**COSMIC Semantic Segmentation Framework**

(Content-based Object Summarization to Monitor Infrequent Change)  
CL #18-4652

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**Long-term Problem:** Deep space missions such as the Mars Reconnaissance Orbiter collect more data than can be sent back to Earth due to limited communications bandwidth.

**Long-term Solution:** Machine learning algorithms can be deployed on board orbiters to prioritize the downlink of scientifically interesting images to Earth, making better use of limited communications bandwidth.

**Given a dataset of interesting images, like impact craters:**

...And semantic labels for those images:

...We can train models to identify new, unseen, valuable images.

**Immediate Problem:** However, basic machine learning research is necessary to boost real-world performance on identifying these images, and numerous neural network architectures must be evaluated in terms of accuracy and compute requirements, which involves software development challenges.

**Immediate Solution:** A framework is designed to reduce redundant development, to standardize the algorithm testing process, and to allow developers to focus on the implementation details of novel machine learning algorithms.

**2) Using subsets of the Dataset of LabeledImages for training and testing...**

**3) We can Evaluate models consistently after a standardized Curriculum.**

**4) And Log the results in an easily-comparable format.**

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from cosmic import *  
# 1. Easily modify or extend models  
class VggNet19_Dice(Vgg19Model):  
    name = 'VGG19/dice'  
    def loss(self, x, y):  
        yhat = self.heatmap(x)  
        return dice_loss(y, yhat)

# 2. Test them in one line  
Evaluator(VggNet19_Dice(), Dataset({'./fresh_impacts'}))

# ...many hours of computing  
# 3. See results in ./VGG19/dice

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**Conclusion:** The framework designed and the utility modules included will help researchers to efficiently test and compare new machine learning models with a torrent of newly-labeled data of the Martian surface.