

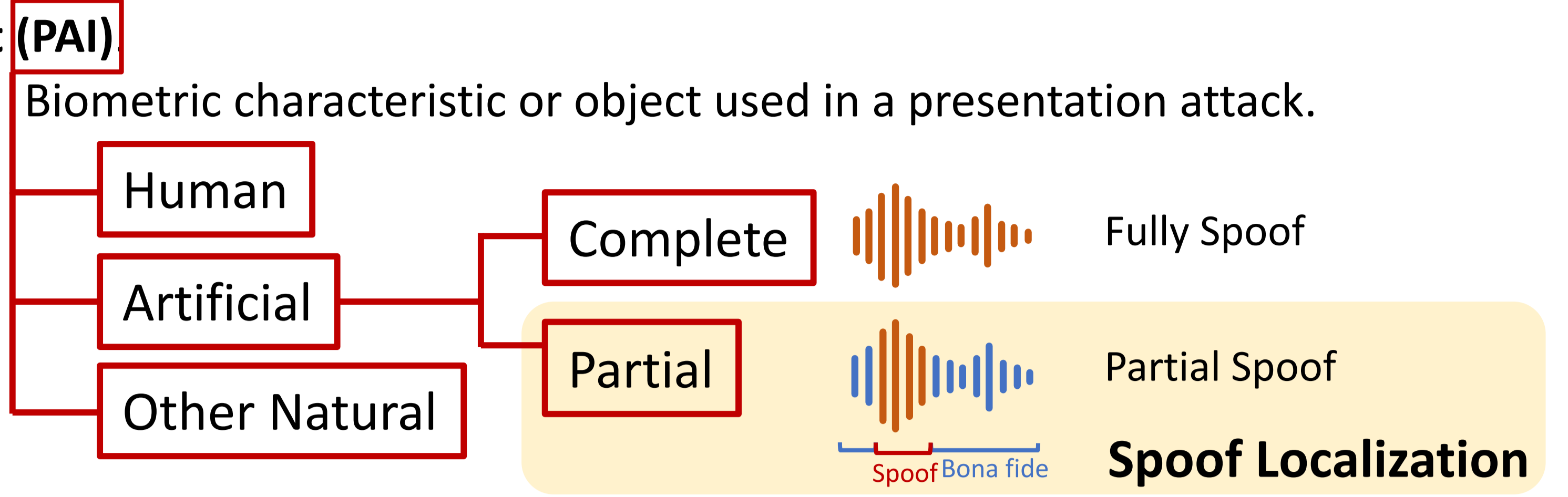
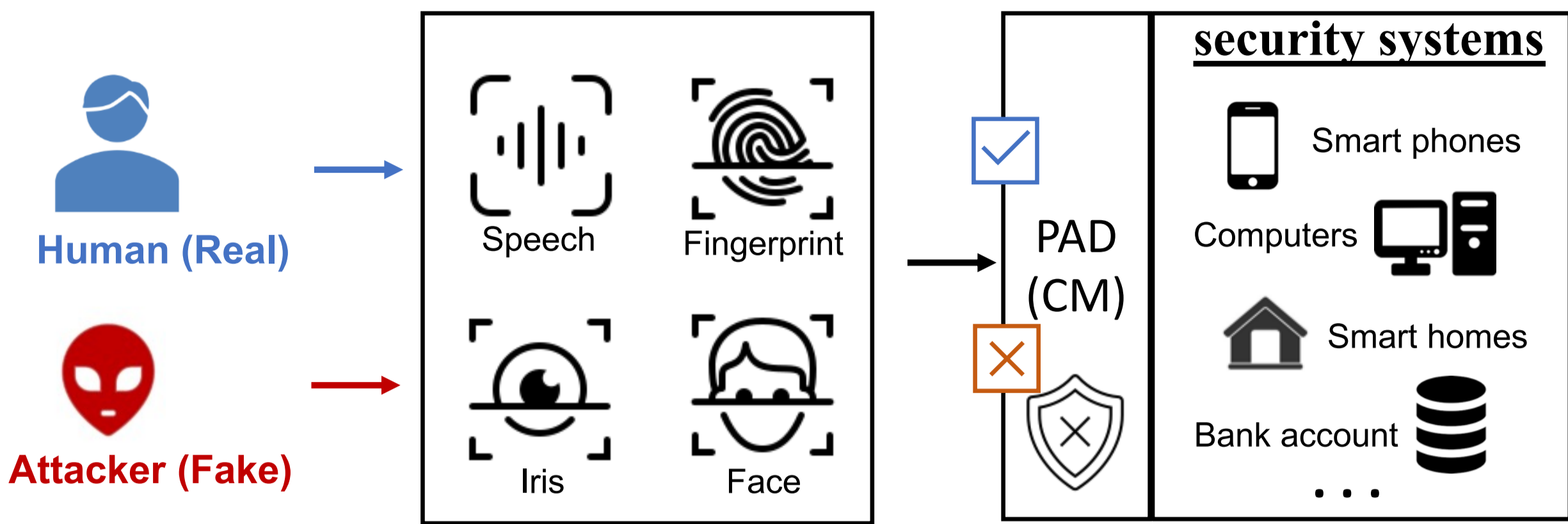
Range-Based Equal Error Rate for Spoof Localization

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Introduction

ISO/IEC JTC1 SC37 Biometrics: ISO/IEC 30107: Information technology — Biometric presentation attack detection (2016)

Biometric technologies are vulnerable to **Presentation Attack Instrument (PAI)**

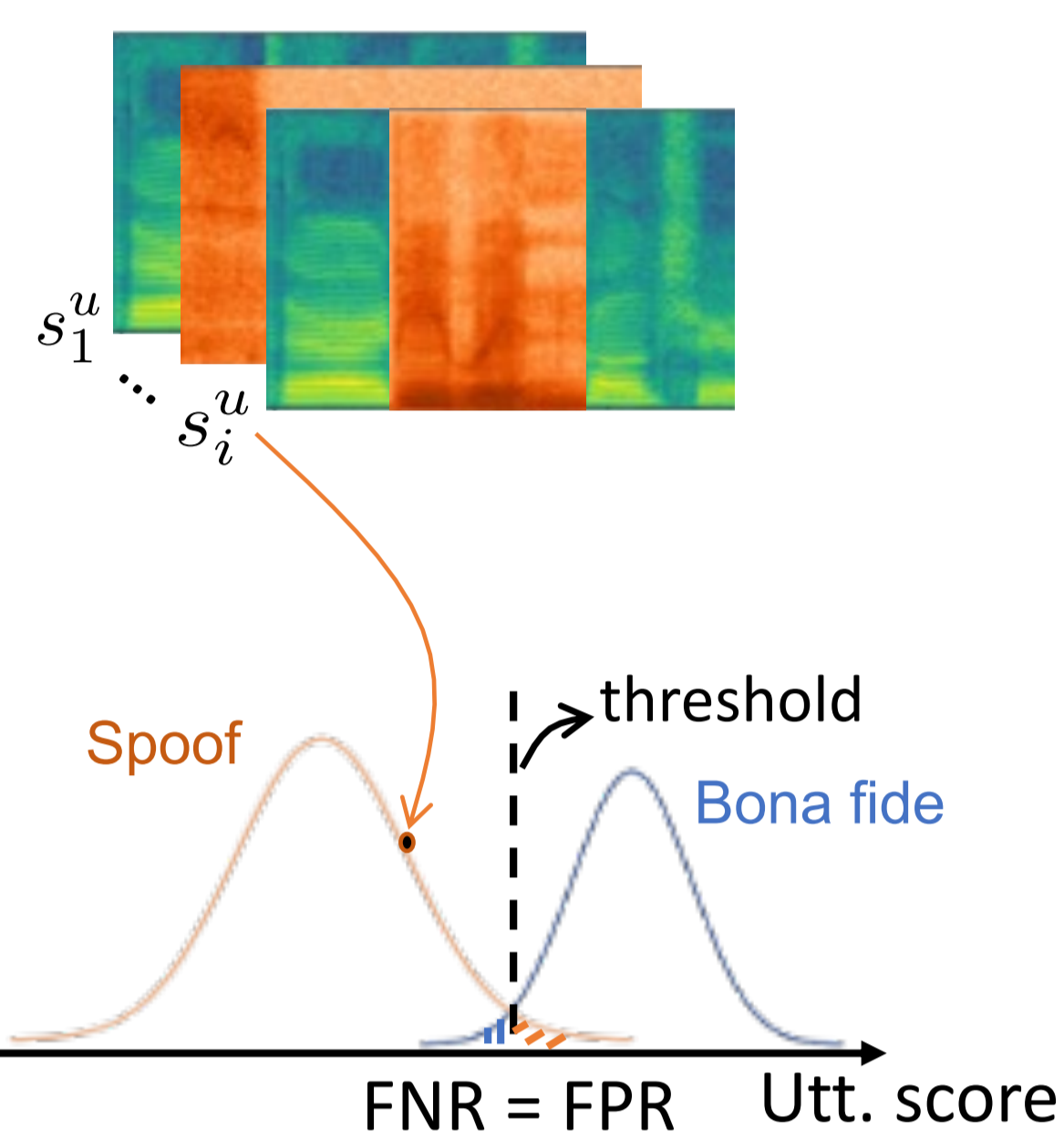


EERs in Partial Spoof

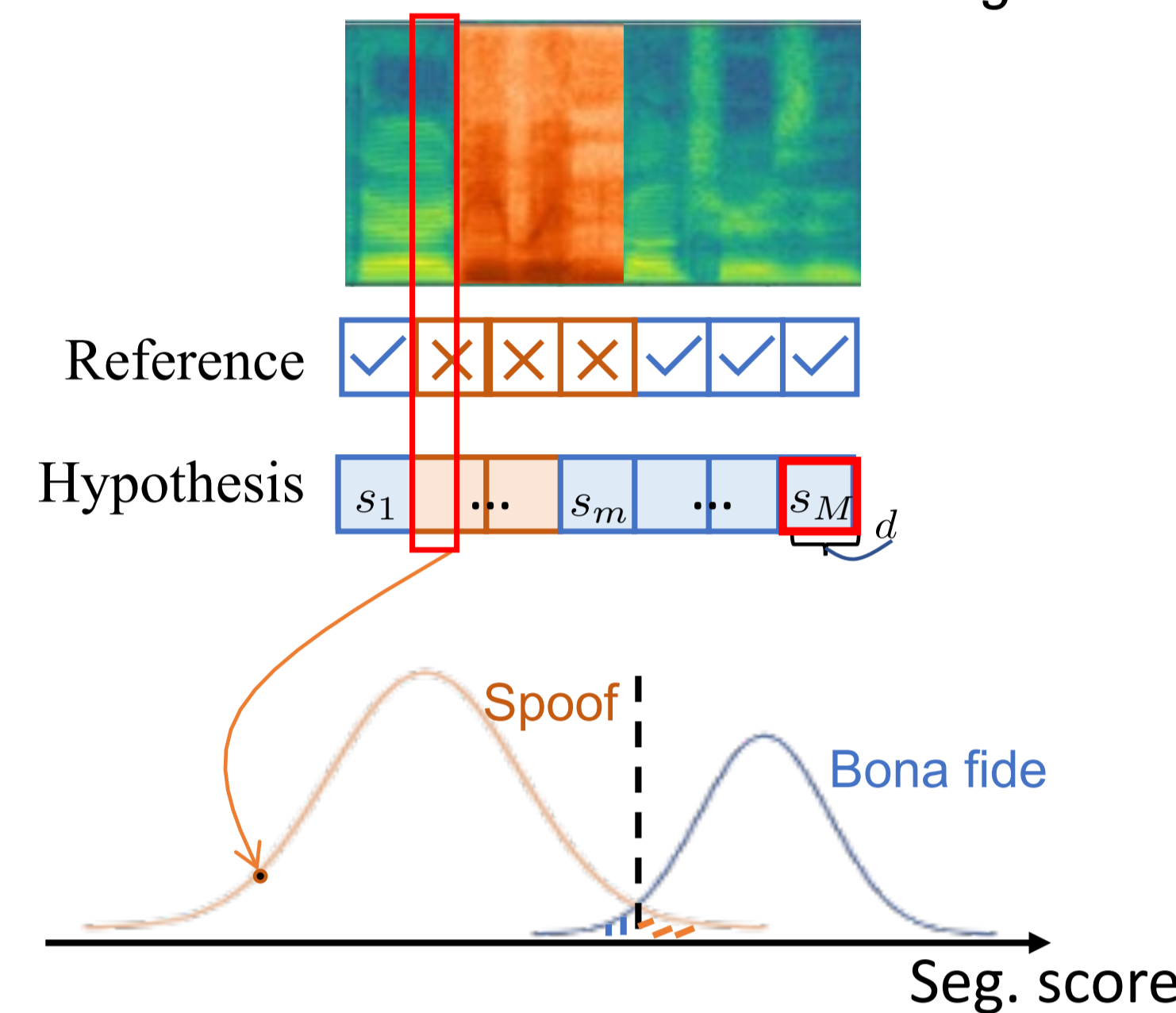
Table 1: Confusion matrix for spoof localization.

Reference	Hypothesis	
	Positive (spoof)	Negative (bona fide)
Positive (P)	TP	FN
Negative (N)	FP	TN

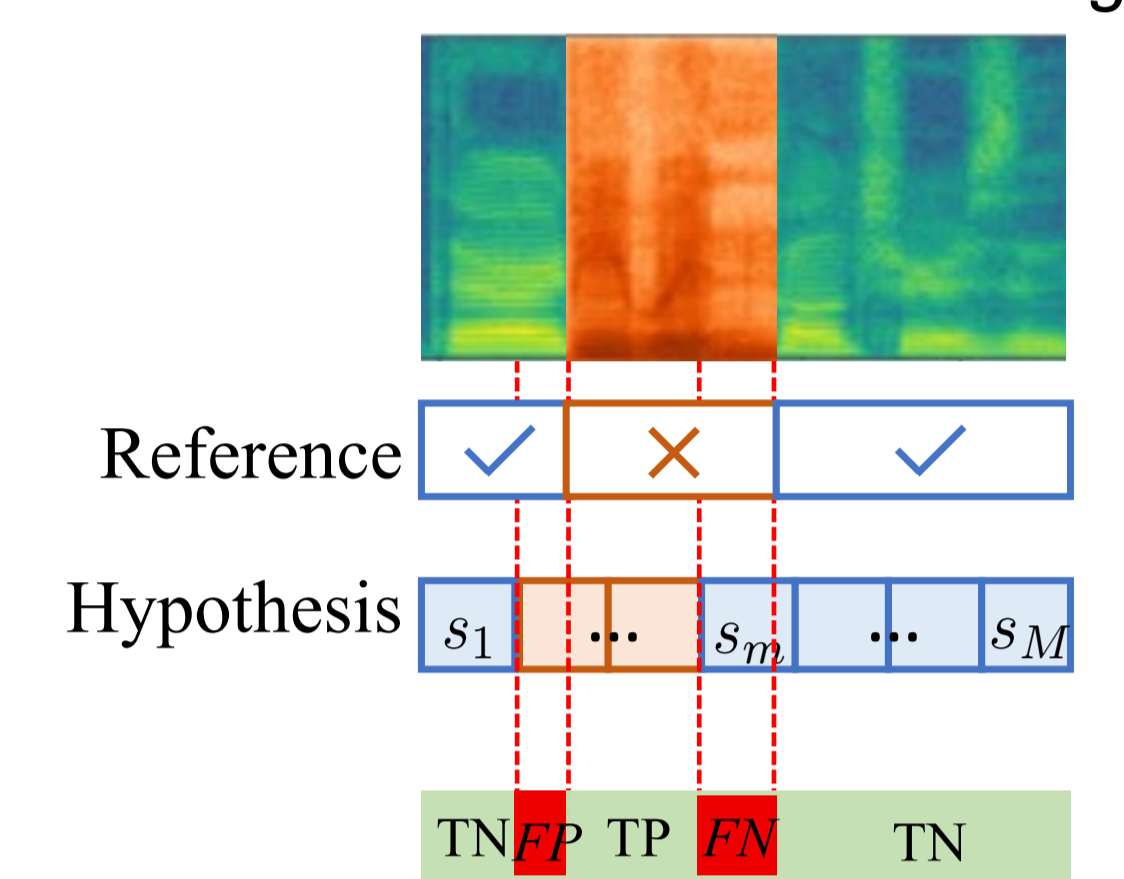
• Utterance EER



• Segment EER (Point-based)
Number of misclassified segments



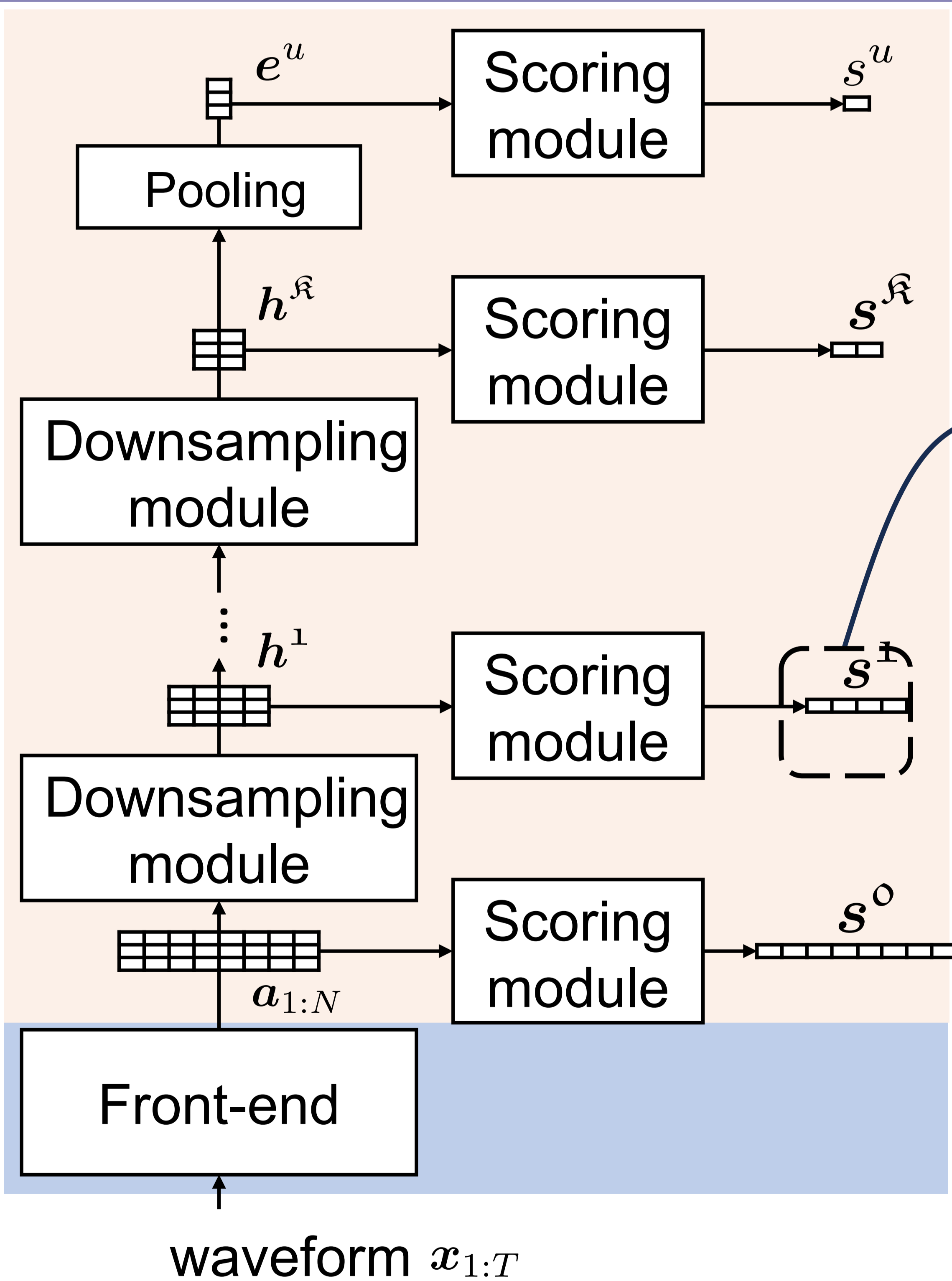
• Range-based EER
Duration of misclassified regions



(Please refer to the paper for calculating Range-Based EER with an upgraded binary search algorithm.)

Range-Based EER vs. Point-Based EER

Database: PartialSpoof [1]



Range-based and point-based EER (%) of multi-reso. CM in the eval. set of PartialSpoof.

Each row represents the temporal resolution for training and shares the same predicted scores, while each column presents the temporal resolution for error measurement.)

Predicted Score	Reso. of Training	Range-based EER	Point-based EER						
			10	20	40	80	160	320	640
s^0	20	30.40	29.78	12.84	11.94	10.52	8.42	5.96	4.06
s^1	40	30.11	29.93	29.94	11.94	10.51	8.43	5.98	4.10
s^2	80	30.65	30.12	30.12	30.15	10.92	8.70	6.14	4.15
s^3	160	31.36	30.49	30.50	30.52	30.56	9.24	6.40	4.11
s^4	320	33.91	33.39	33.38	33.41	33.45	33.48	6.34	3.97
s^5	640	37.38	37.53	37.53	37.54	37.56	37.56	37.54	5.19

Point-based EER is sensitive to the measurement resolutions.

- **Upper triangular** \triangleleft : measurement reso. > training reso.
- **Diagonal**: measurement reso. = training reso.
 - “Underestimation”: Smaller value only means the task is easier and does NOT mean that spoof localization is more accurate.
- **Lower triangular** \triangleleft : measurement reso. < training reso.

Range-based EER can measure errors at a finer level.

Conclusion

Using (purple box) **range-based EER**, or point-based EER with unseen and finer temporal resolutions compared with the training resolution. And considering range-based EER when the training temporal resolution is unknown!

References

- [1] L. Zhang, X. Wang, E. Cooper, J. Yamagishi, J. Patino, N. Evans. (2021) An Initial Investigation for Detecting Partially Spoofed Audio. Proc. Interspeech 2021, 4264-4268.
- [2] L. Zhang, X. Wang, E. Cooper, J. Yamagishi (2021) Multi-task Learning in Utterance-level and Segmental-level Spoof Detection. Proc. ASVspoof workshop 2021, 9-15.
- [3] L. Zhang, X. Wang, E. Cooper, N. Evans, J. Yamagishi, "The PartialSpoof Database and Countermeasures for the Detection of Short Fake Speech Segments Embedded in an Utterance," in IEEE/ACM Transactions on Audio, Speech, and Language Processing, vol. 31, pp. 813-825, 2023, doi: 10.1109/TASLP.2022.3233236.
- [4] **This one**: Lin Zhang, Xin Wang, Erica Cooper, Nicolas Evans and Junichi Yamagishi, "Range-Based Equal Error Rate for Spoof Localization." (INTERSPEECH 2023)



More about
Partial Spoof