OCR-Based Document Classification

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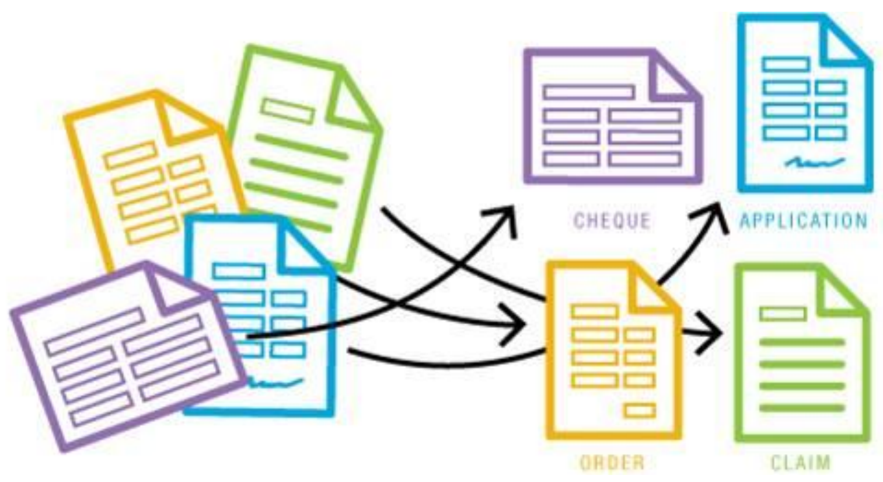
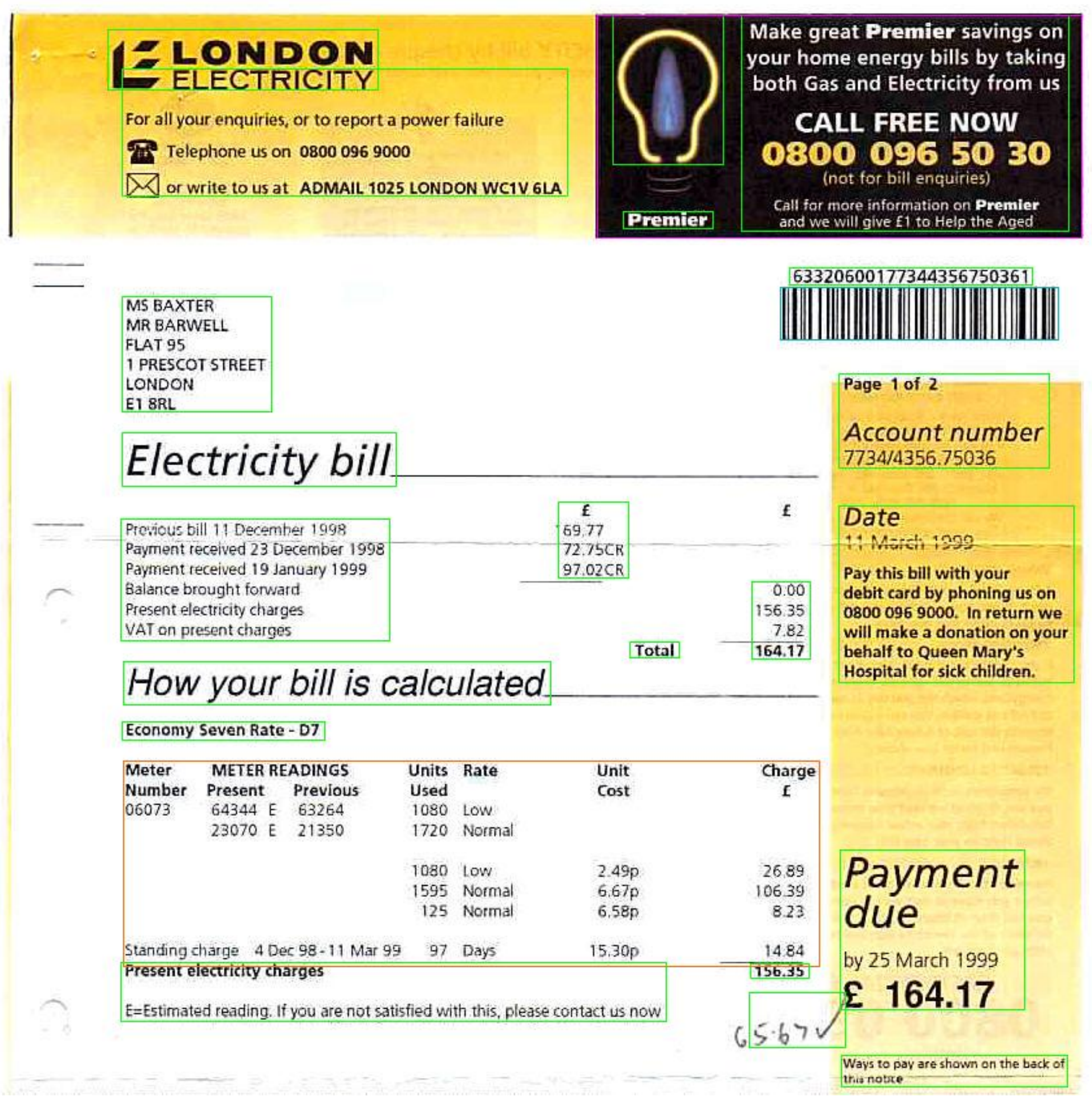
DOCUMENT CLASSIFICATION

- Document classification is the sorting of documents into predefined categories.
- **T**he trend of the paperless office in the recent years prompted a large growth in more efficient document processing and retrieval, driven largely by the incentive of reducing labor costs.
- Document classification has been studied previously to support the classification of wartime archival documents, medical journals, identity documents, forms and financial documents
- Toshiba hopes to integrate document classification into their e-BRIDGE Re-Rite product to enable workflow automation.



OPTICAL CHARACTER RECOGNITION (OCR)

- Extracts text , blocks from scanned images
- Segments the Text in region blocks



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	23070	E	21350	1720	Normal		
				1080	Low	2.49p	26.89
				1595	Normal	6.67p	106.39
				125	Normal	6.58p	8.23
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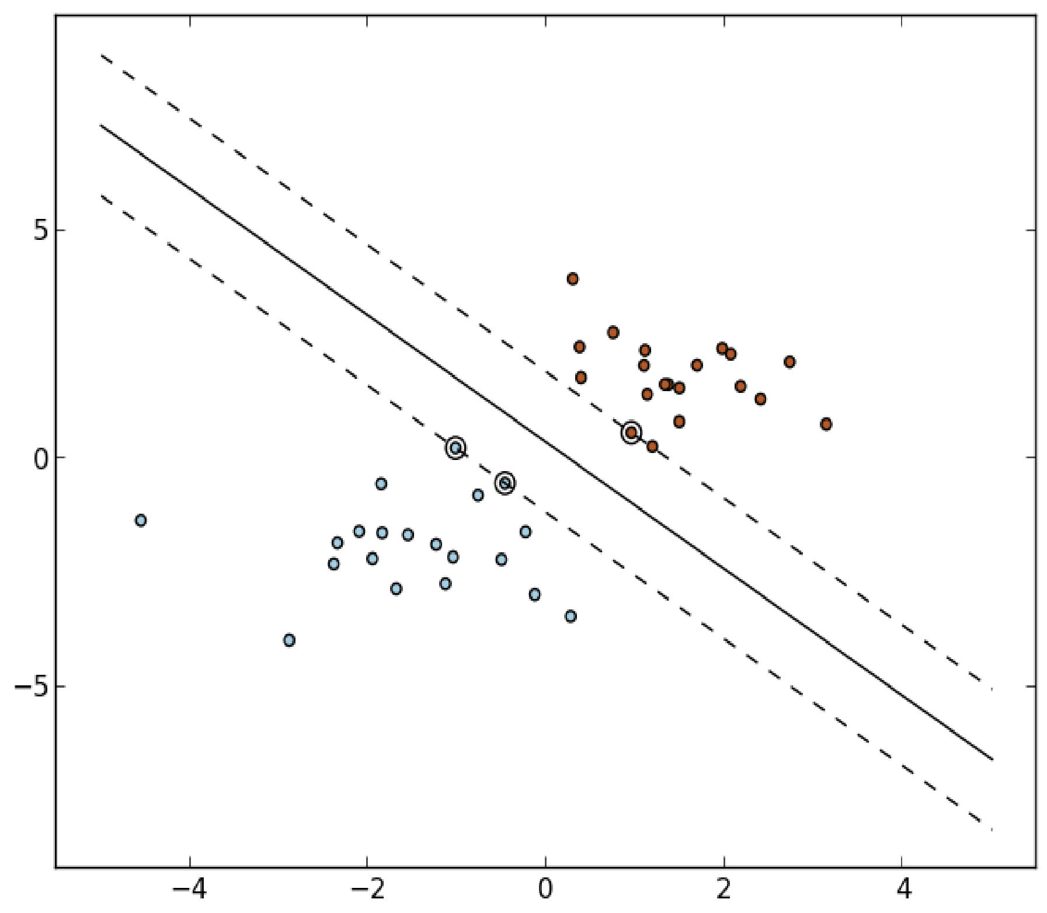
MACHINE LEARNING

- A branch of Artificial Intelligence, Machine Learning is good at making predictions with large volumes of data.
- Also used for speech recognition, handwriting recognition and spam filtering

Support Vector Machine (SVM)

- A support vector machine constructs a hyper-plane or set of hyper-planes in a high or infinite dimensional space and finds a separating hyperplane with the maximum margin i.e. the largest distance to the nearest training data points of any class



CLASSIFIER FEATURES

Preprocessing

- Levenshtein Distance, Thesaurus

Semantic Features

- Keyword Exist, Number Words, Number Numeric Words

Visual Features

- Number of blocks of each type, Total area taken by each block type, Block Widths

Combination Semantic and Visual Features

- Word Size, Word Position

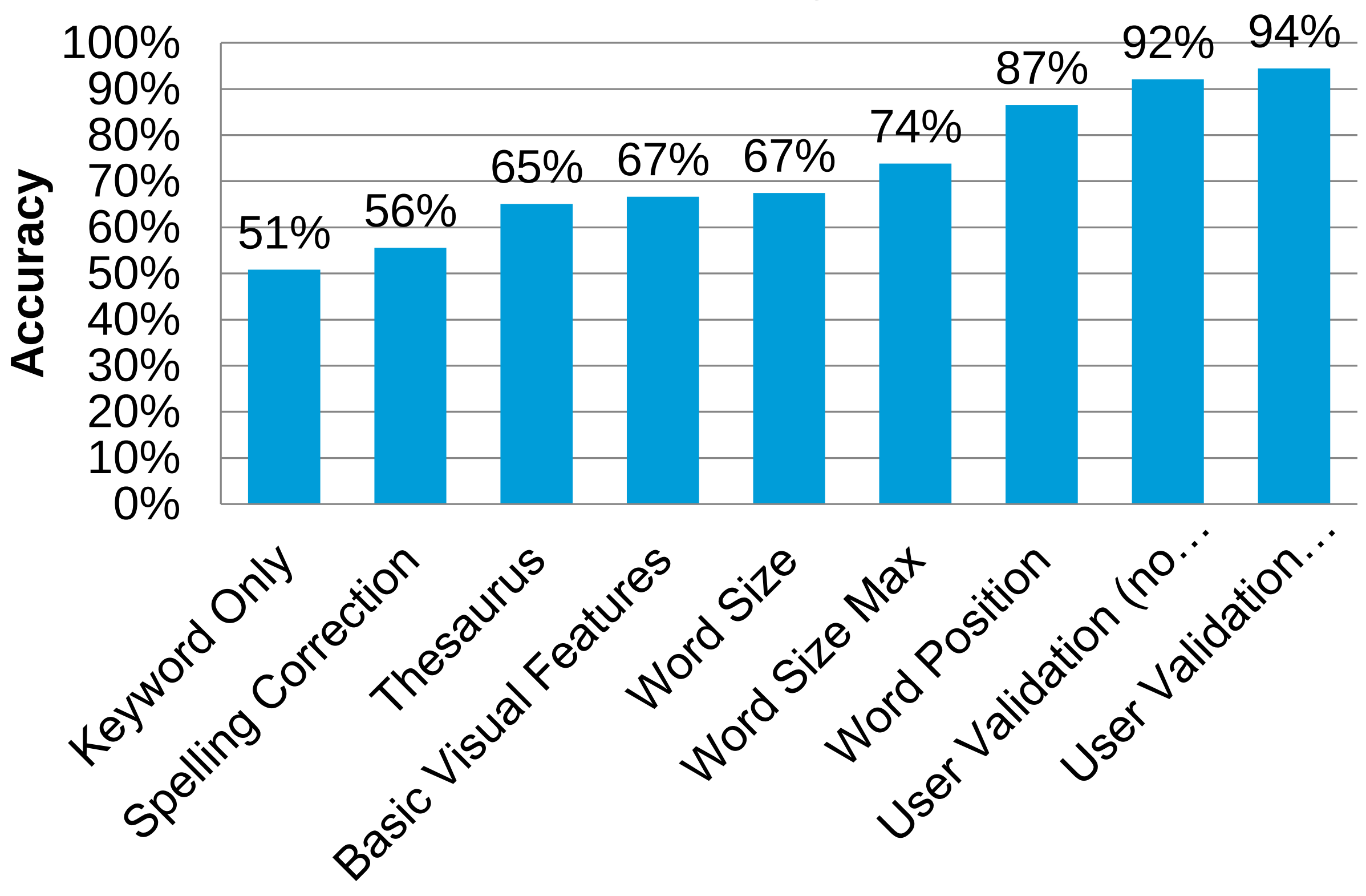
User Validation

- Keyword Search , Prediction Probabilities

ACCURACY

- Below shows the graph showing the amount of improvement gained at each revision of the classifier. Each revision trained the model containing an additional feature

Classifier Accuracy During Each Revision

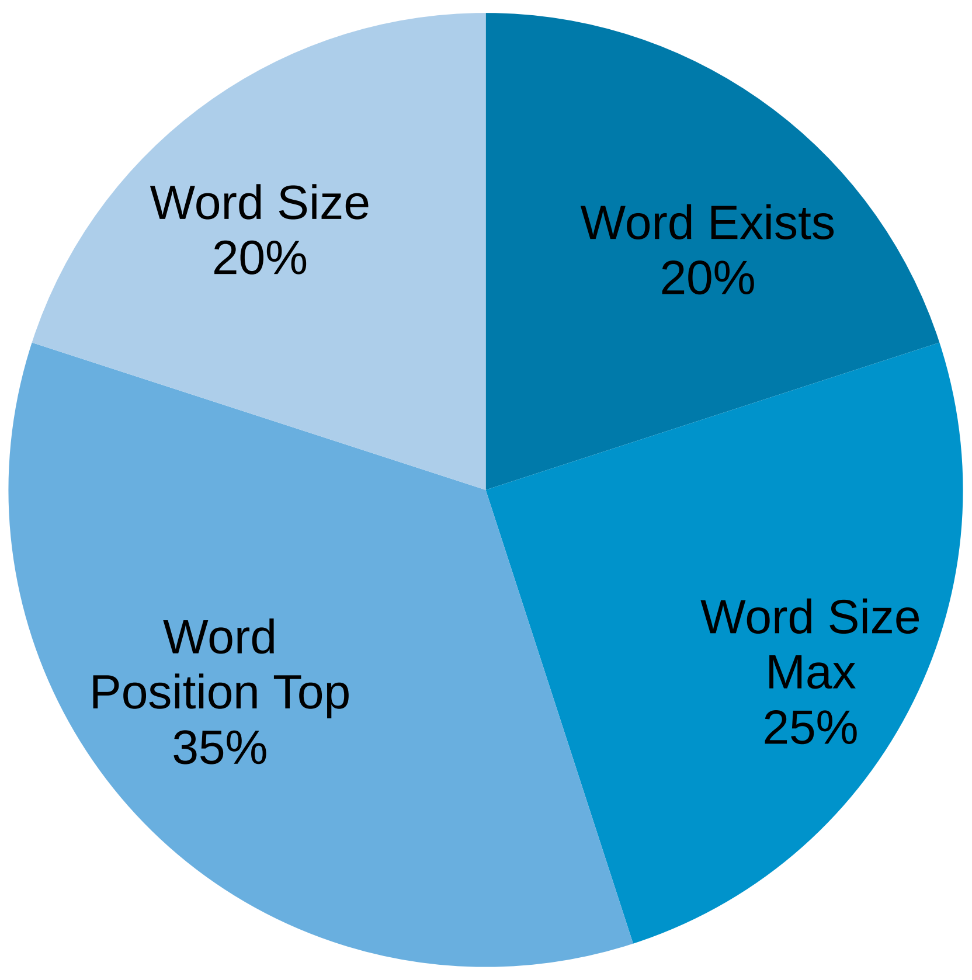


Accuracy Improvement

Feature Name	% Improvement
Word Size	0.79%
Basic Visual Features	1.59%
User Validation (probabilities)	2.38%
Spelling Correction	4.76%
User Validation (no keyword)	5.56%
Word Size Max	6.35%
Thesaurus	9.52%
Word Position	12.70%

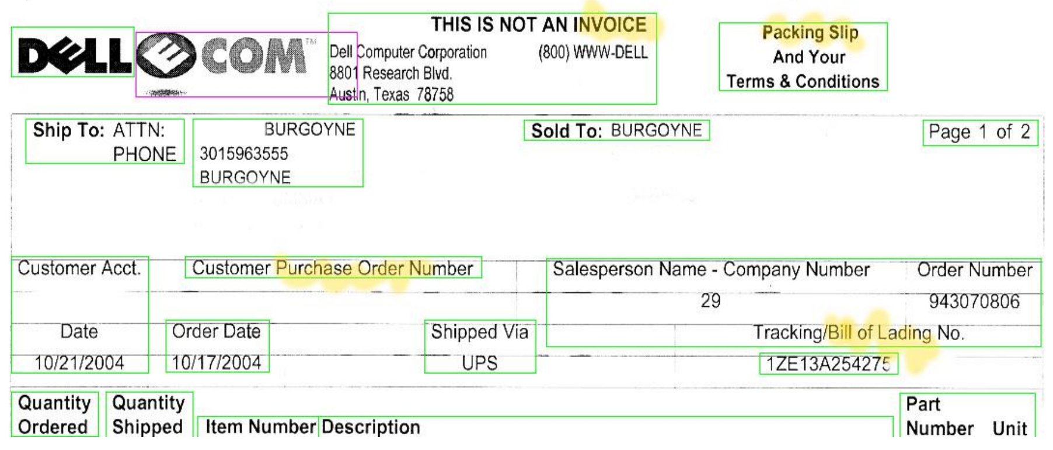
FEATURE IMPORTANCE

20 Most important Features



THINGS TO LOOK OUT FOR

Multiple words in document.



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Customer Acct.	Customer Purchase Order Number	Salesperson Name - Company Number	Order Number
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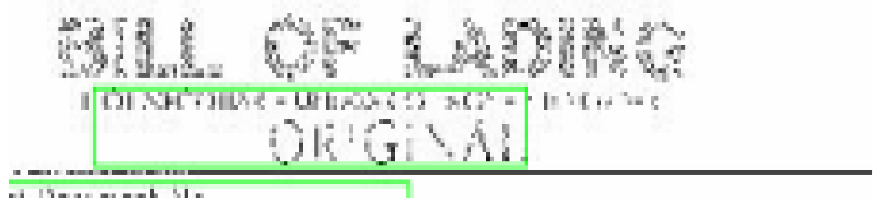
Date	Order Date	Shipped Via	Tracking/Bill of Lading No.
10/21/2004	10/17/2004	UPS	1ZE13A254275

Quantity Ordered	Quantity Shipped	Item Number	Description	Part Number	Unit

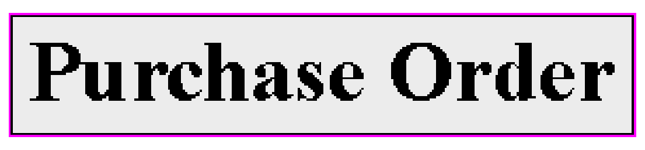
OCR Errors

- Blocks are not always identified by the OCR



BILL OF LADING
ORIGINAL

- Below words were identified as an image.



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More OCR Errors (Spelling)

	Words (Levenshtein Distance < 3)
Incorrect spelled instances of the word 'invoice'	Nvoiceno, iioic, invuiife, voce, iioic, rvoices, nvoi, Invoc, invoceb, invocf, invoco, jlnvoice, jlnvoice, nwoice, tnvotce, Invoicc, lnvoice, mnvoice, unvoice, nvoice
Total	20

Form Errors

- Forms that do not follow the normal conventions of the form type. E.g. Packing slips does not always contain the words 'packing slip' in it.

GENERALIZATION

- Tries to find out how well the model might perform in practice and attempts to determine if there is any bias caused by any unlucky splits of the available data.

K-Folds Cross Validation

Test ID	Predictions Correct	Errors	Accuracy
1	121	4	96.80%
2	122	3	97.60%
3	121	4	97.58%
4	119	6	95.20%
5	116	9	92.80%
Average	119.8	5.2	96.00%

CONCLUSIONS

- Accuracy of the classification and generalization results were consistently high.
- The features that the classifier considered important were reflective of how humans classify documents.
- A large accuracy improvement was seen from fixing OCR errors.
- The amount of user interaction needed has to be considered to integrate the technologies described here into Toshiba's e-BRIDGE Re-Rite.

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