

Instant diagnosis of gastroscopic biopsy via deep-learned single-shot femtosecond stimulated Raman histology

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Supplemental Materials

Table S1. Clinicopathologic characteristics of gastric lesions (JCGC, 3rd) of the 279 studied patient cases.

	Gastric cancer (n=103)	Non-cancerous lesion (n=176)
Average age (SD)	41.13 (±10.55)	32.12 (±14.59)
Gender		
Male	77 (65.0)	72 (40.9)
Female	36 (35.0)	104 (59.1)
Location		
Up 1/3	24 (23.3)	3 (1.7)
Middle 1/3	28 (27.2)	2 (1.2)
Mean diameter (range)	3.814	
Macroscopic type		
Type 0	18 (17.5)	NA
Type 1	19 (18.4)	NA
Type 2	46 (43.7)	NA
Type 3	10 (9.7)	NA
Type 4	9 (8.7)	NA
Type 5	2 (2.0)	NA
Histological type		
Noncancerous	NA	176 (100)
Papillary (pap)	3 (2.9)	NA
Tubular (tub)	43 (41.7)	NA
Poorly differentiated (por)	39 (37.9)	NA
Mucinous (muc)	6 (5.8)	NA
Signet ring cell (sig)	12 (11.7)	NA
Degree of differentiation		
Differentiated	46 (44.7)	NA
Undifferentiated	57 (55.3)	NA

Table S2. Number of included patients and images.

	Total images (patients)	Non- cancerous images (patient)	Cancer images (patients)
Training- Validation	62431(224)	41352(133)	21079(91)
Test	26756(55)	17722(43)	9034(12)
Total	89187(279)	59074(176)	30113(103)

	Total images (patients)	Differentiated images (patient)	Undifferentiated images (patients)
Training- Validation	16104(78)	10997(28)	5107(50)
Test	6902(17)	4713(13)	2189(4)
Total	23006(95)	15710(41)	7296(54)

Table S3. Diagnostic comparison between pathologists and CNN based femto-SRH.

<i>McNemar test (P value)</i>		
Cancerous Identification	SRH vs P1	1
	SRH vs P2	1
	SRH vs P3	0.125
	SRH vs P4	0.125
Differentiation Determination	SRH vs P1	0.625
	SRH vs P2	1
	SRH vs P3	1
	SRH vs P4	0.063

Fig. S1. Optical lay-out of the femto/pico dual-mode SRS microscope. The dash-shaded area represents the femto-SRS part with transform limited femtosecond pulses, while the paths going through SF57 glass rods chirped the pulses to picoseconds for pico-SRS. EOM: electro-optical modulator; PD: photodiode; PMT: photo multiplier tube; LIA: lock-in amplifier; DM: dichroic mirror; GM: galvo mirror.

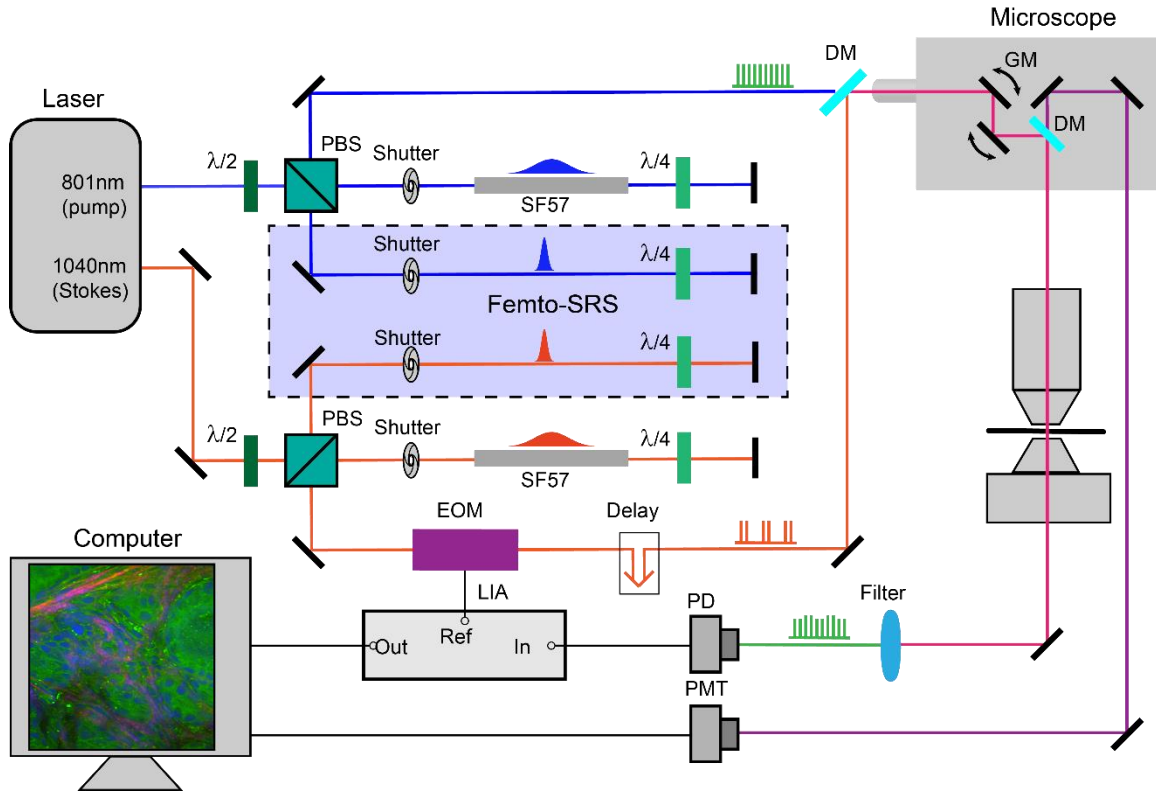


Fig. S2. U-Net conversion of a typical gastric tissue specimen. (a) The prediction results from a single raw femto-SRS image to the dual-channel images, in comparison to the ground truth. (b) Line-cut intensity to illustrate the prediction accuracy. Scale bars: 50 μm .

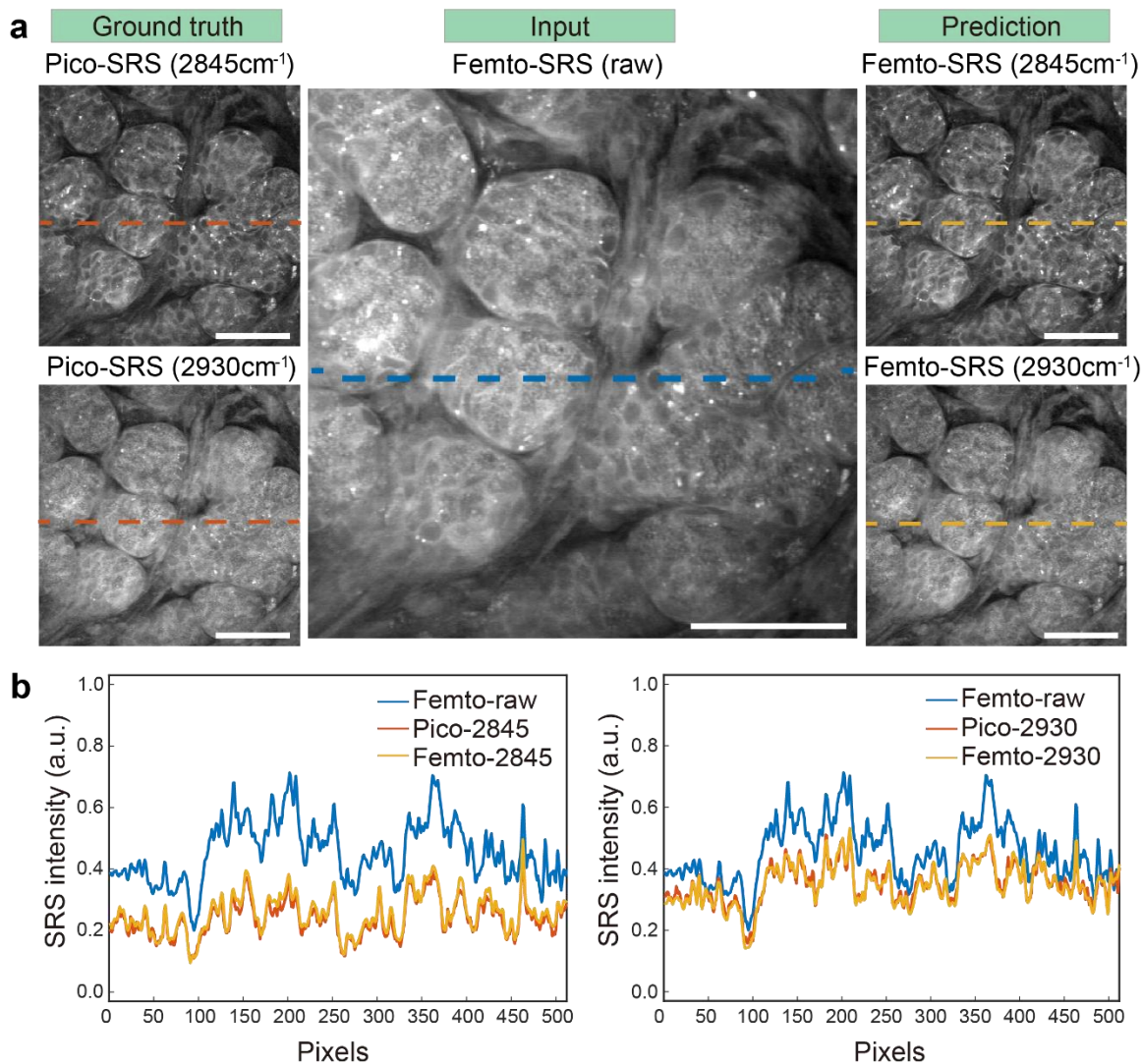


Fig. S3. Representative histological features revealed by femto-SRS images of fresh gastric tissues. (a-e) Normal gastric glands imaged in different sections and states. (f) Intestinal metaplasia with cup-shaped cells. (g) Moderately and (h) poorly differentiated adenocarcinoma. Scale bars: 50 μ m.

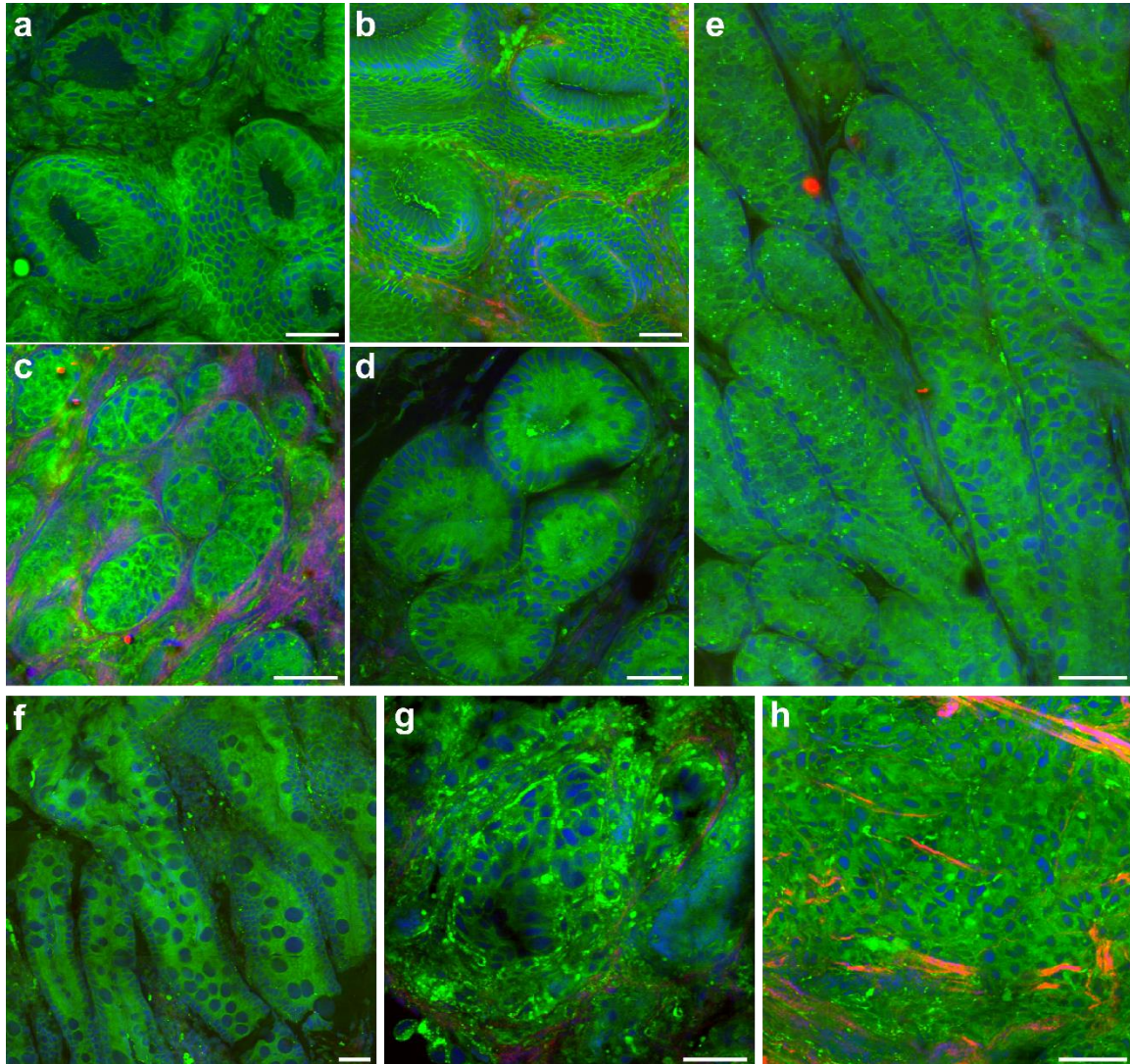


Fig. S4. Work flow of the imaging, CNN training, validation and prediction of large femto-SRS images.

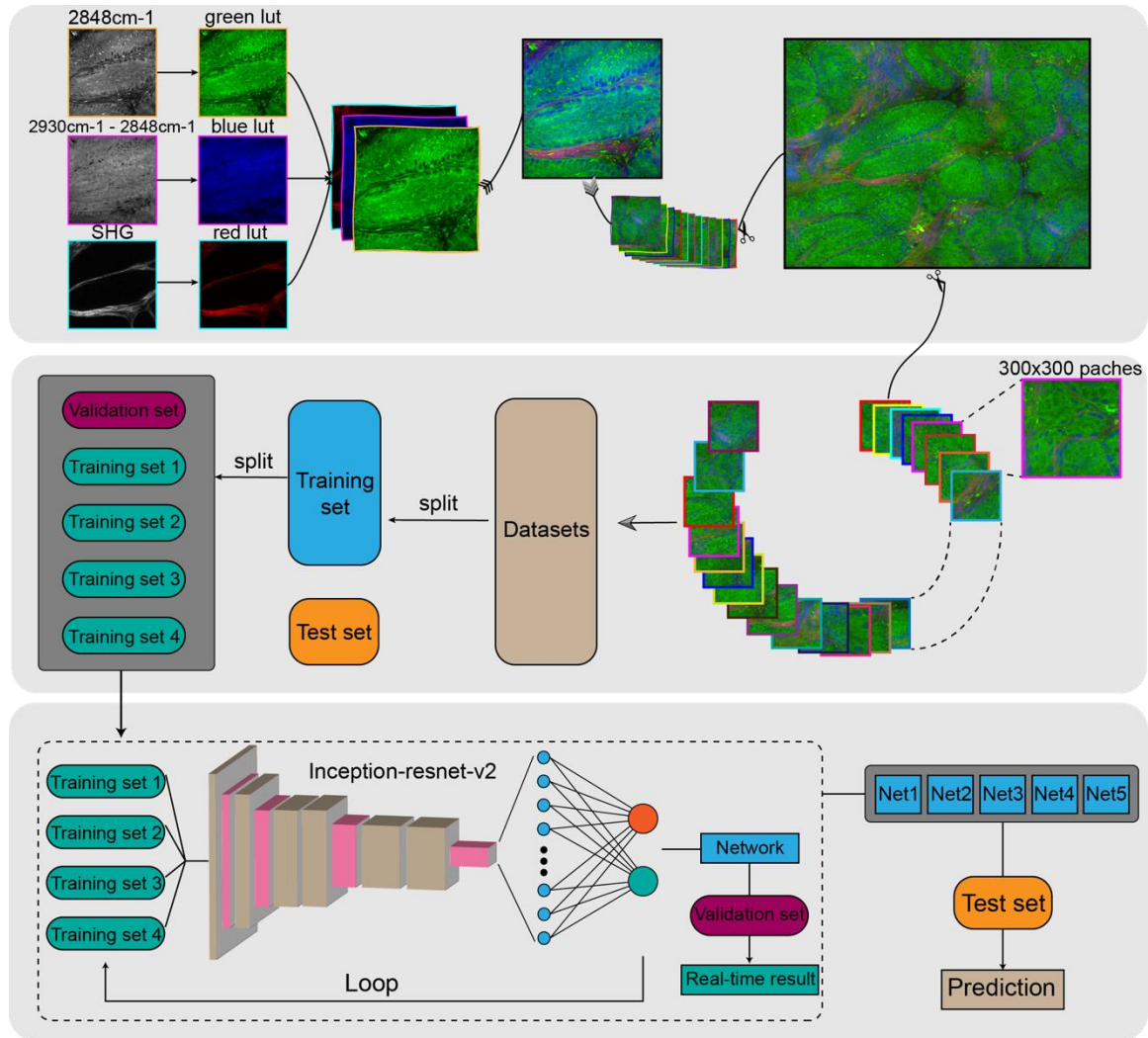


Fig. S5. Training results of the CNNs used to classify (a) cancer vs. non-cancer, and (b) differentiated vs. undifferentiated cancers. The loss function, accuracy function and ROC curves showed the convergency and performance of the neural networks. The Youden's index was found from the ROC curve as the cut-off point for predicting test dataset.

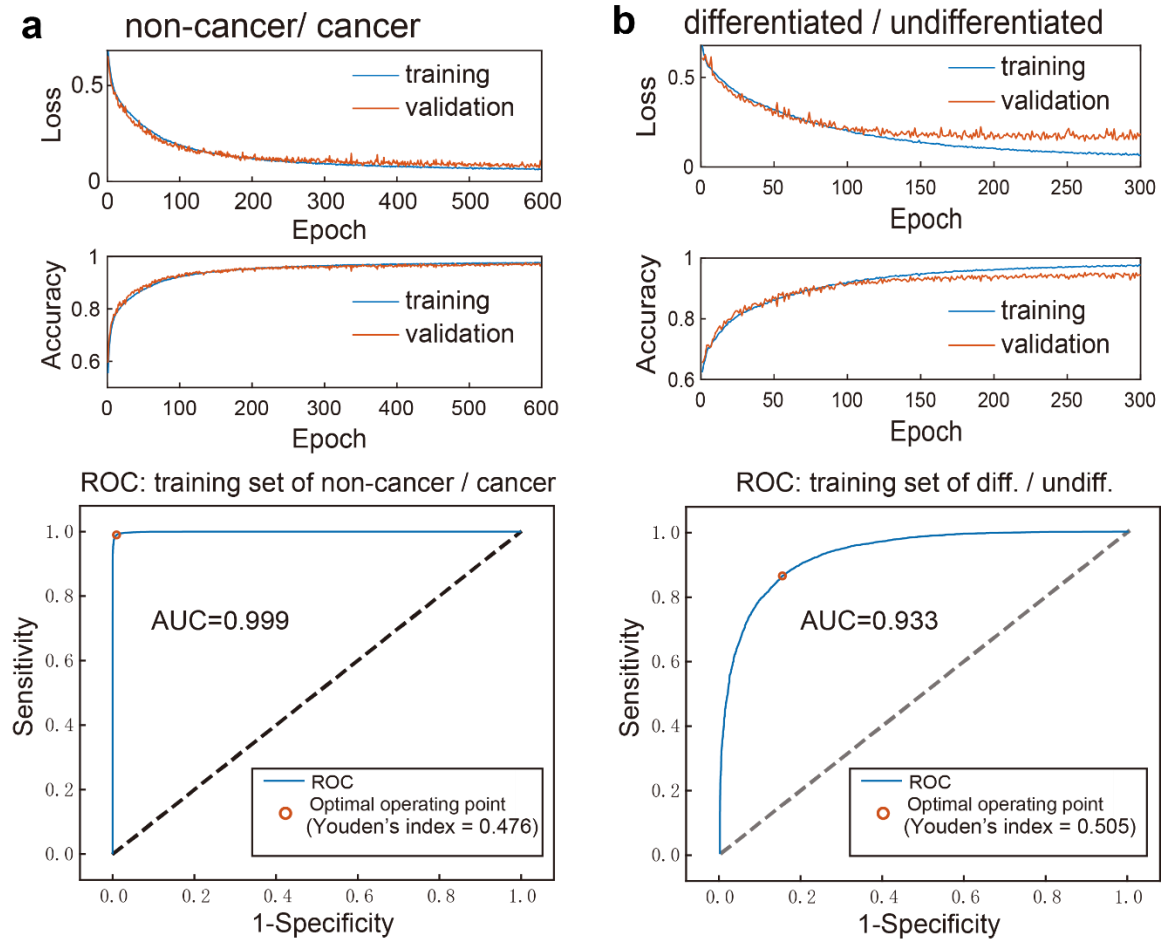


Fig. S6. Diagnostic prediction results of CNN based femto-SRH, compared with the four pathologists on test cases. (a) Non-cancer vs. cancer; (b) Differentiated vs. undifferentiated cancers.

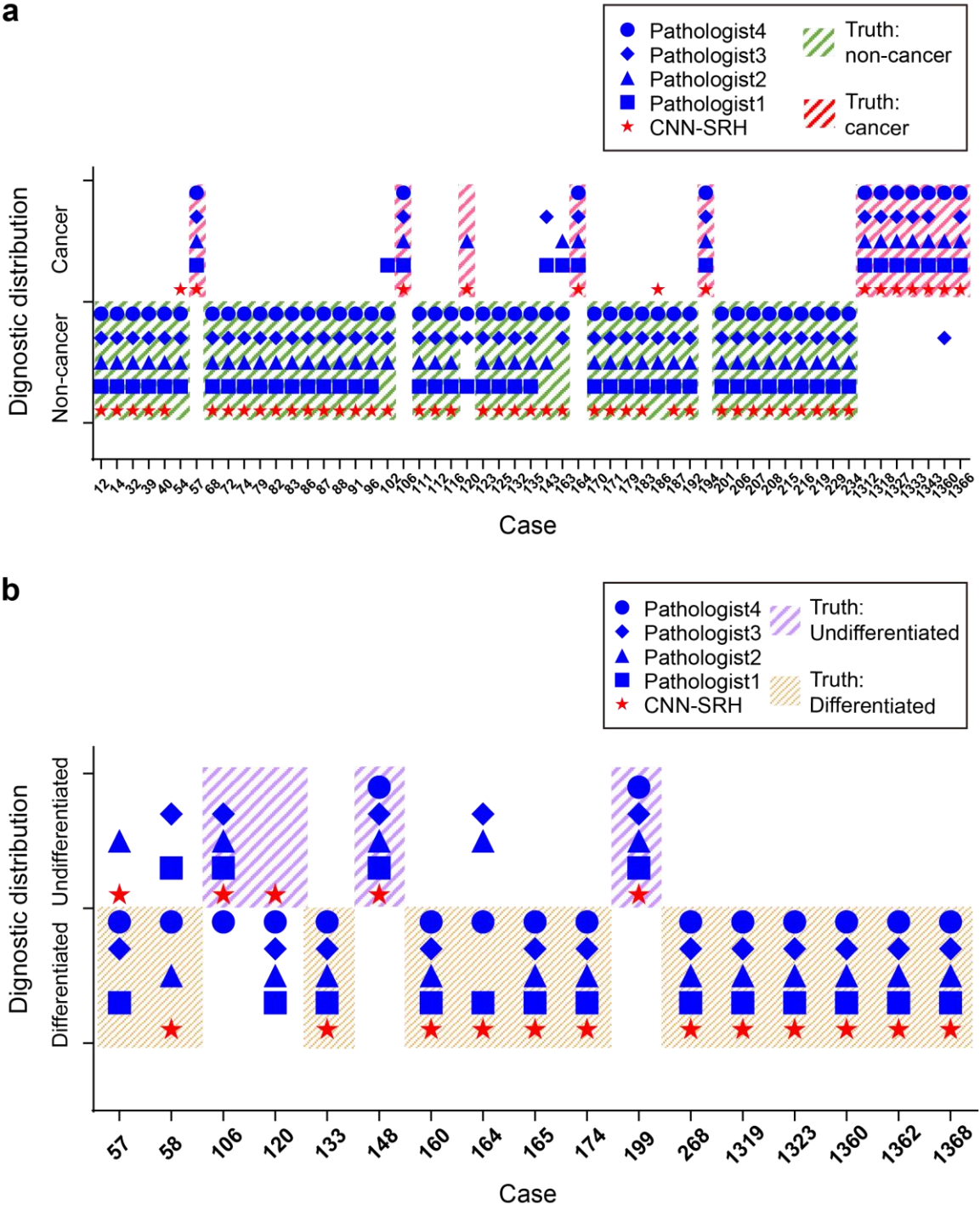


Fig. S7. Workflow of the semantic segmentation of CNN. (a-c) Flip-expansion of a large femto-SRS image, followed by predictions on shifting small tiles. (d) Classification workflow. (e) Segmentation and (f) heatmap coloring. Scale bars: 100 μm .

