

# Feature Extraction and Classification of Plankton

We done things

Dane Skinner   Nick Hockensmith   Kevin Park

Oregon State University

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# Questions of Interest

- Using Histogram and Image Moments as a image feature extraction how accurate are the classification of plankton?

# Kratuchok's Moments

- Calculating *Kratuchok's* moments,

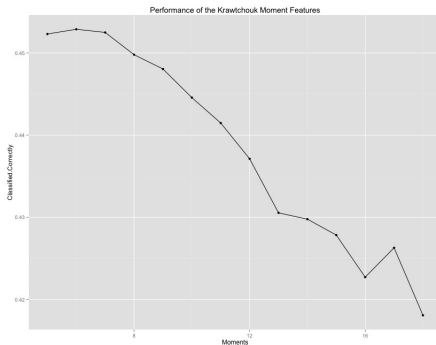
$$Q_{nm} = \sum_{x=0}^{N-1} \sum_{y=0}^{M-1} \bar{K}_n(x; p_1, N-1) \bar{K}_m(y; p_2, M-1) f(x, y),$$

where  $f(x, y)$  is the pixel intensity,  $K_n(a; p, N)$  are the weighted Krawtchouk polynomials, and  $m, n \in \mathbb{N}$  is the order of the moment in the  $x$ - and  $y$ -direction.

- Kratuchok moments are invariant under scaling, rotation, and translation.

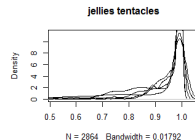
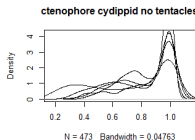
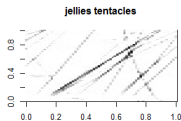
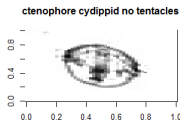
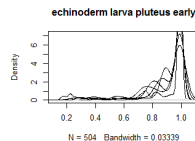
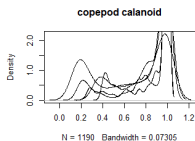
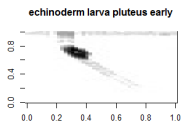
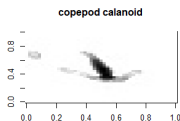
# Kratuchok's Moments

- The training set was further divided into a training and validation set to determine the order of moments that yielded the “best” classification of the validation set.
- As you can see below, it appears that the 6<sup>th</sup> moment offers the best prediction of the validation set.



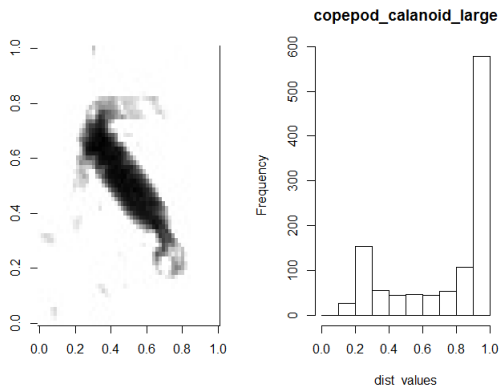
# Histogram Method

- Some of species of plankton give distinct distributions of gray scale values.



# Histogram Method

- The grayscale is on a  $[0,1]$  interval and we partition the interval into a width of 0.1.
- We have count the number of values that are between  $[0, 0.1]$ ,  $[0.1, 0.2]$ ,  $\dots$ ,  $[0.9, 1]$ .



# Indicoio Package and kNN

- This produces a sparse, 2048 digit feature vector for each image that can then be used to calculate the Euclidean distances between different feature vectors.
- The data extracted from Indicoio was too "noisy" for kNN to make any accurate classifications and the large number of classes made it difficult for computation time.
- The kaggle score was 8.1 ( $\sim 1001$  ranking).

# Kaggle Results: Histogram & Momements

- We were fairly surprised at some of our results.
- Histogram method produced a score of 3.29.

660	11	Miusay	3.288775	2	Wed, 11 Mar 2015 23:58:04	
-		<b>Keyark</b>	<b>3.295601</b>	-	Mon, 11 May 2015 09:38:29	Post-Deadline
<b>Post-Deadline Entry</b> If you would have submitted this entry during the competition, you would have been around here on the leaderboard.						
661	11	Attila Egri	3.305361	22	Mon, 16 Mar 2015 23:45:01 (-39.73)	
662	11	Sinbad <sup>18</sup>	3.326039	3	Wed, 21 Jan 2015 14:27:00	

- Combination of Histogram and 10<sup>th</sup>-order Krawtchouk scored 2.66<sup>1</sup>.

597	-	Pieter Gerrit Bosma	2.653109	1	Fri, 19 Dec 2014 09:01:26	
598	-	Shical Yang	2.657105	9	Fri, 06 Feb 2015 09:31:45 (-3.9d)	
-		<b>Black Heart</b>	<b>2.668862</b>	-	Tue, 12 May 2015 16:31:39	Post-Deadline
<b>Post-Deadline Entry</b> If you would have submitted this entry during the competition, you would have been around here on the leaderboard.						
599	12	Dan Tybor	2.668967	3	Wed, 14 Jan 2015 04:13:31	

<sup>1</sup>readJPEG not set to default



# Kaggle Results:

- 20<sup>th</sup>-order Krawtchouk moments produced a score of 2.18.

522	12	BRES 90	2.173581	6	Mon, 16 Mar 2015 23:35:47 (-0.1h)
-		<b>Black Heart</b>	<b>2.183565</b>	-	<b>Thu, 14 May 2015 01:21:01</b> <small>Post-Deadline</small>
<b>Post-Deadline Entry</b> If you would have submitted this entry during the competition, you would have been around here on the leaderboard.					
523	12	39rus	2.185156	6	Tue, 23 Dec 2014 23:13:32

- Histogram and 6<sup>th</sup>-order Krawtchouk combo produced a score of 2.13.

514	16	BearZhou	2.126454	9	Sat, 14 Mar 2015 01:13:42 (-0.2h)
-		<b>Black Heart</b>	<b>2.131628</b>	-	<b>Thu, 14 May 2015 21:33:30</b> <small>Post-Deadline</small>
<b>Post-Deadline Entry</b> If you would have submitted this entry during the competition, you would have been around here on the leaderboard.					

# Conclusions and Final Thoughts

- Krawtchouk moments required 400 features to achieve it's best Kaggle rank of 523/1049.
- The Histogram method required only 10 features to achieve it's best Kaggle rank of 661/1049.

As future work,

- Perform variable selection for dimension reduction on the Krawtchouk moments.
- Increase the number of bins measured in the Histogram method.
- Look towards 2-D filters for additional features.