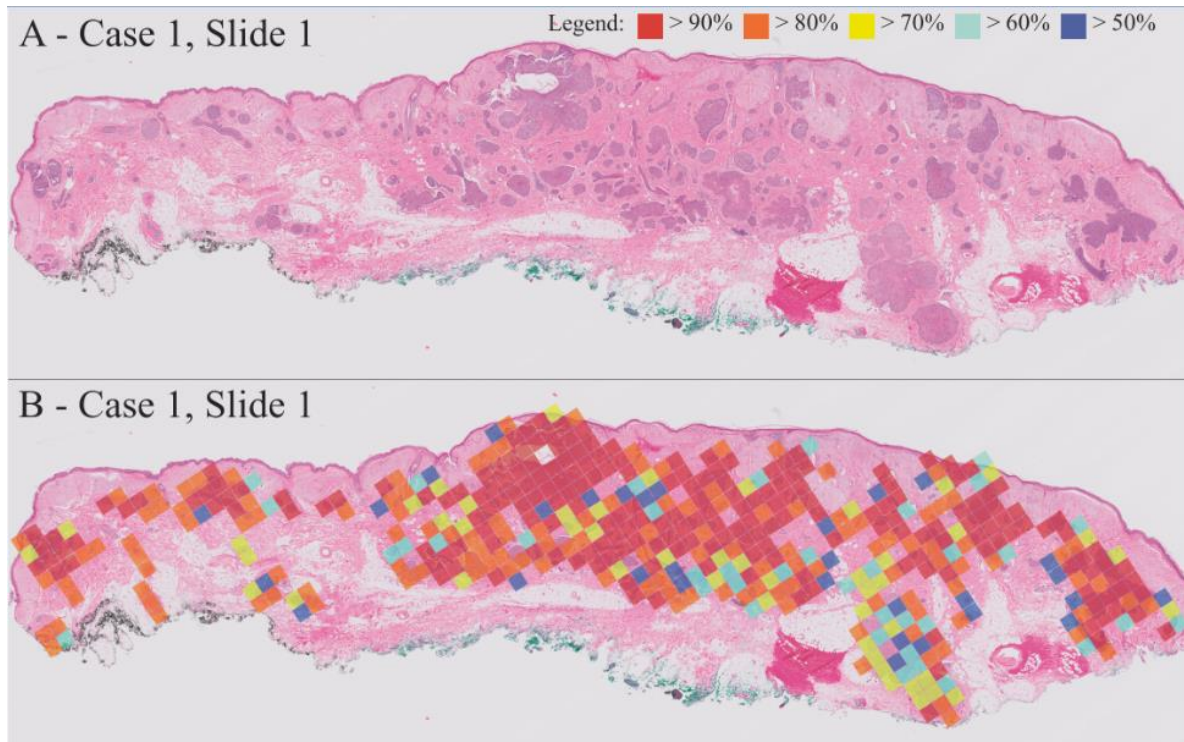


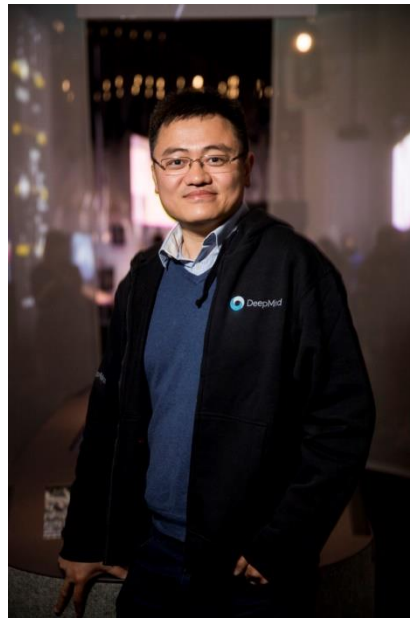
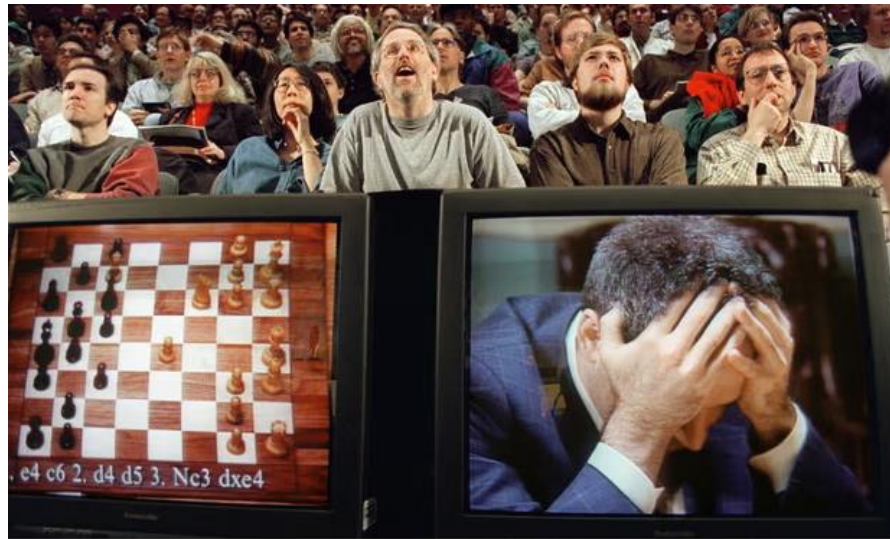


Artificial intelligence for Basal Cell Carcinoma Better than a human?



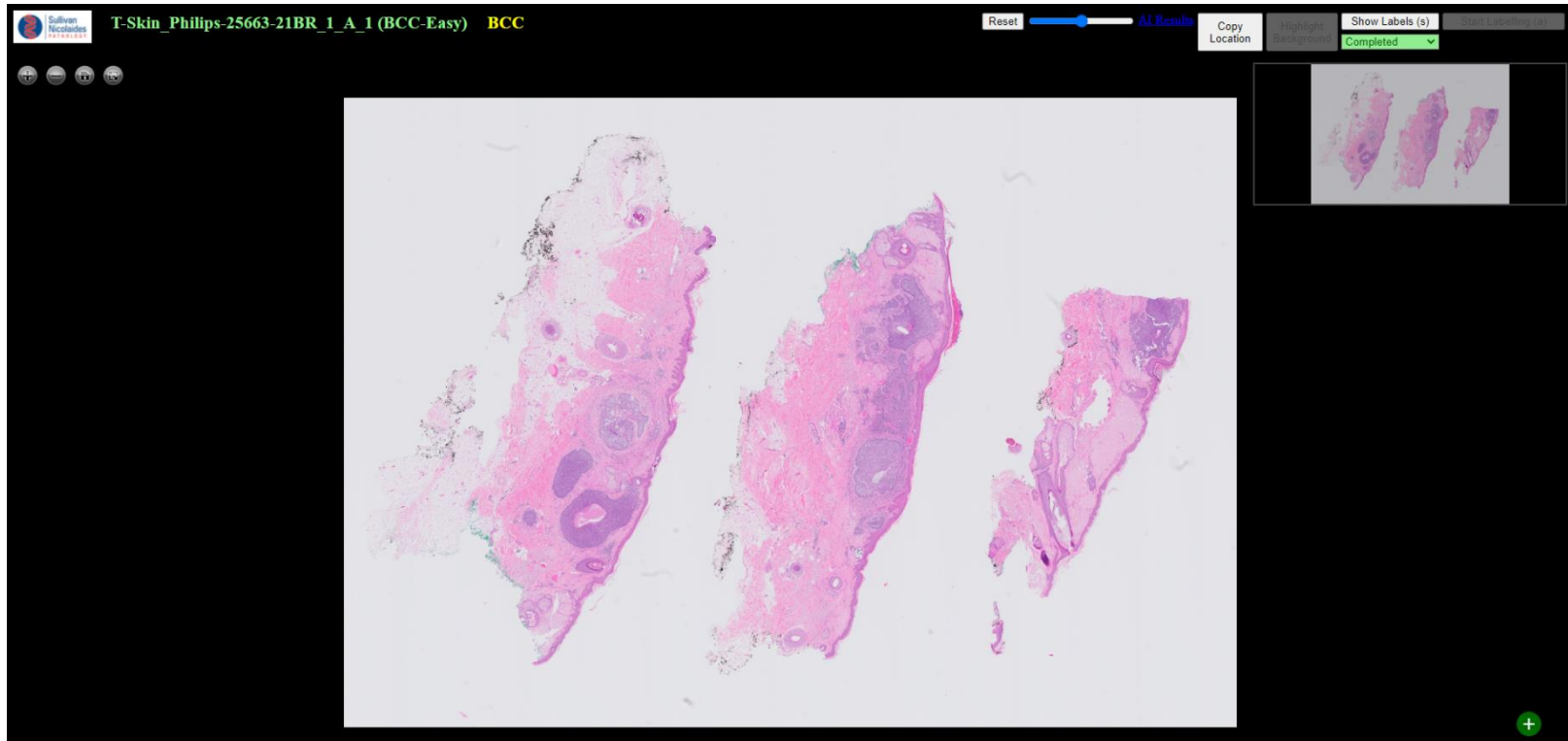


Abandoned



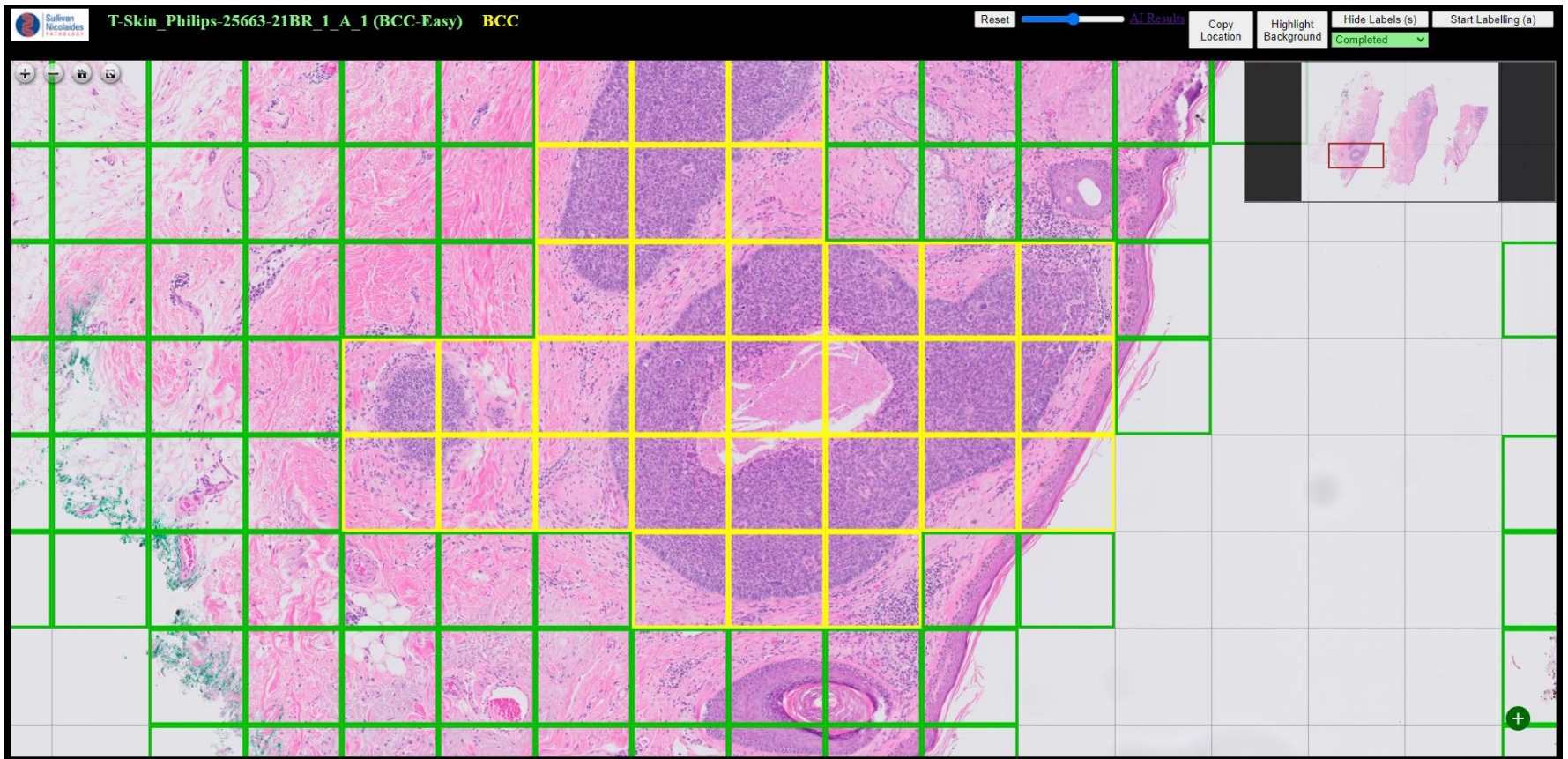


How can AI perform in the diagnosis of Basal Cell Carcinoma?



- 1061 glass slides
- 616 with BCC
- 445 without BCC – enriched for BCC mimics

	A	B	C	D	E	F	G	H
1		All Patier	All Specim	All Slide	Test Slid	10x Rec	20x Rec	10x, 20x Recall
2	BCC	396	465	616	147	100.0%	99.3%	98.0%
3	Non-BCC slides							
4	Basaloid hyperplasia overlying dermatofibr	15	15	24	4	25.0%	100.0%	100.0%
5	Trichoblastoma	5	5	7	1	0.0%	100.0%	100.0%
6	Desmoplastic trichoepithelioma	10	10	15	4	75.0%	100.0%	100.0%
7	Sebaceoma	8	8	9	2	100.0%	100.0%	100.0%
8	Cylindroma	10	10	15	6	50.0%	50.0%	66.7%
9	Spiradenoma	10	10	11	4	100.0%	100.0%	100.0%
10	Pilomatixoma	7	7	12	3	100.0%	100.0%	100.0%
11	Solar keratosis	31	39	45	7	100.0%	100.0%	100.0%
12	Mantleoma	2	2	4	4	75.0%	100.0%	100.0%
13	Intraepidermal carcinoma	67	72	91	18	94.4%	100.0%	100.0%
14	Squamous cell carcinoma	40	40	56	9	88.9%	100.0%	100.0%
15	Sebaceous carcinoma	9	9	13	3	33.3%	100.0%	100.0%
16	Microcystic adnexal carcinoma	2	2	8	3	100.0%	100.0%	100.0%
17	Squamoid eccrine ductal carcinoma	6	7	13	5	60.0%	60.0%	100.0%
18	Merkel cell carcinoma	30	30	64	10	90.0%	90.0%	90.0%
19	Metastatic carcinoma	3	3	7	3	100.0%	100.0%	100.0%
20	Melanoma in-situ	2	2	3	2	100.0%	100.0%	100.0%
21	Melanoma invasive	1	1	1	1	100.0%	100.0%	100.0%
22	Melanoma invasive and in-situ	13	13	13	4	100.0%	100.0%	100.0%
23	Benign lichenoid keratosis	1	1	1	0			
24	Compound Naevus	2	2	2	0			
25	Dysplastic compound naevus, high-grade	2	2	2	0			
26	Dysplastic compound naevus, low-grade	2	3	3	0			
27	Epidermal cyst	1	1	1	0			
28	Changes relating to excoriation	2	2	2	0			
29	Ruptured Follicle	1	1	1	0			
30	Haemangioma	1	1	1	0			
31	Intradermal Naevus	4	4	4	3	100.0%	100.0%	100.0%
32	Junctional naevus	1	1	1	1	100.0%	100.0%	100.0%
33	Keratoacanthoma	2	2	2	0			
34	Lymphoid Proliferation	1	1	1	0			
35	Miscellaneous	1	1	1	0			
36	No recorded anomaly	2	2	2	1	100.0%	100.0%	100.0%
37	Non-specific inflammation	2	2	2	0			
38	Neuro-endocrine carcinoma	2	2	4	0			
39	Poorly differentiated carcinoma	4	4	4	1	100.0%	100.0%	100.0%
40	Poroma	2	2	2	0			
41	Scar - organising	4	4	5	1	100.0%	100.0%	100.0%
42	Solar lentigo	1	1	1	0			
43	Sebaceous adenoma	1	1	5	0			
44	Seborrheic Keratosis	10	12	13	5	100.0%	100.0%	100.0%
45	Syringoma	1	1	1	0			
46	Tumour of follicular infundibulum	11	11	11	2	100.0%	100.0%	100.0%
47	Trichilemmoma	14	14	15	3	100.0%	100.0%	100.0%
48	Trichoepithelioma	4	4	6	1	100.0%	100.0%	100.0%
49	Viral wart	2	2	2	0			



- Tiling: each patch labelled by pathologist as BCC or non-BCC
- ~87,000 patches BCC, ~1.7 million patches non-BCC
- Used these patches to train AI to predict BCC vs. non-BCC

> Pathology. 2023 Apr;55(3):342-349. doi: 10.1016/j.pathol.2022.10.004. Epub 2022 Dec 21.

Artificial intelligence for basal cell carcinoma: diagnosis and distinction from histological mimics

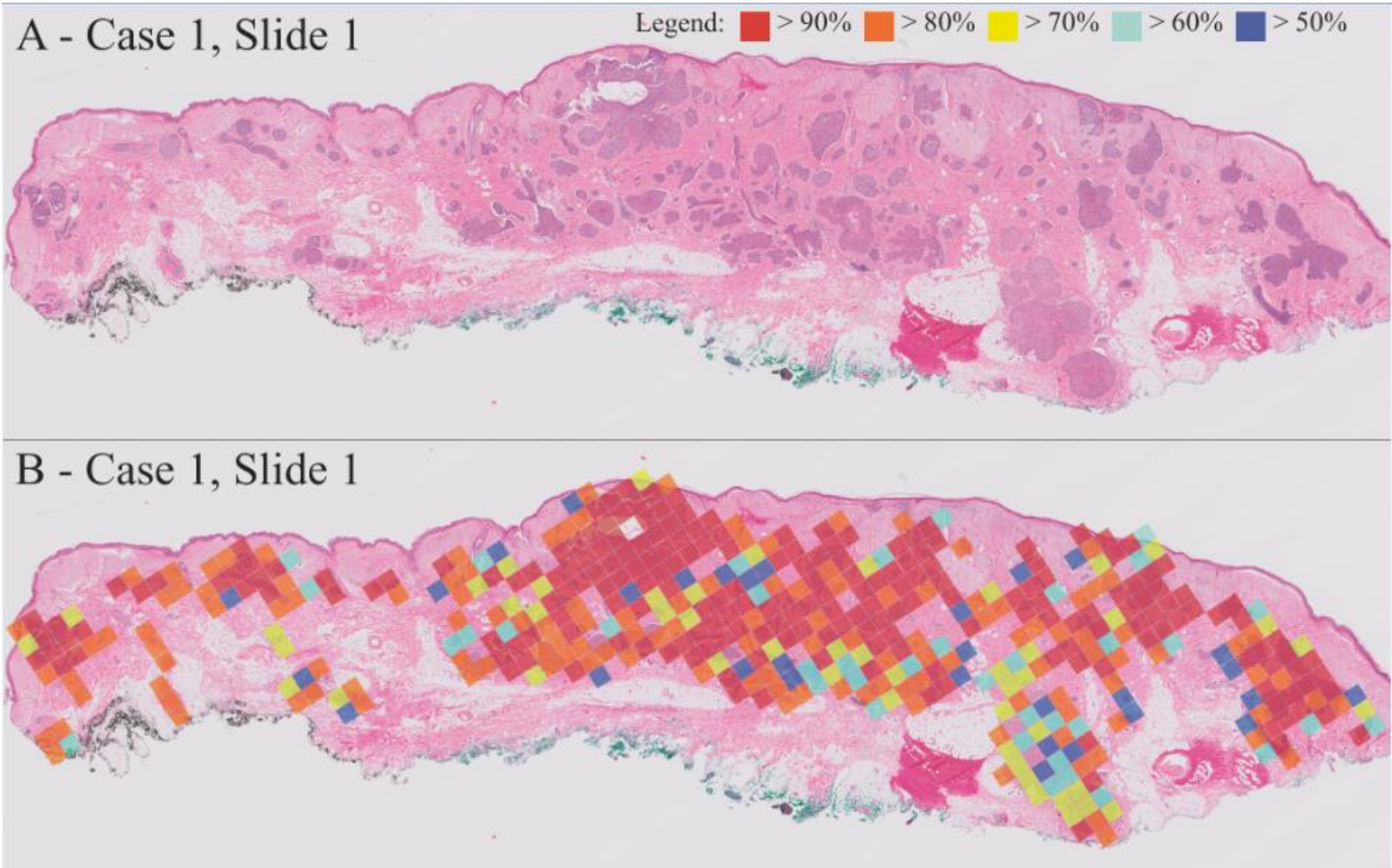
Blake O'Brien ¹, Kun Zhao ², Tingting Amy Gibson ², Daniel F Smith ², David Ryan ²,
Joseph Whitfield ², Christopher D Smith ², Mark Bromley ²

Test set 246 WSI – 147 with BCC, 99 without

240/246 WSI classified correctly

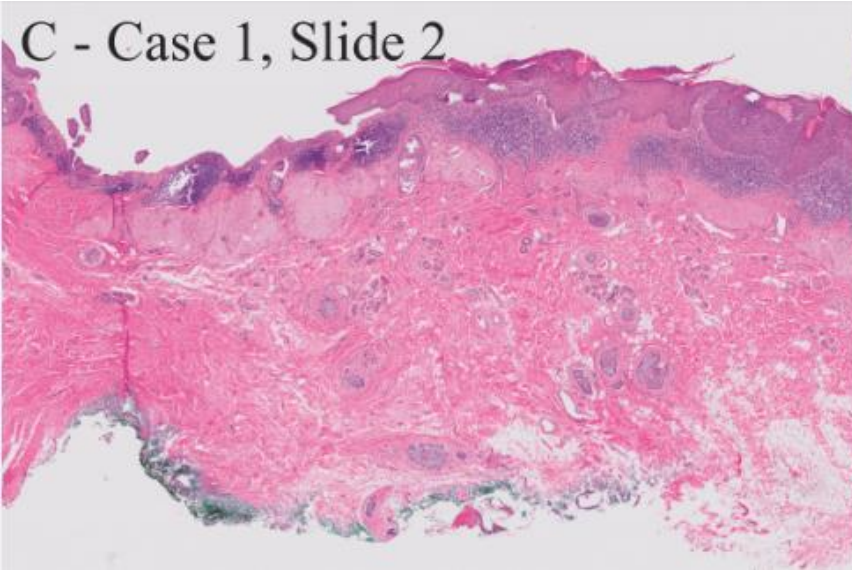
98% sensitivity, 97% specificity

AI slide-level prediction:
BCC present, 94% confidence

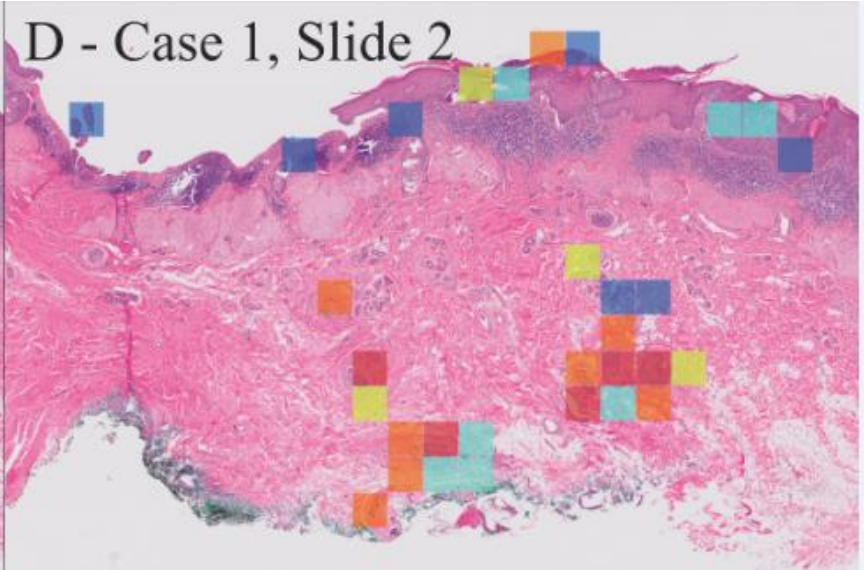


Observations

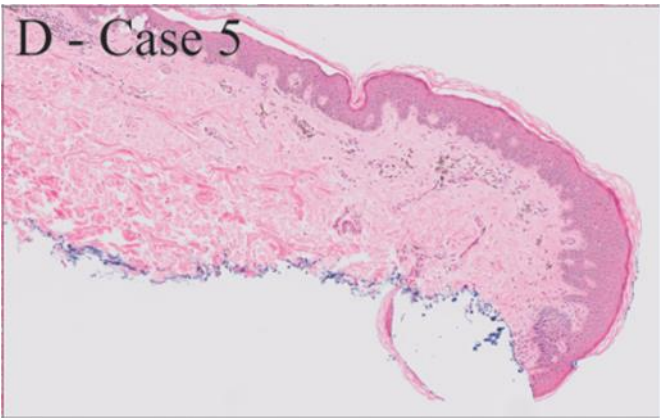
C - Case 1, Slide 2



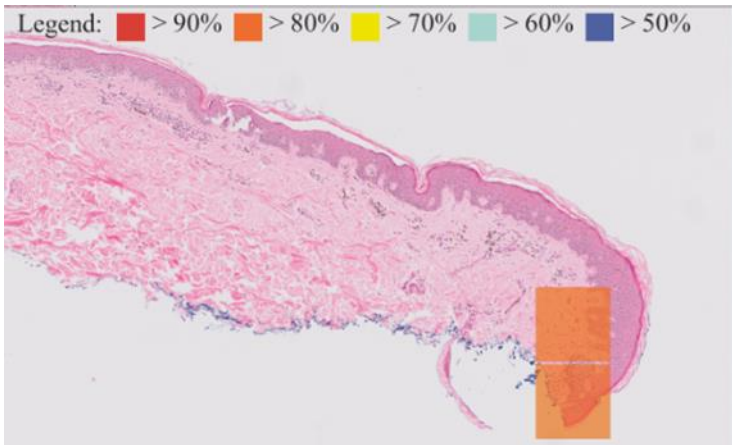
D - Case 1, Slide 2



D - Case 5

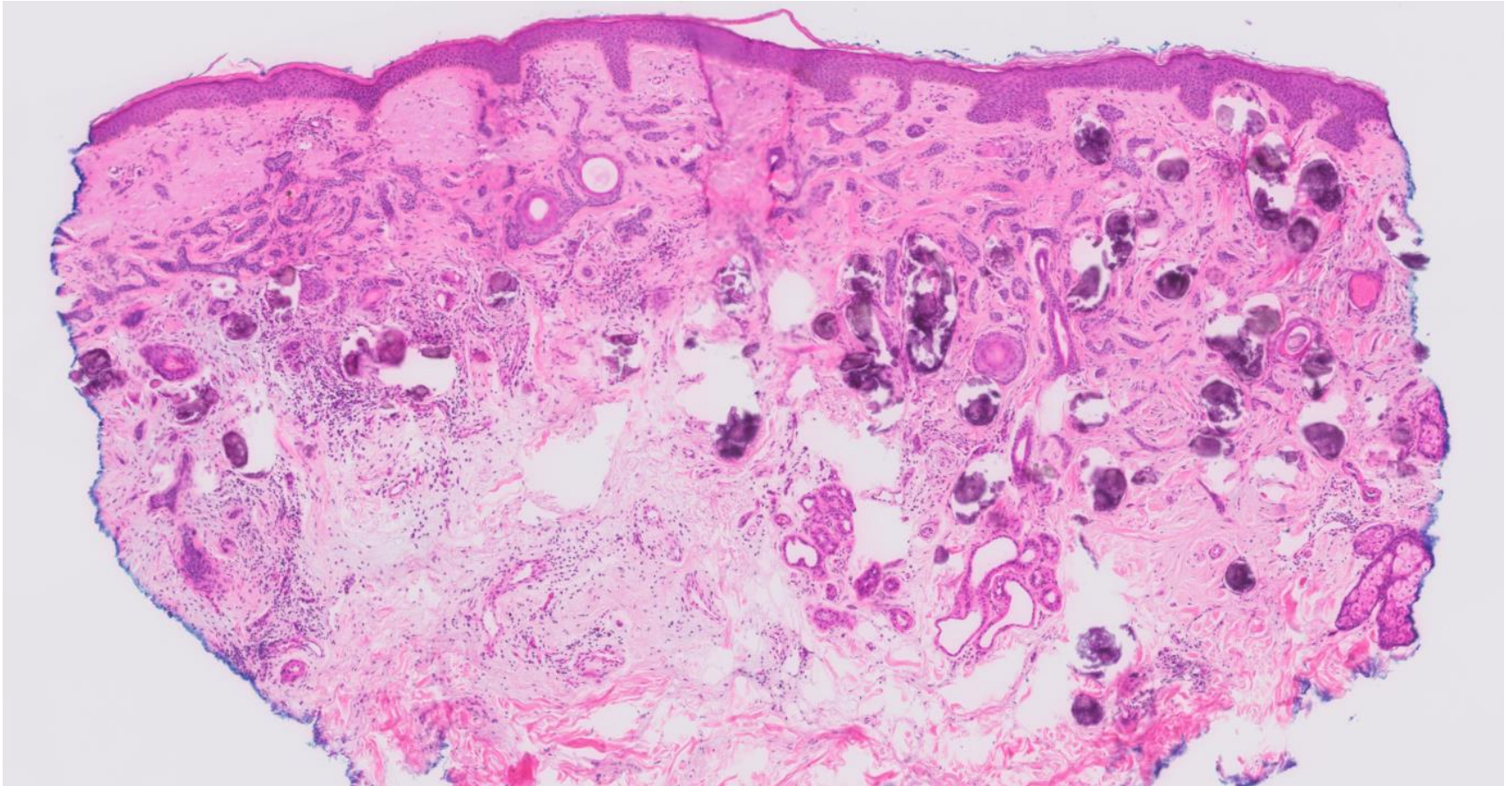


Legend: ■ > 90% ■ > 80% ■ > 70% ■ > 60% ■ > 50%

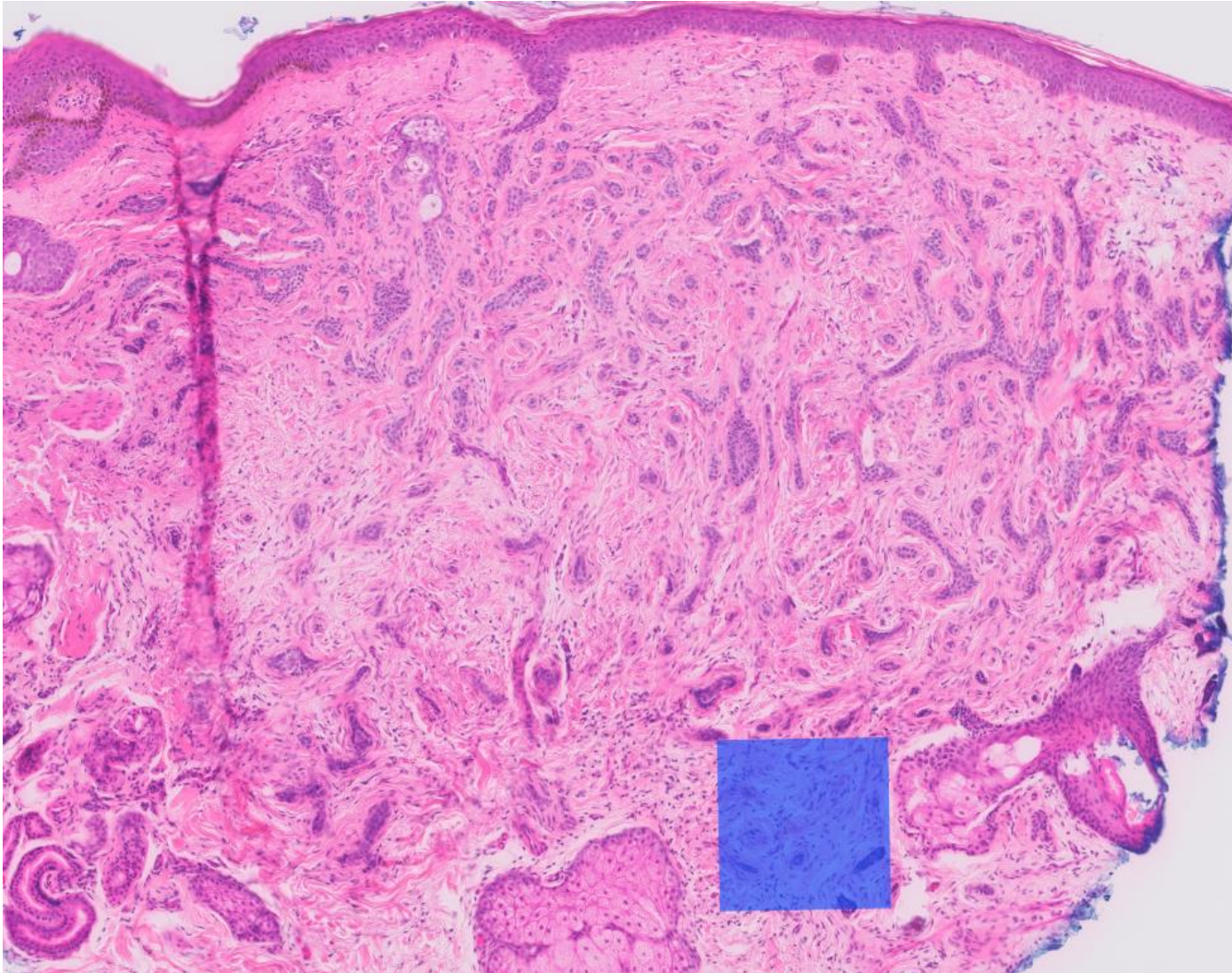


AI impressive performance in distinguishing mimics

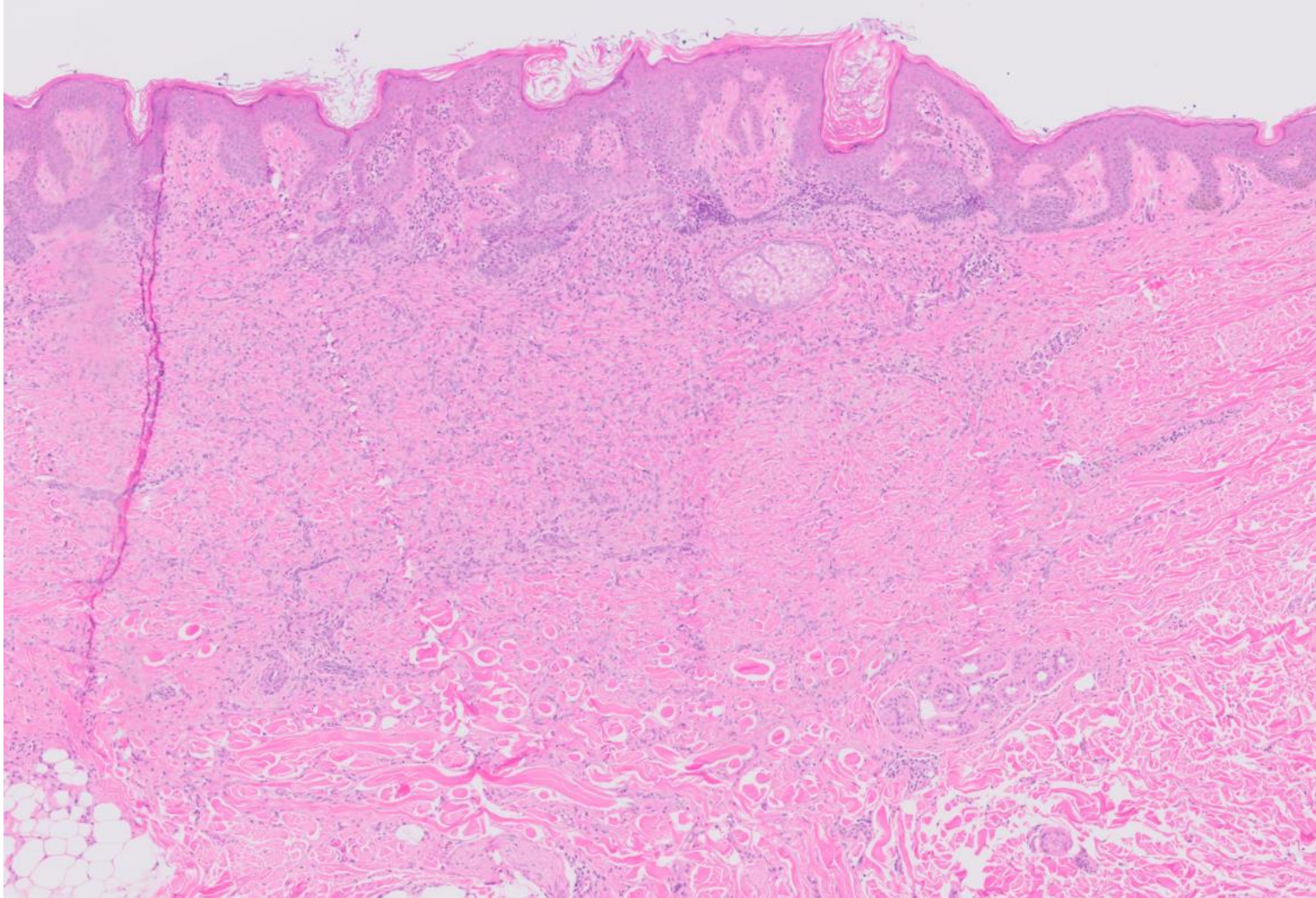
Pathologist: Favour desmoplastic trichoepithelioma



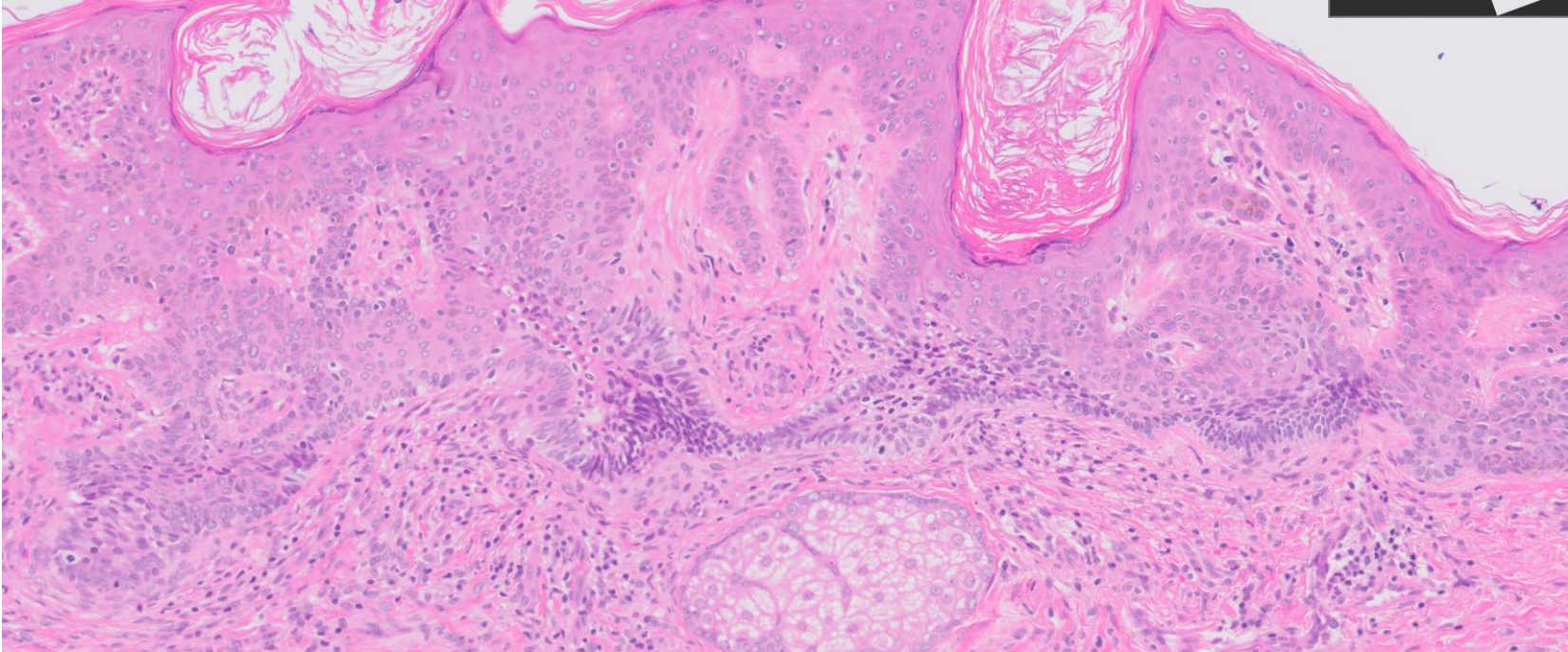
AI: **Not BCC**, 96% confidence



Pathologist: Basaloid hyperplasia overlying dermatofibroma



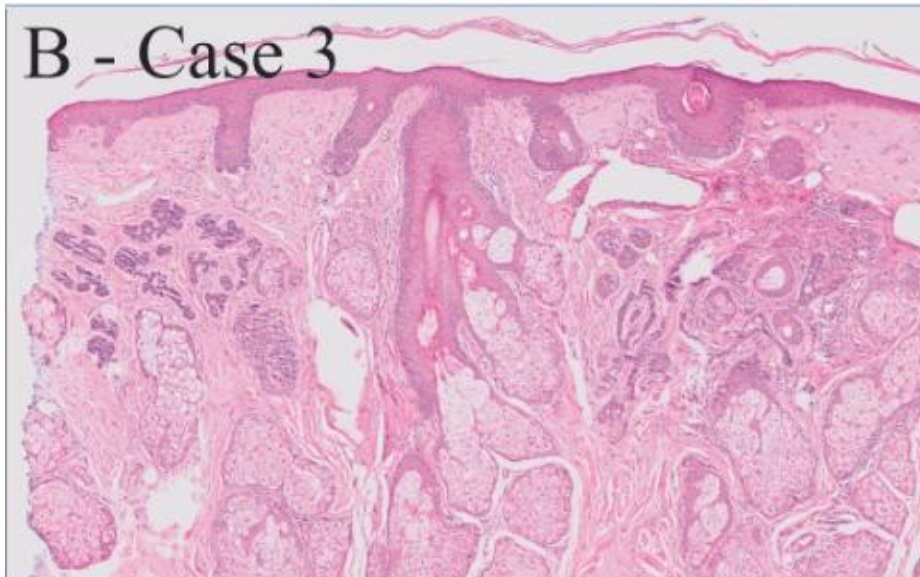
AI: **Not BCC**, 98% confidence



Pathologist: Benign appendageal lesion, favour mantleoma

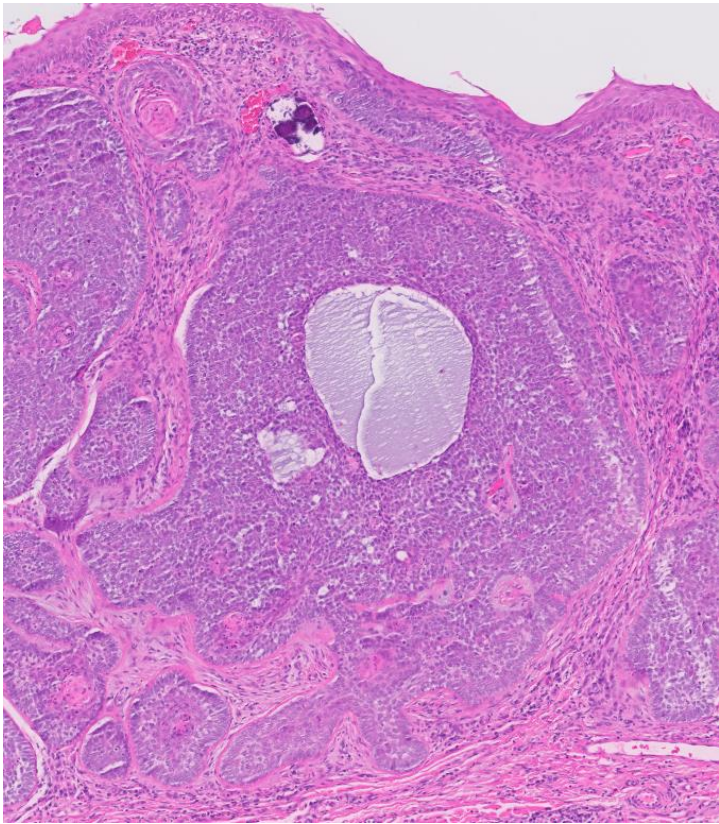
Morning Blake,
If the AI program can tell
this is Not a BCC, I retire
ASAP!
Thanks.

AI: **Not BCC**, 98% confidence



How do humans work?

Input



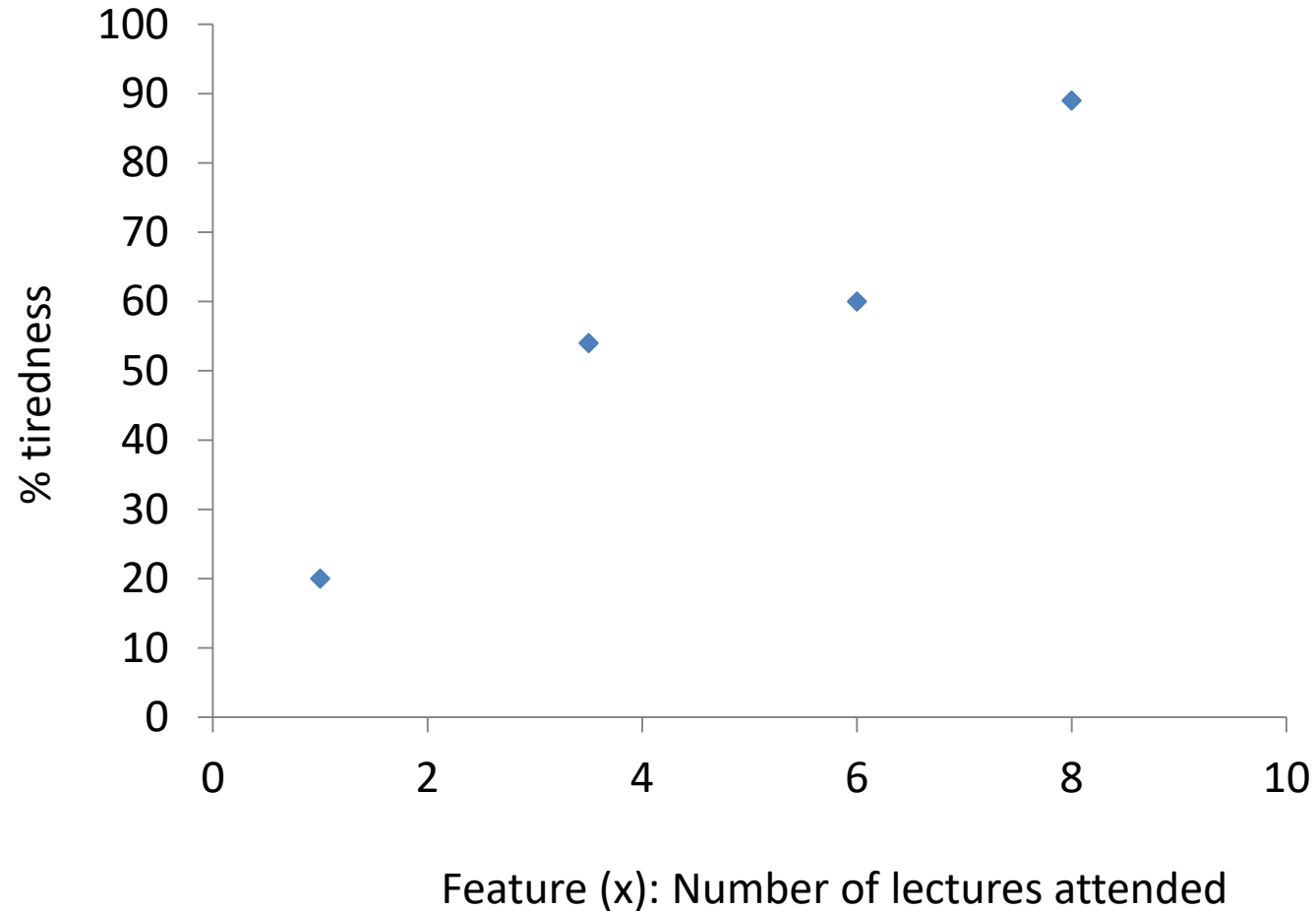
Output



Basal cell carcinoma

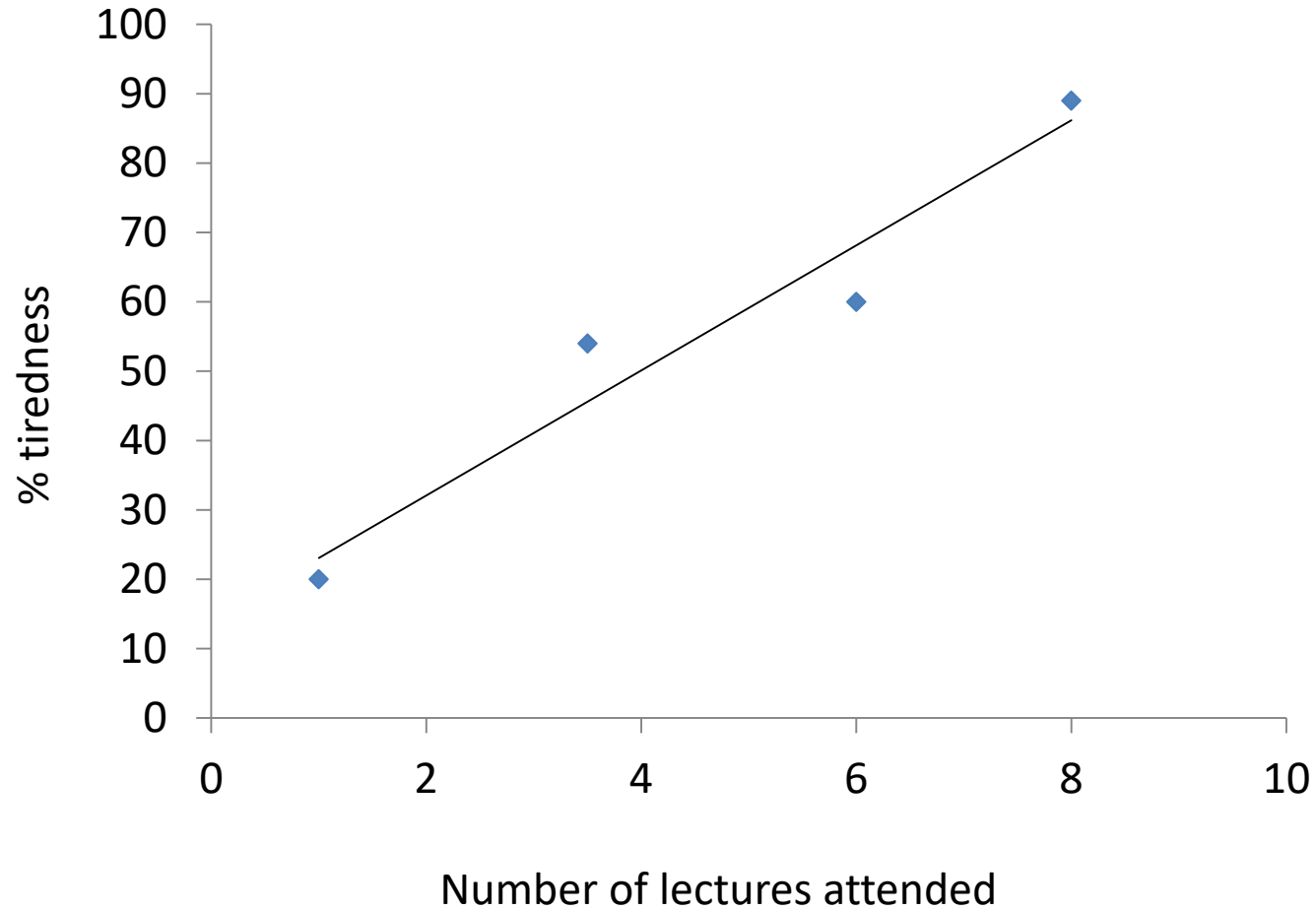
Weights and bias

Predict: How tired is a conference participant?



$$y = mx + c$$

$$y = \mathbf{w}x + \mathbf{b}$$



Lectures attended (x_1)

$$y = w_1x_1 + b$$

Lectures attended (x_1)

$$y = w_1x_1 + b$$

Cups of coffee (x_2)

$$y = w_1x_1 + w_2x_2 + b$$

Lectures attended (x_1)

$$y = w_1x_1 + b$$

Cups of coffee (x_2)

$$y = w_1x_1 + w_2x_2 + b$$

Food quality at break-time (x_3)

$$y = w_1x_1 + w_2x_2 + w_3x_3 + b$$

Lectures attended (x_1)

$$y = w_1x_1 + b$$

Cups of coffee (x_2)

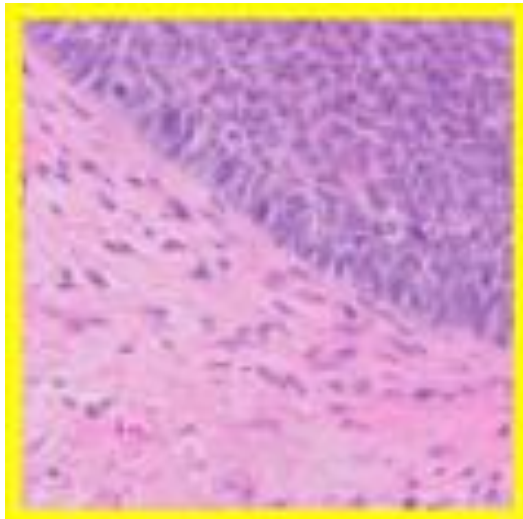
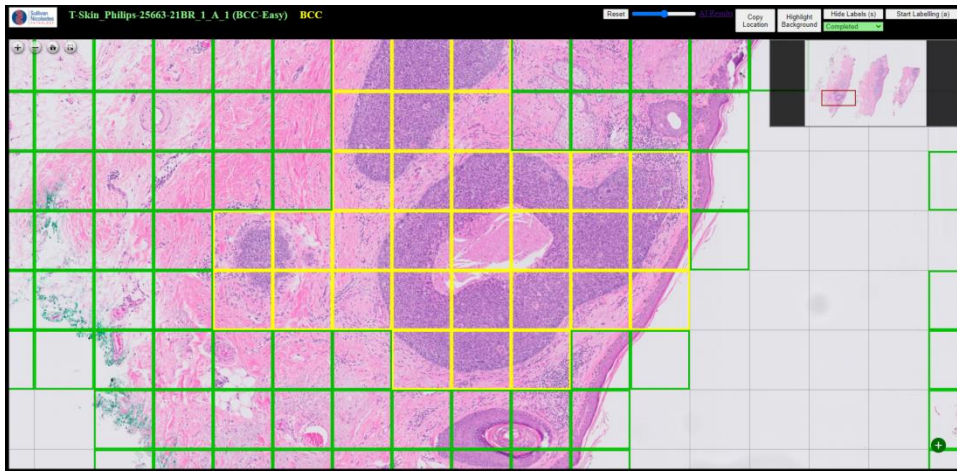
$$y = w_1x_1 + w_2x_2 + b$$

Food quality at break-time (x_3)

$$y = w_1x_1 + w_2x_2 + w_3x_3 + b$$

Distance travelled to be at the conference (x_4)

$$y = w_1x_1 + w_2x_2 + w_3x_3 + w_4x_4 + b$$



Each tile has 512 x 512 pixels
Each pixel is a feature

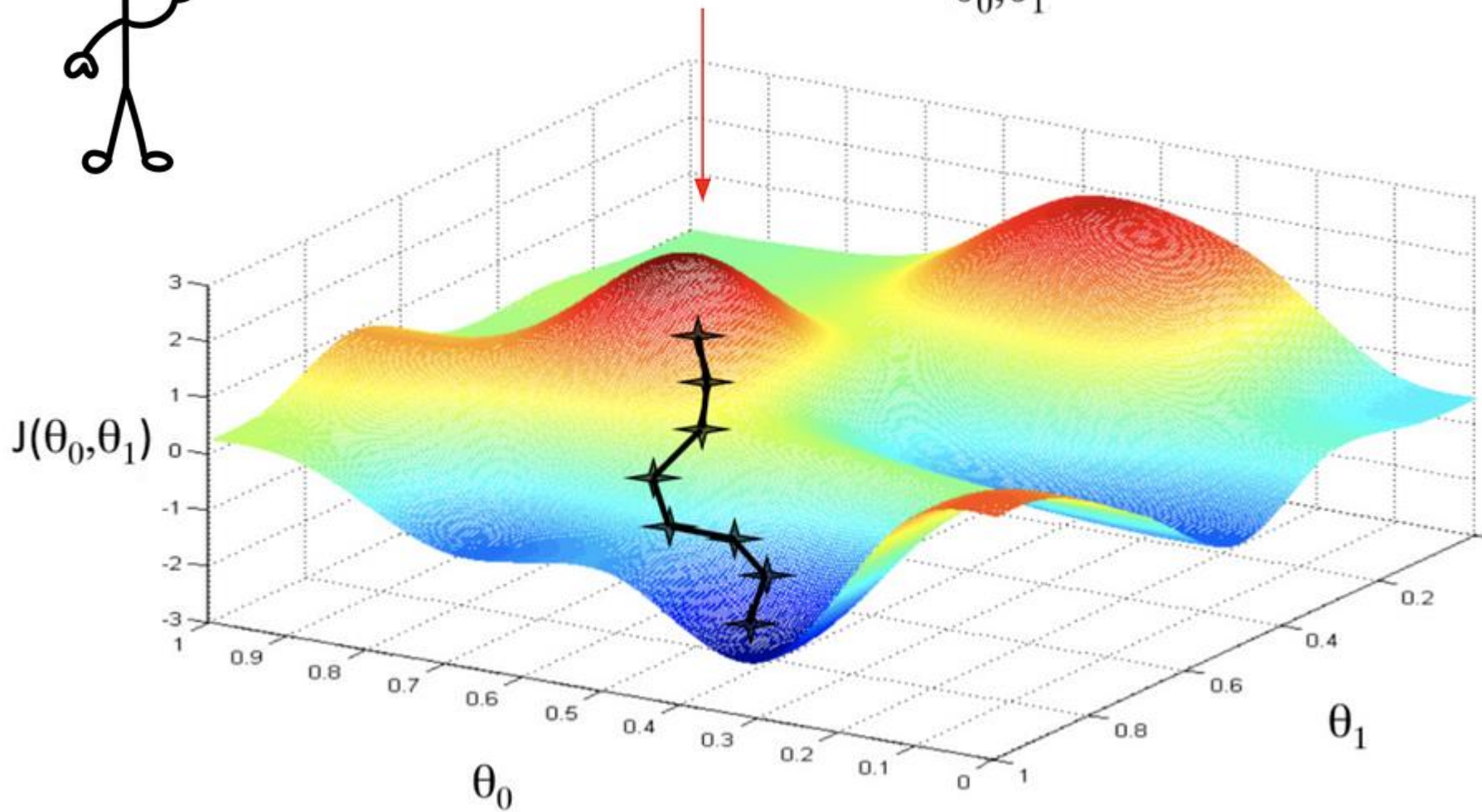
X1 = Pixel location 1
X2 = picture location 2

262144 features

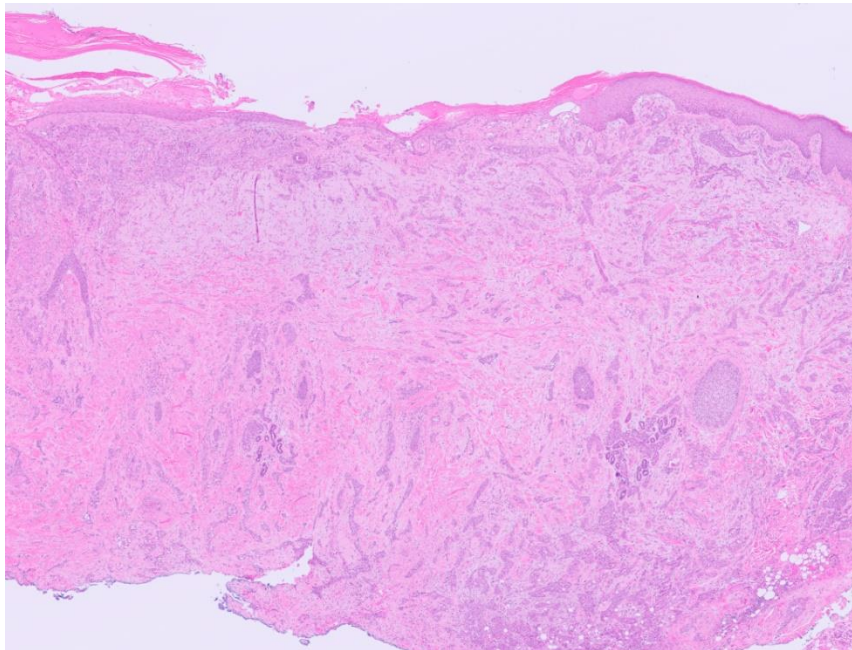
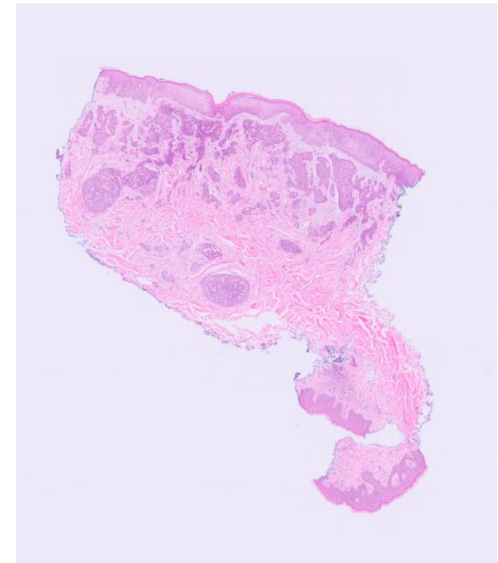
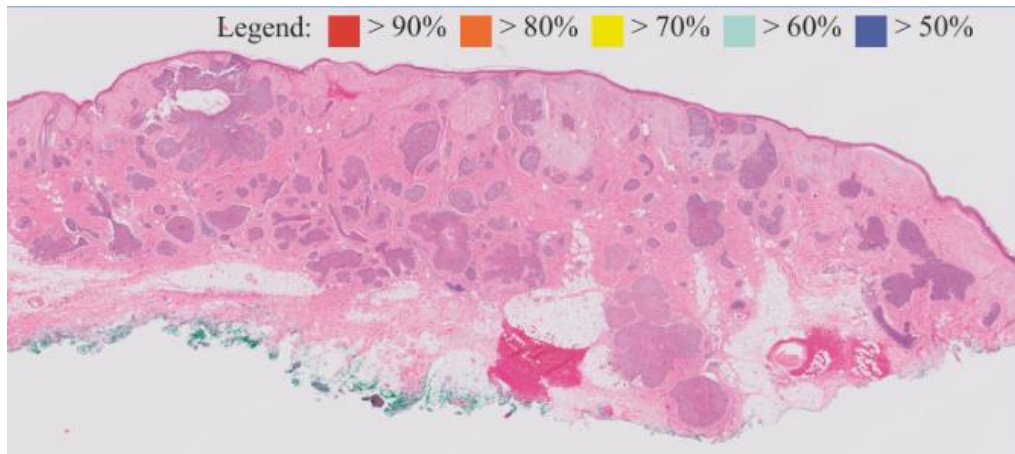
$$y = w_1x_1 + w_2x_2 + \dots + w_{262144}x_{262144} + b$$



we are here with random value θ_0, θ_1



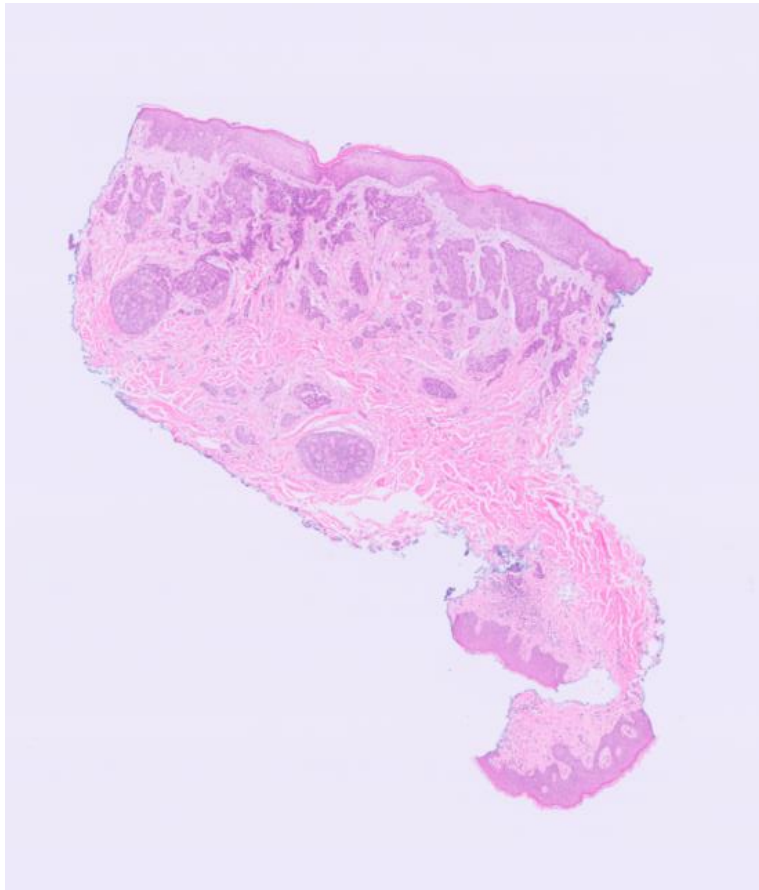
Greatest potential value



“If AI can tell this is not BCC, I’m sold”

Pathologist: Metastatic breast cancer

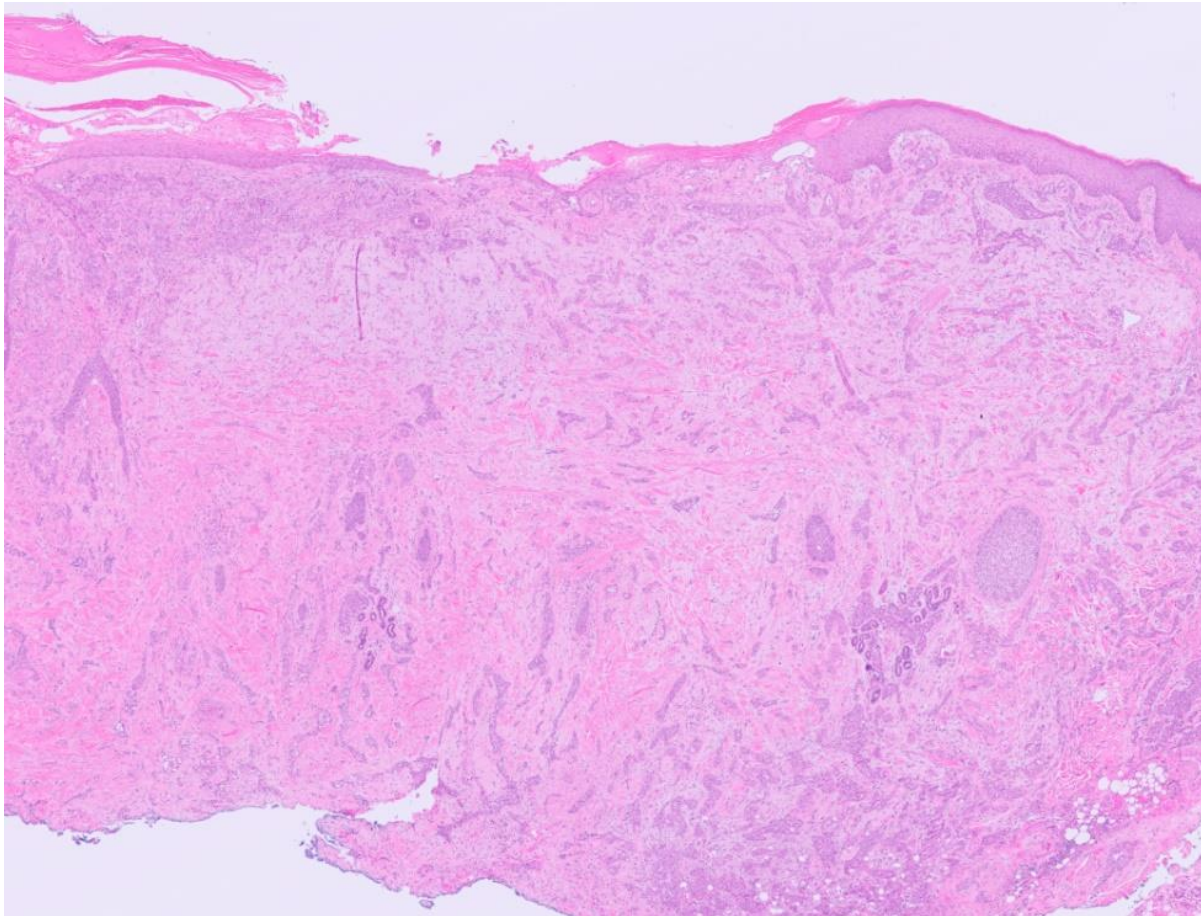
AI: **Not BCC**, 57% confidence



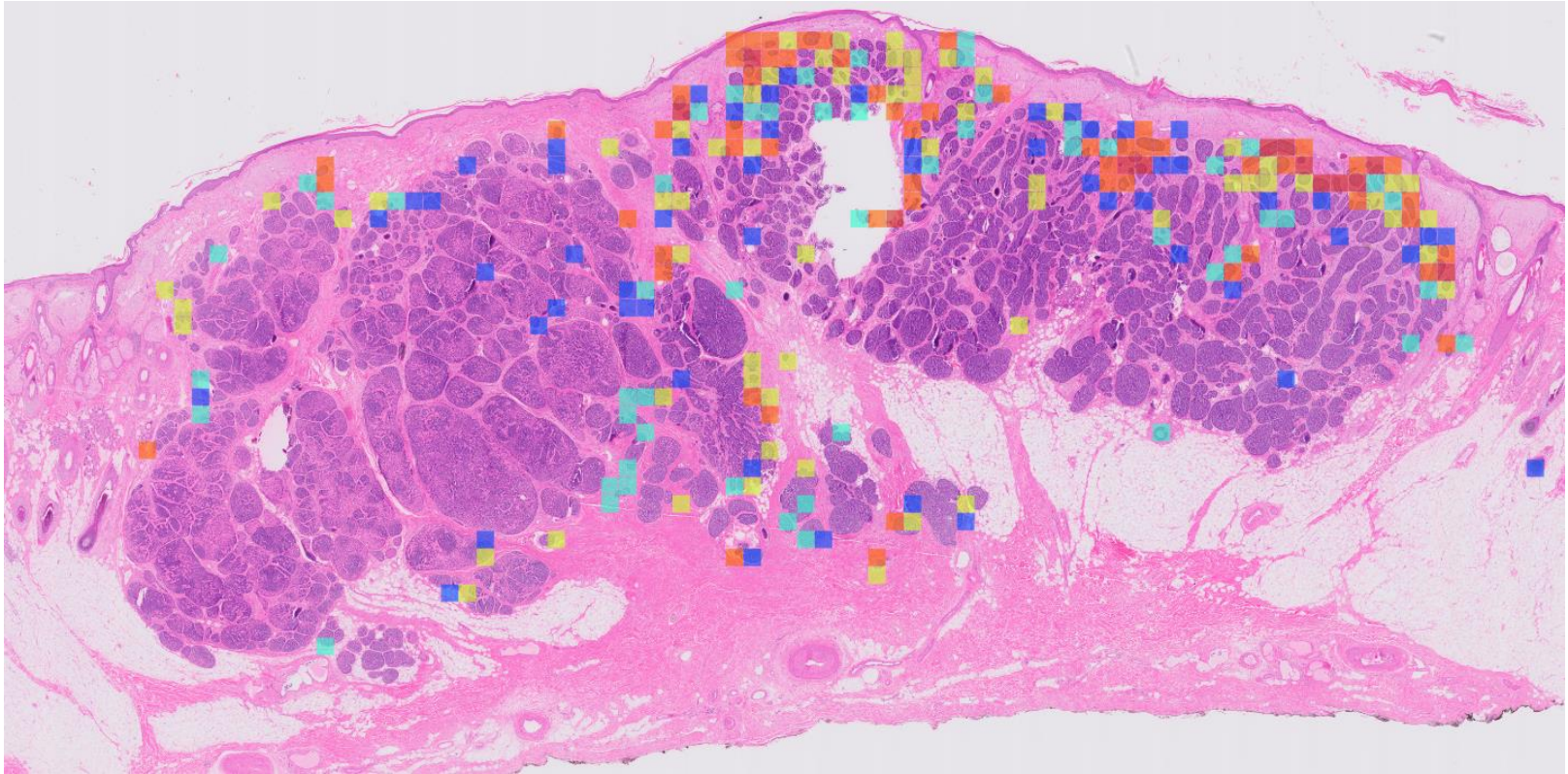
83 year-old woman. History provided: posterior scalp, BCC

Pathologist: Metastatic cholangiocarcinoma

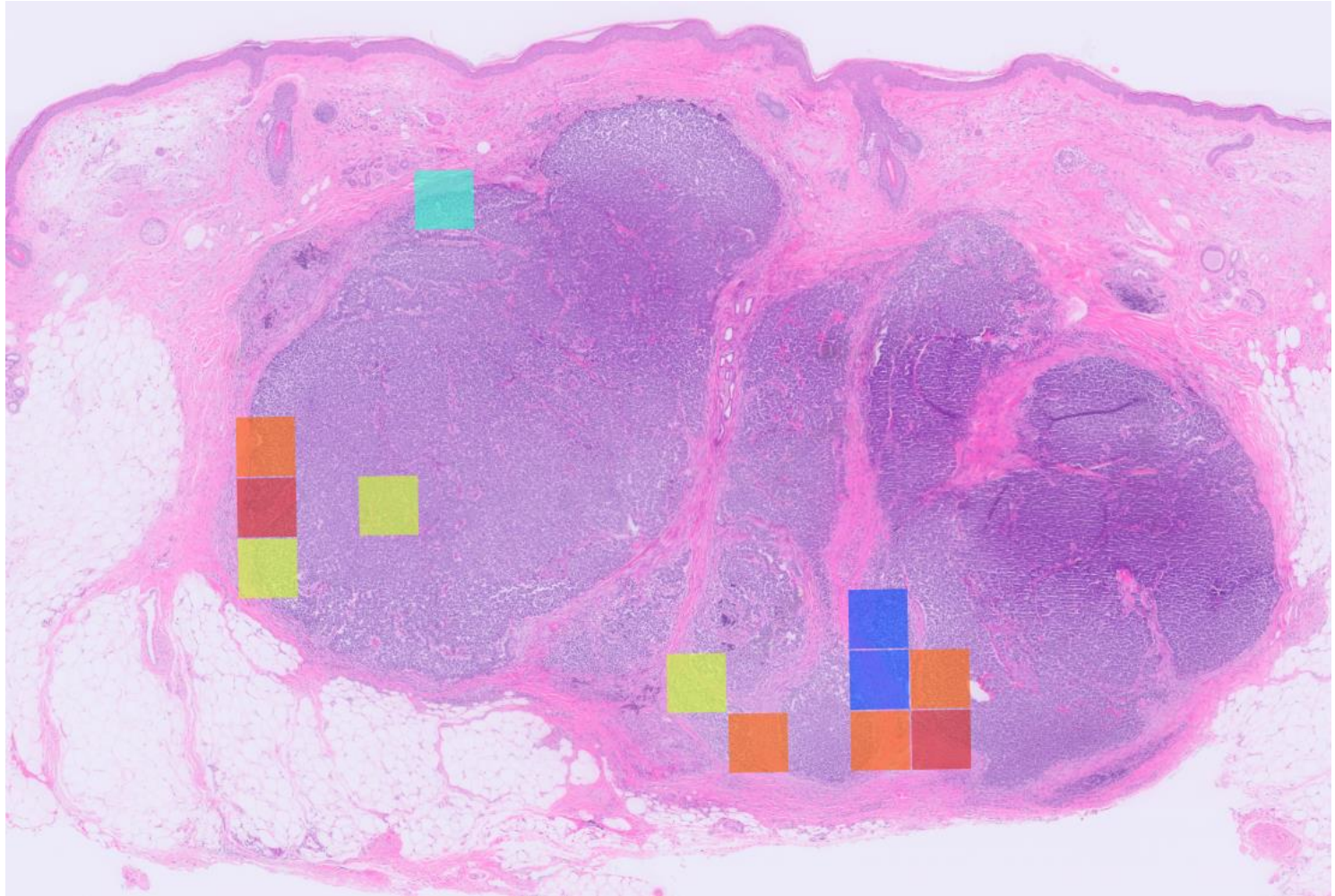
AI: **Not BCC**, 86% confidence



False positives

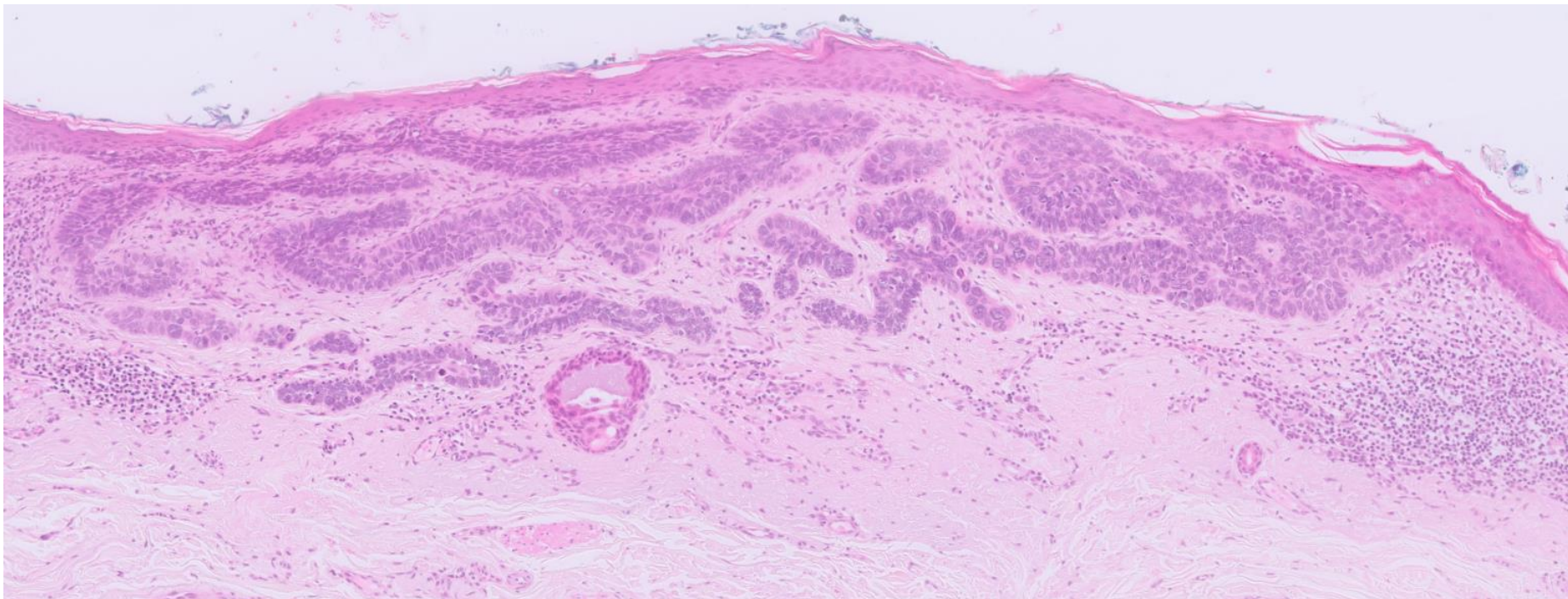


AI prediction: BCC, 51% confident

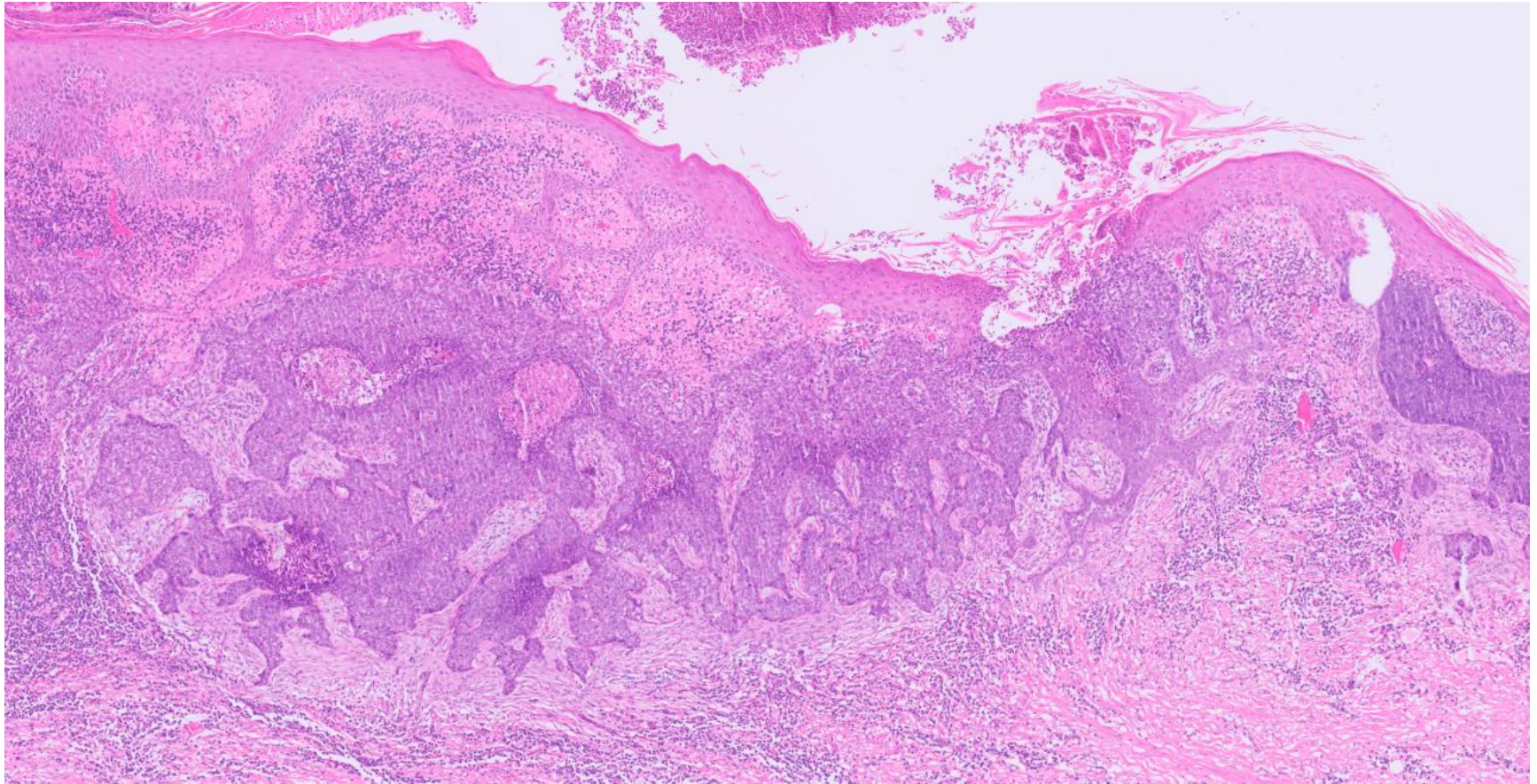


AI Prediction: BCC, 54% confident

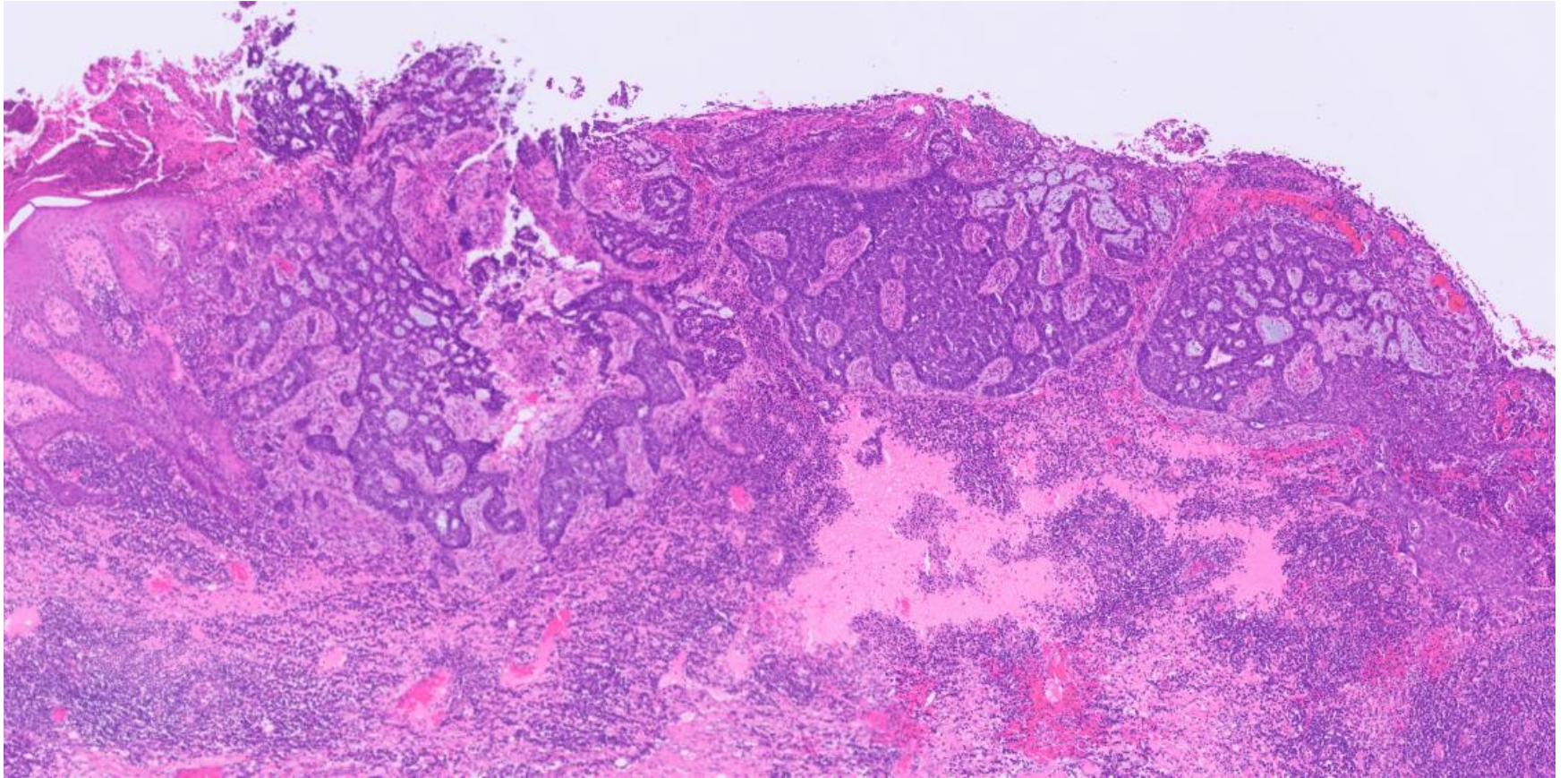
False negatives



AI Prediction: Not BCC, 72% confident



AI Prediction: Not BCC, 66% confident



AI Prediction: Not BCC, 91% confident

Thank you

- Colleagues at SNP
- Computer science team at SNP

