Using machine learning to support autonomous vehicles making moral decisions

STAT 451 Project

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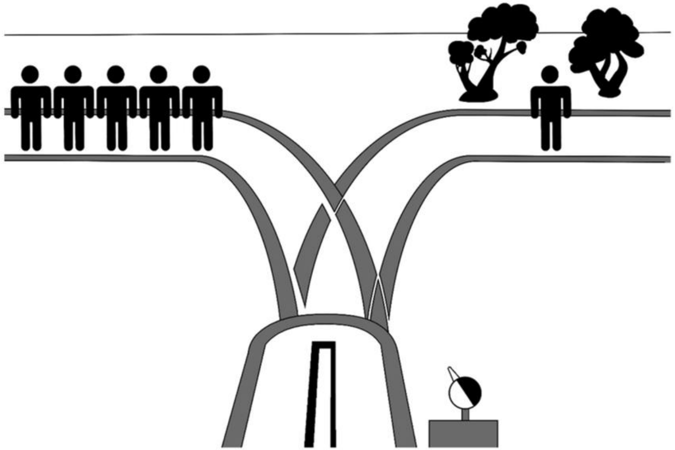
❑ Research Questions

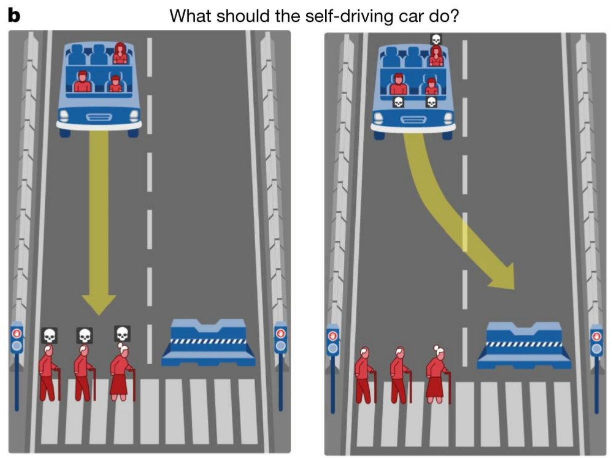
➢ How autonomous vehicle deal with moral dilemmas?



Objective: develop a model to help AV make decisions when facing moral dilemmas.

❑ Research Questions

➢ If you were an AV, what will you do? — an online experiments conducted by Edmond et al., 2018.



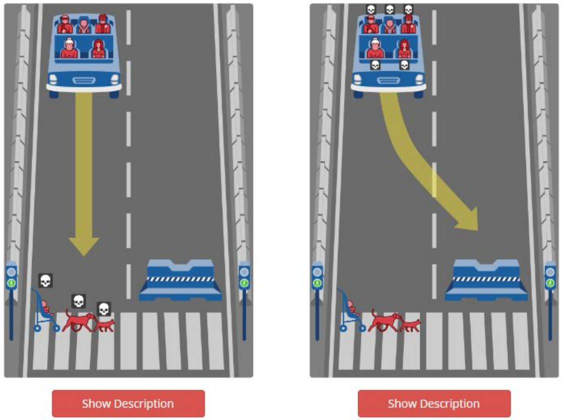
Q1: What model can help to make moral decisions from a human perspective?

Q2: What features (attributes of the characters and the situations) influence individuals' moral preferences to save or sacrifice specific groups in AV-related dilemmas?

❑ Datasets and methods

- ➢ Each row is a scenario, which is a combination of people with different characteristics.

- ➢ total: 10505 rows/observations



(one scenario example)

…	children	dog	cat	…	old male	old female	…	
…	1	1	1	…	0	0	…	

❑ Datasets and methods

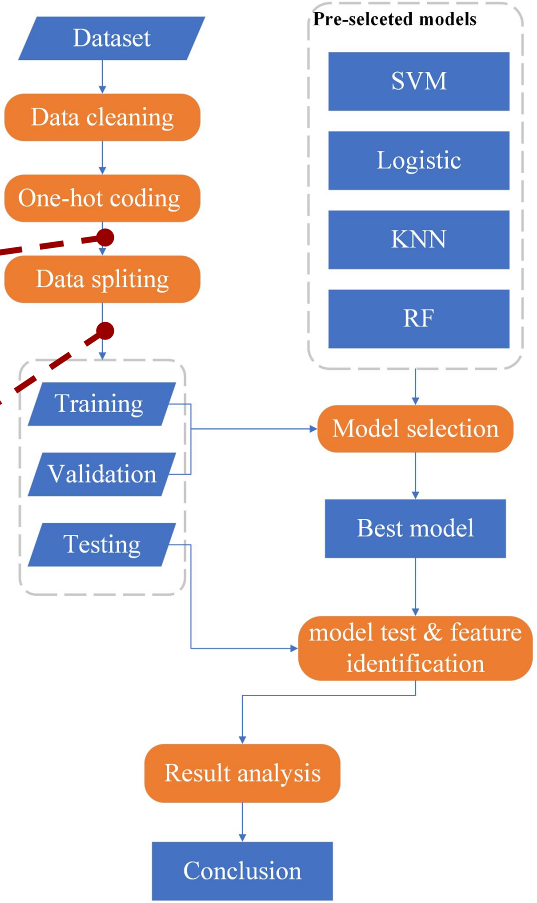
➢ Technique routes

One-hot encoding:

- 10505 × 112 (111 features + 1 target variable)

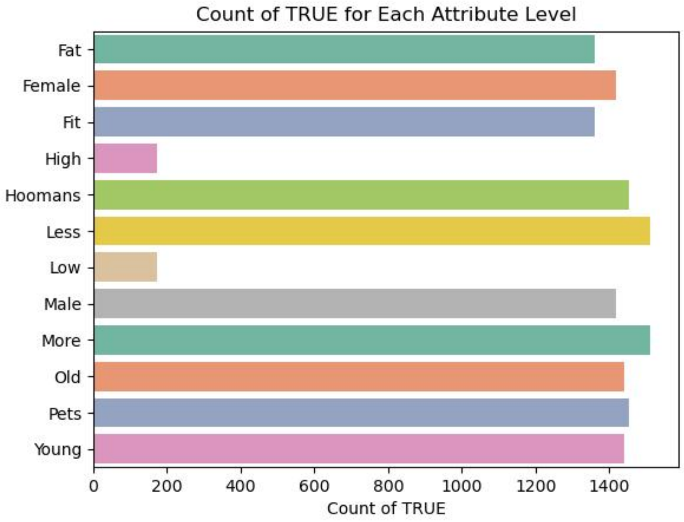
Data splitting:

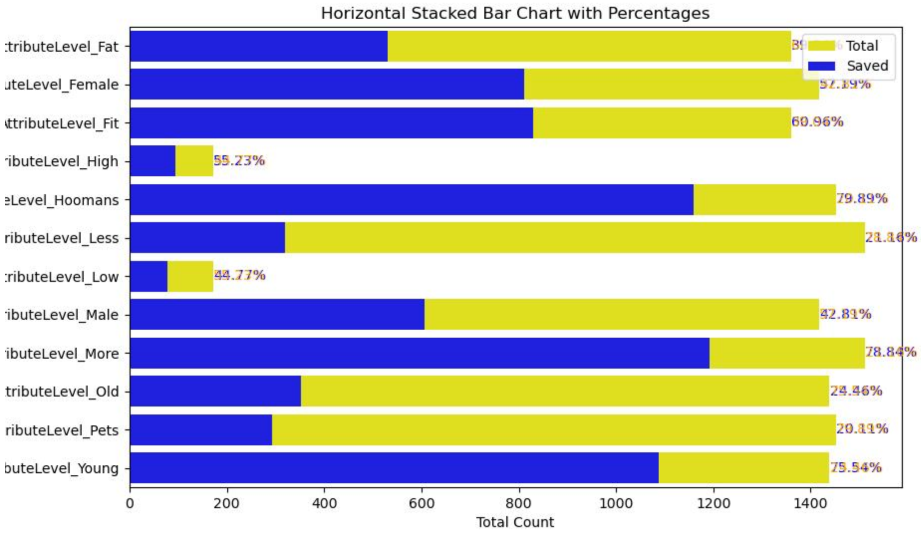
- training data - (7353, 112) - 70%
- validation data - (1576, 112) - 15%
- testing data - (1576, 112) - 15%



❑ Results

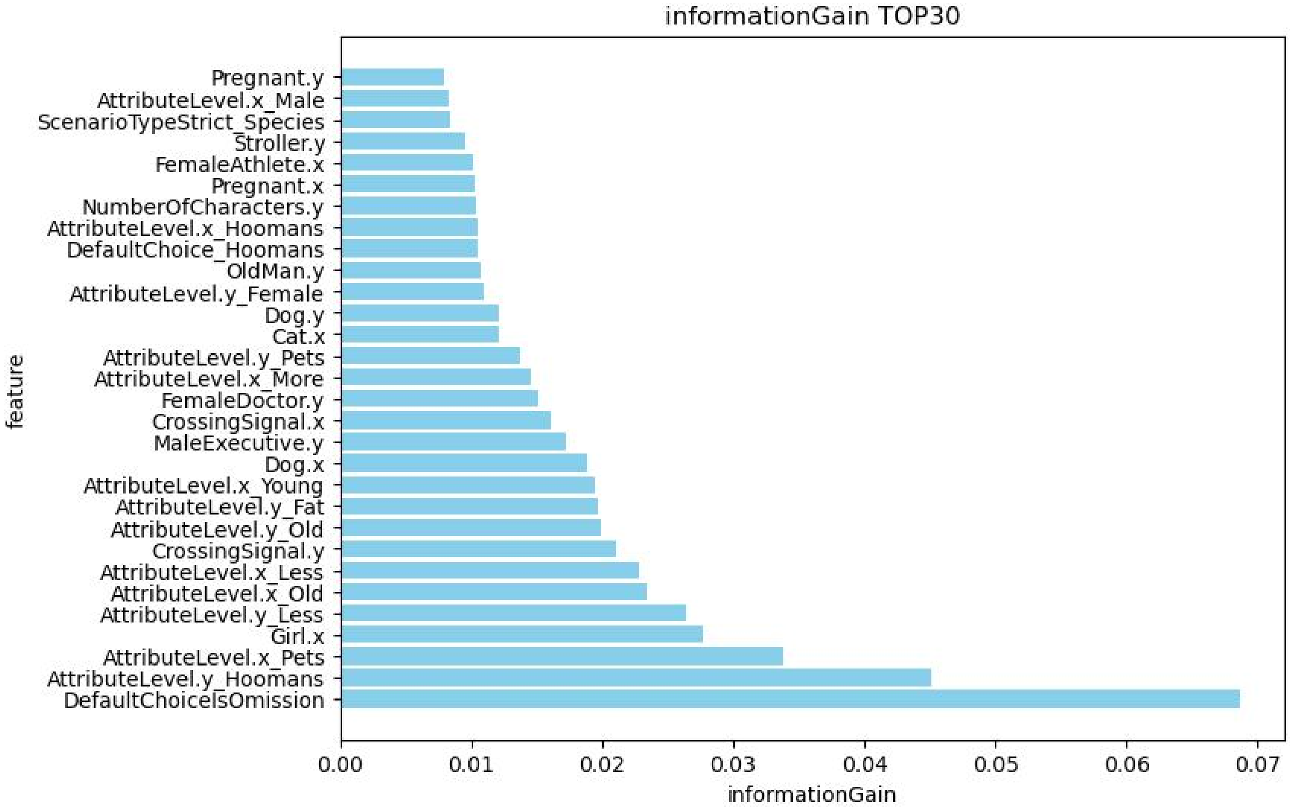
➢ Exploratory Data Analysis





❑ Results

➢ Exploratory Data Analysis

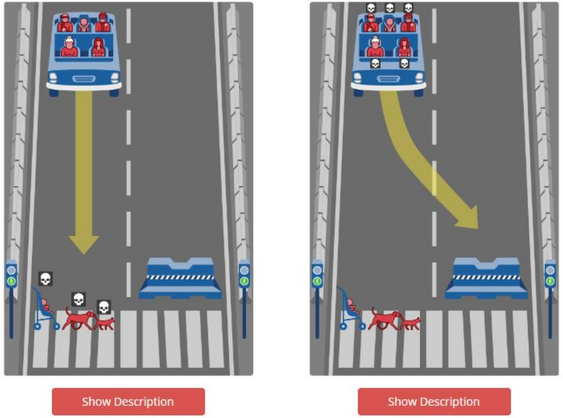


❑ Preprocessing

Two rows with the same ID

One row with feature labeled .x and .y

Remove the same or contrary features in .y



…	children.x	dog.x	Intervention.x	…	children.y	dog.y	Intervention.y	…
…	1	1	0	…	0	1	1	…

❑ Preprocessing

1. Choose the rows from the US

2. Combine rows and remove some .y features

3. Remove rows contain missing values

4. One-hot encoding

5. Data splitting:
   - training data - (7353, 112) - 70%
   - validation data - (1576, 112) - 15%
   - testing data - (1576, 112) - 15%

❑ Results

➢ Model performance

prediction

observation

SVM

	positive	negative
positive	464	252
negative	182	678

RF

	positive	negative
positive	465	251
negative	207	653

kNN

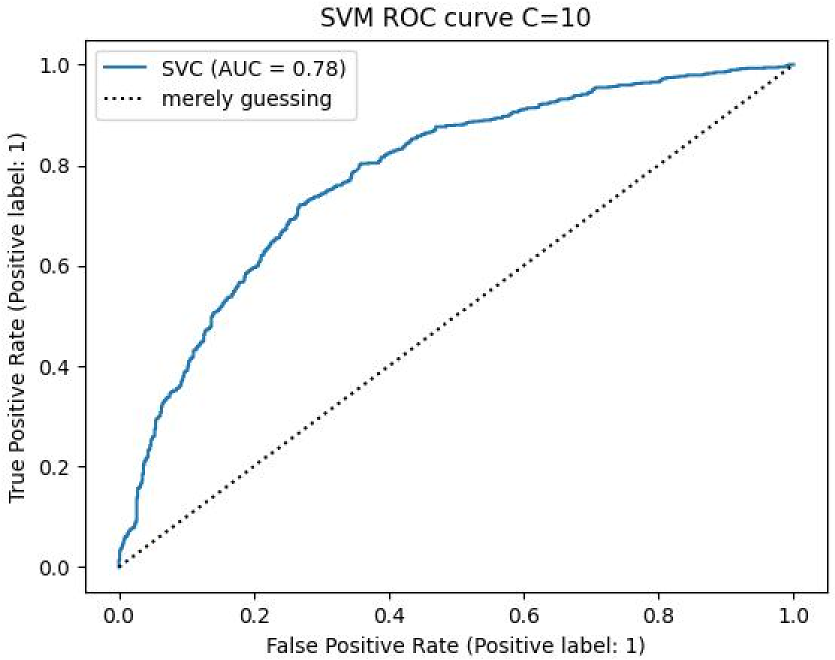
	positive	negative
positive	437	279
negative	191	669

Logistic

	positive	negative
positive	**469**	247
negative	187	673

❑ Results

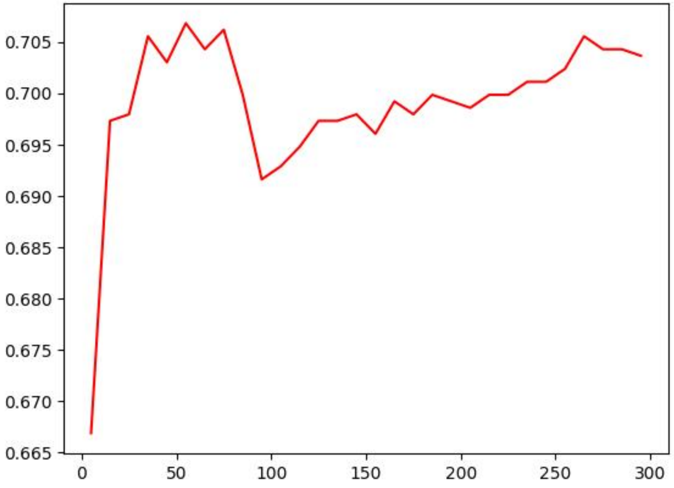
- ➢ SVM (C=10,kernel='rbf',probability=True)

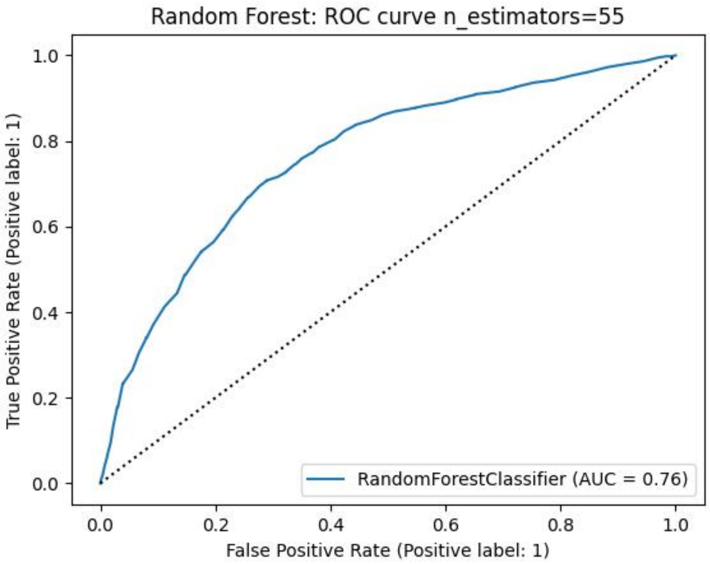


On test data, accuracy:0.725, precision score: 0.729, recall score: 0.788

❑ Results

➢ Random Forest (n_estimators=55)

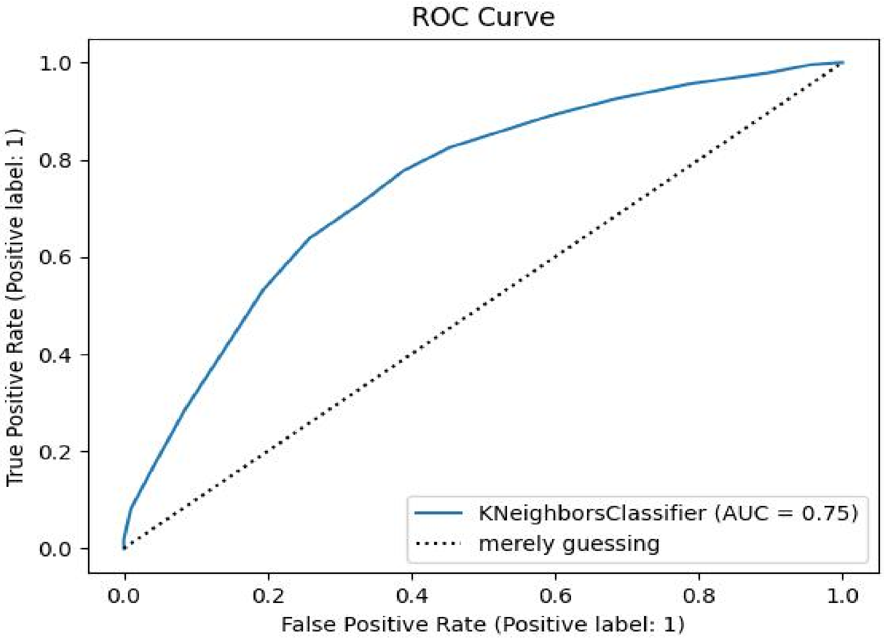




On test data, accuracy:0.709, precision score: 0.722, recall score: 0.759

❑ Results

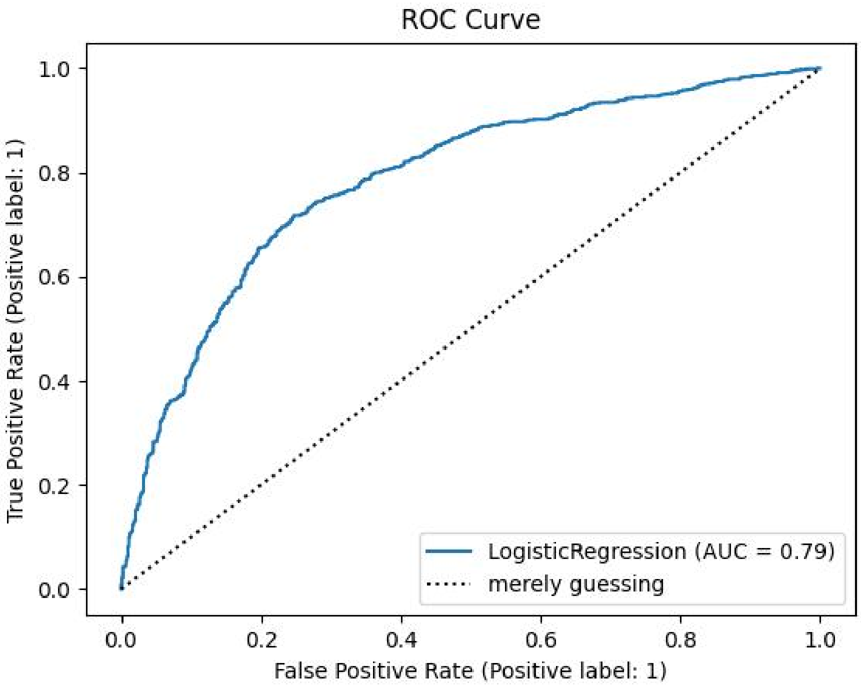
- kNN (metric='euclidean', n_neighbors=17)



On test data, accuracy:0.702, precision score: 0.778, recall score: 0.706

❑ Results

➢ Logistic Regression (C=2, max_iter=500)



On test data, accuracy:0.725, precision score: 0.783, recall score: 0.732

❑ Conclusion

- ➢ Models
- ➢ Features

```
ScenarioOrder: 0.0968961397961013
CrossingSignal.y: 0.039959649151486726
NumberOfCharacters.x: 0.03857100216475041
NumberOfCharacters.y: 0.03704163729547549
DefaultChoiceIsOmission.y: 0.03203180845558651
CrossingSignal.x: 0.03171784452507852
DefaultChoiceIsOmission.x: 0.02612886372150328
Man.y: 0.0236415643118627
Woman.y: 0.022573508764777556
Man.x: 0.02109407822013728
Woman.x: 0.02068058292891325
LeftHand.x: 0.019733409611225015
LeftHand.y: 0.01948737424878349
Barrier.x: 0.01934453516860985
PedPed: 0.01864154637011021
DescriptionShown.x: 0.018388277915336426
DescriptionShown.y: 0.017563617457196944
Template.x_Mobile: 0.016484783205943532
Template.y_Mobile: 0.015245619133468178
Barrier.y: 0.014658707335310567
```

❑ Conclusion

- ➢ Takeaway

- ➢ What to improve

Thank you

Questions?

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