



Automated Rock Slope Screening Using Computer Vision

Presented by: Zac Sala

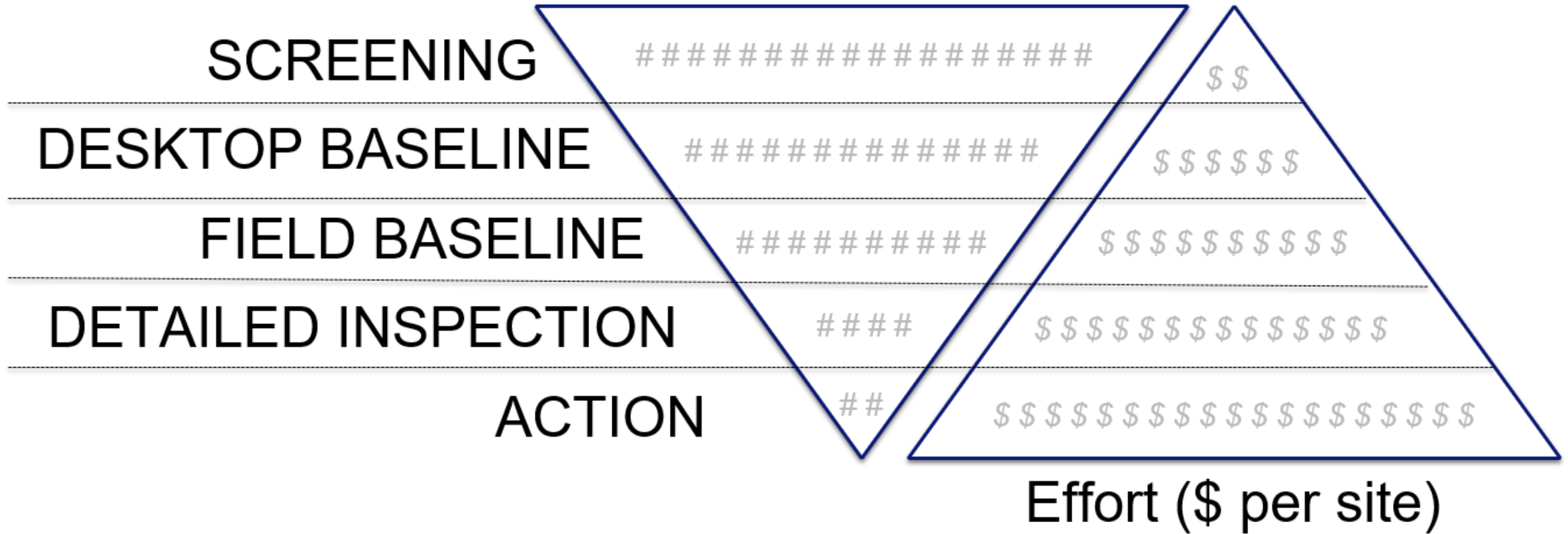
Event: TRB GAM Subcommittee Meeting

Date: January 6, 2021

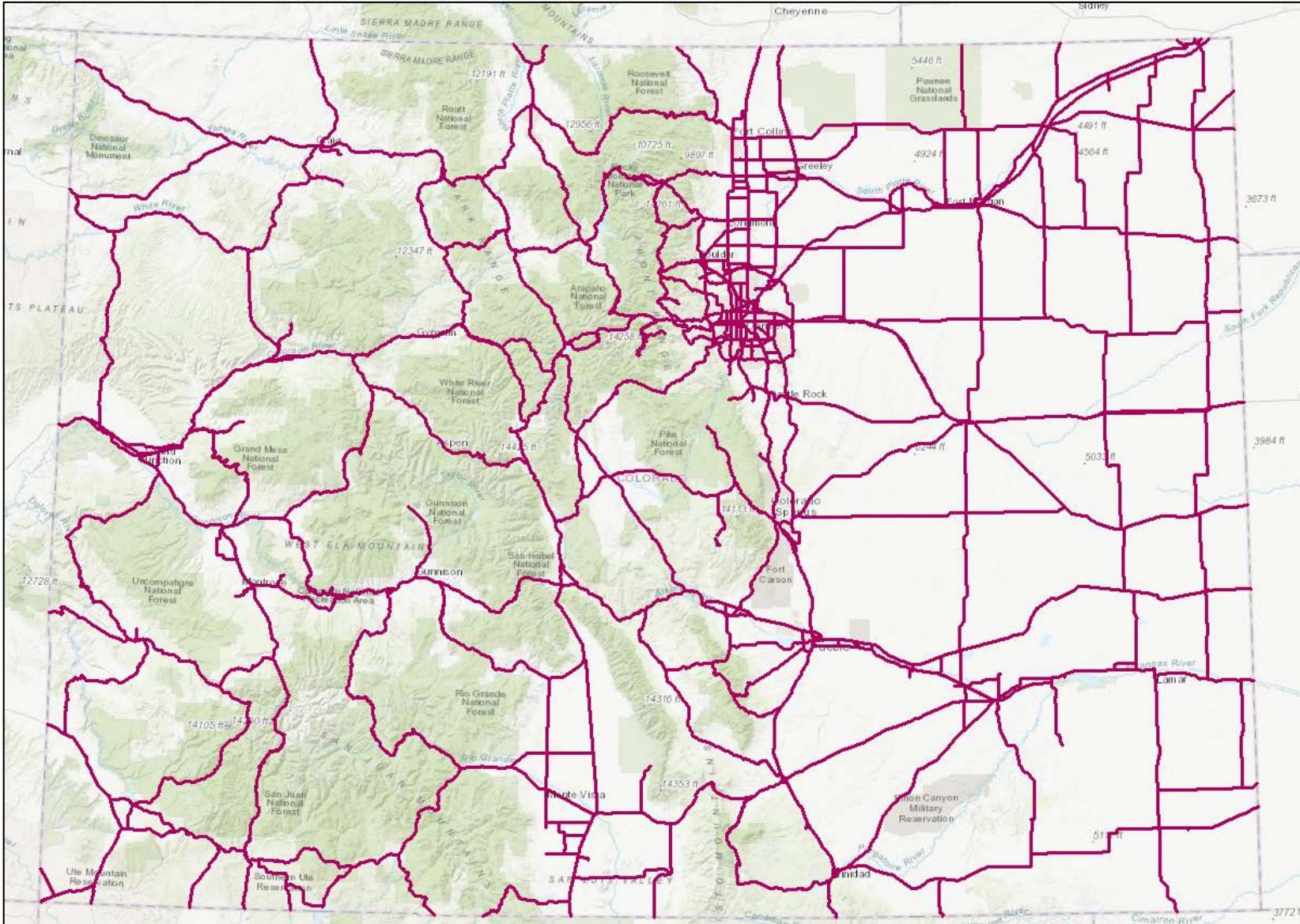


Risk Management Frameworks

Scale (# of sites)



The Scale is BIG!

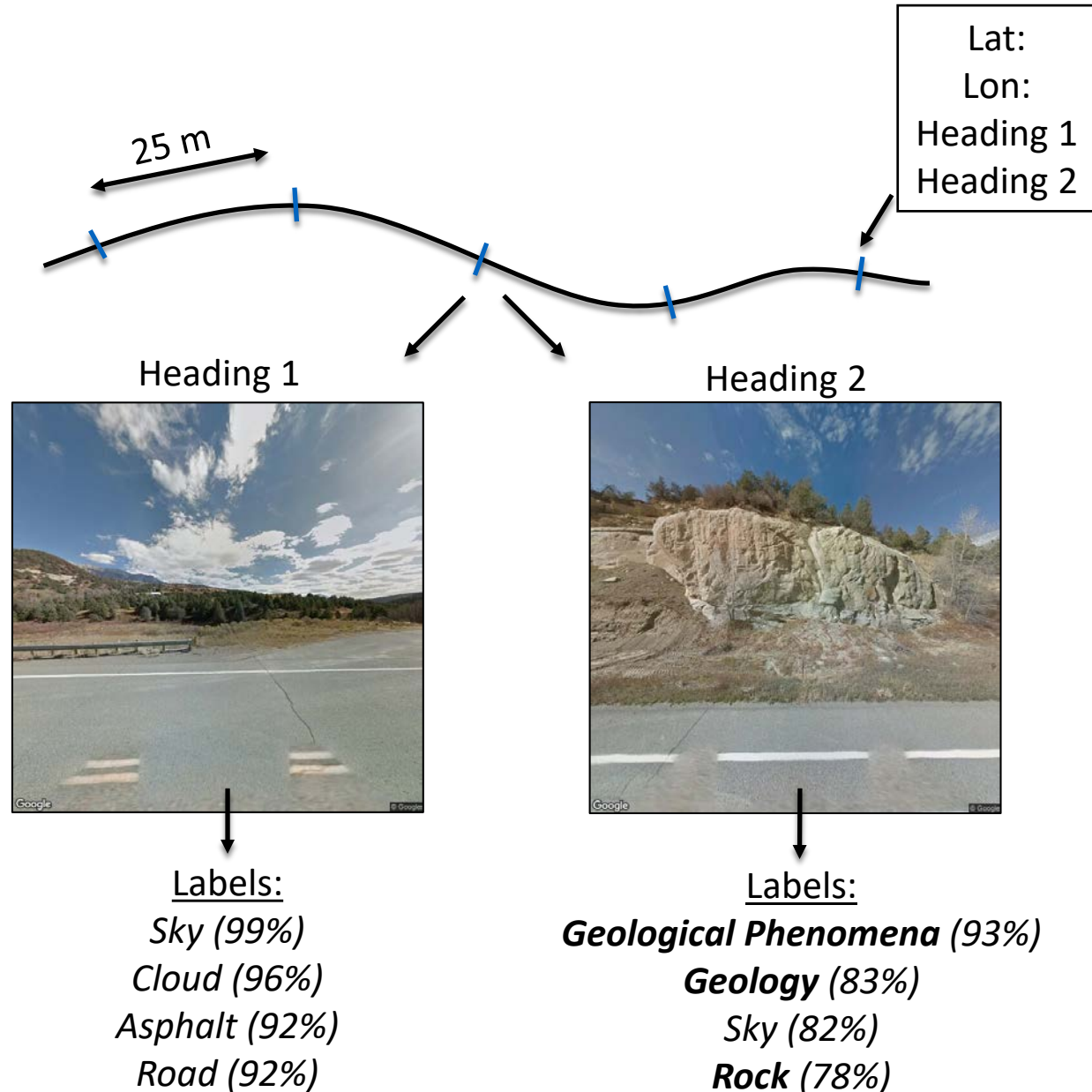
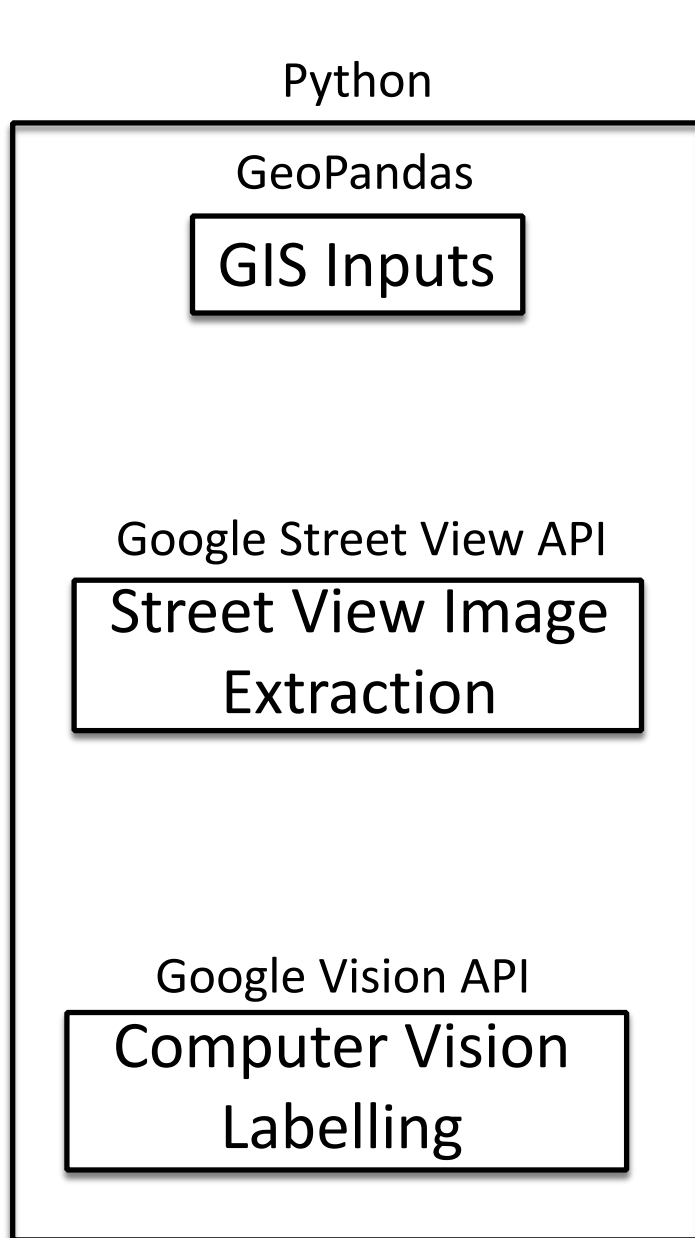


Colorado is BIG
>9,000 center-line miles

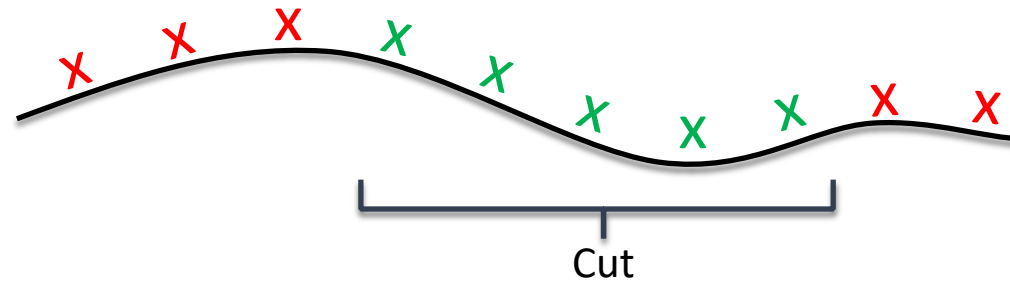
Death by 1000 Rock Slopes



The Solution

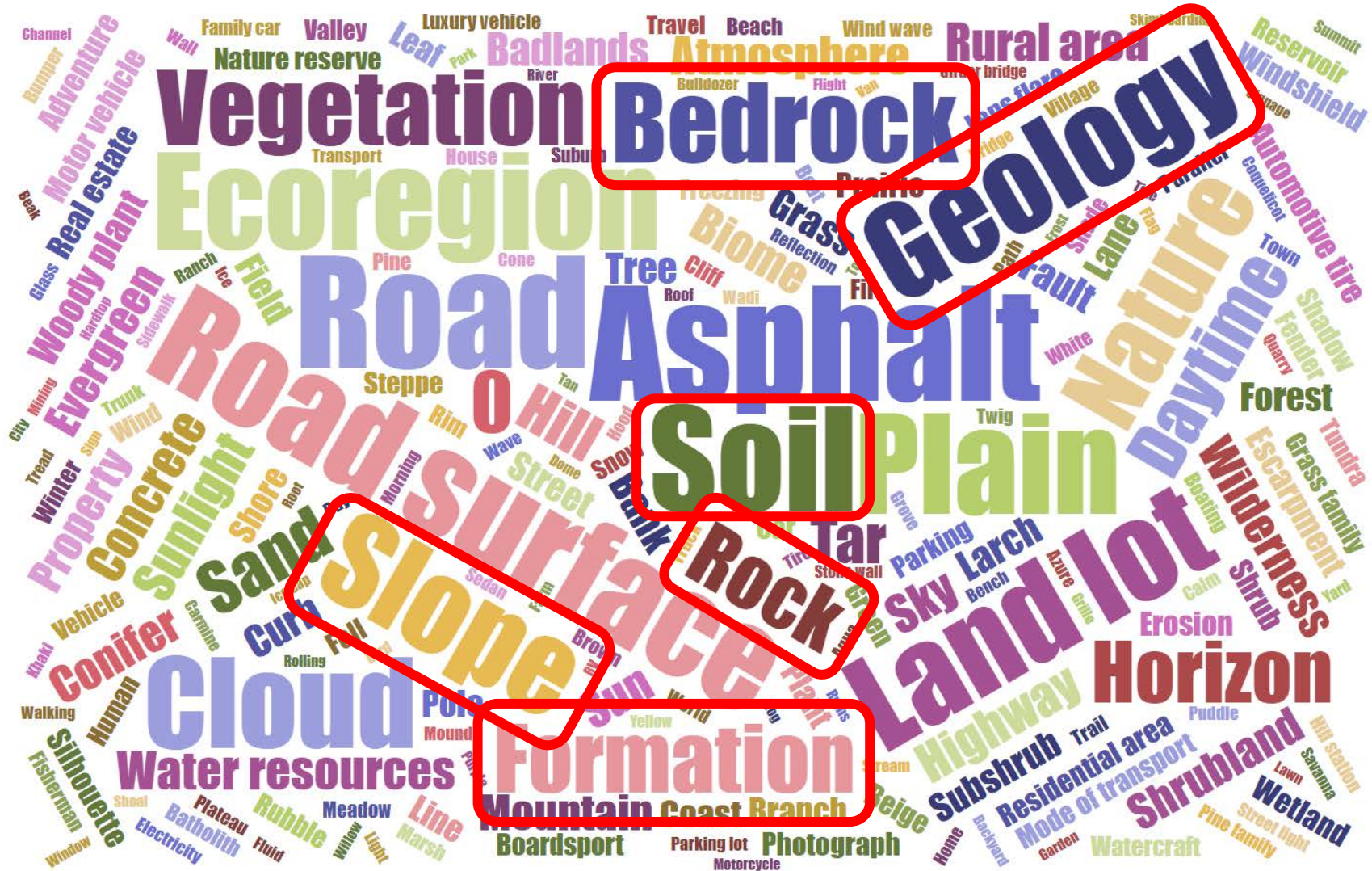


Defining Cuts



With sufficient photo spacing cuts can be delineated spatially using classification results

How Well Does it Work?



1000 Rock Cut Photos
1000 Not Rock Cut Photos

Even Google Gets Confused



CARNIVORE – 92%



MISSILE – 62%

Label Performance

Dominant Rock Cut Labels	Dominant Non-Rock Cut Labels
Terrain	Plain
Geology	Land lot
Geological phenomenon	Road
Soil	Asphalt
Bedrock	Landscape
Asphalt	Cloud
Road	Road surface
Formation	Ecoregion
Road surface	Infrastructure
Outcrop	Natural landscape

It's Working!

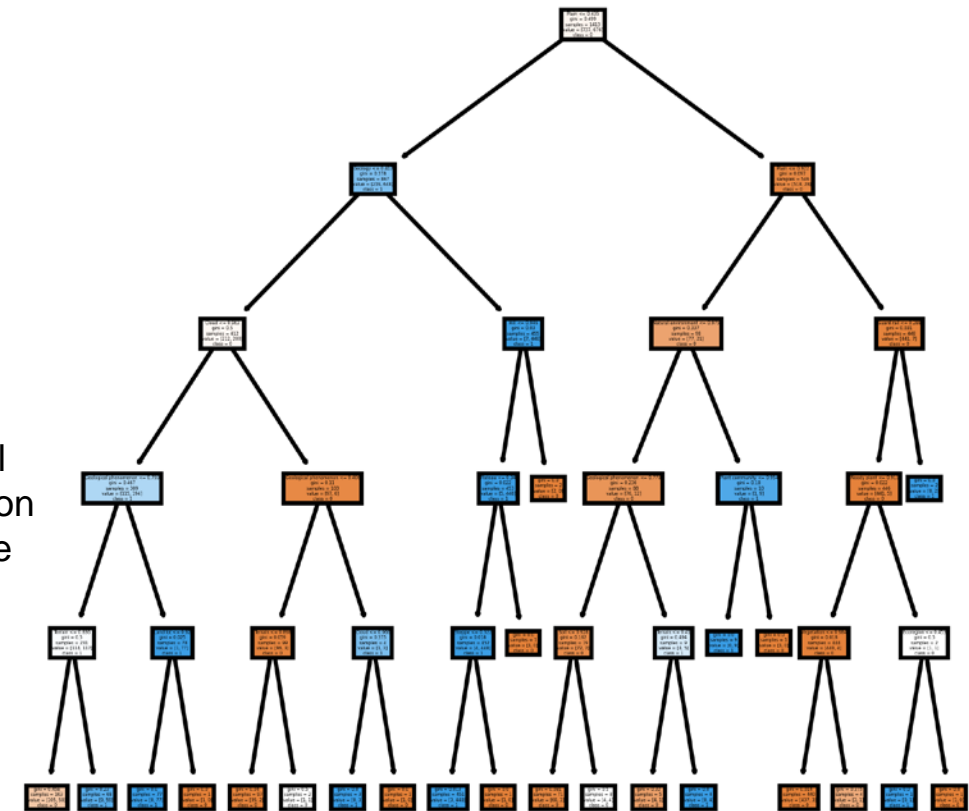
Logistic Regression (90-95% accuracy)

Logit Regression Results						
=====						
Dep. Variable:	rockbool	No. Observations:	2019			
Model:	Logit	Df Residuals:	2006			
Method:	MLE	Df Model:	12			
Date:	Tue, 08 Dec 2020	Pseudo R-squ.:	0.7612			
Time:	21:32:54	Log-Likelihood:	-333.93			
converged:	True	LL-Null:	-1398.4			
Covariance Type:	nonrobust	LLR p-value:	0.000			
=====						
	coef	std err	z	P> z	[0.025	0.975]

Plain	-2.0742	0.247	-8.384	0.000	-2.559	-1.589
Terrain	2.8333	0.367	7.716	0.000	2.114	3.553
Geology	2.1309	0.414	5.143	0.000	1.319	2.943
Geological phenomenon	2.5642	0.378	6.789	0.000	1.824	3.305
Slope	1.2001	0.298	4.029	0.000	0.616	1.784
Cloud	-1.7356	0.241	-7.195	0.000	-2.208	-1.263
Landscape	-1.4578	0.315	-4.632	0.000	-2.075	-0.841
Natural landscape	-1.3801	0.317	-4.352	0.000	-2.002	-0.758
Plant community	1.0785	0.297	3.631	0.000	0.496	1.661
Horizon	-2.7693	0.570	-4.859	0.000	-3.886	-1.652
Natural environment	1.6853	0.345	4.878	0.000	1.008	2.362
Daytime	-2.1201	0.571	-3.713	0.000	-3.239	-1.001
Hill	-2.8150	0.507	-5.549	0.000	-3.809	-1.821
=====						

Decision Trees (85-92% accuracy)

- Ex:
- Geology
 - Plain
 - Soil
 - Cloud
 - Slope
 - Hill
 - Geological phenomenon
 - Landscape
 - Terrain
 - Prairie
 - Landlot



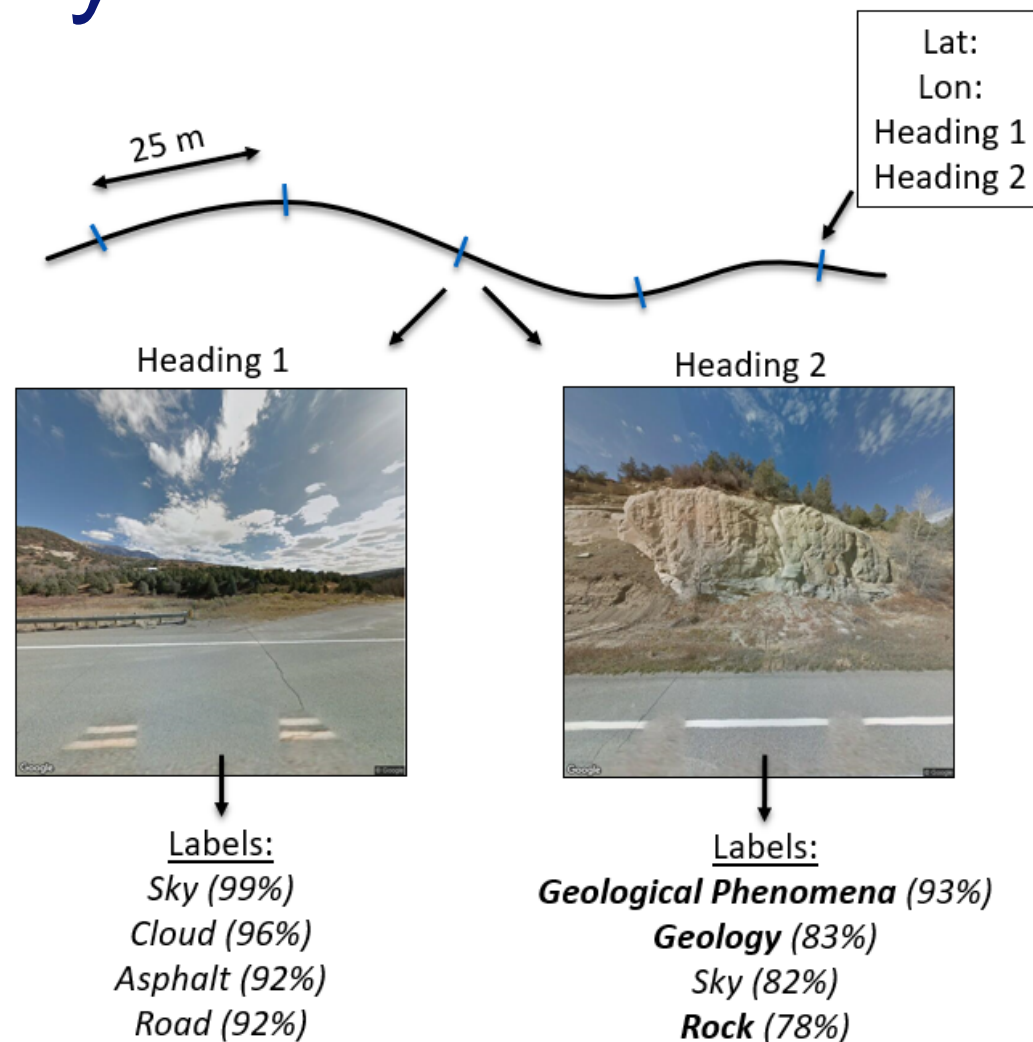
User Interface

BGC Slope Screening Tool

The screenshot displays the BGC Slope Screening Tool interface. On the left is a map of the western United States, showing state boundaries and major geographical features. The map is centered on the Colorado Plateau region. On the right, there is a control panel with two tabs: "Highway Markers" and "Point Locations". The "Point Locations" tab is active. Below the tabs, there are three input fields: "Highway" (set to 133A), "Starting Mile Point" (set to 20), and "Ending Mile Point" (set to 22). A blue "Process Section" button is located below these fields. Below the control panel, there is a "Location" field showing coordinates: 38.8197827749905, -107.69100803578401. To the right of the coordinates are "Zoom To" and "Collapse" buttons. Below the location field, there is a photo viewer showing a landscape image of a desert valley. Above the photo, the azimuth is displayed as 116.0883065084. At the bottom left of the map area, there is a "(VIDEO)" label. At the bottom center, there is a "Powered by Esri" logo.

Summary

- Using Google's pre-trained machine learning algorithms
- Can be applied to large ubiquitous street level datasets
- Speed up assessment workflow for large # of sites – allowing for multiple iterations, making change detection easier as new data becomes available



Future Work

- Refine photo extraction code for complex highway geometries
- Add image masking/editing methods to remove photo artifacts such as the street view car shadow
- Select final classification scheme
- Test in areas outside of Colorado
- Apply to other street level data, such as State DOT roadway survey databases

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