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Income Level Prediction

Overview

- Objective:
  - To predict whether a person makes over 50K a year.

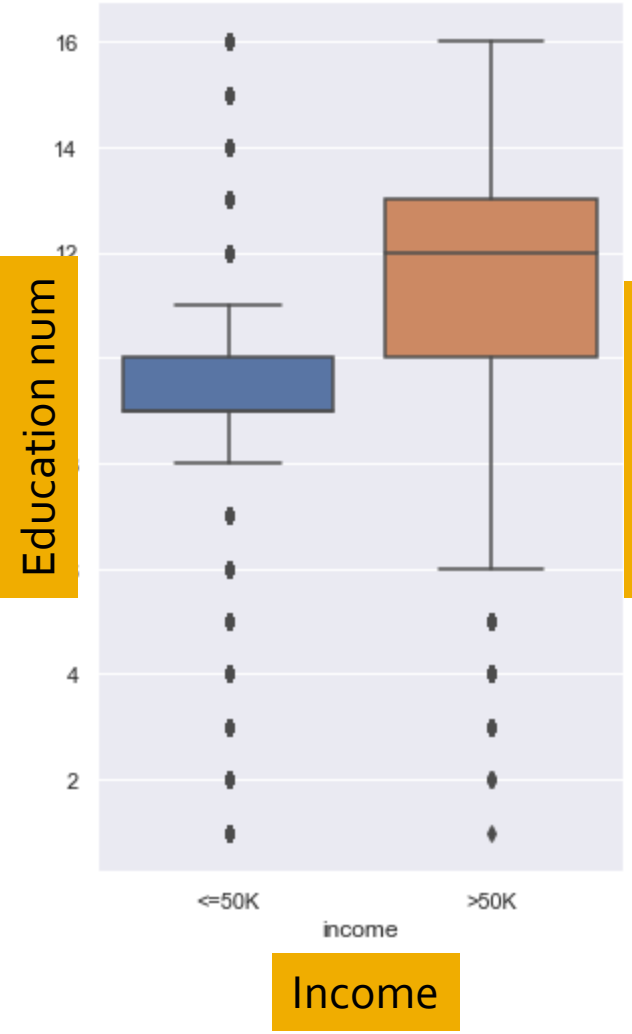
- Data:
  - 1994 US census database
  - ~ 32,000 observations with 14 variables
  - Source: http://archive.ics.uci.edu/ml/datasets/Adult

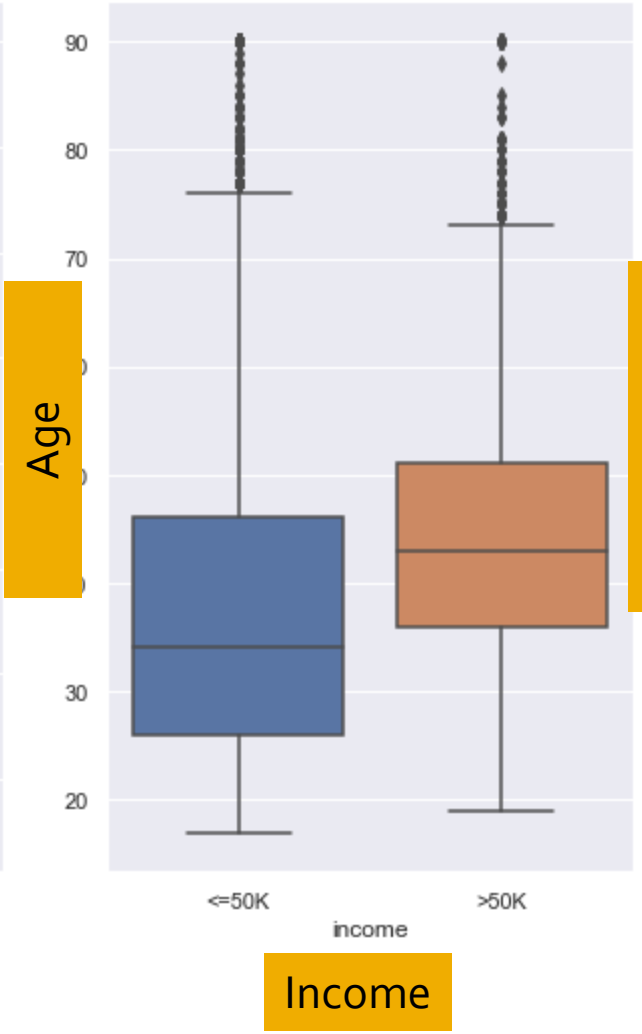
Data

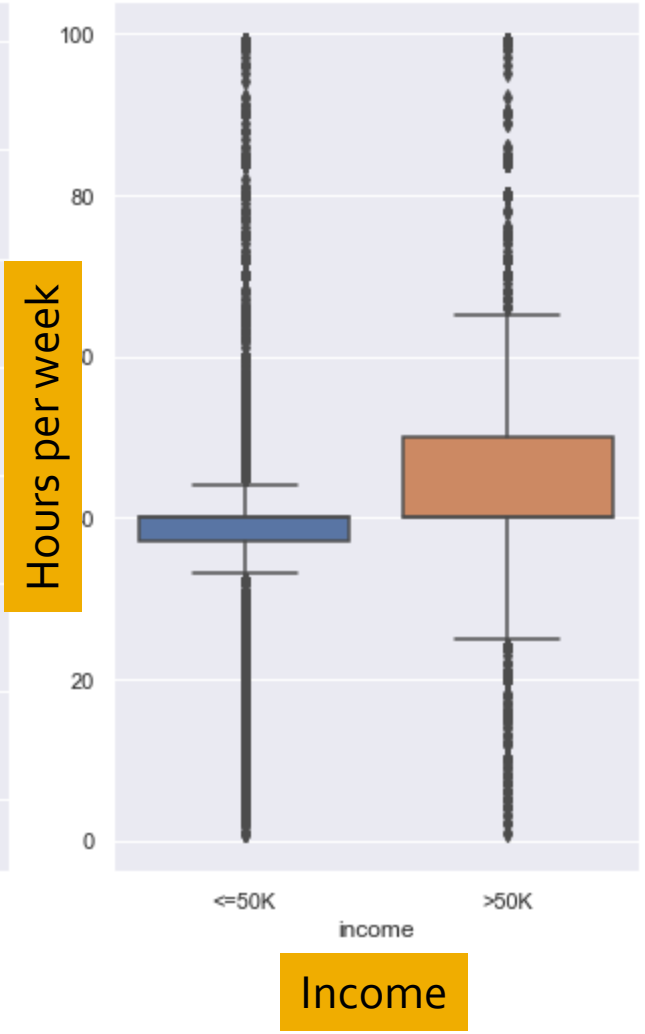
- 13 features
- 1 target variable: income (<=50k, > 50k)

Age	Workclass	Education_level	Education-num	Marital-status	Occupation	Relationship	Race	Sex	apital-gain	capital-loss	Hours/week	Native-country	Income
int	object	object	float	object	object	object	object	object	float	float	float	object	object
39	State-gov	Bachelors	13	Never-married	Adm-clerical	Not-in-family	White	Male	2174	0	40	United-States	<=50K
50	Self-emp-not-inc	Bachelors	13	Married-civ-spouse	Exec-managerial	Husband	White	Male	0	0	13	United-States	<=50K
38	Private	HS-grad	9	Divorced	Handlers-cleaners	Not-in-family	White	Male	0	0	40	United-States	<=50K
53	Private	11th	7	Married-civ-spouse	Handlers-cleaners	Husband	Black	Male	0	0	40	United-States	<=50K
28	Private	Bachelors	13	Married-civ-spouse	Prof-specialty	Wife	Black	Female	0	0	40	Cuba	<=50K

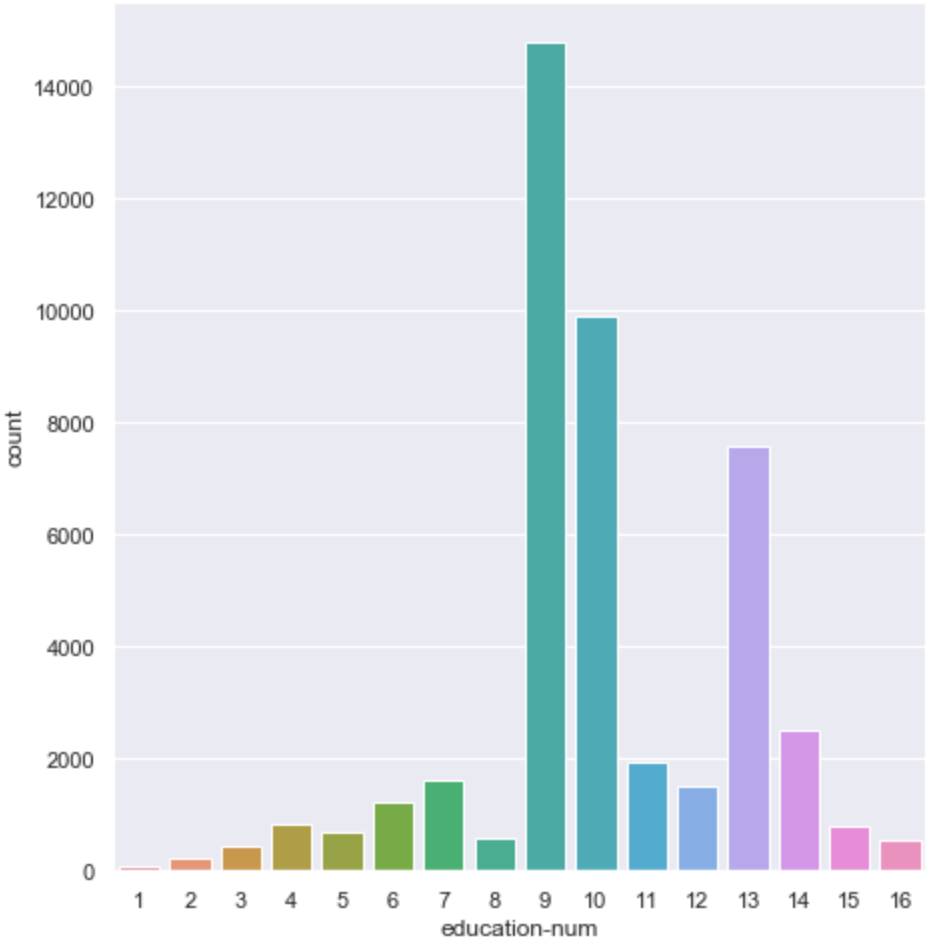
EDA: Education, age, and hours per work



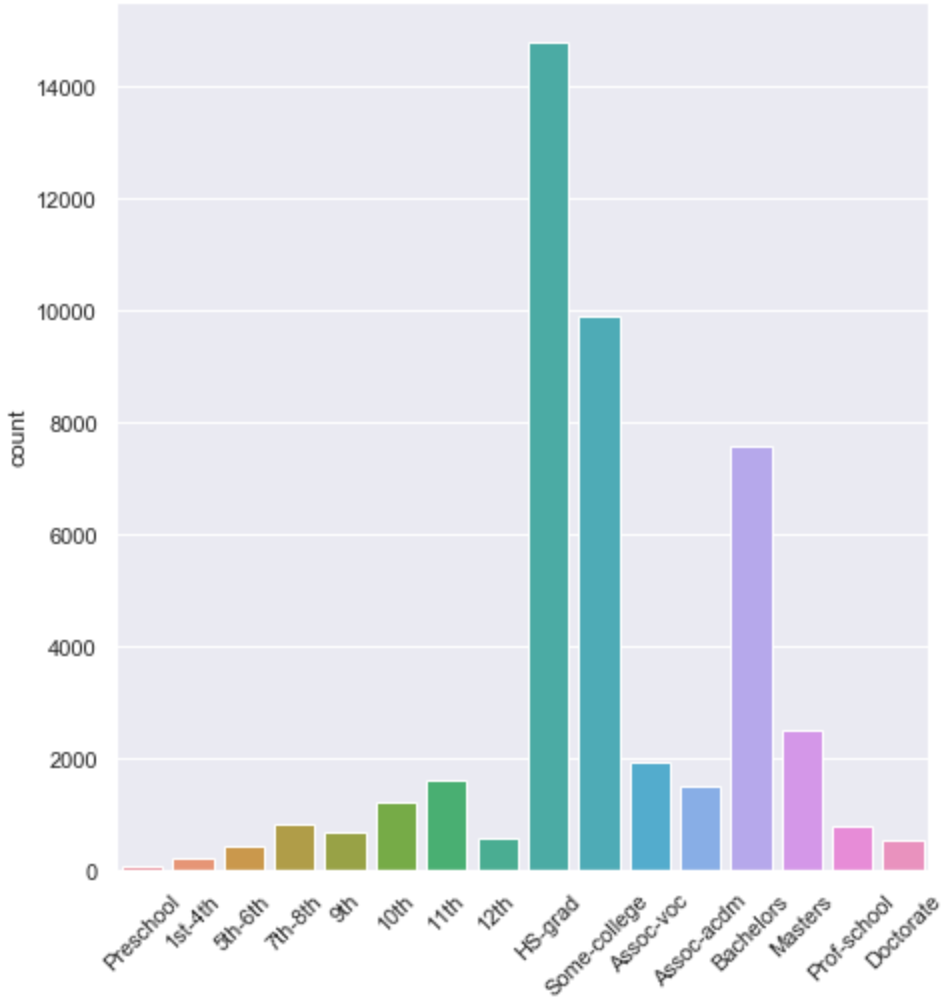




EDA: Education num and education level

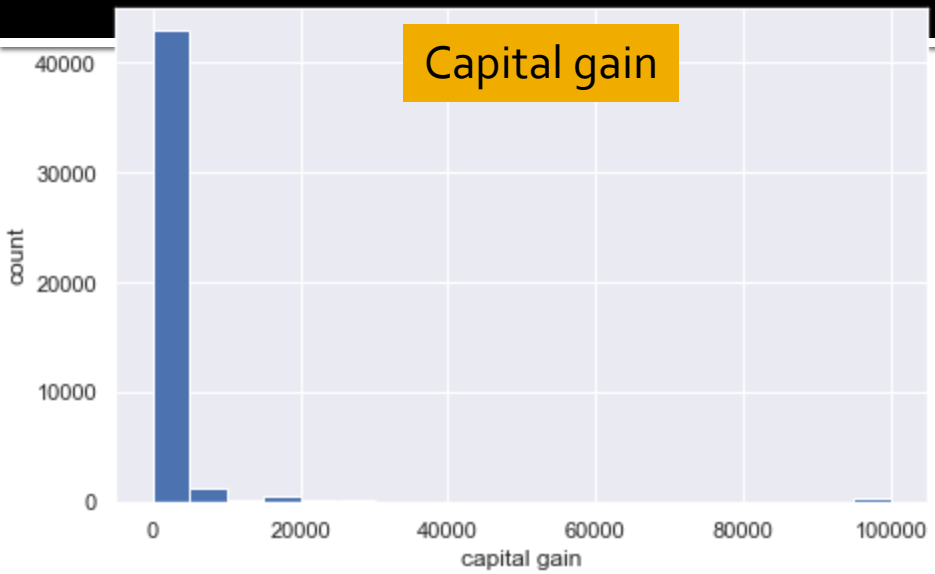


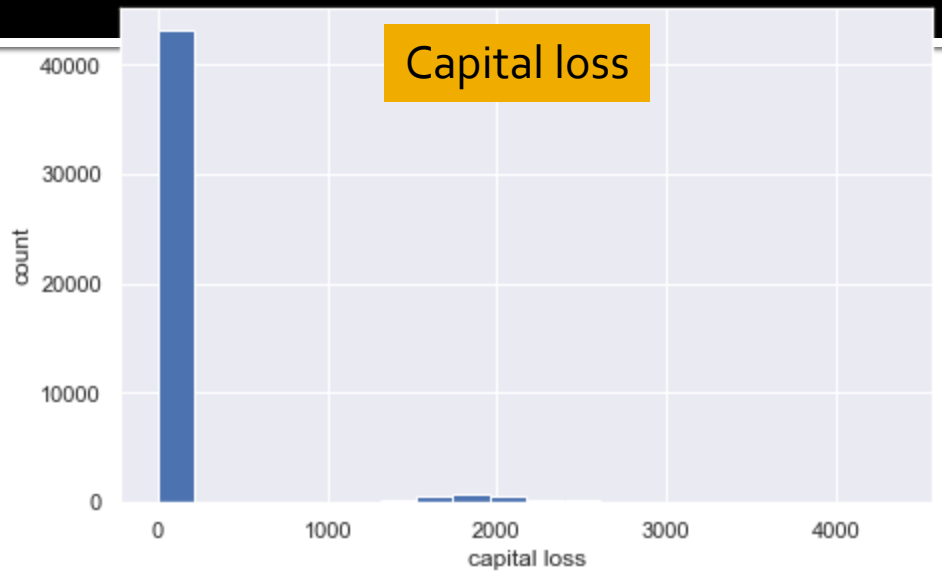
Education num

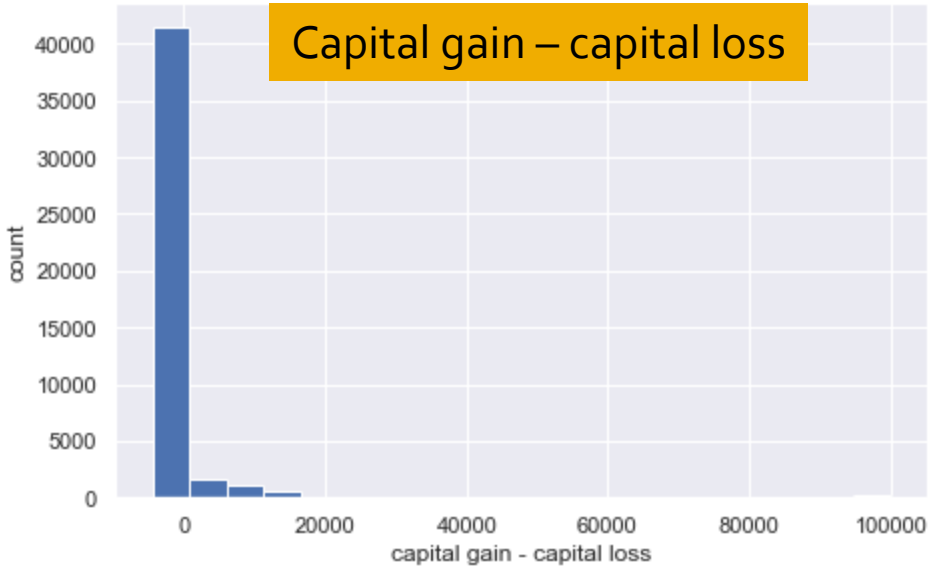


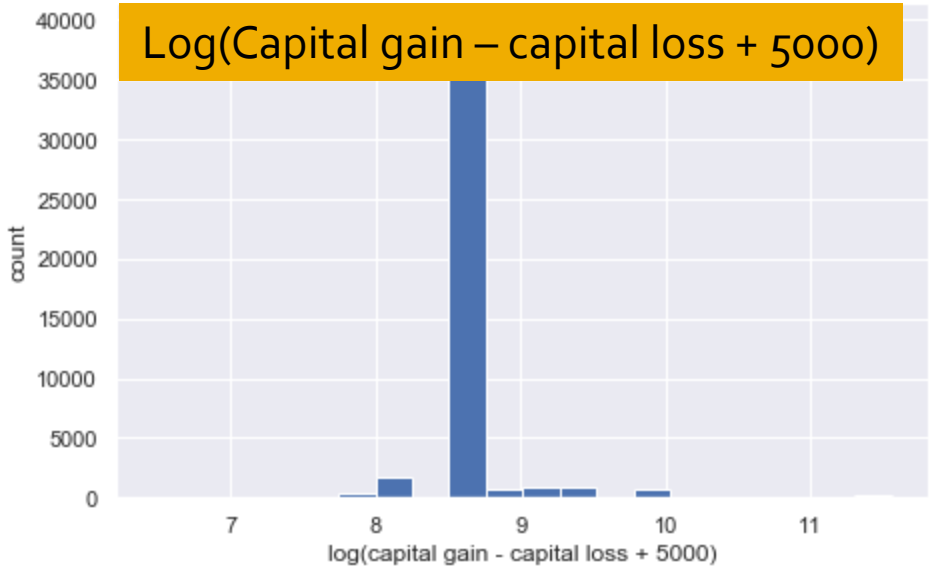
Education level

EDA: Capital gain and capital loss

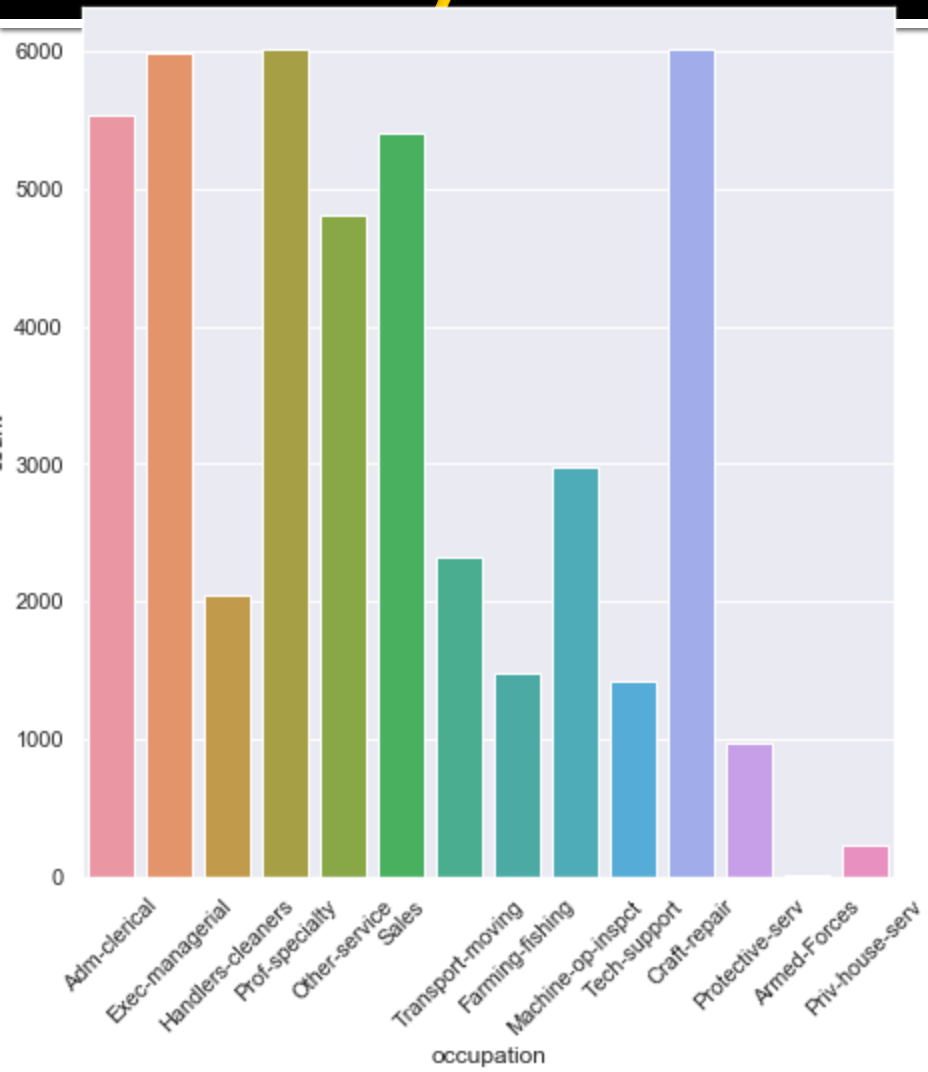




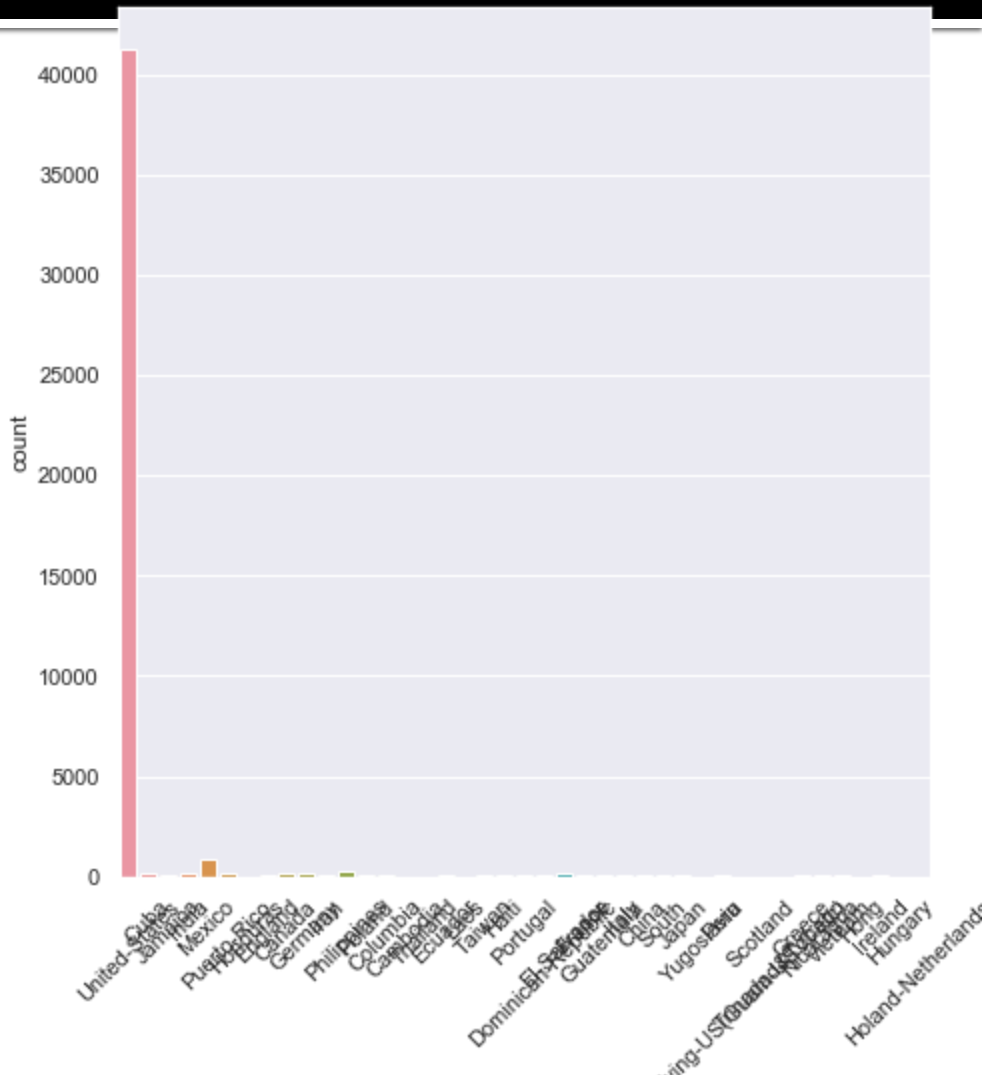




EDA: Occupation and native country

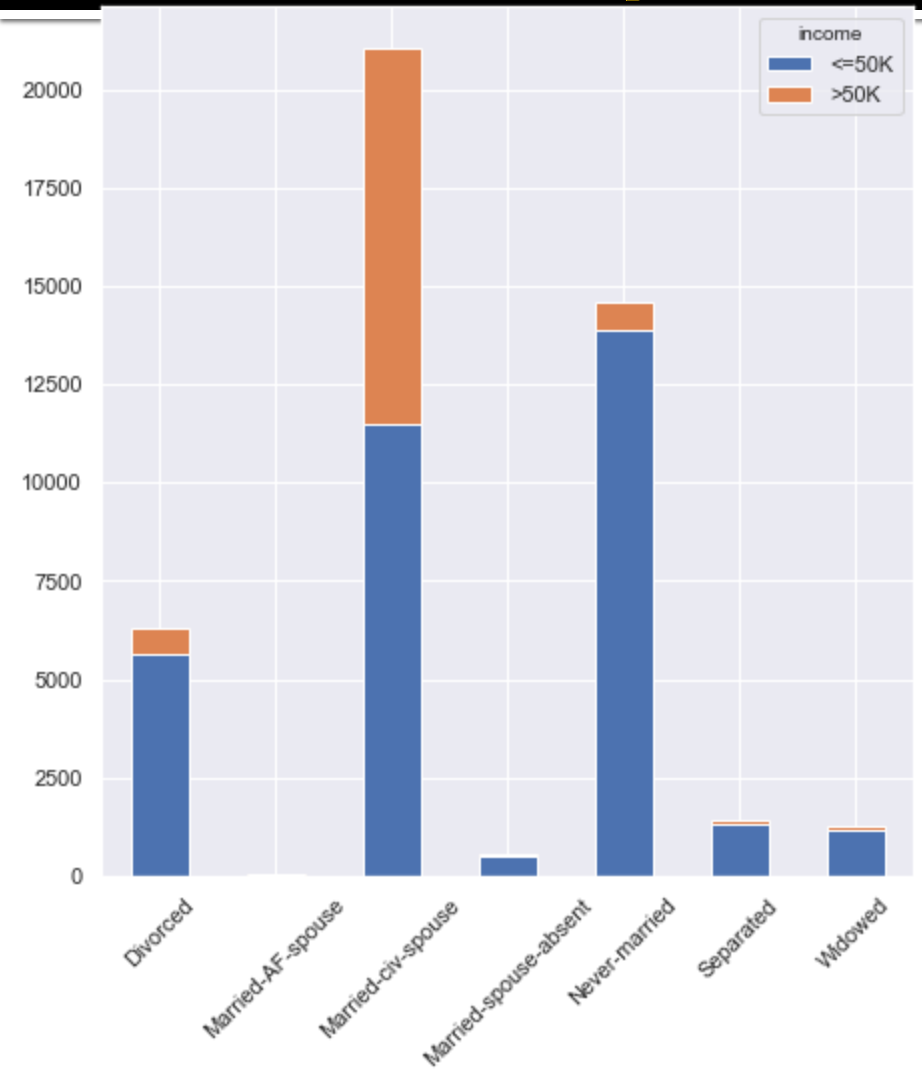


Occupation

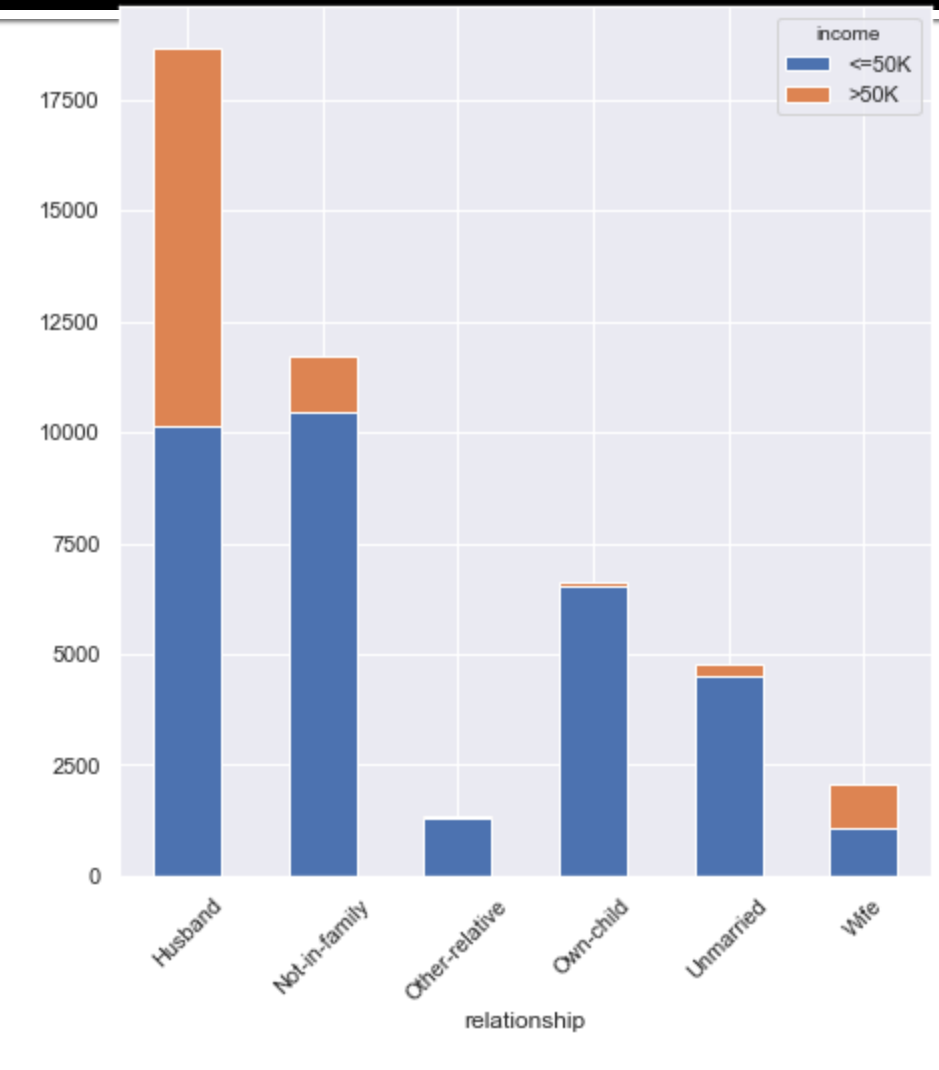


Native country

EDA: Marital status and relationship



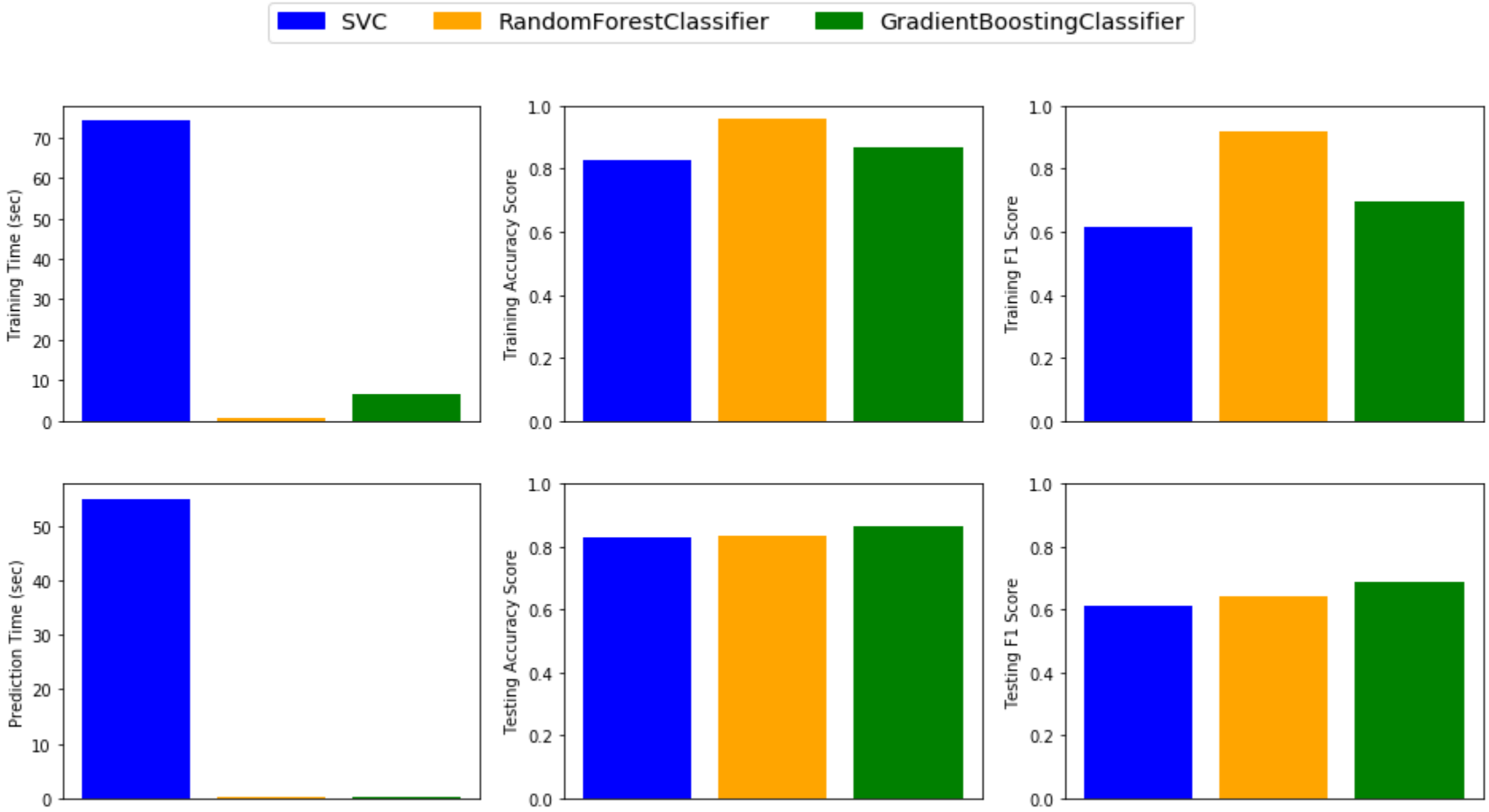
Marital status



Relationship

Gradient Boost is Selected

Data are divided into train-test sets using 80-20 split

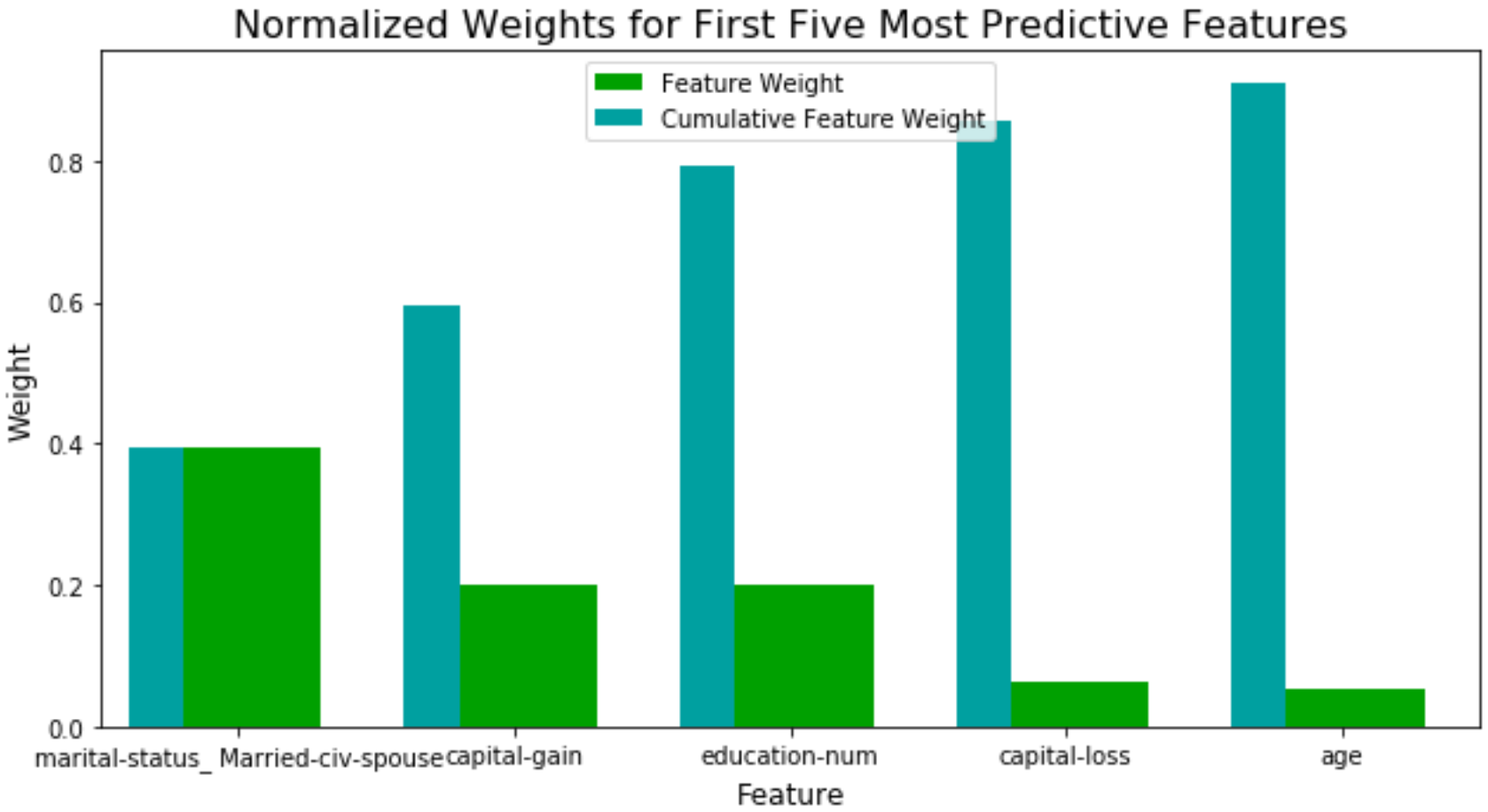


Feature Engineering

Initial	• Initial model with raw features
Education	• Discard a redundant feature: education level
Capital	• Combine features: capital gain and capital loss
Native	• Recode native country as U.S. and other
Optimize	• Optimize hyper-parameters

Model Evolution

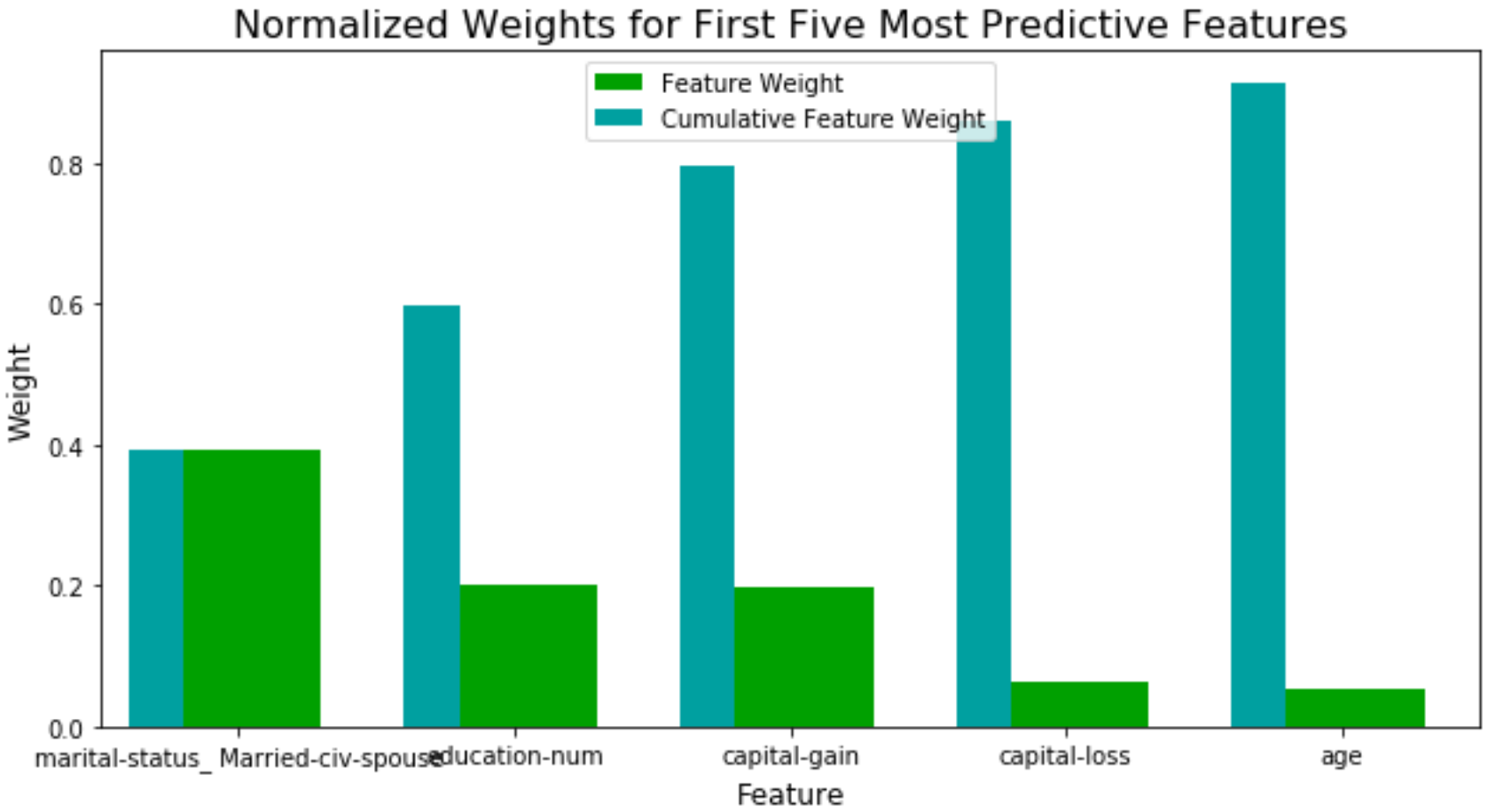
Accuracy	0.8630
Precision	0.7821
Recall	0.6073



Initial → Education → Capital → Native → Optimize

Model Evolution

Accuracy	0.8636
Precision	0.7831
Recall	0.6091



Initial → Education → Capital → Native → Optimize

Model Evolution

Accuracy	0.8636
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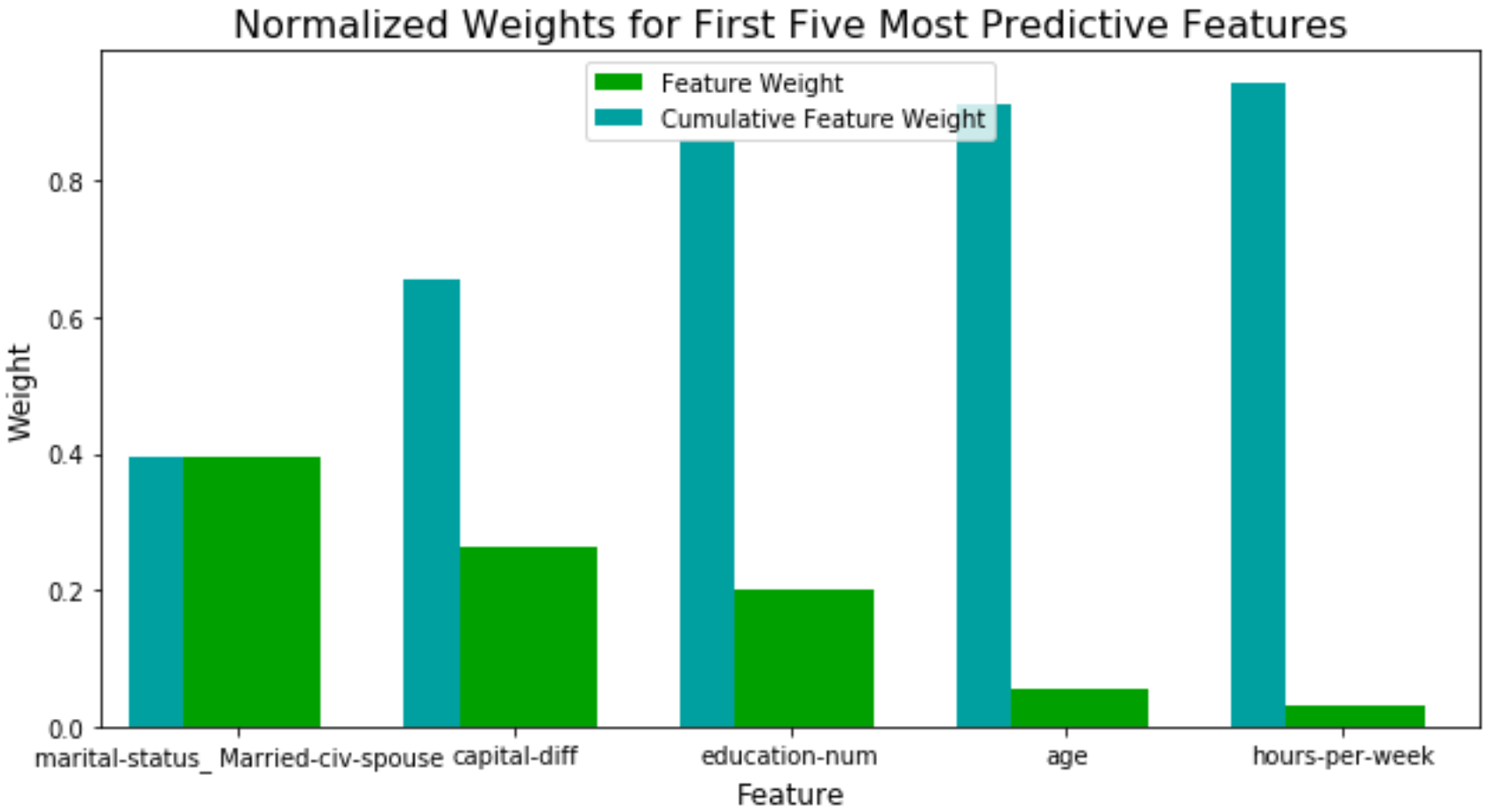
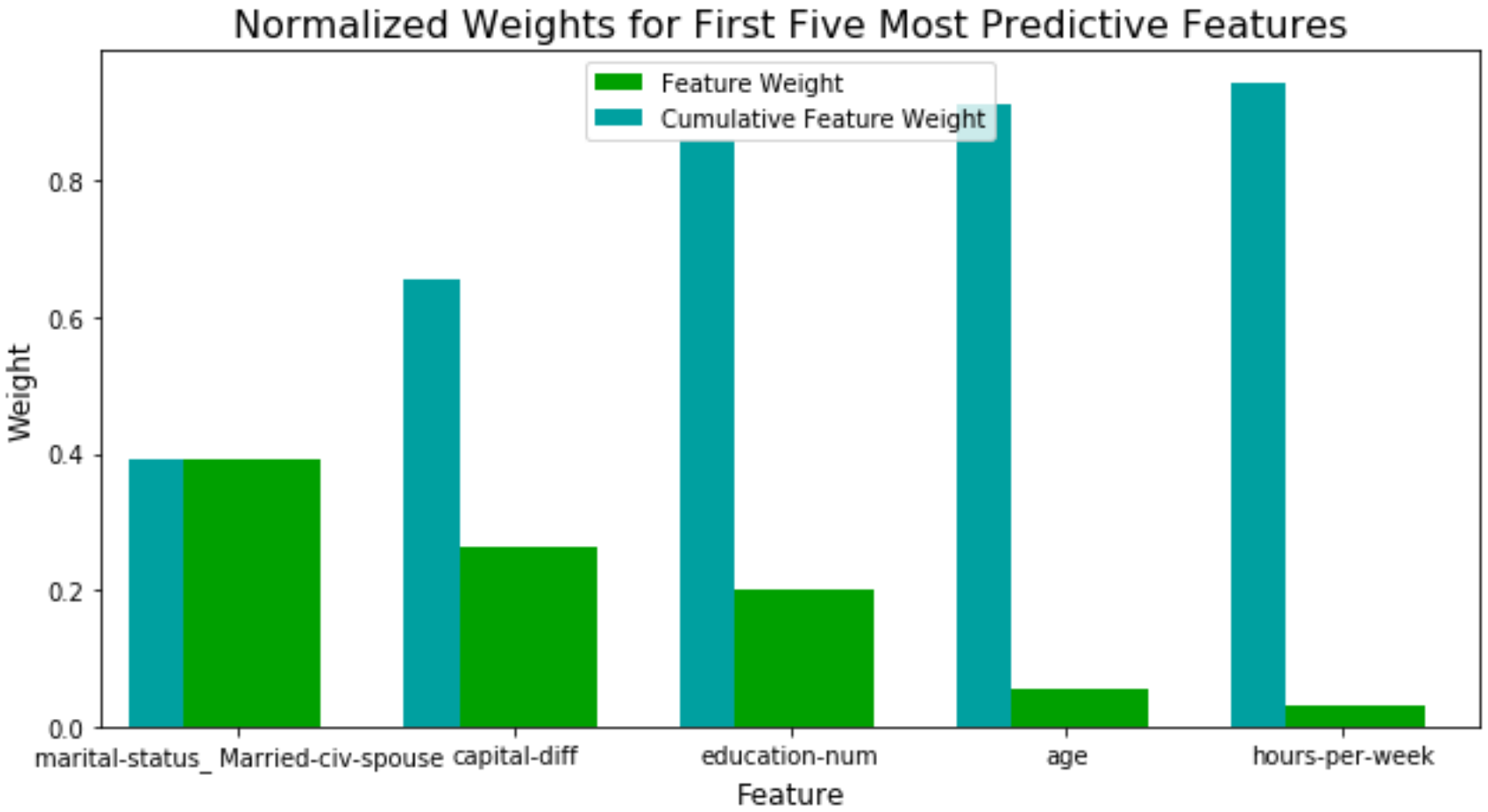


Initial → Education → Capital → Native → Optimize

Model Evolution

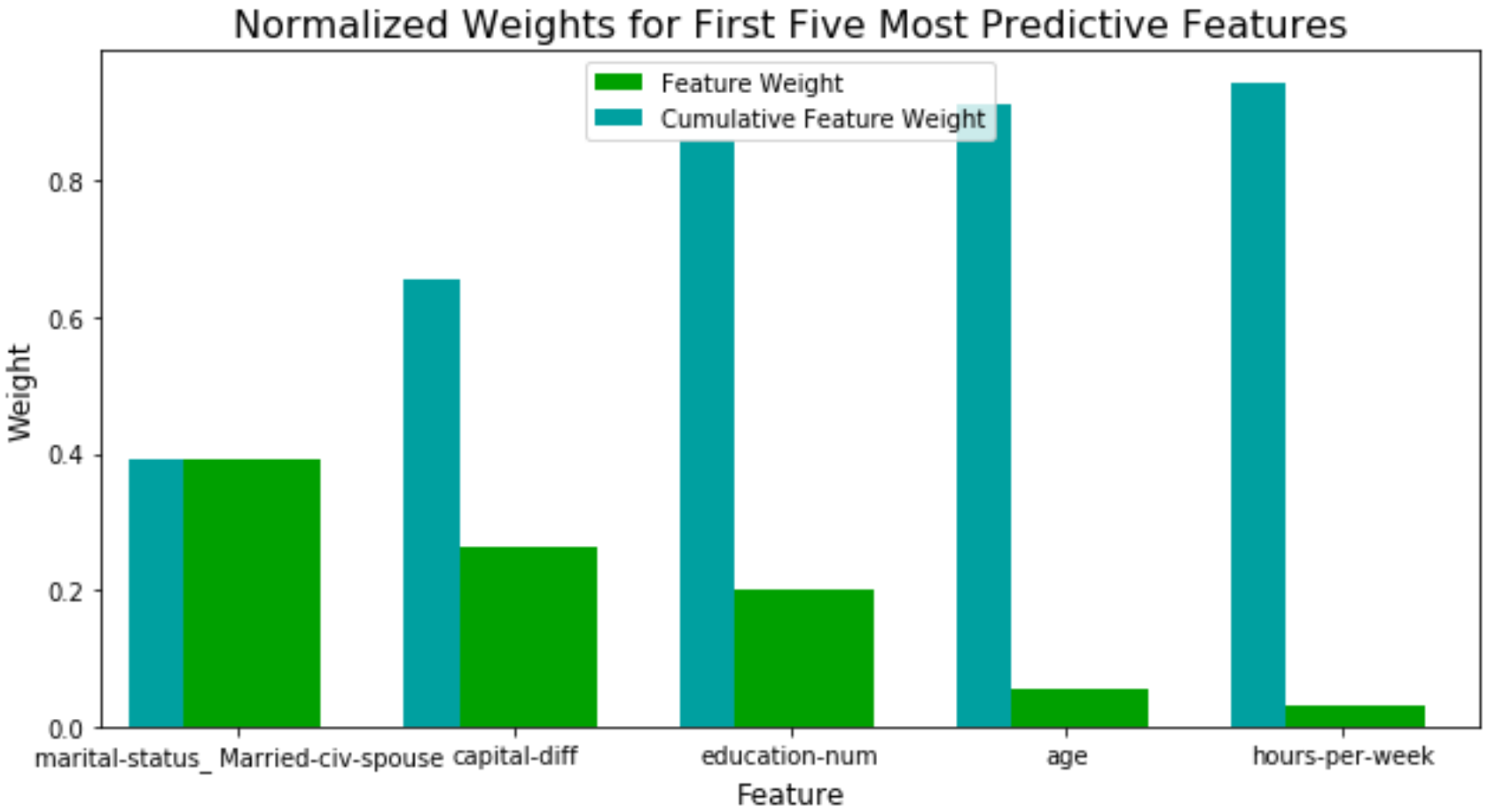
Accuracy	0.8640
Precision	0.7849
Recall	0.6091



Initial → Education → Capital → Native → Optimize

Model Evolution

Accuracy	0.8714
Precision	0.7853
Recall	0.6503



Initial → Education → Capital → Native → Optimize

Summary

- Gradient Boosting is selected over SVC and Random Forest based on running time, accuracy, and F1 score.

- Model is improved/simplified progressively by feature engineering:
  - Discarding redundant feature
  - Combining capital gain & capital loss
  - Recoding native country