INTERNATIONAL HELLENIC UNIVERSITY

DEPARTMENT OF INFORMATION AND ELECTRONIC ENGINEERING / IHU

AN ENSEMBLE ARCHITECTURE OF CLASSIFIERS FOR PATENT CLASSIFICATION

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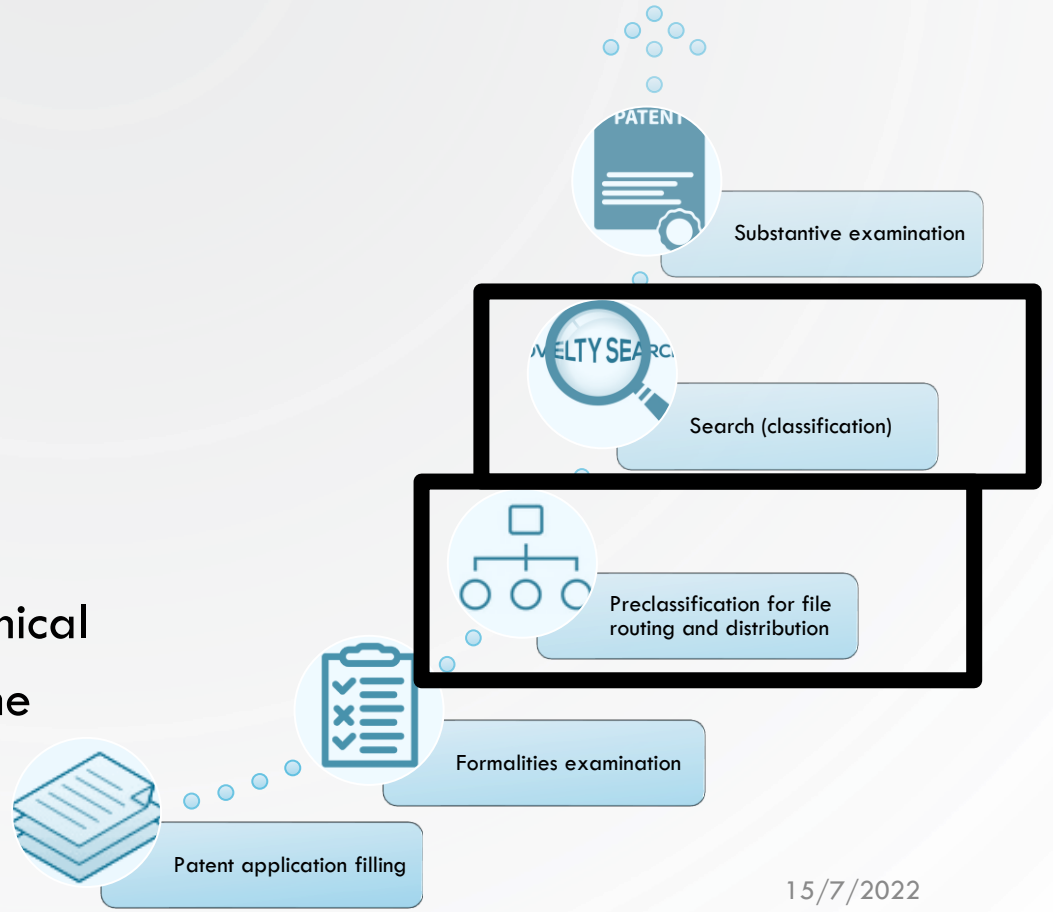
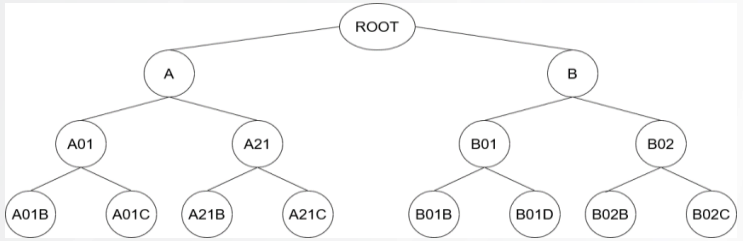
THE GLOBAL PATENT SYSTEM: HOW IT WORKS

- Preclassification: the assignment of one or more classification codes
- Quite important task:
  - it will enable correct routing and distribution to search division
  - it will enable patents with similar technical features to be grouped under the same classification code



* EPO, Guidelines for Examination in the European Patent Office, 2021

THE PROBLEM OF PATENT CLASSIFICATION



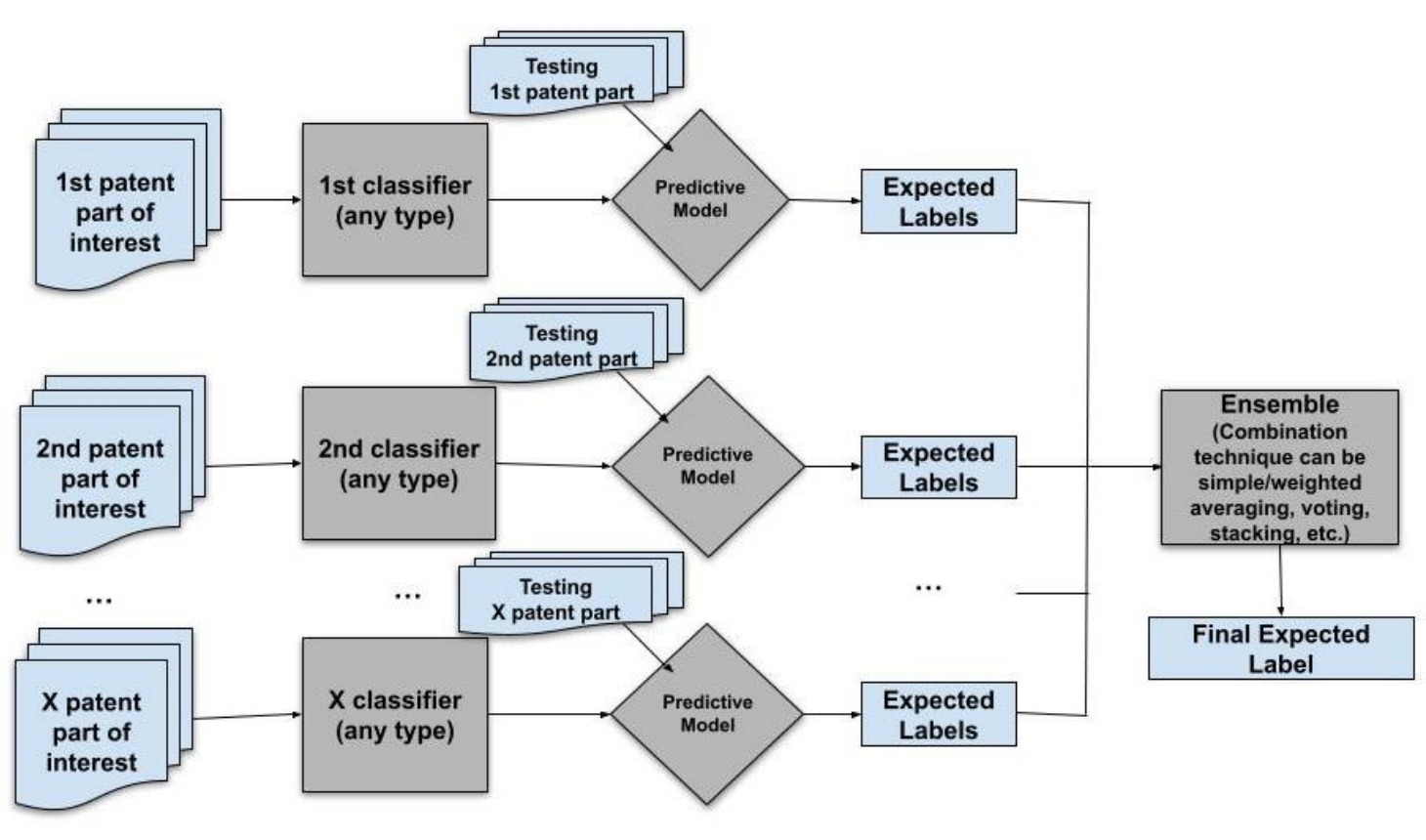
Level	IPC code	Description
Section	A	Human necessities
Class	A01	Agriculture; forestry; animal husbandry; hunting; trapping; fishing
Sub-class	A01B	Soil working in agriculture or forestry; parts, details, or accessories of agricultural machines or implements, in general

- Challenges:
  - In the patent document:
    - Numerous, lengthy, full of technical terminologies, complexity of invention
  - In the classification scheme:
    - Complicated hierarchical structure, aproximetely 78,000 IPC/250,000 CPC individual codes, unbalanced distribution of patents among codes (80% of all patent documents are classified in about 20% of the codes)
  - Manual task so far => Need to be supported or fully automated by classification systems

STATE-OF-THE-ART AND OUR CONTRIBUTION

- Current research efforts in patent classification:
  - They combine NLP and ML/DL techniques [1-4]
  - They apply several simplifications:
    - Work with well-represented codes
    - Work at higher level of the classification hierarchy
- Current research efforts in patent classification with respect to ensemble techniques:
  - They apply ML methods
  - They work at higher level of the classification hierarchy
- **Our contribution:** We introduce a new ensemble architecture for automated patent classification at multiple levels (an extension of a previous work presented in [8])

ENSEMBLE ARCHITECTURE



DATA COLLECTION: CLEF-IP 2011

Patent documents that have English text

Patent documents that have main classification category

Patent documents that have all required metadata (title, abstract, description, claims, applicant, inventors)

1st data collection/pool: Patent text from title

2nd data collection/pool: Patents text from abstracts

3rd data collection/pool: Patents text from description

4th data collection/pool: Patent text from claims

5th data collection/pool: Patents text from applicants

6th data collection/pool: Patents text from inventors

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An entertainment machine comprising a display
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comprising two or more zones 28, 30, 32, each
with an associated identifier 34, 36, 38. The
identifier may comprise for example a
colour ....
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Dataset used contains 541,131 patents and is available here: https://github.com/ekamater/CLEFIP2011_XML2MySQL

EXPERIMENTAL ORGANIZATION

DL model	Data utilization	Preprocessing	Language model	Ensemble combination	Task	Level
Bi-LSTM	Abstract, Description, Claims, Title, Applicants, Inventors	cleaning punctuation, symbols and numbers, and stop word removal	Domain-specific pre-trained embedding with 300 dimension [4]	Simple/Weighted averaging	Single	Subclass and Group

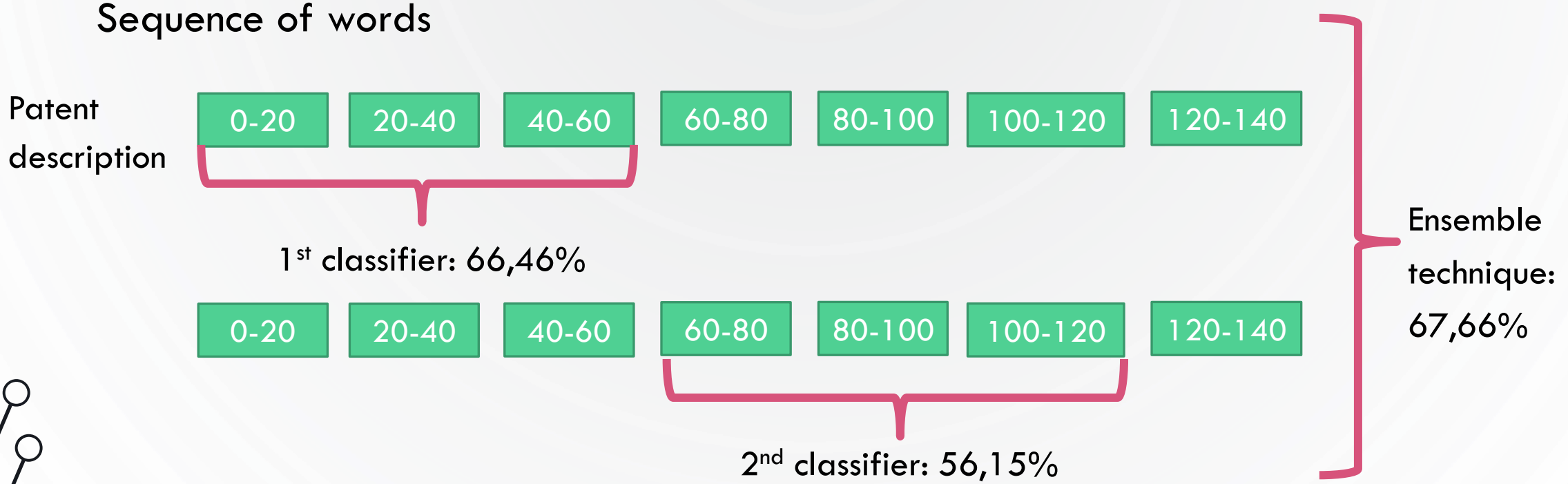
RESULTS

Subclass/Group

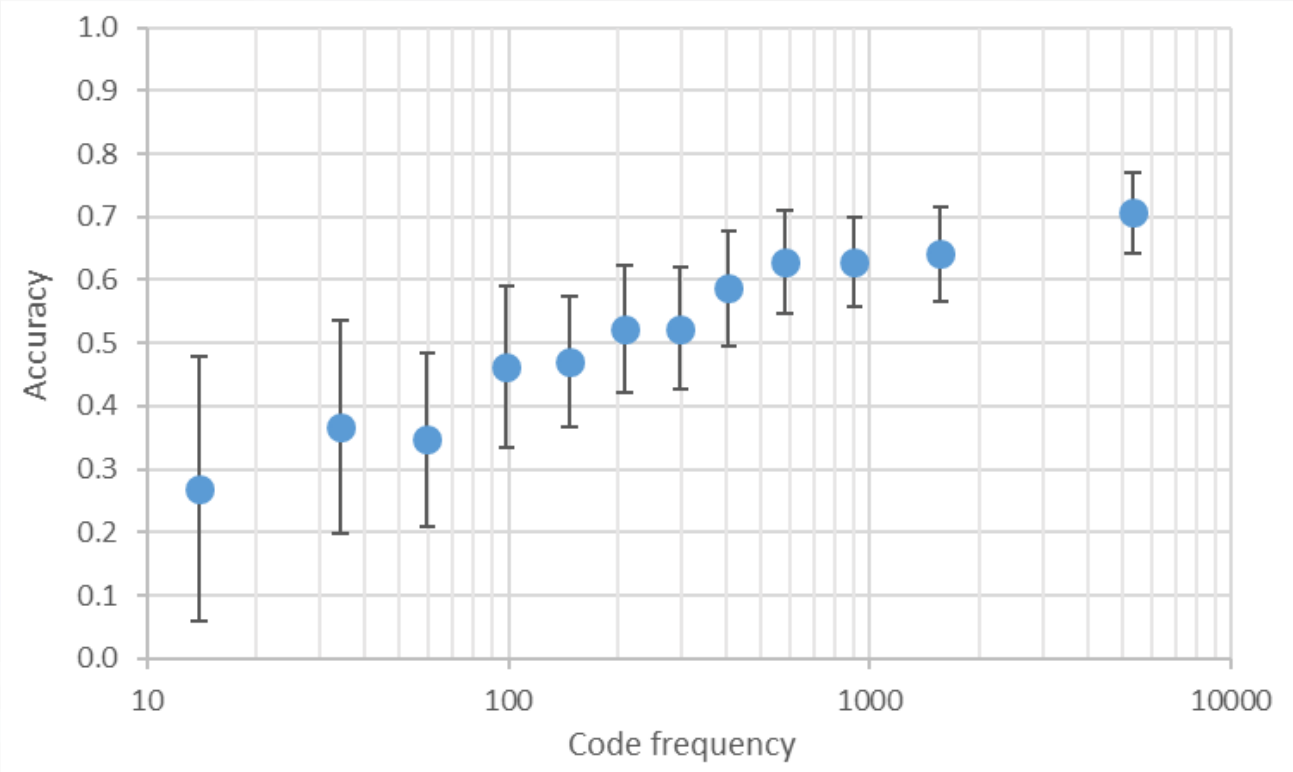
	1. Abstract	2. Description	3. Claims	4. Title	5. Applicants	6. Inventors
Individual Bi-LSTM classifier	63.76/44.68	66.46/47.23	64.56/45.10	59.58/40.74	24.32/12.93	11.52/6.01
Ensemble (simple averaging of classifiers 1-3)	70.39/52.52					
Ensemble (simple averaging of classifiers 1-6)	70.67/53.06					
Ensemble (weighted averaging of classifiers 1-6)	70.70/53.11					

INTERESTING OBSERVATION

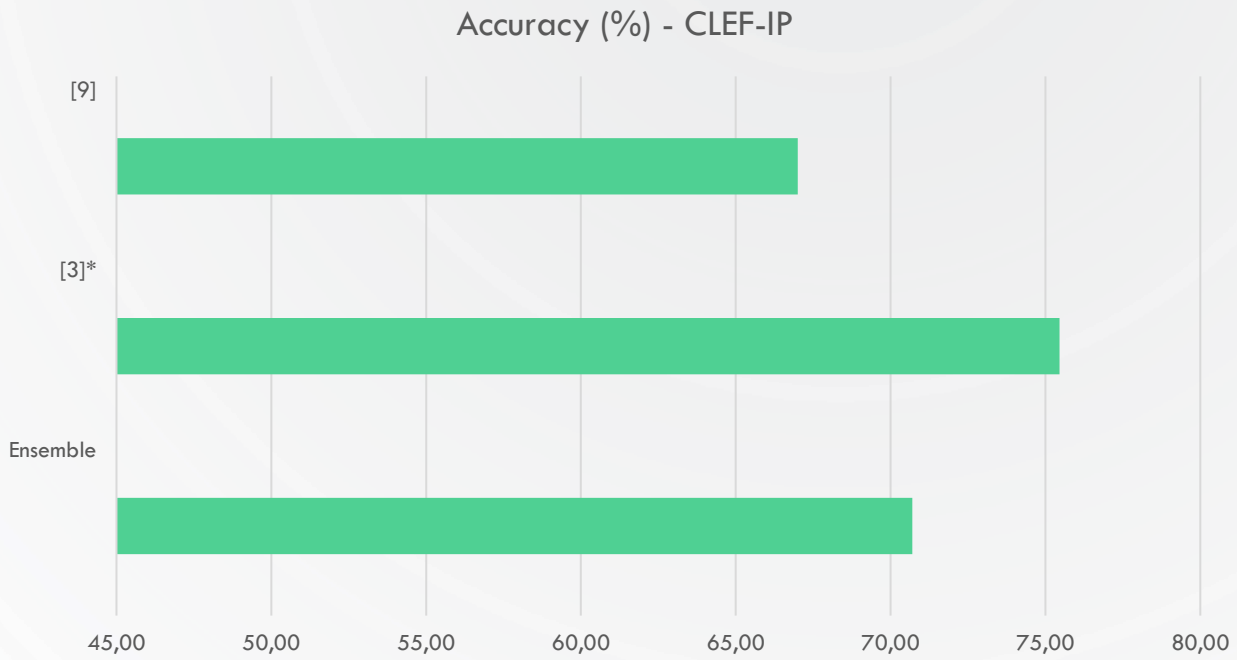
Sequence of words



INTERESTING OBSERVATION – IMPACT OF IMBALANCE DATASET

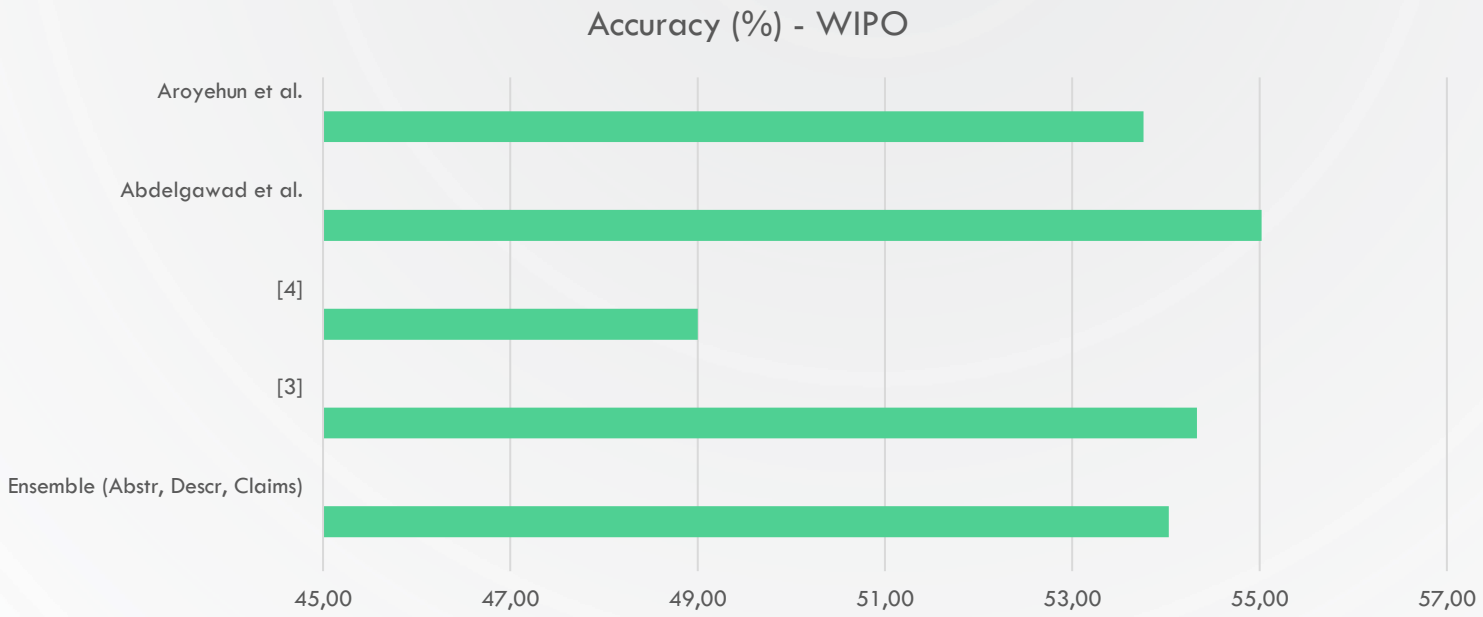


COMPARISON WITH RELATED WORK

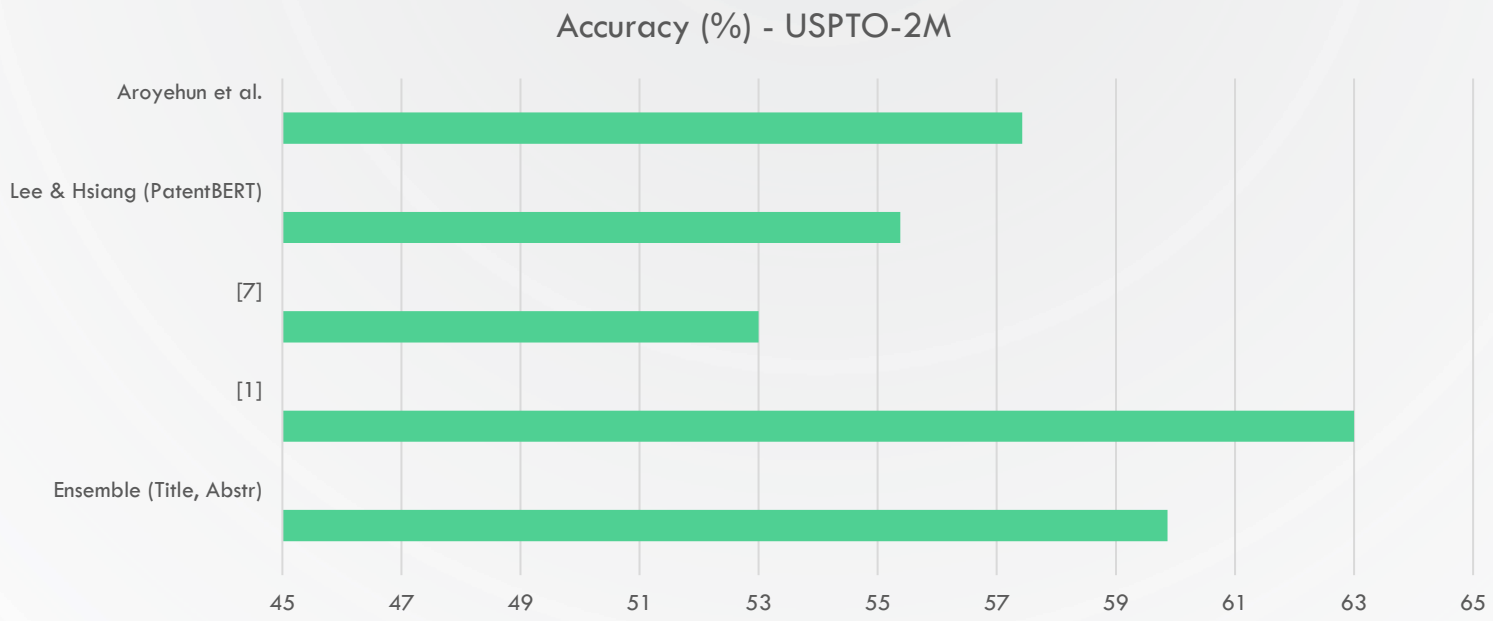


* Recall (top 4)

ONGOING WORK…



ONGOING WORK



CONCLUSIONS

- An ensemble architecture for automated patent classification was proposed.
- The ensemble architecture was instantiated in the single-label classification task at the subclass and group level category of the IPC 5+level hierarchy.
- The combination of classifiers outperform the same classifiers when used as standalone solutions and performs well compared with current state of the art (considering that we used a simple DL model without further fine-tuning).
- Combinations of different patent parts should be carefully explored (future work)
- Simplifications used in literature such as working with well-represented codes should be carefully explored (future work)

REFERENCES

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THANK YOU!

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