

Bringing Efficiencies to Criminal Justice Manual Coding

Applied Machine Learning using
ROTA: Rapid Offense Text Autocoder

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*Presenting Author

Introduction to Offense Text Coding



Introduction to Offense Text Coding

Offense Text

```
THEFT MV
```



Introduction to Offense Text Coding

Offense Text

ASLT/BAT JUV FAC/AGENT



Introduction to Offense Text Coding

Offense Text

THEFT MV
ASLT/BAT JUV FAC/AGENT
Int.Possess Ammonia w/o Consent
ARMED ROBBERY
POSS BURGULARY TOOLS
ARSON
NON-AUTO PROP. DAMG
RCRD PRFMNCE W/O CONSENT
Violate Order/Intimidate
Victim-Arrest
DEFIN OP VEH W/O CONSENT

Research Question

What types of offenses are most common in this data?

Introduction to Offense Text Coding

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Challenges

Mixed Capitalization
Mixed punctuation
Abbreviations
Jargon
Misspellings
Multiple pieces of info

Introduction to Offense Text Coding

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Reality

Data cleaning
can take
many hours,
even days



Research Question

What types of offenses are most common in this data?

Classification by NCRP Codes

Discover Data **Share Data** **About** **Resources** **Help**

Resource Guide
National Corrections Reporting Program

About the National Corrections Reporting Program (NCRP)

The National Corrections Reporting Program (NCRP) compiles offender-level data on admissions and releases from state and federal prisons and post-confinement community supervision. The data are used to monitor the nation's correctional population and address specific policy questions related to recidivism, prisoner reentry, and trends in demographic characteristics of the incarcerated and community supervision populations. The Bureau of Justice Statistics (BJS) has administered the NCRP since 1983. The U.S. Bureau of the Census served as data collection agent for BJS until October 2010, when Abt Associates assumed this position.

From 2000 to 2009, NCRP data were archived each year in four, year-specific files that corresponded to the four files that states were asked to submit to the Census Bureau. The four files are: Prison Admissions (Part A), Prison Releases (Part B), Parole Exits (Part C), and Prison Custody (Part D). For example, the 2009 NCRP dataset consists of prison admissions occurring in 2009, prison releases occurring in 2009, parole exits occurring in 2009, and prisoners in custody on December 31, 2009.

Starting in 2011, NCRP data will be archived in a single, multi-year Term Record file. A Term Record represents a single period of incarceration for an individual offender. Each year, the archived Term Record file will be replaced by a new Term Record file that incorporates new NCRP data collected and processed during the previous year, as well as updates to previously collected data. The Term Records were created from the Prison Admissions (Part A), Prison Releases (Part B), and Prison Custody (Part D) records submitted by states since 2000. With a few lines of computing code (included with the archive), an analyst can create a prison admission, release, or custody file from the Term Record file.

In addition to the Term Record file, four additional files are being archived:

- Prison Admissions (Part A), Prison Releases (Part B), and Prison Custody (Part D) records that were not used to build the Term Record file.

Table of Contents

- [About the National Corrections Reporting Program \(NCRP\)](#)
- [Term Histories](#)
- [Using the NCRP Resource Guide](#)
- [Data Restrictions](#)
- [File Structure](#)
- [NCRP Concepts and Definitions](#)
- [Additional Resources](#)
- [Other National Corrections Reporting Program Resources](#)
- [Download NCRP Data](#)

Research Question

What types of offenses are most common in this data?

Classification by NCRP Codes

APPENDIX F. OFFENSE CODES FOR THE NATIONAL CORRECTIONS REPORTING PROGRAM

	MURDER Charge Category
010	Accessory After the Fact, Murder
010	Accessory to Murder
010	Felony Murder
010	Murder
010	Murder Accessory After the Fact
010	Willful Murder
011	Assault and Battery by Force Likely to Produce Death
011	Assault and Battery with Intent to Kill
011	Assault with Intent to Kill
011	Malicious Striking and Wounding with Intent to Kill
011	Murder, Attempted
011	Shooting with Intent to Kill
012	Conspiracy to Commit Murder
012	Murder, Conspiracy

	UNSPECIFIED HOMICIDE
013	Homicide
013	Homicide - Willful Kill
013	Unspecified Homicide
014	Unspecified Homicide, Attempted/Conspiracy

	VOLUNTARY/NONNEGLIGENT MANSLAUGHTER
015	Manslaughter with Intent
015	Nonnegligent Manslaughter
015	Pre-meditated Manslaughter
015	Voluntary Manslaughter
016	Voluntary/Nonnegligent Manslaughter, Attempted/Conspiracy

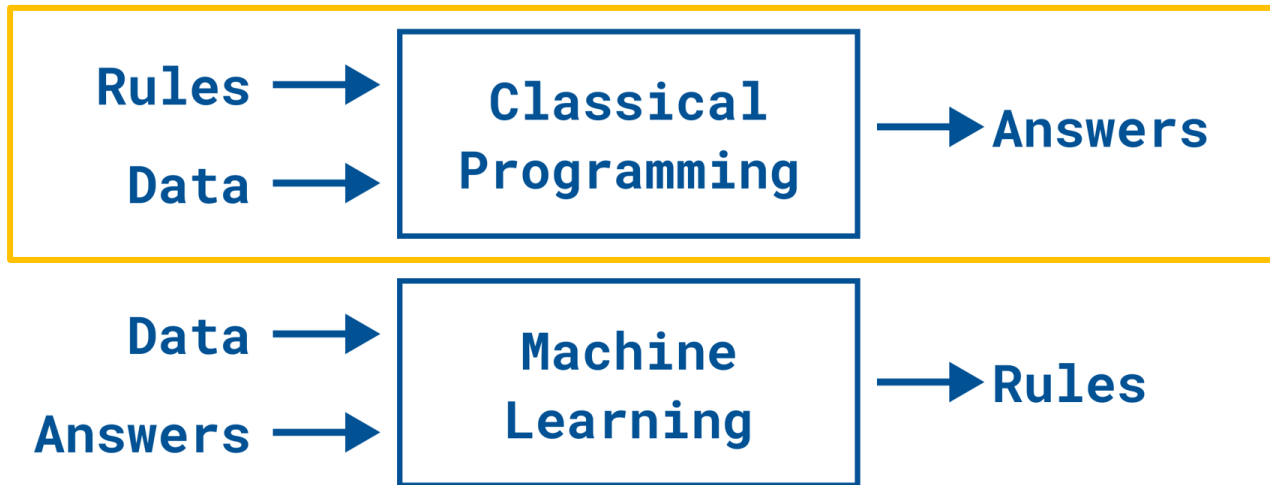
	MANSLAUGHTER - VEHICULAR
020	Causing Death by Operating Auto While Under Influence of Drugs or Alcohol
020	Manslaughter, Vehicular
020	Reckless Homicide, Vehicular
020	Vehicular Manslaughter
021	Manslaughter, Vehicular, Attempted
022	Manslaughter, Vehicular, Conspiracy

Research Question

What types of offenses are most common in this data?

An Applied Machine Learning Problem

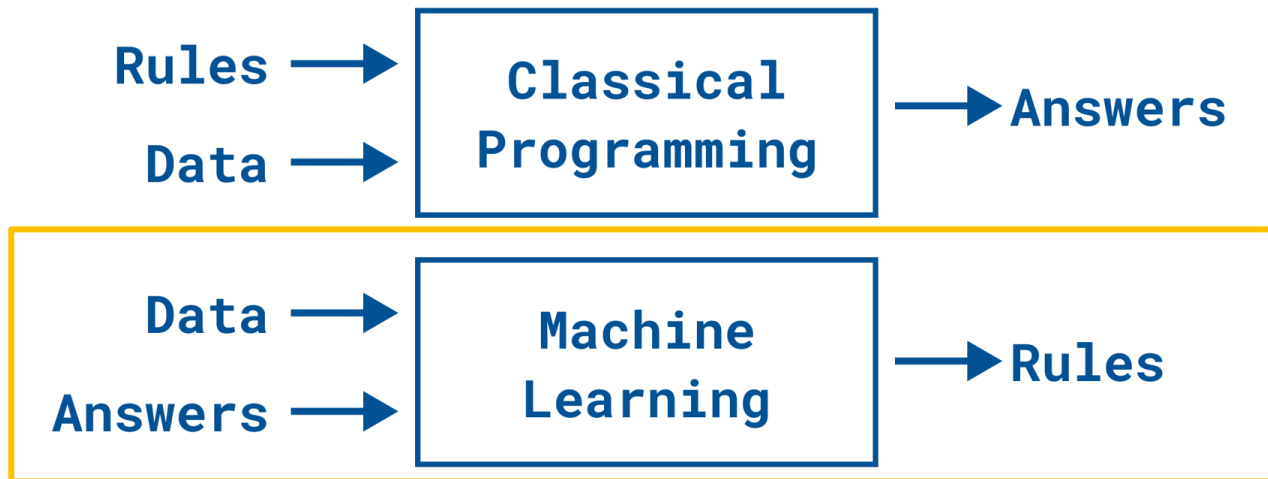
Can we write some categorization rules to solve this?



Adapted from Chollet, F. (2017). *Deep learning with Python*. Simon and Schuster.

An Applied Machine Learning Problem

- 84 Charge Category Codes
- 260,887 records, 60,672 unique offense text & code pairs



Adapted from Chollet, F. (2017). *Deep learning with Python*. Simon and Schuster.

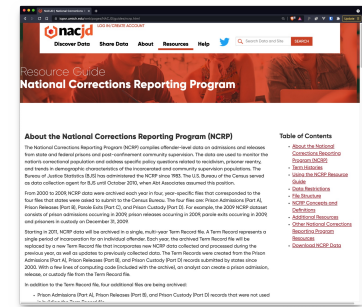
Training Data

- Offense Code crosswalk with examples from all 50 states

State Description	BJJ Code	BJJ Description
Violation places person in danger of death or serious injury	670	Public Order Offenses
Vote more than once in same election	670	Public Order Offenses
Wage money etc. on animal fighting	671	Public Order Offenses, Attempted
Unlawful use of savings bank terms	671	Public Order Offenses, Attempted
Felony violations of perpetual care/preneed trust fund	672	Public Order Offenses, Conspiracy
Install malware, take control/disable computer, >= \$1000	672	Public Order Offenses, Conspiracy
...

Training Data

- Offense Code crosswalk with examples from all 50 states



State Description	BJS Code	BJS Description	NCRP Charge Category
Violation places person in danger of death or serious injury	670	Public Order Offenses	PUBLIC ORDER OFFENSES - OTHER
Vote more than once in same election	670	Public Order Offenses	PUBLIC ORDER OFFENSES - OTHER
Wage money etc. on animal fighting	671	Public Order Offenses, Attempted	PUBLIC ORDER OFFENSES - OTHER
Unlawful use of savings bank terms	671	Public Order Offenses, Attempted	PUBLIC ORDER OFFENSES - OTHER
Felony violations of perpetual care/preneed trust fund	672	Public Order Offenses, Conspiracy	PUBLIC ORDER OFFENSES - OTHER
Install malware, take control/disable computer, >= \$1000	672	Public Order Offenses, Conspiracy	PUBLIC ORDER OFFENSES - OTHER
...

Data

Answers

Natural Language Processing Model Training Overview

- Multi-class classification (84 categories)
- Transformer model
 - Distil-RoBERTa model architecture
- Iterative text processing using regular expressions (regex)
- Trained on a publicly available national lookup table combined with other hand-labeled offense text datasets.



Model Performance

- Model was evaluated using 3-Fold cross validation
- Highest performance benefits from many examples to train on

NCRP Category	Average Precision	Average Recall	Average Support
ESCAPE FROM CUSTODY	0.988	0.991	4035
DRIVING WHILE INTOXICATED	0.986	0.981	2391
CONTEMPT OF COURT	0.982	0.987	2952
BURGLARY	0.979	0.981	2214
POSSESSION/USE - MARIJUANA/HASHISH	0.977	0.970	556

Model Performance

- Lowest performance does not see as many examples to train on

NCRP Category	Average Precision	Average Recall	Average Support
TAX LAW (FEDERAL ONLY)	0.373	0.233	30
FLIGHT TO AVOID PROSECUTION	0.460	0.407	38
CONTRIBUTING TO DELINQUENCY OF A MINOR	0.544	0.333	50
DRIVING UNDER INFLUENCE - DRUGS	0.567	0.603	34
UNSPECIFIED HOMICIDE	0.610	0.554	60

Model Performance

Metric	Precision	Recall
Average Per Category	0.811	0.786

Metric	Value
Accuracy	0.934

Demo

The screenshot shows a web browser window with the URL `share.streamlit.io/rtiinternational/rota-app/main/app.py`. The page title is "Rapid Offense Text Autocoder".

Intro

Criminal justice research often requires conversion of free-text offense descriptions into overall charge categories to aid analysis. For example, the free-text offense of "eluding a police vehicle" would be coded to a charge category of "Obstruction - Law Enforcement". Since free-text offense descriptions aren't standardized and often need to be categorized in large volumes, this can result in a manual and time intensive process for researchers. ROTA is a machine learning model for converting offense text into offense codes.

Currently ROTA predicts the Charge Category of a given offense text. A charge category is one of the headings for offense codes in the [2009 NCRP Codebook, Appendix F](#).

The model was trained on [publicly available data](#) from a crosswalk containing offenses from all 50 states combined with three additional hand-labeled offense text datasets.

For more information on the model, please see the [model repo](#).

This model and application were developed by the [RTI International Center for Data Science](#).

Single Coder Demo

Input Offense

FRAUDULENT USE OF A CREDIT CARD OR DEBT CARD >= \$25,000

Predictions

	label	confidence
0	FORGERY/FRAUD	100
1	LARCENY/THEFT - VALUE UNKNOWN	0
2	EMBEZZLEMENT	0
3	PUBLIC ORDER OFFENSES - OTHER	0
4	TRAFFIC OFFENSES - MINOR	0
5	OFFENSES AGAINST COURTS, LEGISLATURES, AND COMMISSIONS	0
6	OBSTRUCTION - LAW ENFORCEMENT	0
7	PROPERTY OFFENSES - OTHER	0
8	MISDEMEANOR UNSPECIFIED	0
9	COMMERCIALIZED VICE	0
10	TAX LAW (FEDERAL ONLY)	0

Bulk Coder

⚠ Note: Your input data will be deduplicated on the selected column to reduce computation requirements. You will need to re-join the results on your offense text column.

<https://bit.ly/rti-rota>

ROTA

Rapid Offense Text Autocoder

Intro

 models 2021.05.18.15  release v2021.05.18.15 DOI 10.5281/zenodo.4770492

Criminal justice research often requires conversion of free-text offense descriptions into overall charge categories to aid analysis. For example, the free-text offense of "eluding a police vehicle" would be coded to a charge category of "Obstruction - Law Enforcement". Since free-text offense descriptions aren't standardized and often need to be categorized in large volumes, this can result in a manual and time intensive process for researchers. ROTA is a machine learning model for converting offense text into offense codes.

Currently ROTA predicts the *Charge Category* of a given offense text. A *charge category* is one of the headings for offense codes in the [2009 NCRP Codebook: Appendix F](#).

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<https://bit.ly/rti-rotax>

Demo

Single Coder Demo

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Predictions


	label	confidence
0	FORGERY/FRAUD	100
1	LARCENY/THEFT - VALUE UNKNOWN	0
2	EMBEZZLEMENT	0
3	PUBLIC ORDER OFFENSES - OTHER	0
4	TRAFFIC OFFENSES - MINOR	0
5	OFFENSES AGAINST COURTS, LEGISLATURES, AND COMMISSIONS	0
6	OBSTRUCTION - LAW ENFORCEMENT	0
7	PROPERTY OFFENSES - OTHER	0
8	MISDEMEANOR UNSPECIFIED	0
9	COMMERCIALIZED VICE	0
10	TAX LAW (FEDERAL ONLY)	0

Users can search for a single text string
Predictions include an estimate of confidence

<https://bit.ly/rti-rotax>

Demo

Bulk Coder

 *Note:* Your input data will be deduplicated on the selected column to reduce computation requirements. You will need to re-join the results on your offense text column.

Upload File

Bulk Upload



Drag and drop file here

Limit 10MB per file • XLSX, CSV

Browse files

Users can also upload a bulk file and
download predictions as a CSV

<https://bit.ly/rti-rota>

Demo

3 Predict Using Column: OFFENSE DESCRIPTION

Compute Predictions

Sample Output

	OFFENSE DESCRIPTION	charge_category_pred	charge_category_pred_con...
0	1st Deg Intentional Homi...	MURDER	100
1	1st Reckless Homicide/Ad...	UNSPECIFIED HOMICIDE	98
2	MANSLAUGHTER	MANSLAUGHTER - NON-VEHIC...	97
3	Homicide by Intox Use of...	MANSLAUGHTER - VEHICULAR	99
4	INJ/DEATH-ALCHOL TO MINO...	MANSLAUGHTER - NON-VEHIC...	59
5	ABDUCTION	KIDNAPPING	100
6	1st Deg. Sexual Assault/...	RAPE - FORCE	100
7	SEXUAL ASSAULT OF SPOUSE	SEXUAL ASSAULT - OTHER	99
8	INCEST	RAPE - STATUTORY - NO FO...	52
9	CAUSE CHILD VIEW SEX ACT...	LEWD ACT WITH CHILDREN	84
10	ARMED ROBBERY	ARMED ROBBERY	100

[Download as CSV](#)

Users can also upload a bulk file and
download predictions as a CSV

<https://bit.ly/rti-rotax>

Open Source

Technologies

- Streamlit
- ONNX

zenodo Search Upload Communities

May 18, 2021 Software Open Access

RTInternational/rota: 2021.05.18.15

Peter Baumgartner; Emily Hadley; Anna Godwin

ROTA: Rapid Offense Text Autocoder

Criminal justice research often requires conversion of free-text offense descriptions into overall charge categories to aid analysis. For example, the free-text offense of "eluding a police vehicle" would be coded to a charge category of "Obstruction - Law Enforcement". Since free-text offense descriptions aren't standardized and often need to be categorized in large volumes, this can result in a manual and time intensive process for researchers. ROTA is a machine learning model for converting offense text into offense codes.

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The model was trained on [publicly available data](#) from a crosswalk containing offenses from all 50 states combined with three additional hand-labeled offense text datasets.

The input text is standardized through a series of preprocessing steps. The text is first passed through a sequence of 500+ case-insensitive regular expressions that identify common misspellings and abbreviations and expand the text to a more full, correct English text. Some data-specific prefixes and suffixes are then removed from the text – e.g. some states included a statute as a part of the text. Finally, punctuation (excluding dollar signs) are removed from the input, multiple spaces between words are removed, and the text is lowercased.

Preview

rota-2021.05.18.15.zip

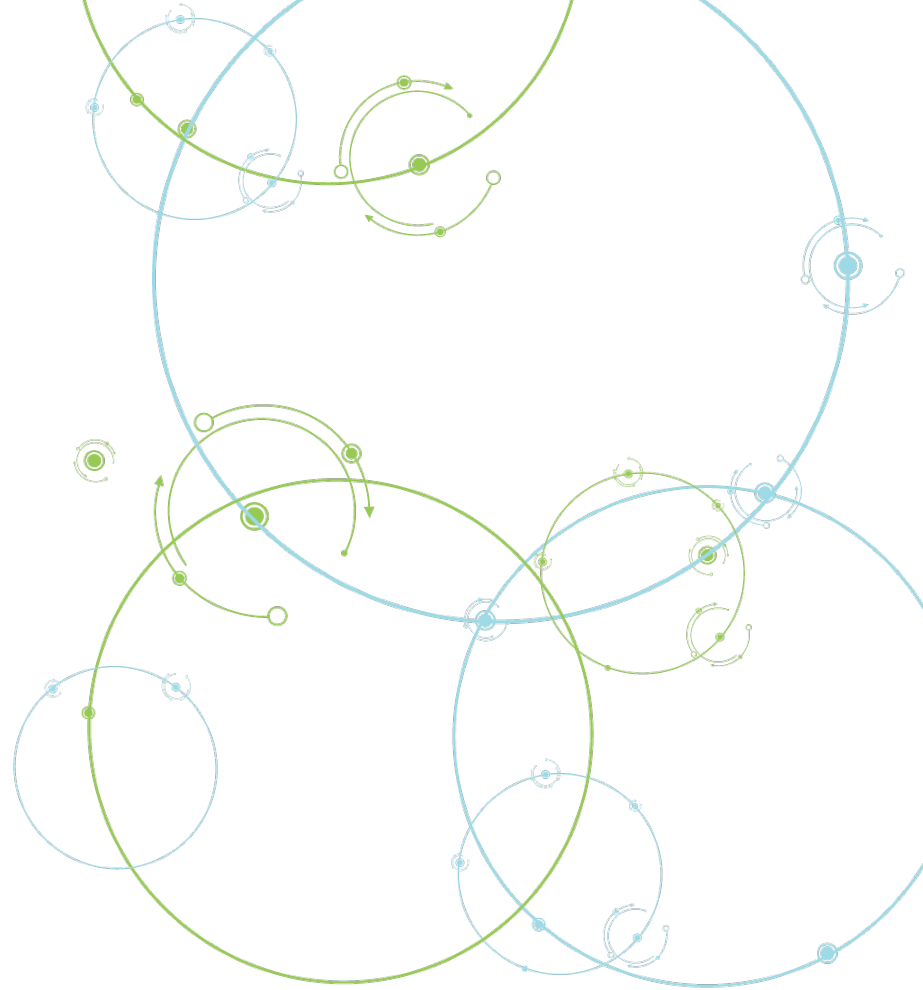
- RTInternational-rota-b5956de
 - .gitattributes 690 Bytes
 - .github
 - workflows
 - onnx-release.yml 2.4 kB
 - .gitignore 2.1 kB
 - LICENSE 11.3 kB
 - README.md 12.9 kB
 - code_map.json 3.1 kB
 - config_backup.json 4.2 kB
 - config.json 7.8 kB
 - merges.txt 456.4 kB
 - model_args.json 2.9 kB
 - onnx-convert-requirements.txt 75 Bytes

Next Steps

Getting the word out

Gathering feedback

Collaborating on additional use cases



Acknowledgements

Thank you to Emily Hadley and Peter Baumgartner for their direct contributions to the development of ROTA.

We are grateful to Debbie Dawes and the members of the Applied Justice Research and APPR Data Management teams at RTI for their input and feedback. Thanks to RTI International and the Center for Data Science for the generous support of this work.

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Thank you

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