BARY at the NTCIR-11 MedNLP-2 Task for complaints and diagnosis recognition

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Overview

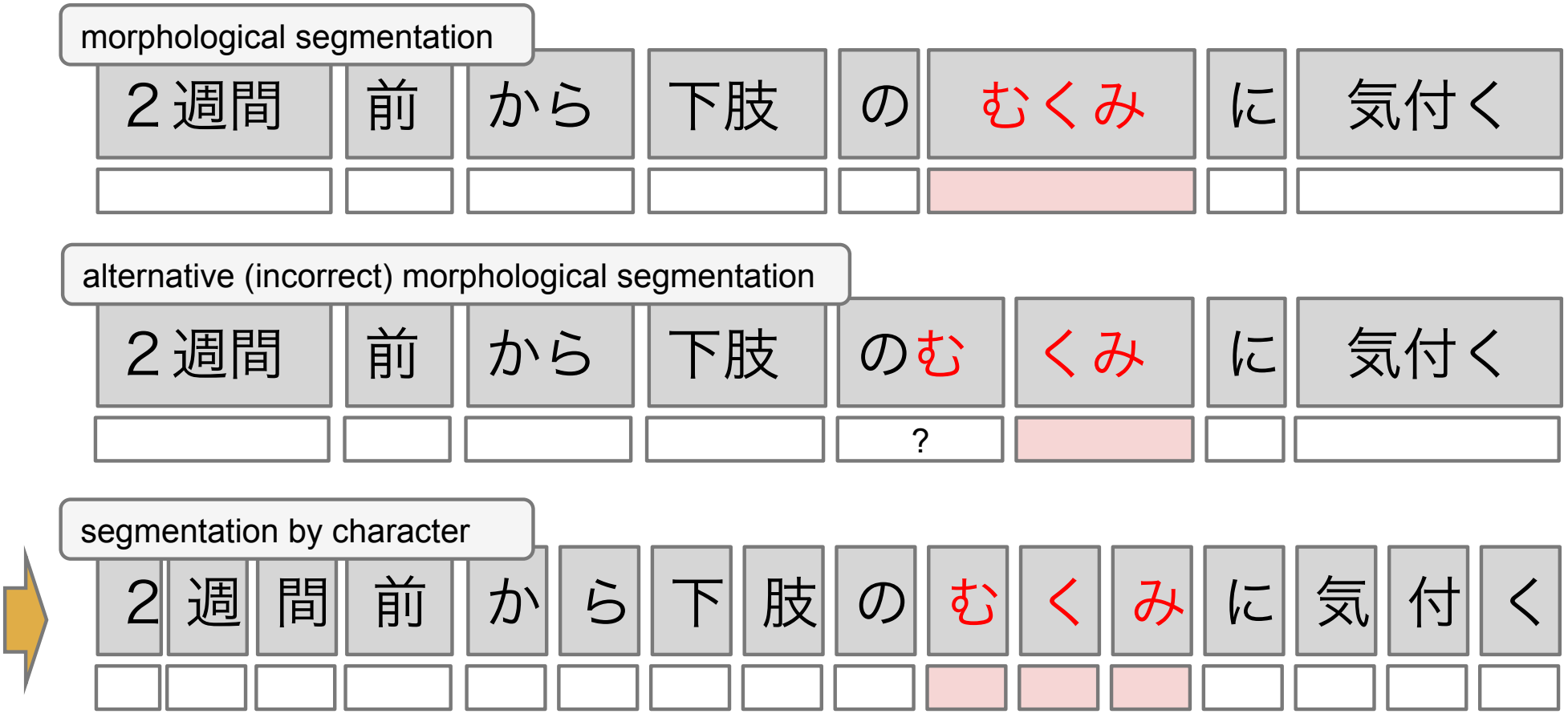
- Character-wise, two-stage, CRF-based sequence labeling
- Recognizes disease names, diagnoses with modalities, and temporal expressions
- Uses affixes extracted from the external terminology resources

Character-level labeling (BARY1-3)

２週間前から下肢のむくみに気付く

ni shu kan mae kara　kashi no mukumi ni kizuku

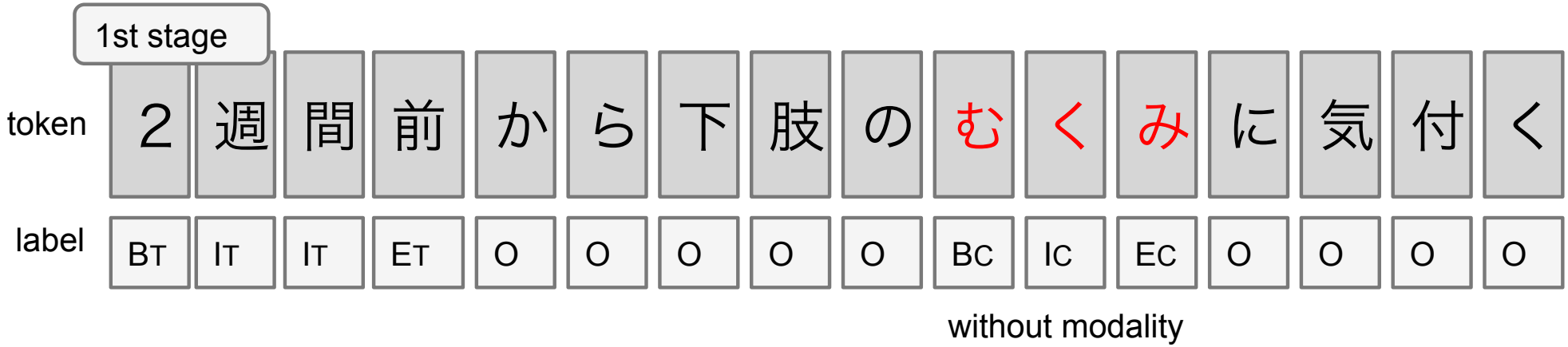
“Aware of a swelling on the lower limb since two weeks ago”

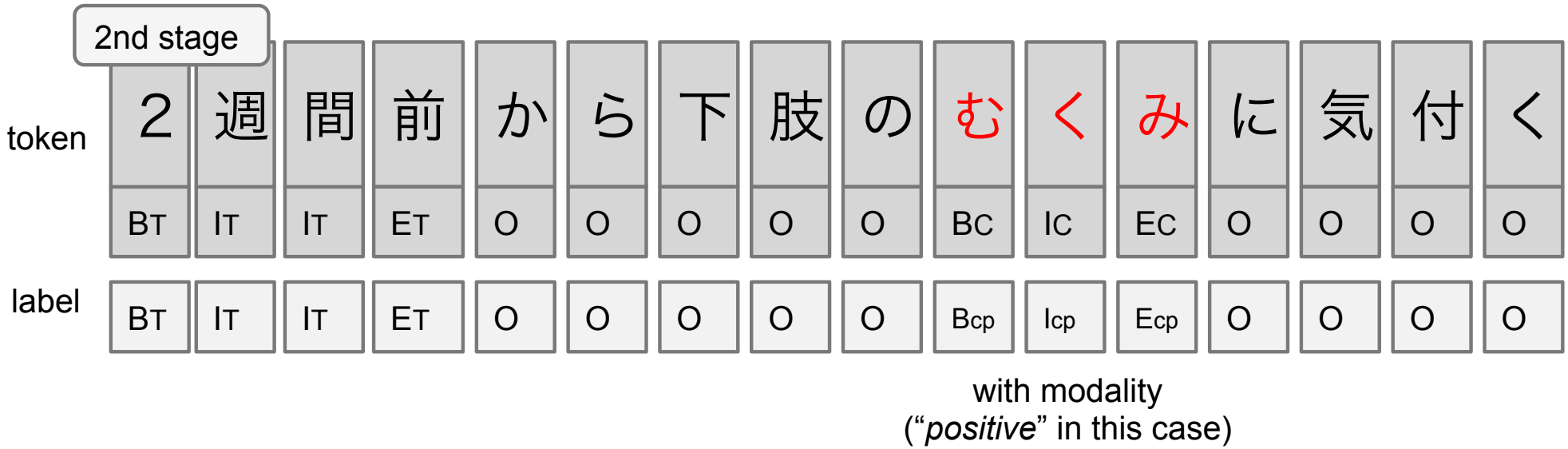


Characters over mophemes

- Pros
  - No propagation of segmentation errors
- Cons
  - Inconsistent amount of information in a fixed context window (3 kanji characters carries more than 3 latin letters)

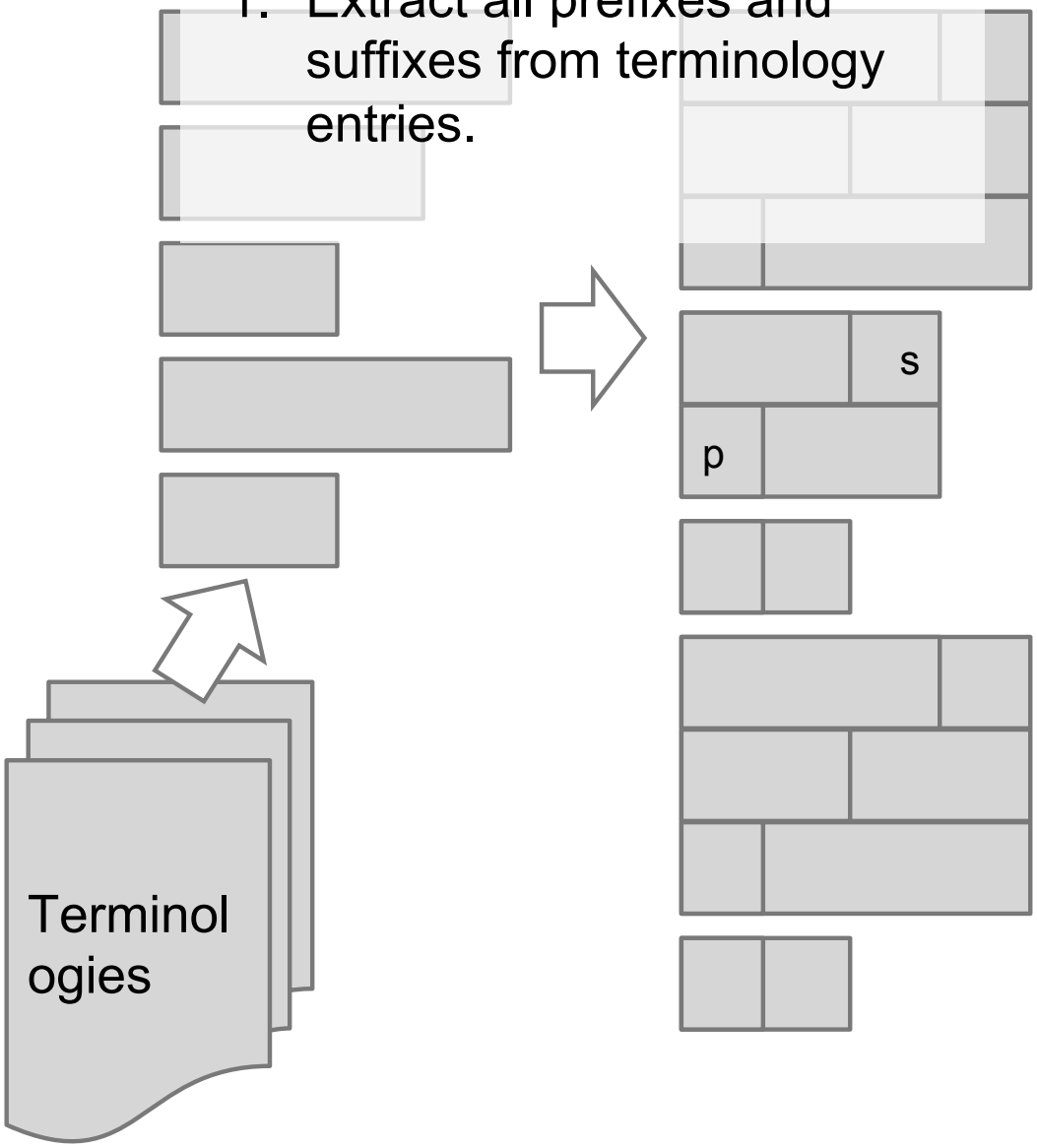
Two-stage model (BARY2,3)





Max-repeat term affixes (BARY-3)

1. Extract all prefixes and suffixes from terminology entries.



2. Count them and filter out low-frequency ones and redundant ones.

y is redundant if there exists x s.t. $y \subseteq x$ and freq(x) = freq(y).

Term affixes: preview of the results

Affix	Freq.	Source entries
高血圧 *high blood pressure, hypertension*	**16**	白衣**高血圧** *white coat* … / **高血圧**性網膜症 .... *retinopathy*
腫脹 *tumefacient*	**9**	上肢**腫脹** *upper limb* ... / 腹部**腫脹** *abdominal* ...
水疱 *bladder*	**4**	**水疱**性中耳炎 … otitis media / 非熱傷性**水疱** *burn* ….
萎縮 *atrophy*, *shrinkage*	**4**	骨**萎縮** *bone* … / **萎縮**性鼻炎 … *rhinitis*
肥厚 *incrassate, thickening, thickened*	**3**	胸膜**肥厚** *pleural* … / **肥厚**性瘢痕 … *cicatrix*
紅斑 *erythema, red patch*	**3**	遊走性**紅斑** *migrating* ... / **紅斑**症 … *disease*
感染症 *infectious disease*	**3**	細菌**感染症** *bacterial* … / 条虫**感染症** *tapeworm* ...
感染 *infection*	**3**	日和見**感染** *opportunistic* … / **感染**性鼻炎 … *rhinitis*
腹水 *ascites*	**2**	異常**腹水** abnormal ... / **腹水**症 *ascites*
肥満 *obesity*	**2**	**肥満**細胞症 ... *disease* / 小児**肥満** *infantile* ...
細菌 *bacteria*	**2**	**細菌**感染症 ... *infection* / **細菌**尿 *bacteriuria*
混濁 *cloudiness*	**2**	角膜**混濁** *corneal* ... / **混濁**尿 ... *urine*
リンパ節腫脹 *tumefacient lymph node*	**2**	肘**リンパ節腫脹** *cubital* ... / 下顎**リンパ節腫脹** *mandibular*
アルコール *alcohol*	**2**	**アルコール**性躁病 … *mania* / **アルコール**依存症 *alcoholism*

This shows affixes that coincide with <c> elements in the MedNLP-2 test set. Extracted from Hyojun Byomei Master, with a threshold of 10+ occurrences.

Other features (conventional)

Input token	Tag	Features					
2 ni (“two”)	**B-T**	**NUMBER**	**O**	**I**	2	2	Noun
日 nichi (“days”)	**I-T**	**CJK**	**O**	**I**	日	日	Noun
前 mae (“ago”)	**I-T**	**CJK**	**O**	**I**	前	前	Noun
か ka (“since”)	**I-T**	**HIRAGANA**	**O**	**I**	か	から	PostP.
ら ra	**I-T**	**HIRAGANA**	**O**	**I**	ら	から	PostP.
発 hatsu (“fever”)	**B-C**	**CJK**	**I**	**O**	発	発熱	Noun
熱 netsu	**I-C**	**CJK**	**I**	**O**	熱	発熱	Noun
。(EOS)	**O**	**KUTEN**	**O**	**O**	。	。	Punct.

Character type

Terminology (string match)

Temporal expression pattern

Character surface

Morphological analysis

Materials

- Terminological resources
  - Hyojun Byomei Master (標準病名マスター) ver 3.13
  - Shojo Shoken Master <Shintai Shoken Hen> (症状所見マスター【身体所見編】) ver 20140306
- Training data provided by the MedNLP-2 task
- Self-developed regular expression patterns

Machine learning setups

- Training using the CRF++ toolkit
- Hyperparameter tuning using 5-fold cross-validation
  - Feature 2-grams and 3-grams in a (-2,2) window
  - Regularization parameter C=1.0, frequency cutoff F=1

Experimental results: models

	Precision	Recall	F-measure
BARY1	89.44	77.41	82.99
BARY2	89.33	78.84	83.76
BARY3	89.66	78.92	83.95

Two-stage model

Affix features and pattern features

Performances on the 51 reports of the the MedNLP-2 test set.
Each system trained on the 102 reports of the training set.

Contributions of features (BARY1)

	Precision	Recall	F-measure
(1): Character surface	ALL: 73.94 C: 73.45 T: 75.80	ALL: 58.11 C: 56.45 T: 65.83	ALL: 65.04 C: 63.81 T: 70.36
(2): (1) + Character type	ALL: 88.00 C: 88.44 T: 86.01	ALL: 79.41 C: 79.57 T: 78.52	ALL: 83.46 C: 83.72 T: 82.02
(3): (2) + Morphological analysis	ALL: 89.40 C: 90.28 T: 85.70	ALL: 79.81 C: 79.90 T: 79.42	ALL: 84.28 C: 84.70 T: 82.34
(4): (3) + Medical terminology	ALL: 89.34 C: 90.08 T: 86.17	ALL: 80.00 C: 80.00 T: 80.03	ALL: 84.35 C: 84.67 T: 82.87

Results from 5-fold cross-validation using the 102 reports of the MedNLP-2 training set