THUIR at the NTCIR-15 Micro-activity Retrieval Task

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Understanding Tasks: 2 in 1

Retrieval Task

Query i Find activity i

Ranking Model

Instance Ranking List

- Instance 1
- Instance 2
- ...
- Instance n-1
- Instance n

$$P(I_j \mid Q_i) = \frac{P(Q_i \mid I_j)P(I_j)}{\sum_{k=1}^{n} P(Q_i \mid I_k)P(I_k)} \propto P(Q_i|I_j)$$

Classification Task

Instance j



Classifier

Activity i

Overall Framework

Feature Extraction

Visual Features + OCR Features + Temporal Features

Lifelog Dataset

Feature Selection

- Chi2 variance
- Correlation
- GBDT
- PCA reduction

Ranking Model

Similarity based Ranking

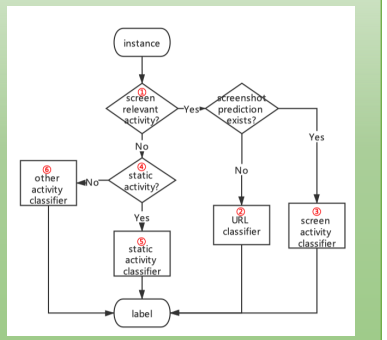
Instance *i*

Activity *j*

Similarity *P*

Classification Model

Multi-level Classifier Based on Knowledge



I. Feature Extraction — (1) Visual & OCR Features

Visual

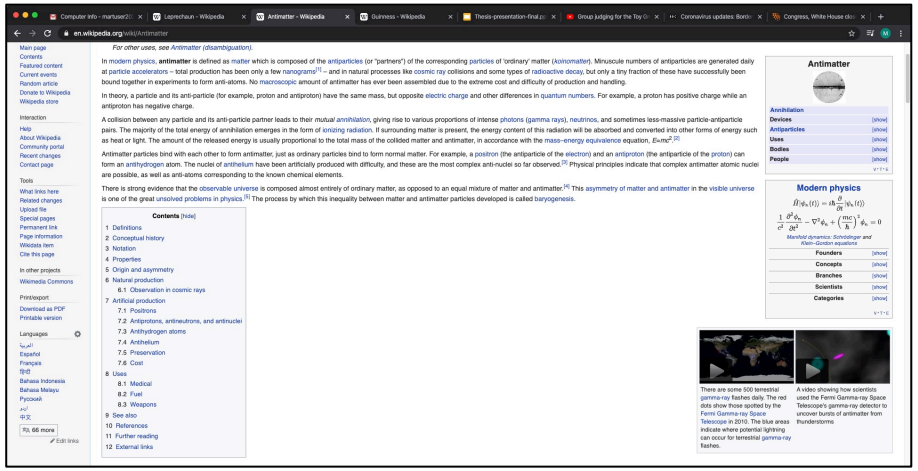
Histogram Similarity

Pair-wise Photo Similarity

Object Detection

Computer、Screen
Window、Table
Indoor
...

OCR



URL extraction

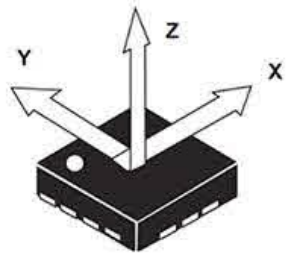
OCR detection

en.Wikipedia.org/wiki/Antimatter

I. Feature Extraction — (2) Temporal Features

Electro-oculography

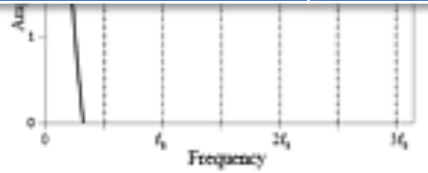
Acceleration and hea



Mouse movements

Feature	Dimension
Photo	4180
Screenshot	1
EOG	62
Acceleration	523
Heart rate	26
Mouse Movement	14
User id	1
All	4806

c values, LPC nt, number of peaks



alues, energy of different frequency bands

II. Feature Selection

Methods

- Chi2
- Correlation
- GBDT
- Correlation + PCA
- Hybrid

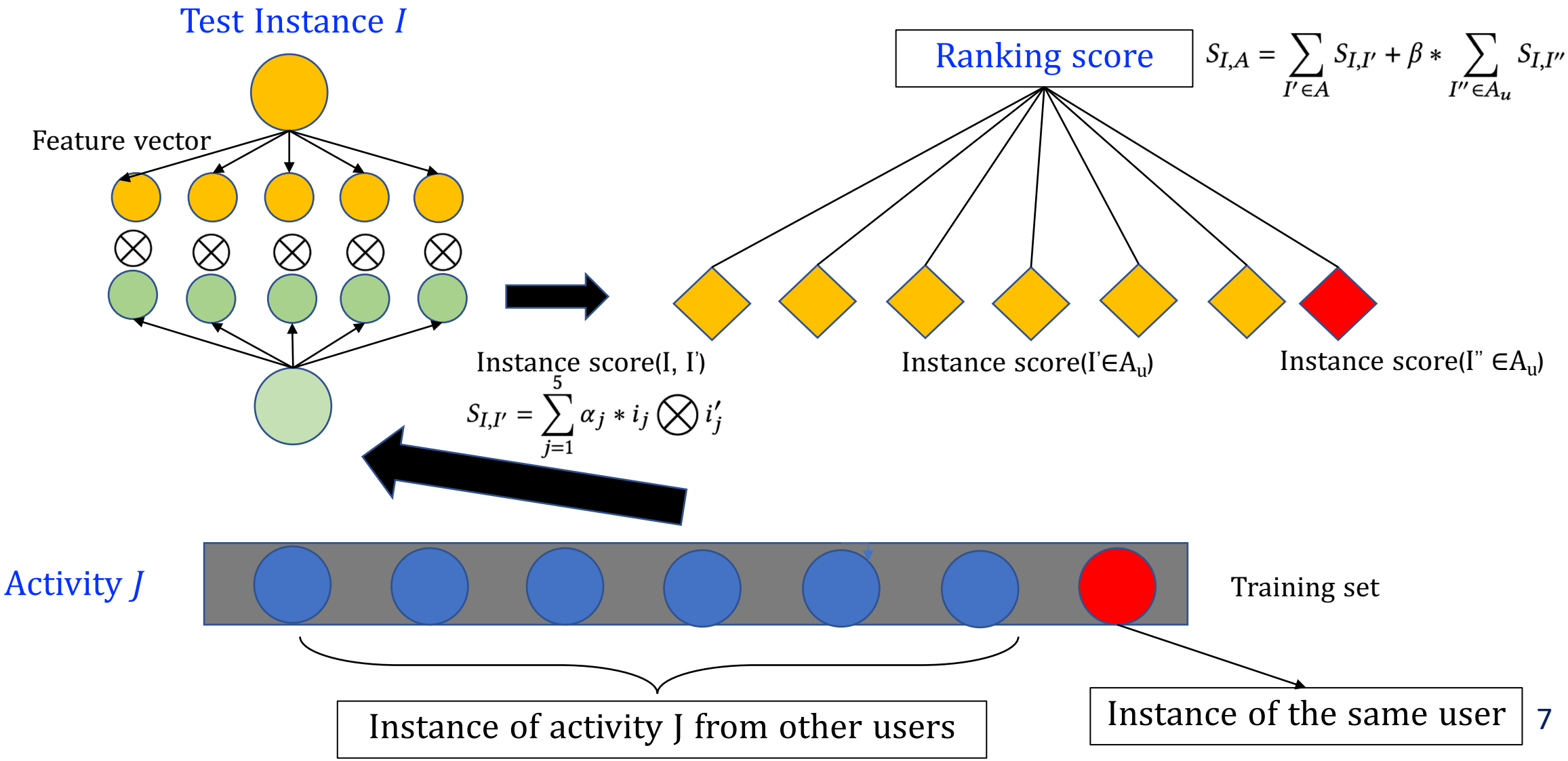
Experiment Result

Method	Accuracy	mAP (classify)	mAP (ranking)
None	0.711	0.820	0.879
Chi2	0.879	0.928	0.971
Correlation	0.868	0.923	0.961
GBDT	0.897	**0.940**	0.973
Hybrid	**0.900**	0.937	0.972
Correlation +PCA(50)	0.872	0.920	0.960
Correlation +PCA(150)	0.889	0.933	**0.974**
Correlation +PCA(250)	0.878	0.926	0.973

Comparison of selected feature set

Methods	Correlation and Chi2	Correlation and GBDT	Chi2 and GBDT
Similarity	0.6219	0.5159	0.5318

III. Ranking Model



IV. Classification Models — (1)Basic Classifier

Classifier	Accuracy	mAP(classify)	mAP(ranking)
LR	0.825	0.899	0.898
SVM	0.821	0.875	0.848
MLP	0.811	0.890	0.910
Random Forest	0.779	0.869	0.927
XGboost	0.826	0.882	0.921
GBDT	**0.836**	**0.901**	**0.947**

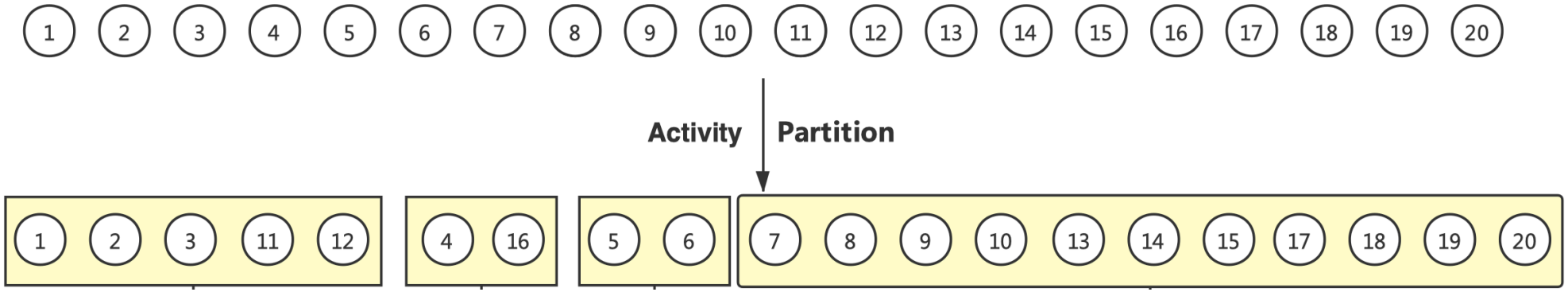
Parameter based Classifier

Tree + Boosting

Tree structure classifiers perform better at ranking task.

Multi-level classifier of tree structure

IV. Classification Models — (2)Rules Detection



Partition Method	Group 1	Group 2	Group 3	Group 4
Impurity	1,2,3,11,12	4, 16	others	-
Similarity	1,3	2, 11, 12	4, 16	others
Cluster	1,3,5,6,8,10	2,4,11,12,16	7,9,13,14,15	17,18,19,20

1, 2, 3, 11, 12 : Screen relevant activities

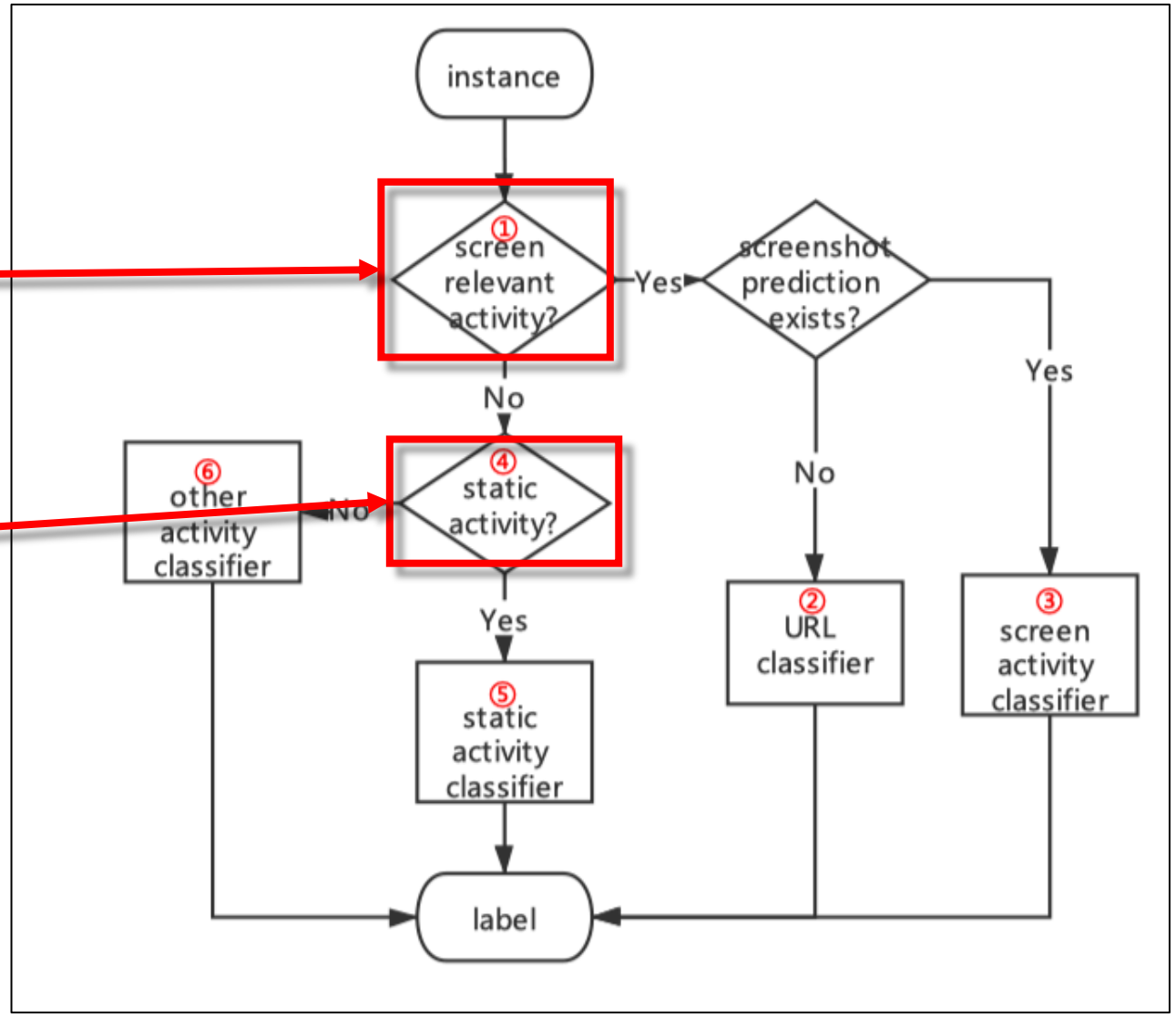
4, 16: Static activities (Zoning out & Close eyes)

IV. Classification Models — (3)Rule-based Classifier

Knowledge rules:

1. Screen-relevant activities are different from others.

2. Static activities (Zoning out & closing eyes) are special at EOG and photo features.



1: Binary GBDT
2: 5-label GBDT
3: 5-label GBDT
4: Binary GBDT
5: Binary GBDT
6: 13-label GBDT

V. Results

Classifier	Accuracy	mAP (classify)	mAP (ranking)	Submission results
Basic GBDT Classifier	0.836	0.901	0.947	0.895
Similarity-based method	0.789	0.843	0.836	0.782
Two-level Classifier (Impurity partition)	0.875	0.921	0.971	0.901
Two-level Classifier (Similarity partition)	0.875	0.926	0.970	0.928
Two-level Classifier (Cluster partition)	0.796	0.880	0.931	0.886
Rule-based Classifier	**0.889**	**0.933**	**0.974**	**0.950**

Similarity based methods: Repetition of micro activity is unstable.

Rule-based Classifier: Knowledge about activities helps classification and ranking.

Takeaways

- Micro-activity is detectable
- Activity retrieval task is equivalent to classification task
- Performing Feature selection is better than nothing
  - Any methods for feature selection performs better than origin features.
- **Multi-level classifier is effective for MART**
  - Rule detection based on activity partition does help.
  - Decision tree and tree structure methods are efficient.

Team Name: **THUIR**

Thanks

THANKS FOR YOUR ATTENTION !

Any Questions?

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