess its validity against the current pipeline.