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WP4: Automated classification of CDW for robotic separation

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CDW RECOGNITION | Image acquisition



CDW RECOGNITION | Materials (classes)

AAC



Asphalt



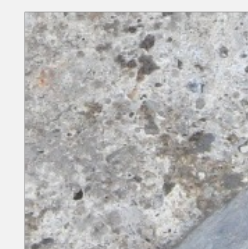
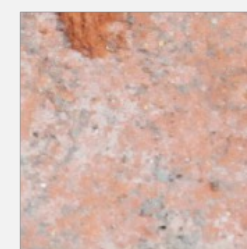
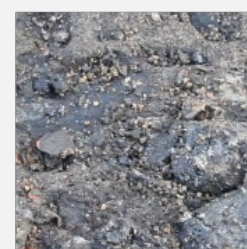
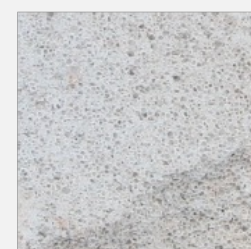
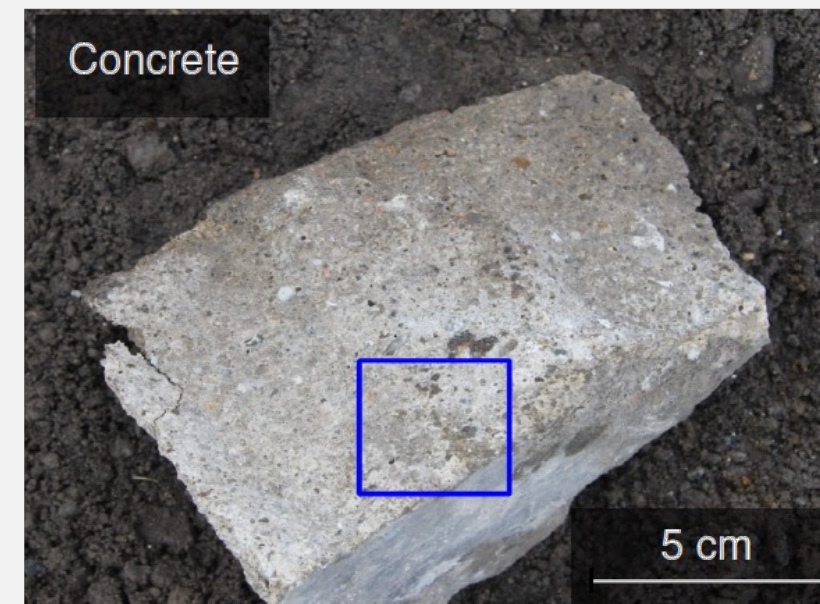
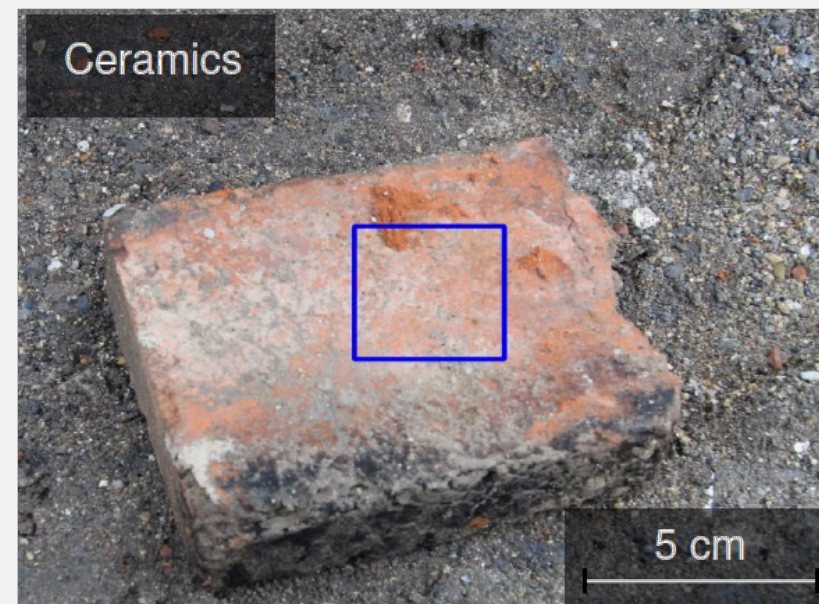
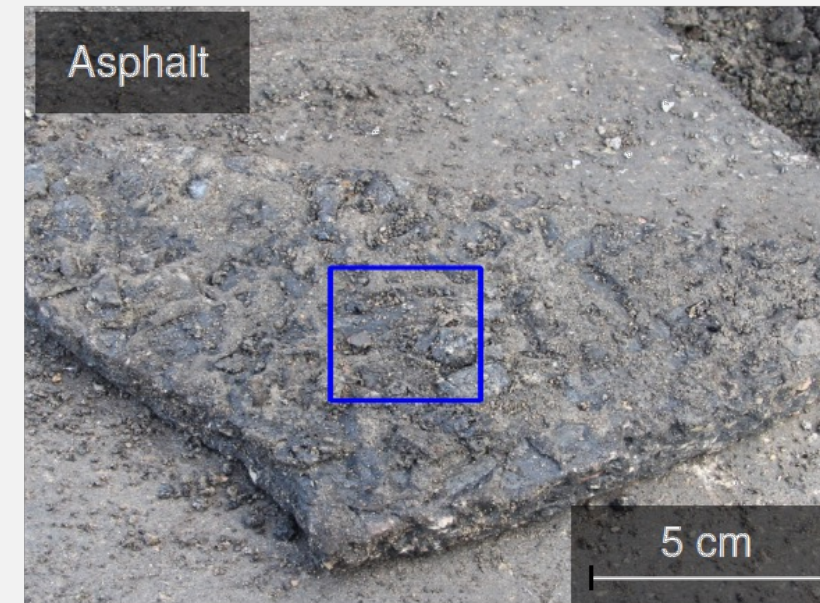
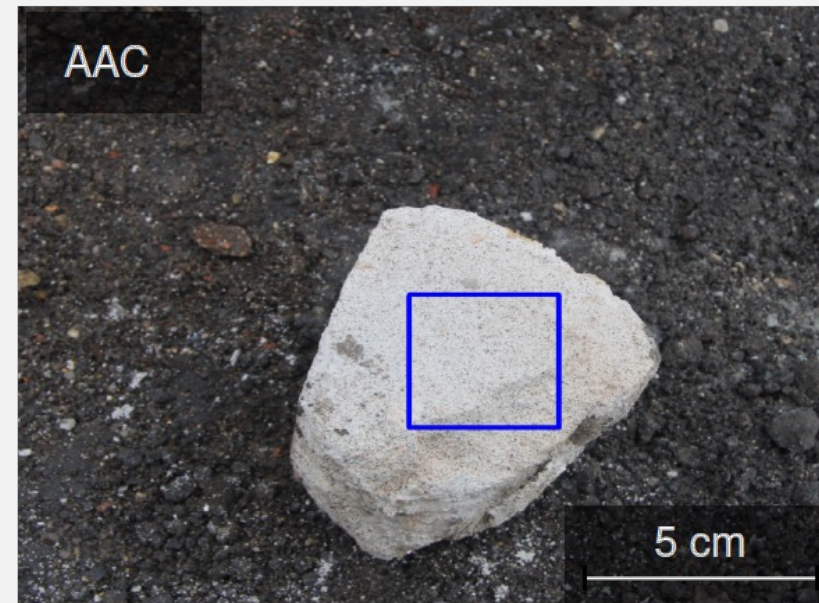
Ceramics



Concrete



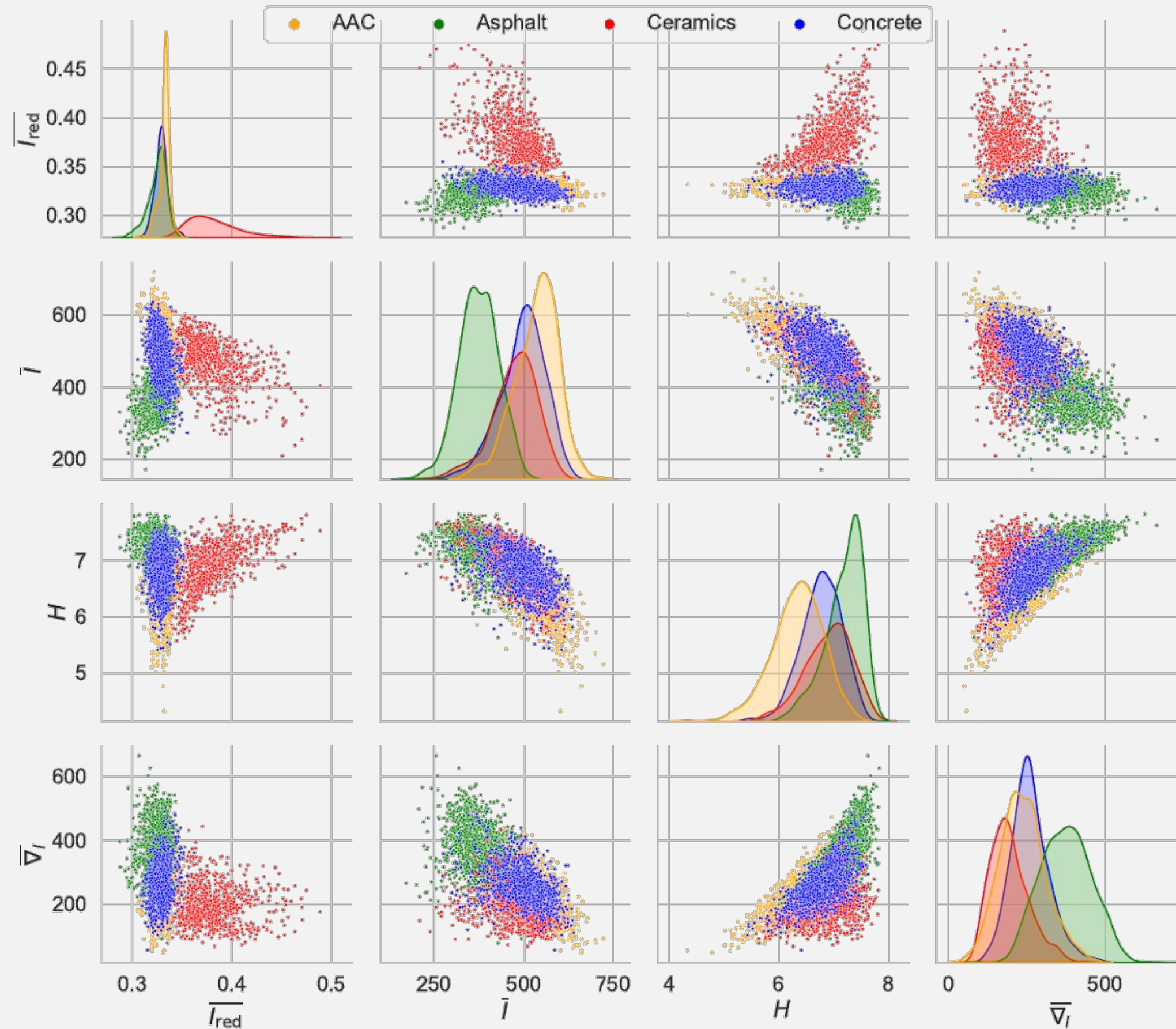
CDW RECOGNITION | Extraction of subsets



200 px

200 px

CDW RECOGNITION | Correlations between texture characteristics (features)



CDW RECOGNITION | Confusion matrices

GB ($\theta_{\text{test}} = 80.9\%$)

True label	Predicted label			
	AAC	Asphalt	Ceramics	Concrete
AAC	77.9% (183)	4.3% (10)	0.4% (1)	17.4% (41)
Asphalt	1.8% (4)	88.9% (201)	0.4% (1)	8.8% (20)
Ceramics	2.6% (4)	0.6% (1)	95.5% (148)	1.3% (2)
Concrete	25.2% (52)	10.2% (21)	0.0% (0)	64.6% (133)

MLP ($\theta_{\text{test}} = 81.5\%$)

True label	Predicted label			
	AAC	Asphalt	Ceramics	Concrete
AAC	72.3% (170)	6.4% (15)	0.4% (1)	20.9% (49)
Asphalt	3.1% (7)	88.5% (200)	0.0% (0)	8.4% (19)
Ceramics	3.2% (5)	0.6% (1)	95.5% (148)	0.6% (1)
Concrete	18.4% (38)	7.3% (15)	0.5% (1)	73.8% (152)

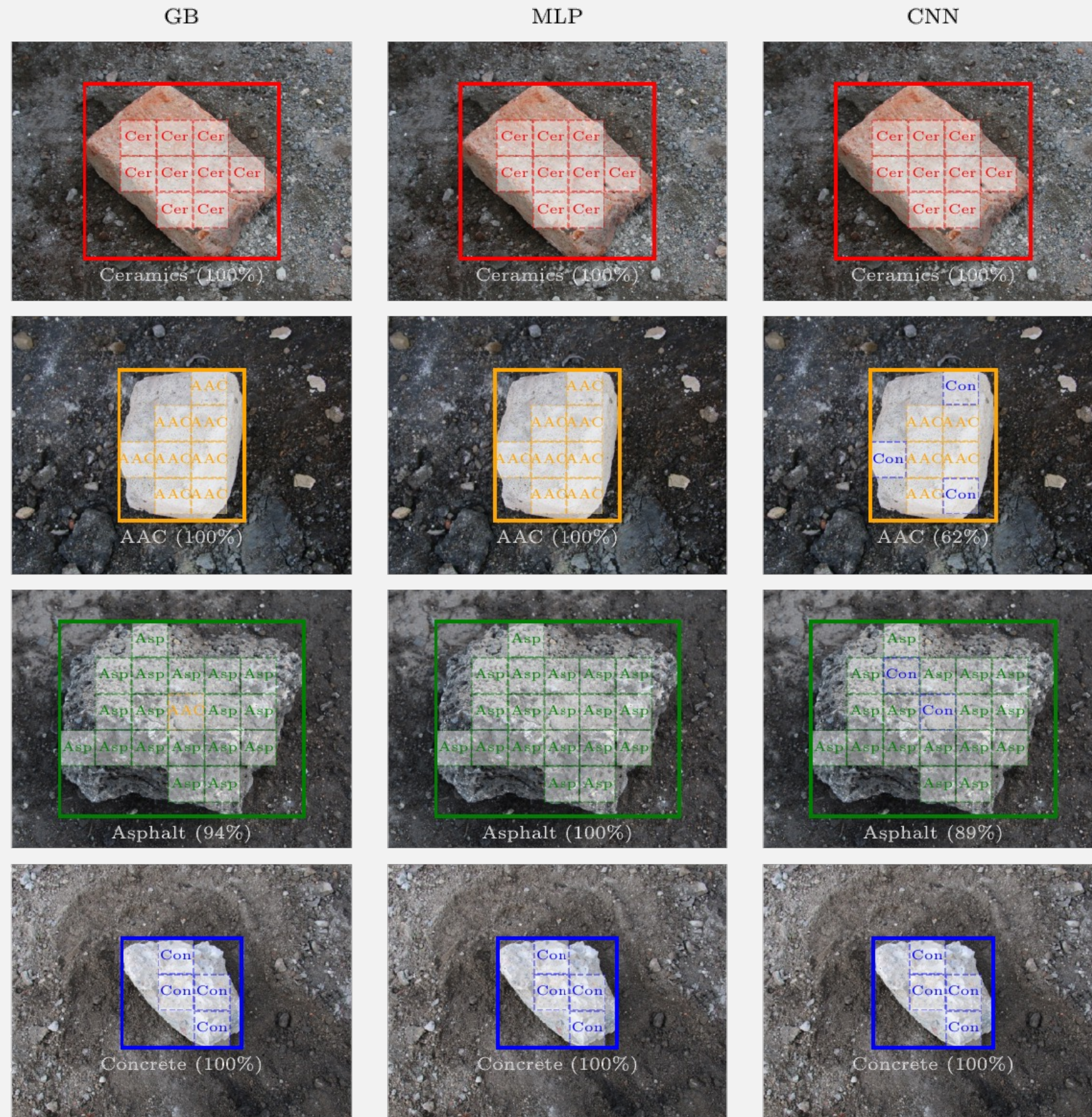
CNN ($\theta_{\text{test}} = 82.1\%$)

True label	Predicted label			
	AAC	Asphalt	Ceramics	Concrete
AAC	68.5% (161)	0.0% (0)	0.0% (0)	31.5% (74)
Asphalt	1.3% (3)	90.3% (204)	0.0% (0)	8.4% (19)
Ceramics	1.9% (3)	0.6% (1)	96.1% (149)	1.3% (2)
Concrete	8.7% (18)	12.1% (25)	1.0% (2)	78.2% (161)

Manual ($\theta_{\text{test}} = 87.2\%$)

True label	Predicted label			
	AAC	Asphalt	Ceramics	Concrete
AAC	84.5% (993)	0.0% (0)	0.8% (9)	14.7% (173)
Asphalt	0.2% (2)	82.1% (928)	0.1% (1)	17.6% (199)
Ceramics	0.1% (1)	0.3% (2)	97.7% (757)	1.9% (15)
Concrete	6.7% (69)	2.7% (28)	2.7% (28)	87.9% (905)

CDW RECOGNITION | Localization and recognition



CDW RECOGNITION | Segmentation (more fragments at a time) – ground truth masks

AAC



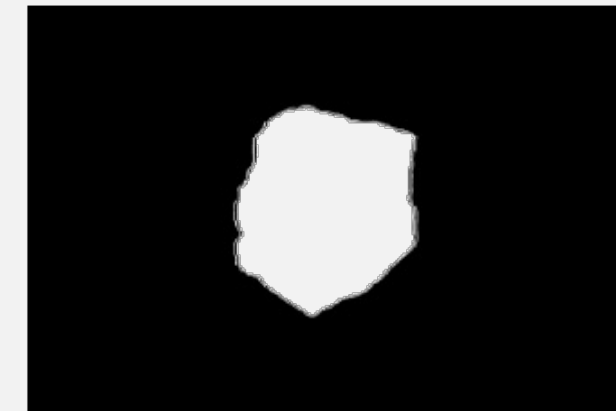
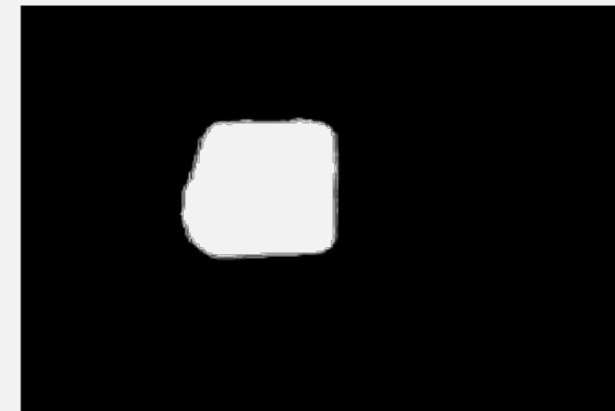
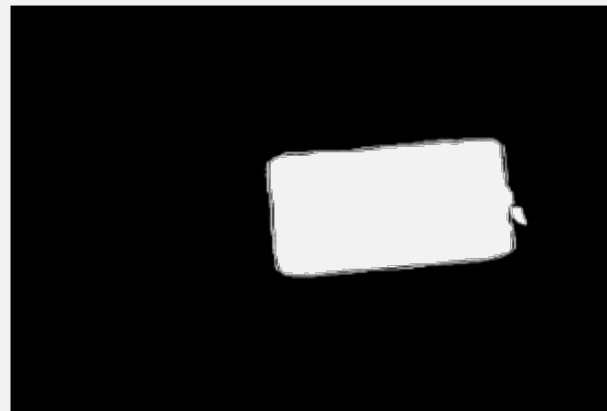
Asphalt



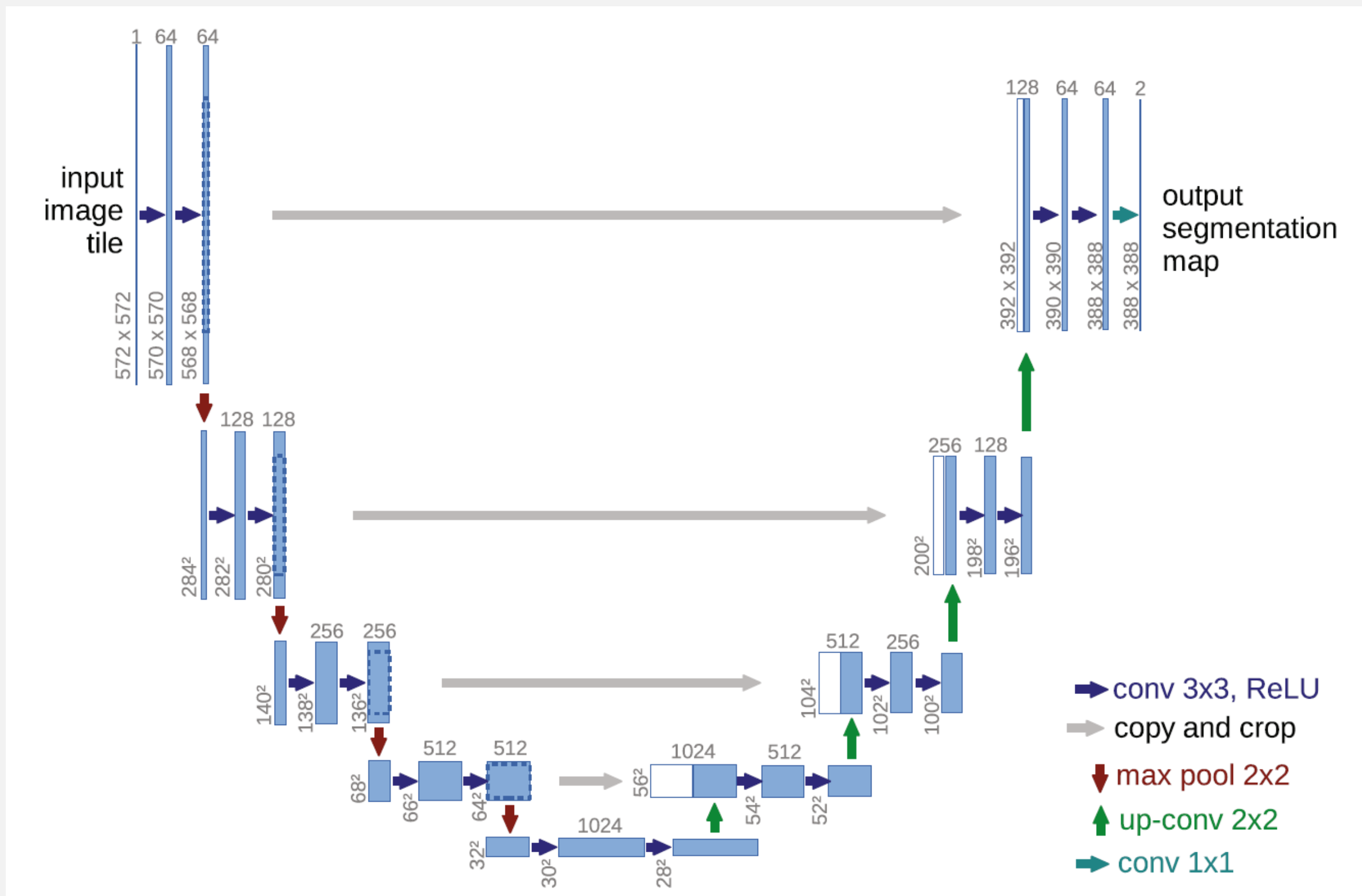
Ceramics



Concrete

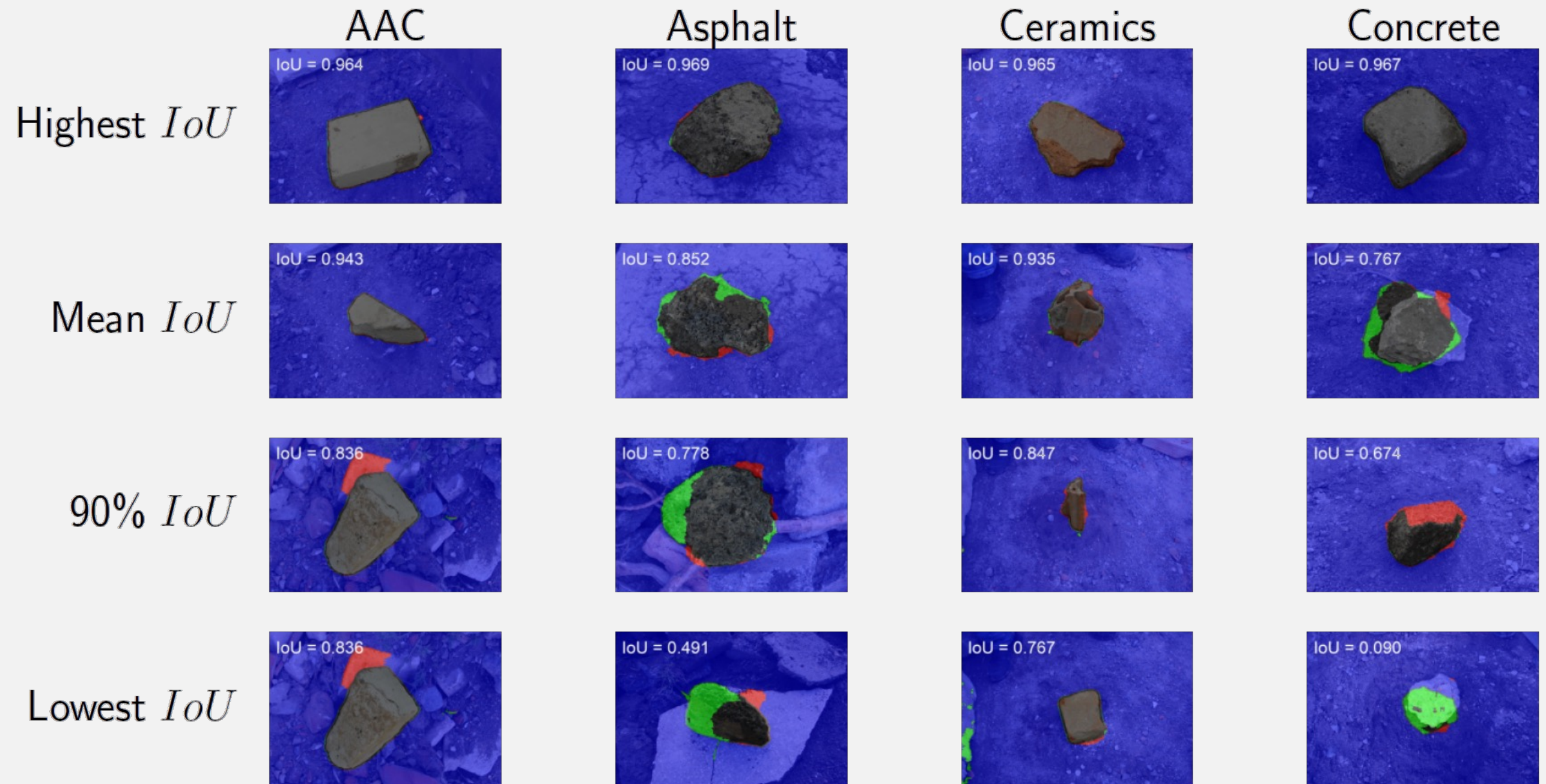


CDW RECOGNITION | Segmentation (more fragments at a time) – U-Net



CDW RECOGNITION | Segmentation (more fragments at a time) – Intersection over Union (*IoU*)

Class	Mean <i>IoU</i>
AAC	0.943
Asphalt	0.865
Ceramics	0.935
Concrete	0.767

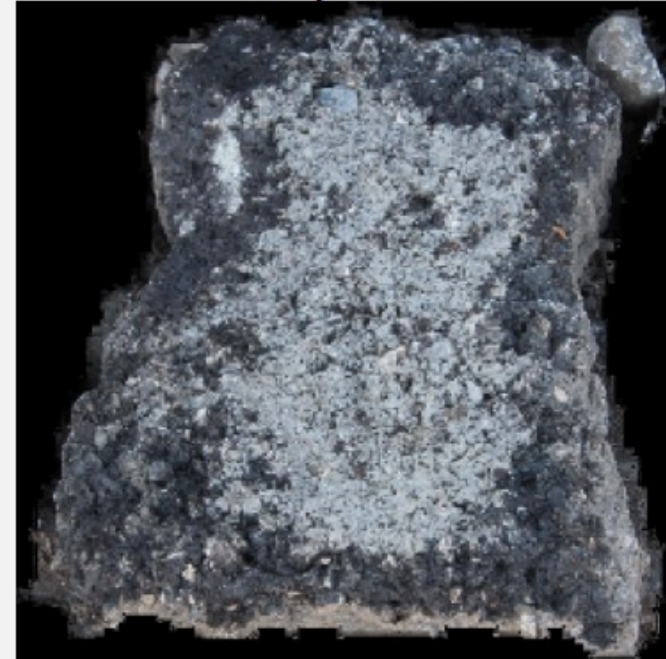


CDW RECOGNITION | Segmentation (more fragments at a time) – ResNet for classification

AAC



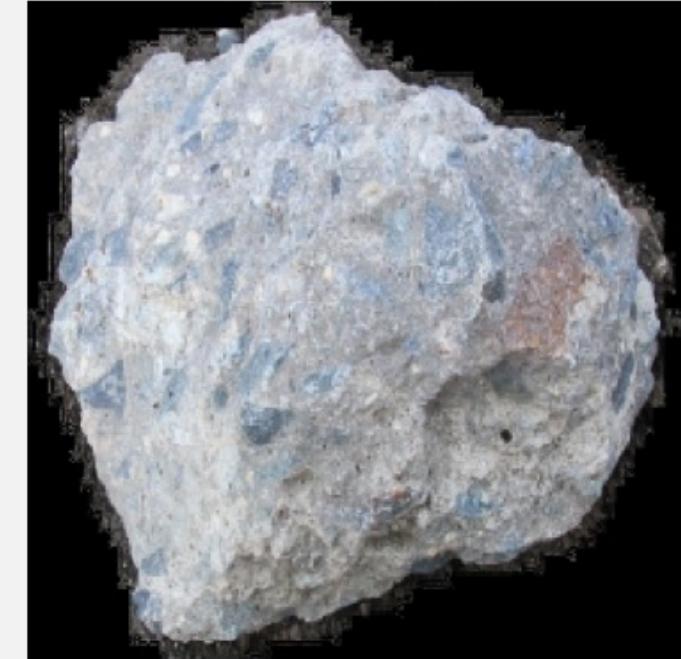
Asphalt



Ceramics



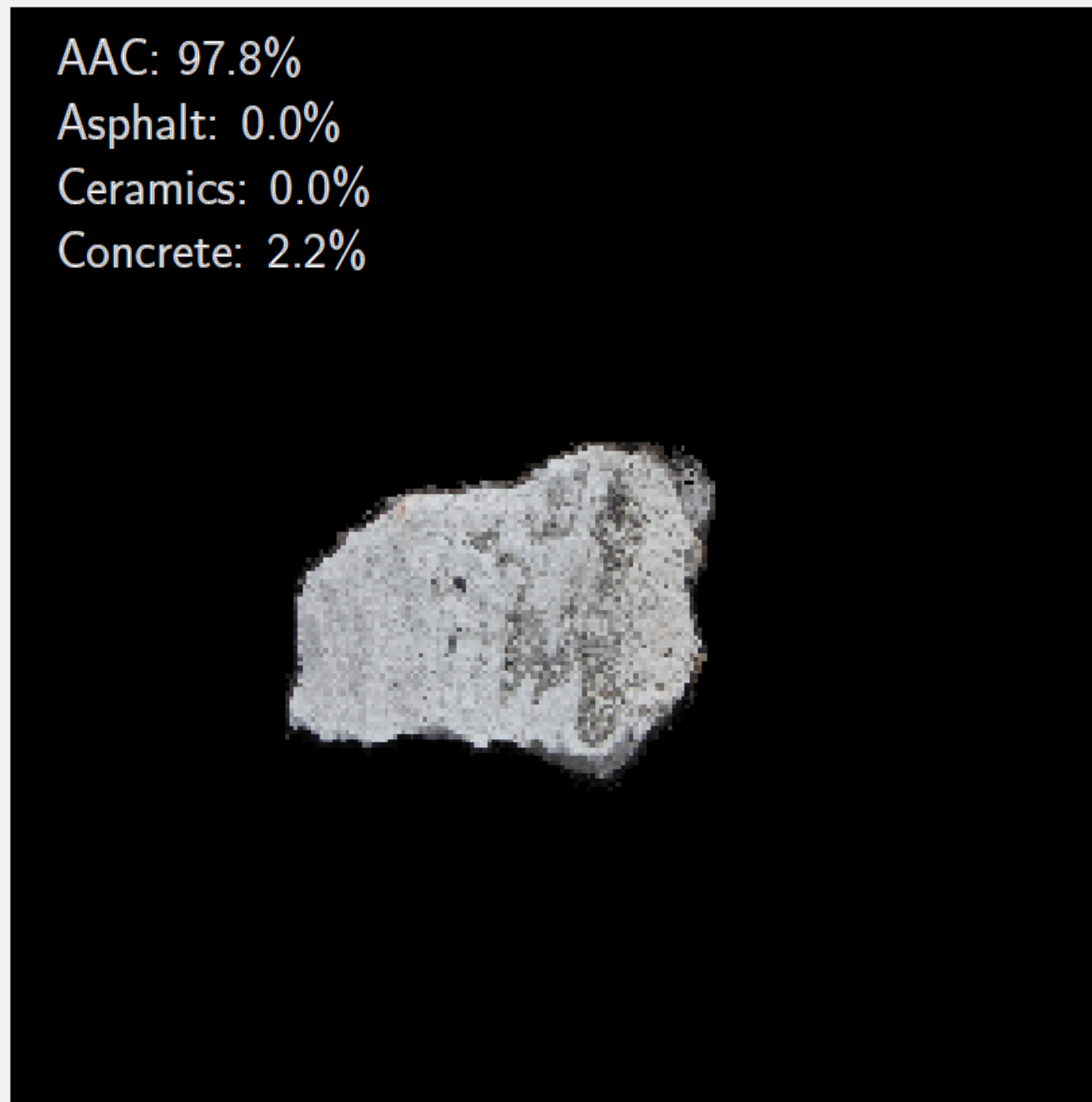
Concrete



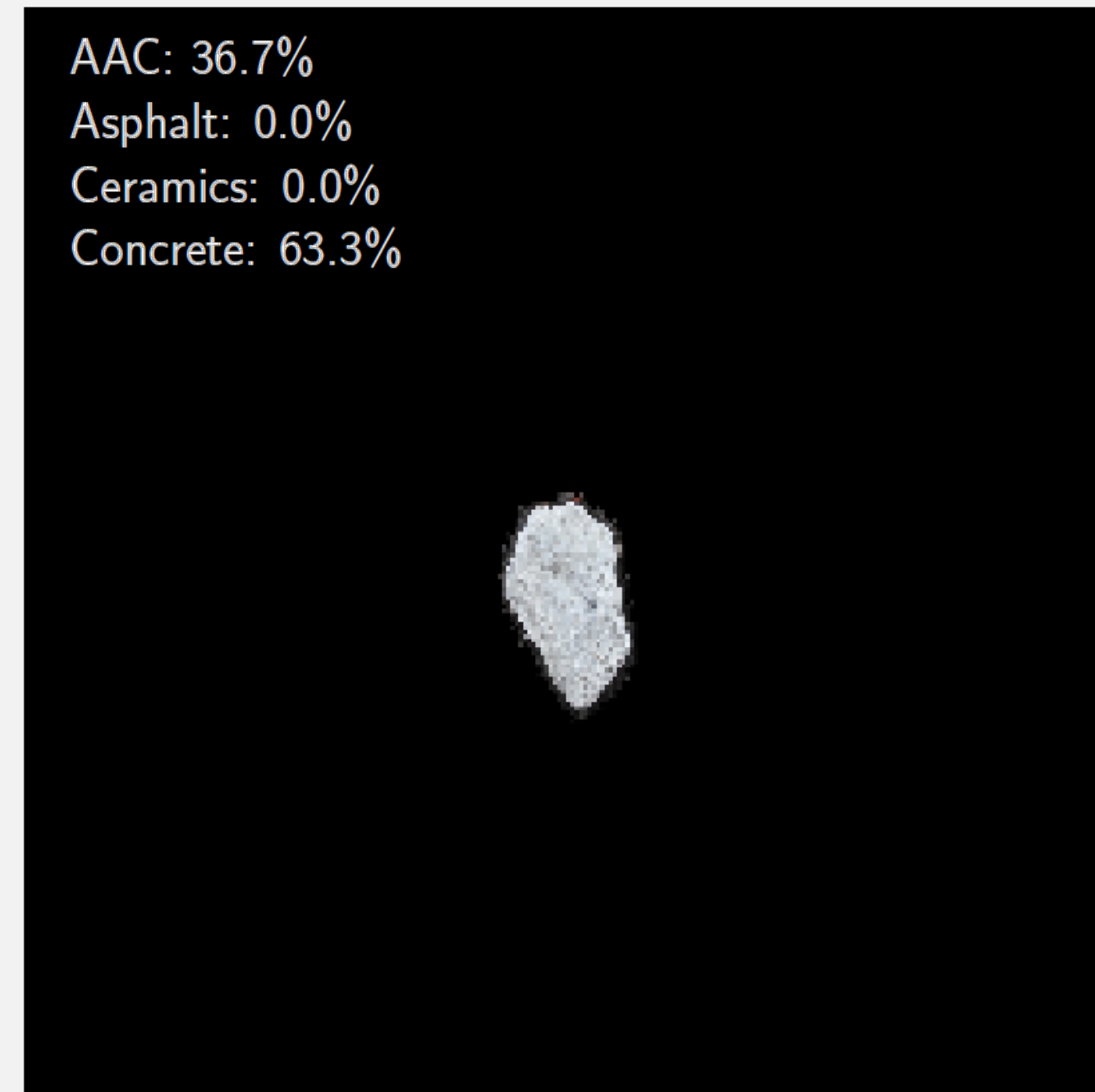
Model	Accuracy (%)
CNN	85.9%
GB	92.3%
MLP	91.3%
ResNet	95.3%

CDW RECOGNITION | Segmentation (more fragments at a time) – ResNet for classification

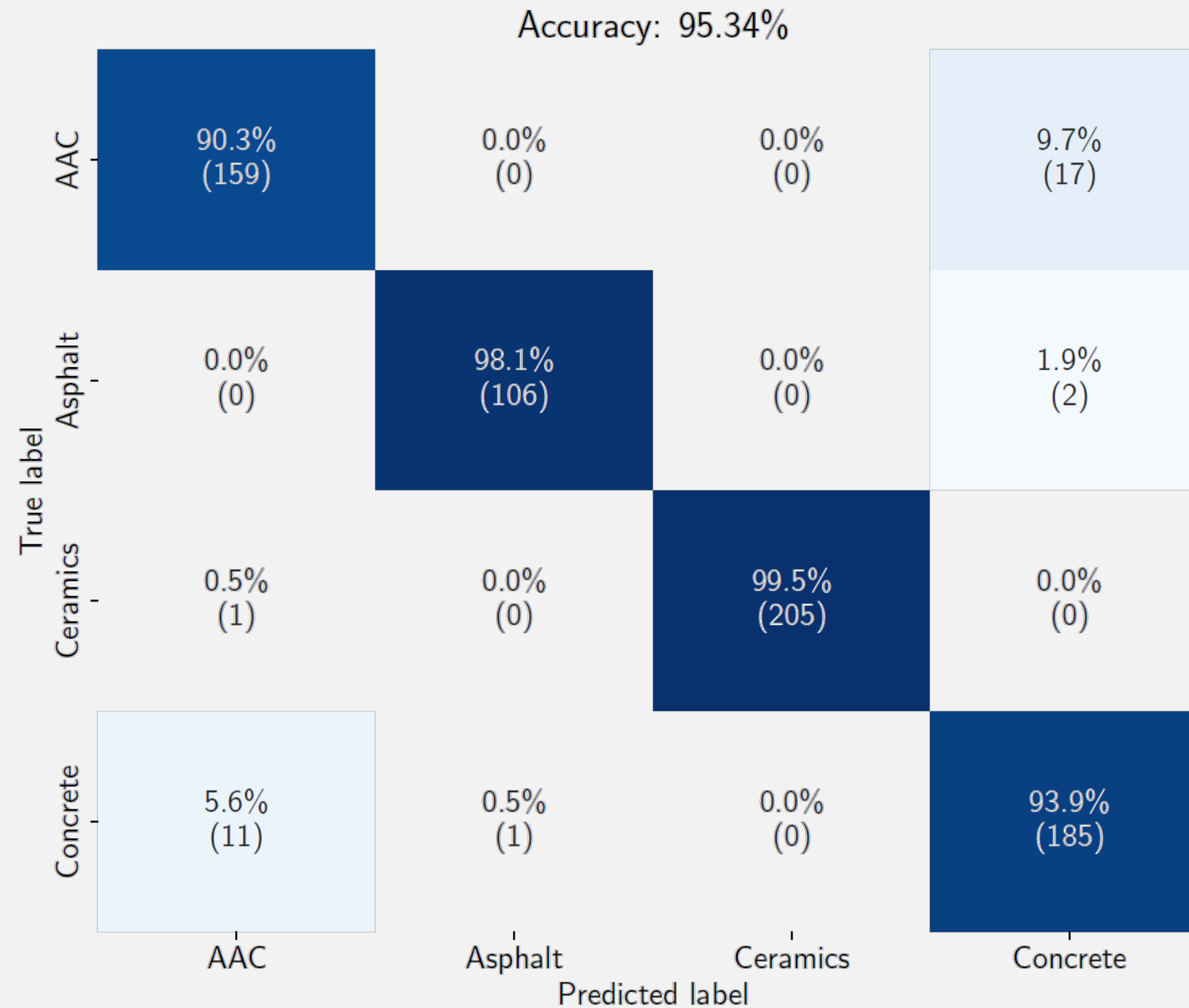
Correct Prediction



Incorrect Prediction



CDW RECOGNITION | Segmentation (more fragments at a time) – ResNet for classification





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THANK YOU FOR YOUR ATTENTION

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