

A rapid machine-learning approach for detecting fish species and body parts

using rapid evaporative ionisation mass spectrometry

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GP [1, 2, 3] inspired by reproductive behaviour of animals





Topics

- 1 Catfishing
- 2 Fish Oil
- 3 Mass Spectrometry
- 4 Classification
- 5 Transformer
- 6 Interpretable Models



Have you been catfished? [4]



Popular restaurant accused of serving cheap Vietnamese catfish to customers who thought they were getting Australian dory

- A Melbourne restaurant has been accused of serving catfish to customers
- Hunky Dory has allegedly been selling frozen fillets of basa as dory
- Owner Greg Robotis has denied allegations he is misleading customers
- The City of Port Phillip is investigating Hunky Dory's Port Melbourne store

By [HARRY PEARL FOR DAILY MAIL AUSTRALIA](#)

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A Melbourne restaurant has been accused of serving a Vietnamese catfish to customers who believe they are ordering Dory.

A whistleblower has alleged that Hunky Dory outlets have been selling frozen fillets of basa, a species of catfish native to the Mekong basin, as fish-of-the-day dory, [The Age](#) reports.

Owner Greg Robotis has denied the claims and said inexperienced staff may have been calling the fish the wrong name.



Aussies! No surprises there...



Catfishing [4], Mislabelling [5], and Quality Assurance [6]

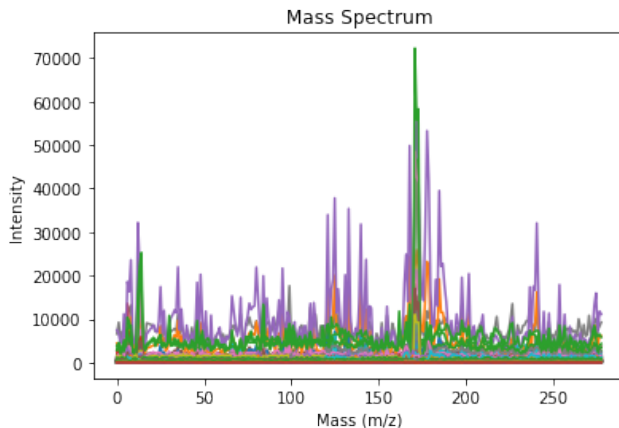
Nutrition Facts	
6 servings per container	
Serving size	4-5 ounces(187g)
Amount per serving	
Calories	200
% Daily Value*	
Total Fat 5g	6%
Saturated Fat 0.5g	3%
Trans Fat 0g	
Cholesterol 80mg	27%
Sodium 610mg	27%
Total Carbohydrate 10g	4%
Dietary Fiber 0g	0%
Total Sugars 3g	
Includes 0g Added Sugars	0%
Protein 27g	
Vitamin D 2mcg	10%
Calcium 79mg	6%
Iron 3mg	15%
Potassium 519mg	10%
*The % Daily Value tells you how much a nutrient in a serving of food contributes to a daily diet. 2,000 calories a day is used for general nutrition advice.	



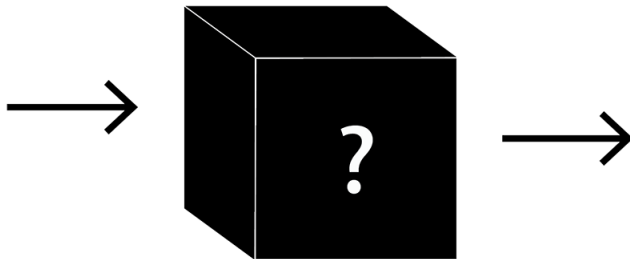
Fish oil is brain food! [7, 8]



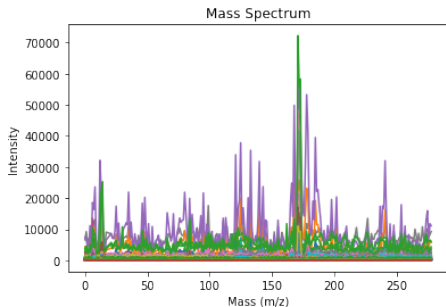
Fish oil analyzed with Mass Spectrometry! [6]



Fish oil analysis can't be blackbox! [9, 10]

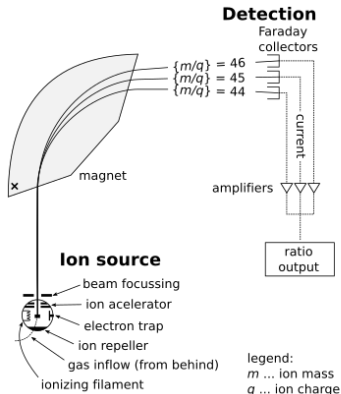


Mass Spectrometry [11, 6, 12] \approx Chemical Fingerprint



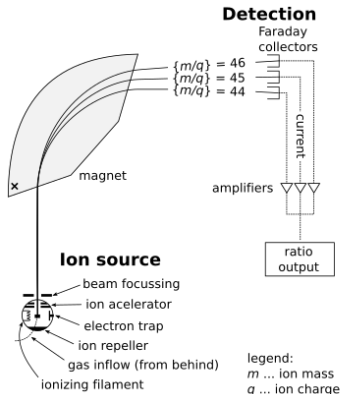
Mass Spectrometry: Steps

- 1 Laser Pen
- 2 Vacuum
- 3 Electromagnetic Field (EMF)
- 4 Detector



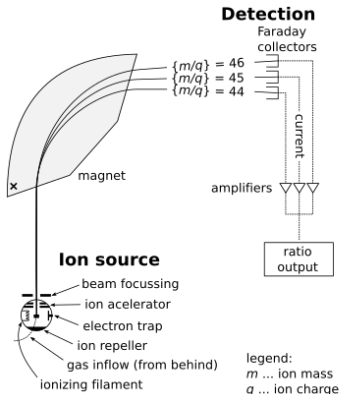
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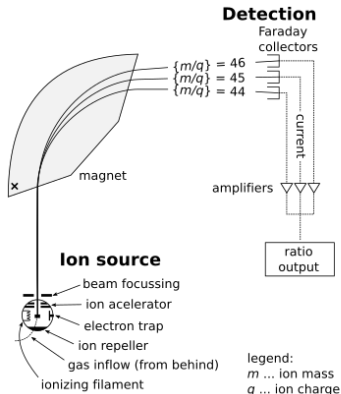
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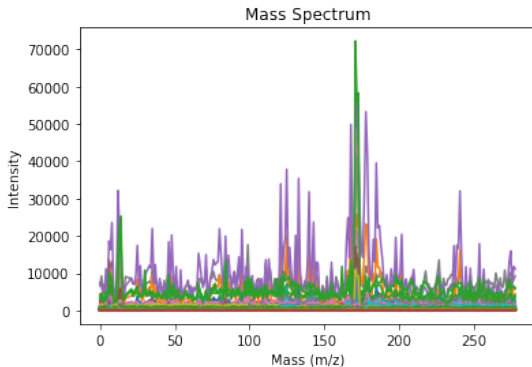
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Mass Spectrometry: Steps

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Fish Species



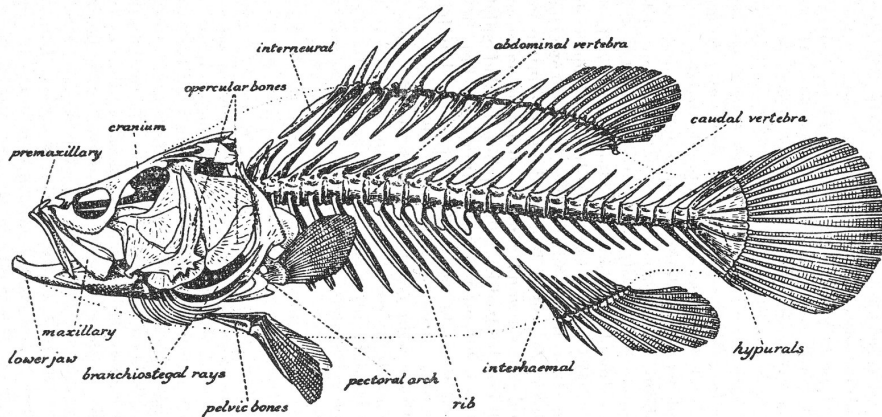
Hoki




Mackerel



Fish Body Parts



Body parts  : fillets, heads, livers, skins, guts and frames



Classification: Datasets



Dataset

Species 

Parts 




Classification: Methods

Dataset	Method
Species  Parts 	RF [13]
	KNN [14]
	DT [15]
	NB [16]
	LR [17]
	SVM [18]
	LDA [19]
	Ensemble [20]
	Transformer [21, 22]
	MCIFC [2, 3]




Classification: Fish Species

Dataset	Method	Train	Test
Species 	RF [13]	100.0% \pm 0.00%	95.88% \pm 4.47%
	KNN [14]	93.24% \pm 2.43%	83.69% \pm 6.91%
	<i>DT [15]</i>	<i>100.0% \pm 0.00%</i>	<i>99.13% \pm 1.72%</i>
	NB [16]	100.0% \pm 0.00%	87.97% \pm 9.57%
	LR [17]	100.0% \pm 0.00%	96.72% \pm 4.75%
	SVM [18]	100.0% \pm 0.00%	95.97% \pm 5.06%
	LDA [19]	98.67% \pm 0.77%	96.47% \pm 3.67%
	Ensemble [20]	100.0% \pm 0.00%	98.16% \pm 3.00%
	Transformer [21, 22]	100.0% \pm 0.00%	99.58% \pm 1.31%
	MCIFC [2, 3]	99.97% \pm 0.15%	94.72% \pm 10.25%

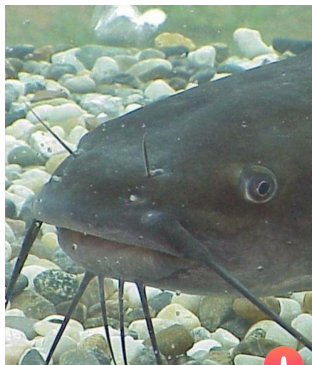


Classification: Fish Body Parts

Dataset	Method	Train	Test
Parts 	RF [13]	100.0% \pm 0.00%	40.00% \pm 15.27%
	KNN [14]	42.88% \pm 5.37%	31.66% \pm 14.49%
	DT [15]	100.0% \pm 0.00%	27.22% \pm 13.25%
	NB [16]	100.0% \pm 0.00%	45.00% \pm 15.60%
	LR [17]	100.0% \pm 0.00%	56.66% \pm 15.27%
	SVM [18]	100.0% \pm 0.00%	56.11% \pm 14.58%
	LDA [19]	75.61% \pm 3.20%	45.55% \pm 16.06%
	Ensemble [20]	100.0% \pm 0.00%	51.66% \pm 15.72%
	Transformer [21, 22]	100.0% \pm 0.00%	63.33% \pm 24.59%
	MCIFC [2, 3]	97.93% \pm 1.59%	55.83% \pm 18.97%



Classification: Avoid Catfishing [4] & Mislabelling [5]



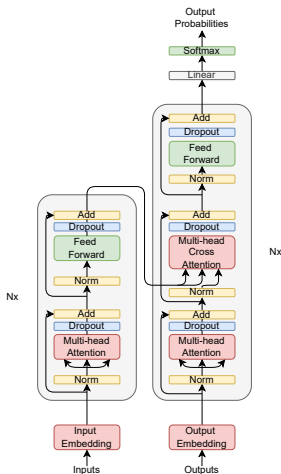
Real Human, 19

📍 8 kilometres away

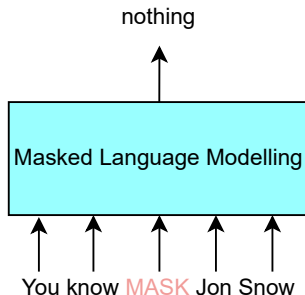
Hello i am real human i enjoy the human hobbies of breathing and walking around on my leg



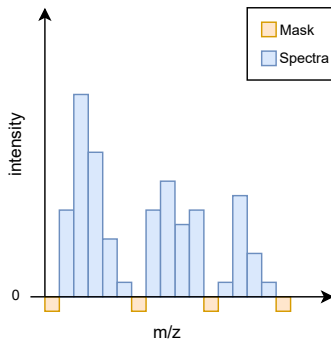
Transformer Architecture [21]



Pre-Training: Masked Spectra Modelling [22]



Pre-Training: Masked Spectra Modelling [22]

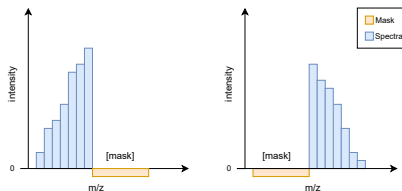


Pre-Training: Next Spectra Prediction [22]

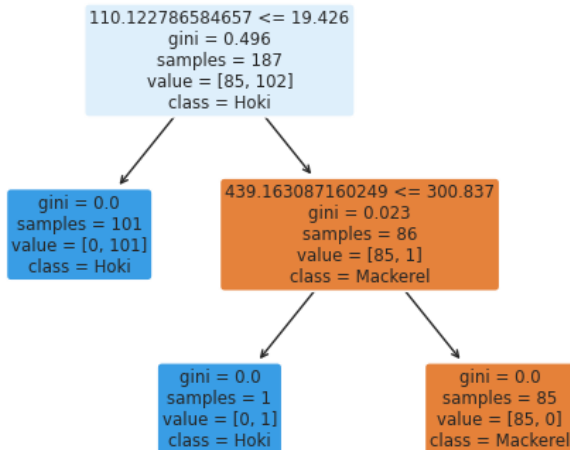
Sentence 1	Sentence 2	Next Sentence?
The quick brown fox	jumped over the lazy dog.	Yes
The quick brown fox	You know nothing Jon Snow.	No



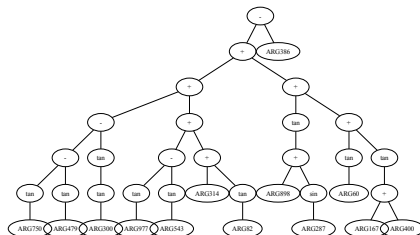
Pre-Training: Next Spectra Prediction [22]



Decision Tree



Genetic Programming Tree - Hoki



Genetic Programming Tree - Fish Species Hoki



Transformer can predict fish species with near-perfect accuracy, **DT** and **GP** provide **accurate**, **interpretable** and **efficient** models for **Rapid Evaporative Ionisation Mass Spectrometry**.



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