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Income Level Prediction

Overview

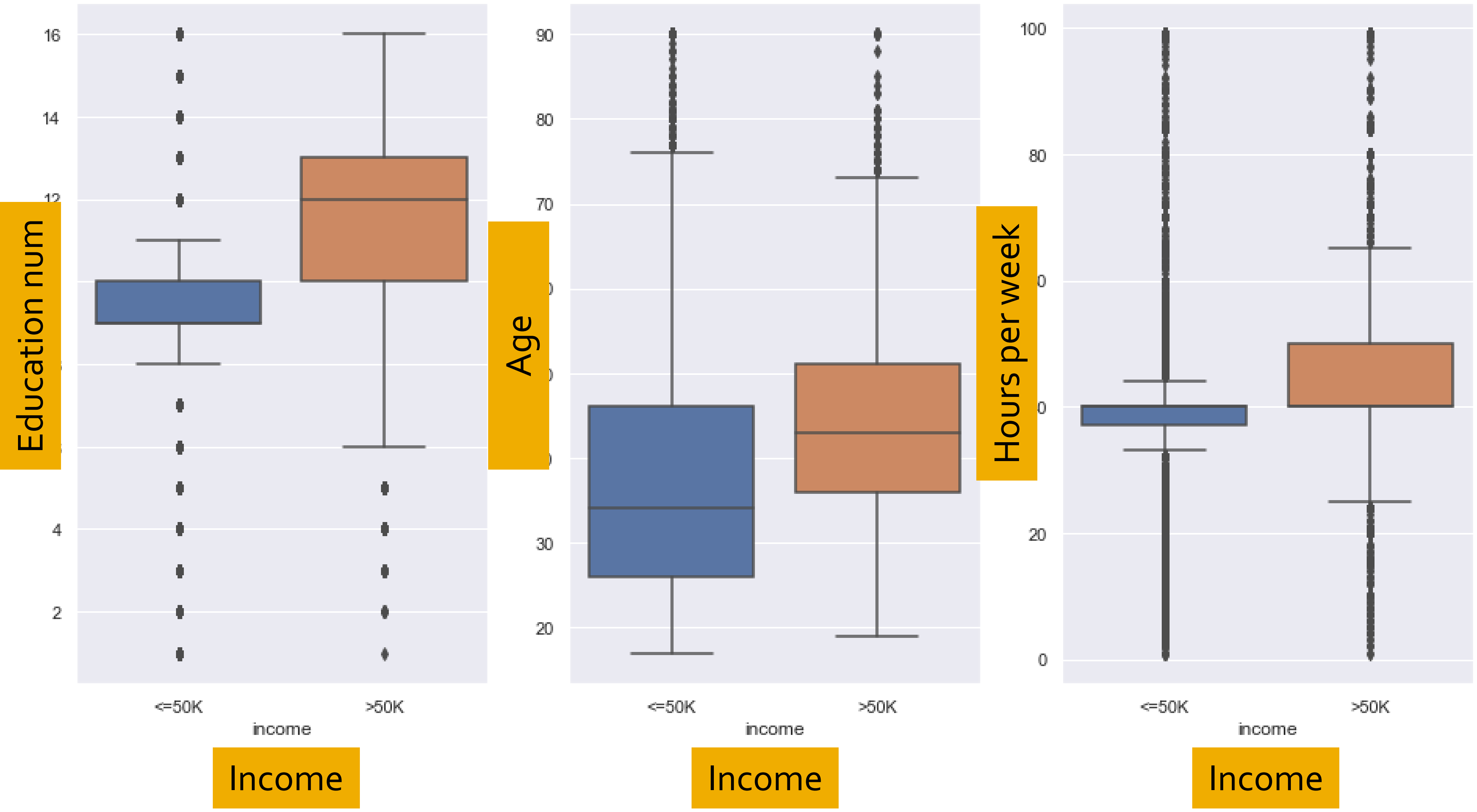
- Prediction task:
  - To determine whether a person makes over 50K a year.
- Data:
  - Extraction of 1994 US census database
  - Approximately 32,000 observations with over 15 variables.
  - Source: http://archive.ics.uci.edu/ml/datasets/Adult

Data

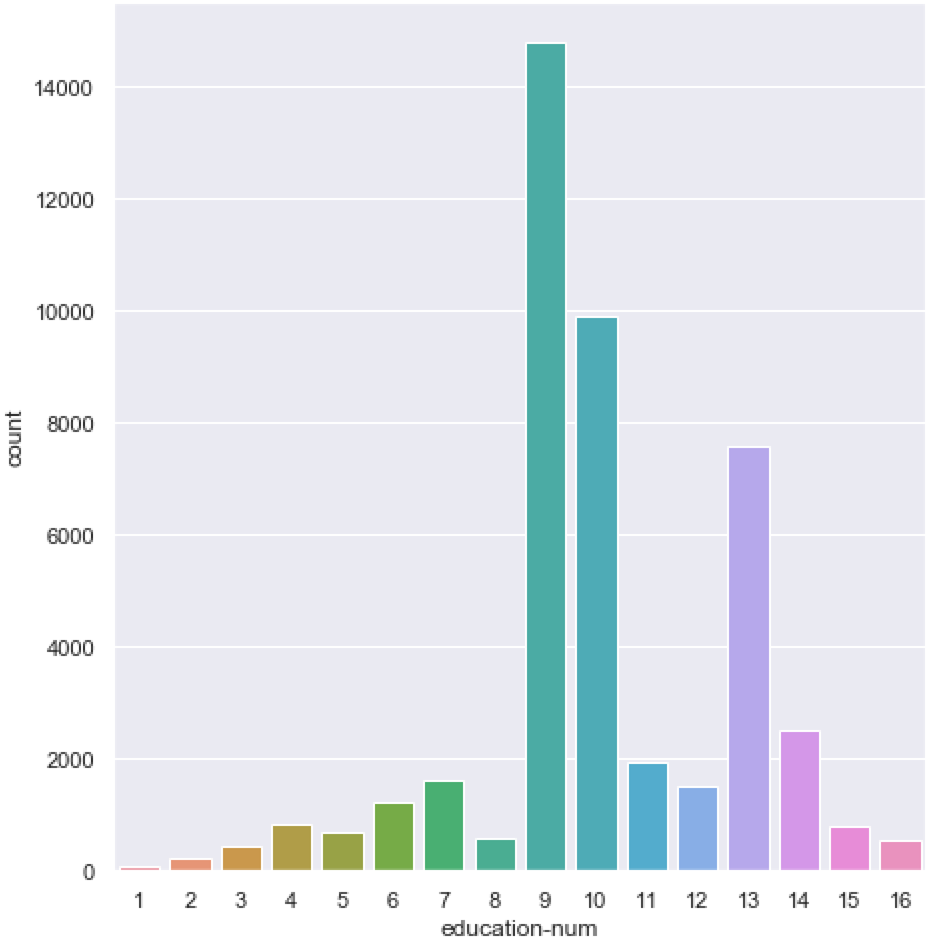
age	workclass	Education_level	education-num	marital-status	occupation	relationship	race	sex	capital-gain	capital-loss	hours-per-week	native-country	income
int	object	object	float	object	object	object	object	object	float	float	float	object	object
39	State-gov	Bachelors	13	Never-married	Adm-clerical	Not-in-family	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

- 14 Variables: 1 int64 + 4 float64 + 9 object

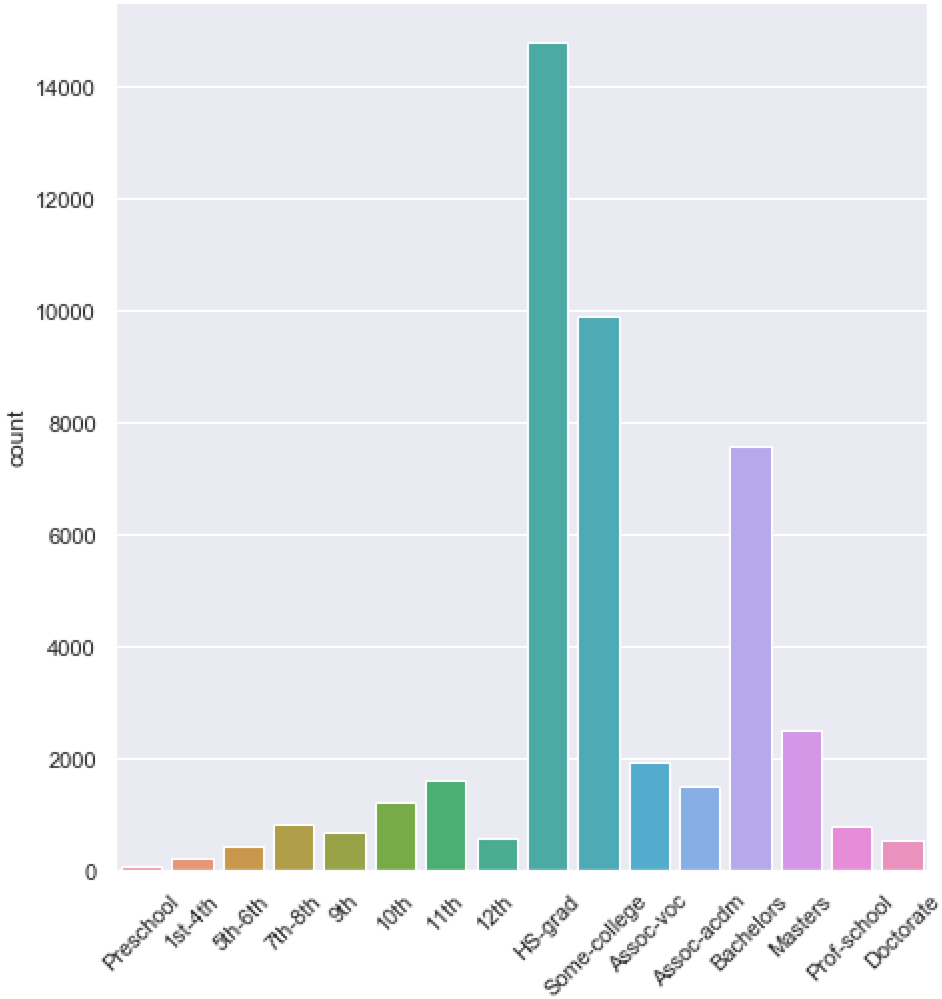
EDA: Education, age, and hours per work



EDA: Education num and education level

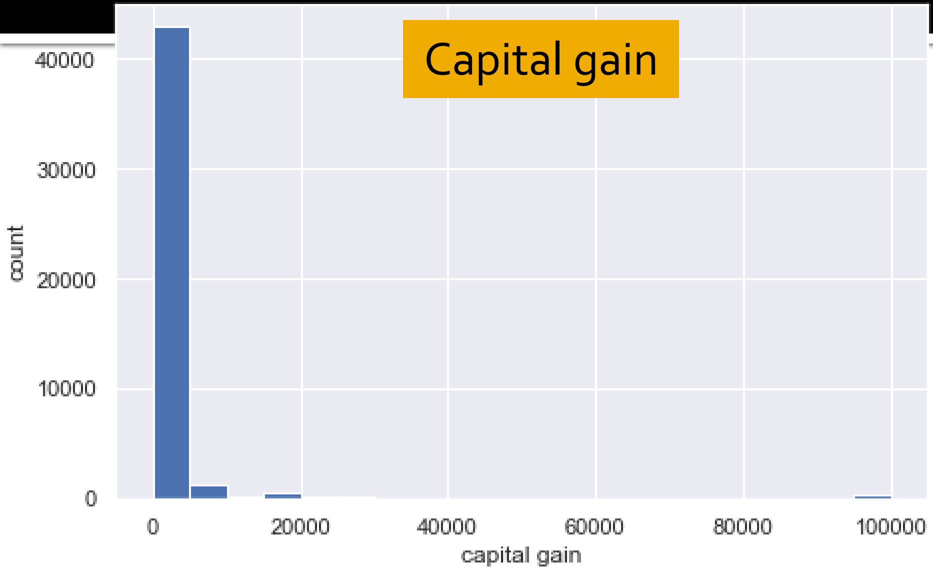


Education num

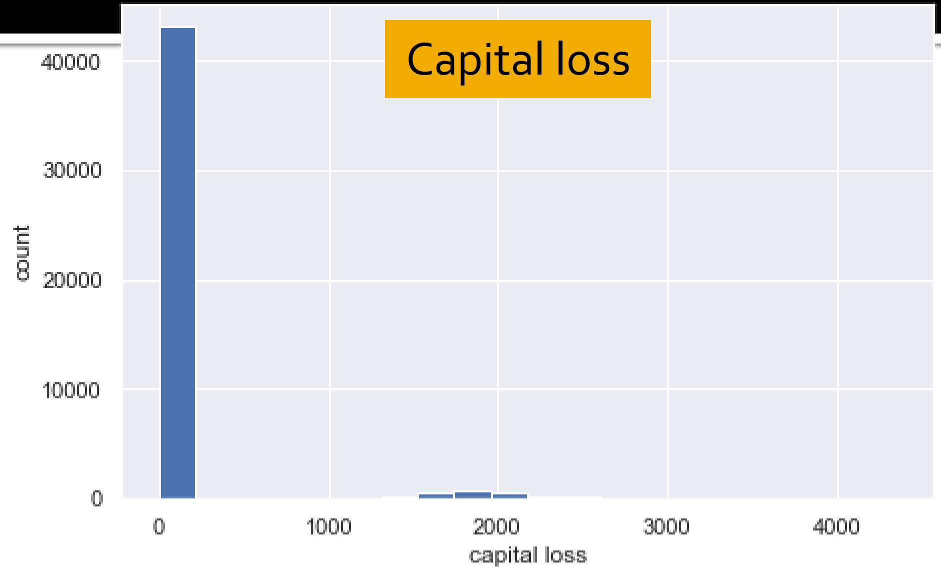


Education level

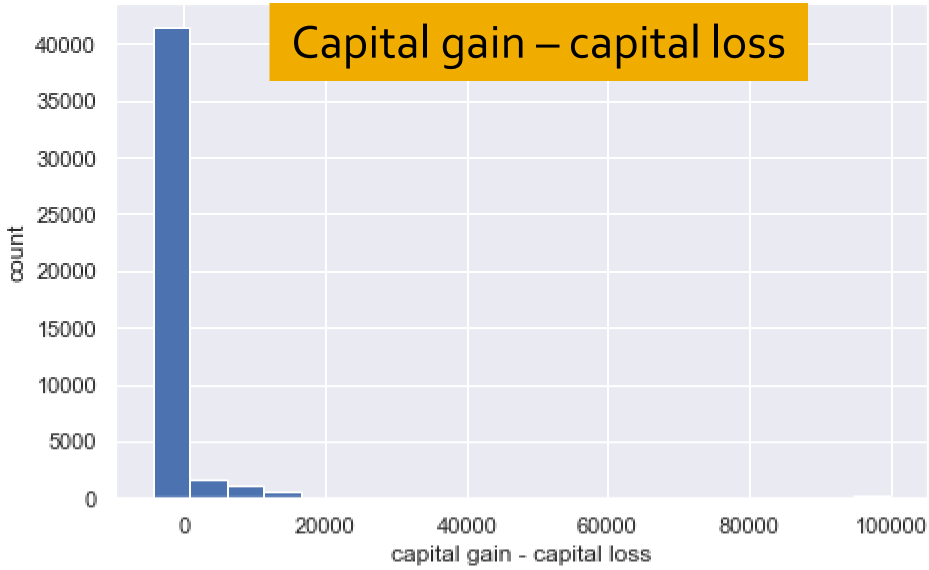
EDA: Capital gain and capital loss



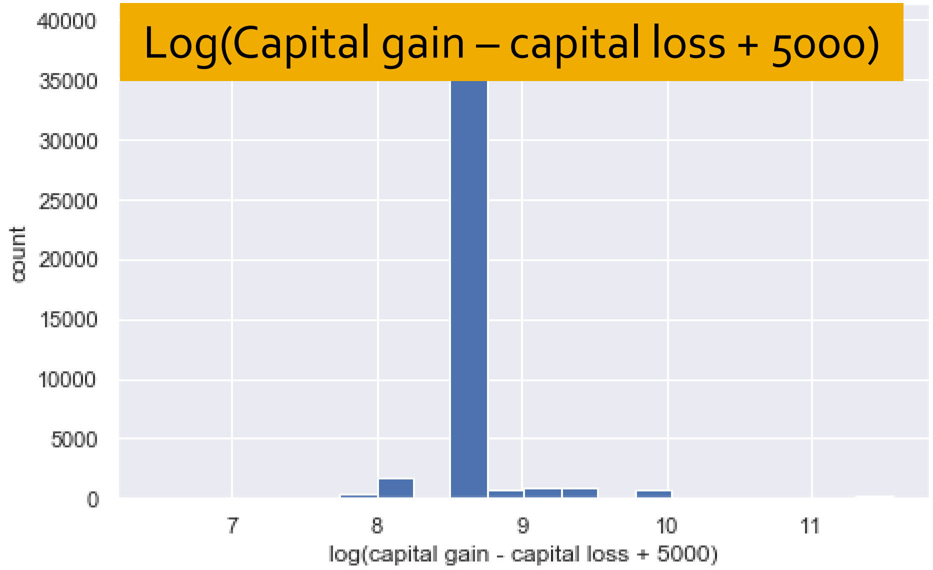
Capital gain



Capital loss

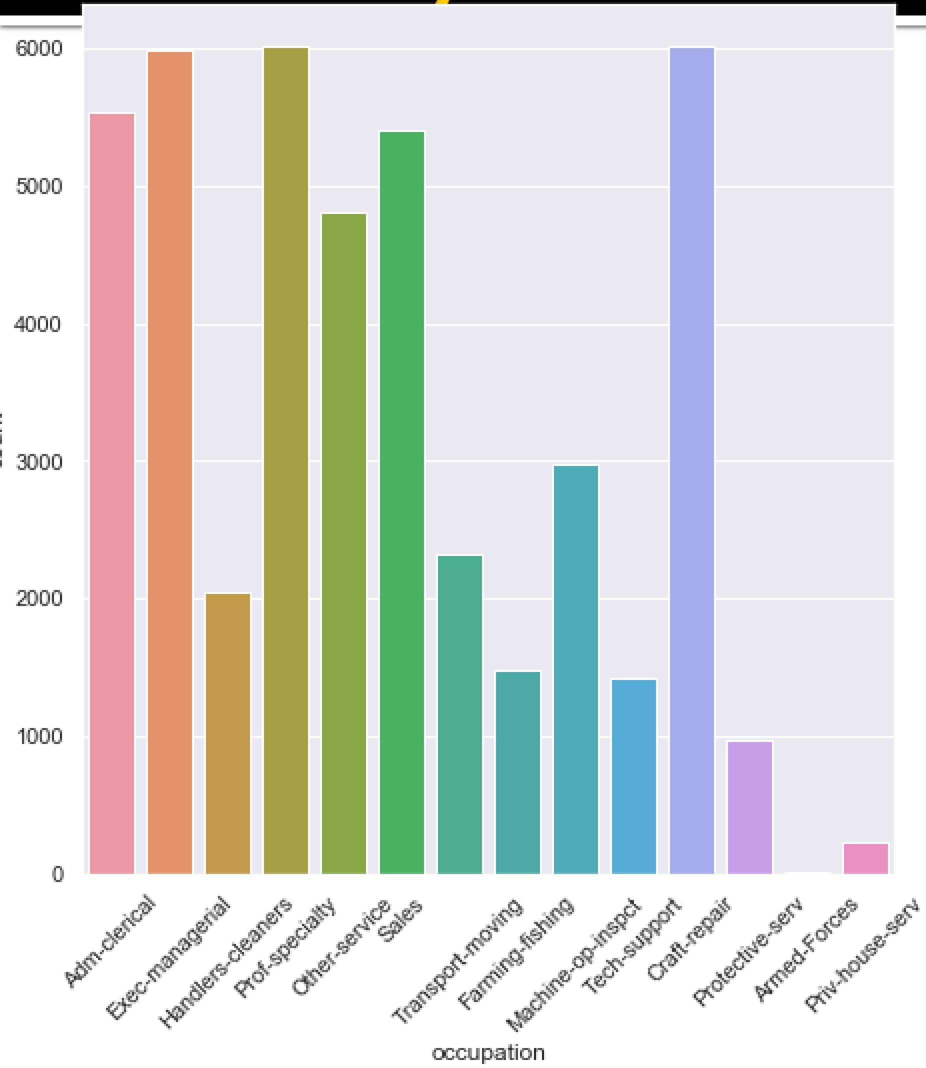


Capital gain – capital loss

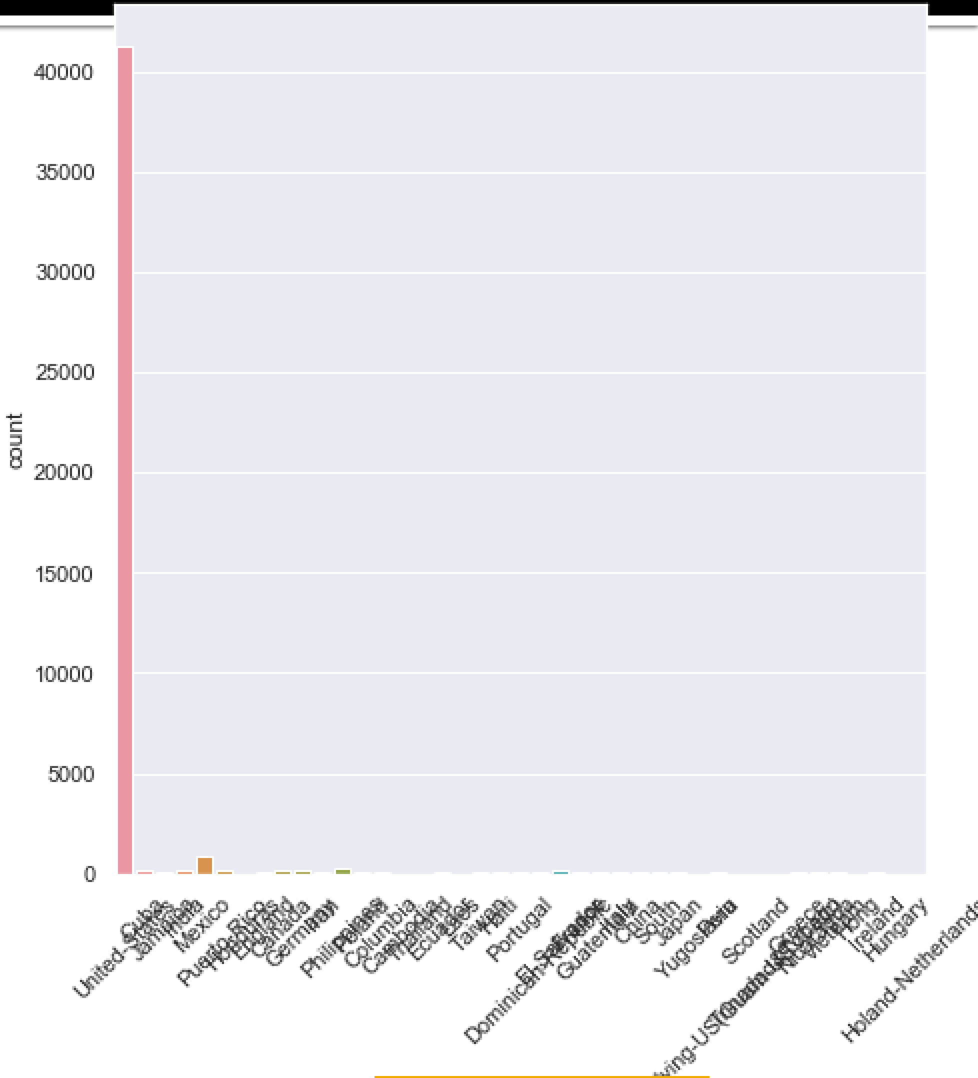


Log(Capital gain – capital loss + 5000)

EDA: Occupation and native country

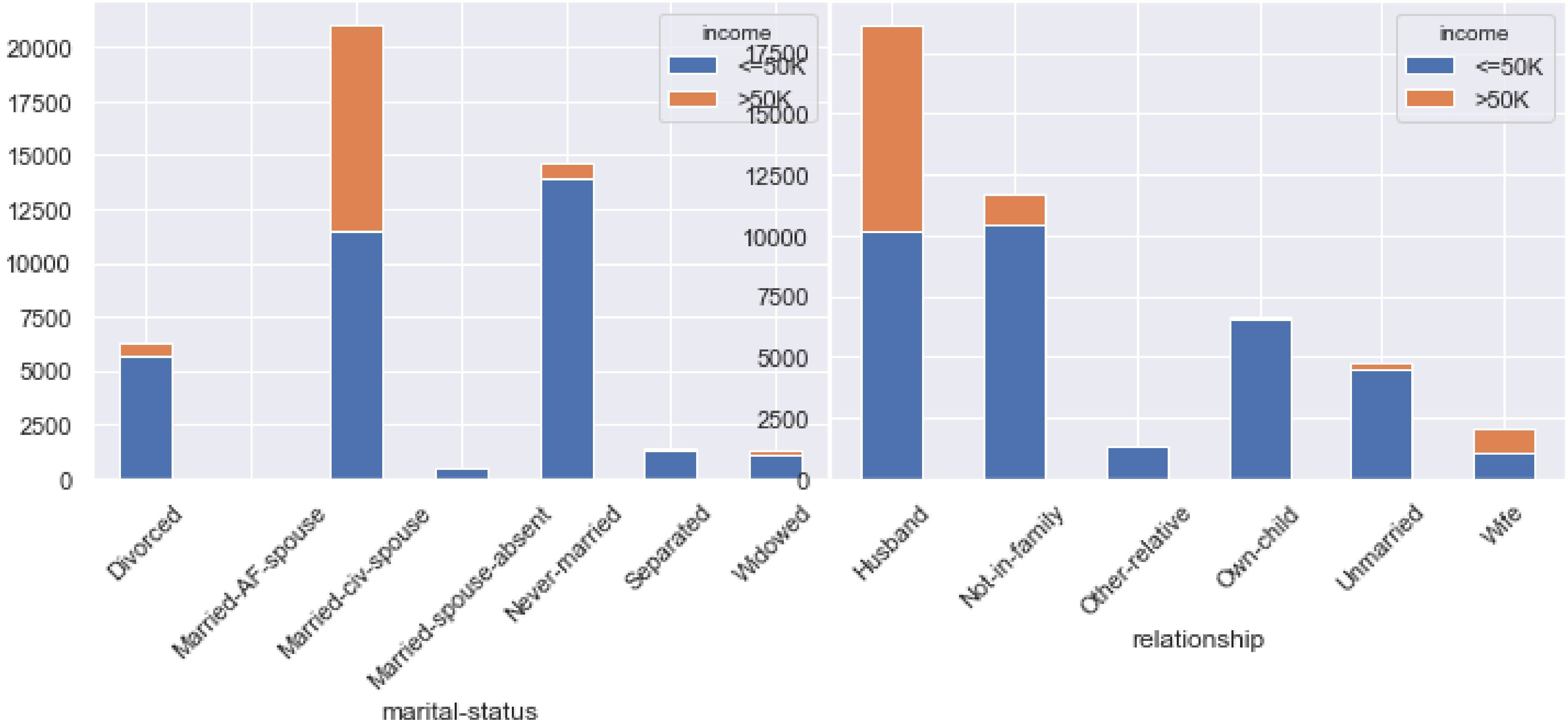


Occupation



Native country

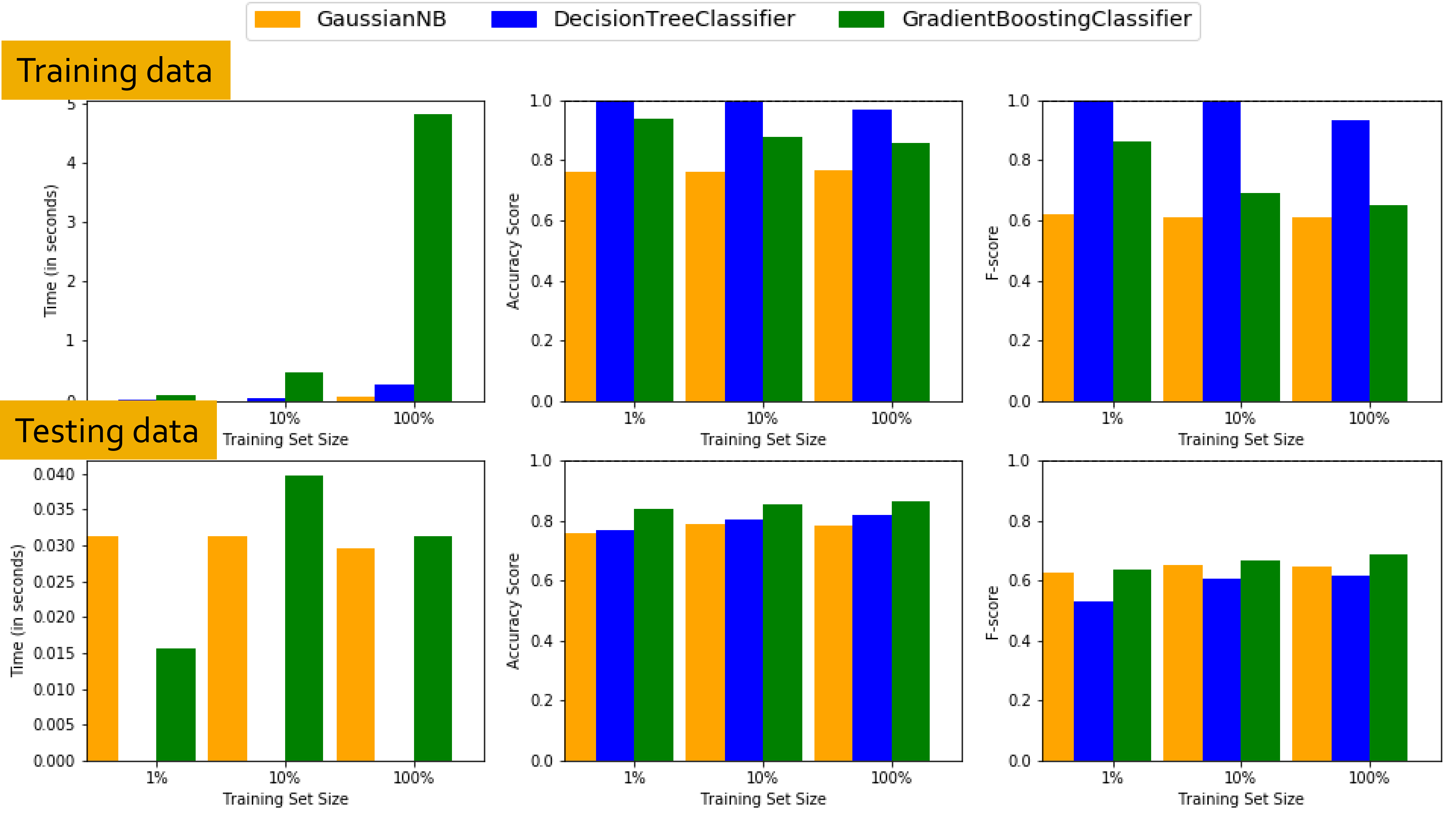
EDA: Marital status and relationship



Marital status

Relationship

Model Selection



Training data

Testing data

Feature Engineering

Initial

- Initial model with raw features

Education

- Discard duplicate feature education level

Capital

- Combine capital gain and capital loss

Native

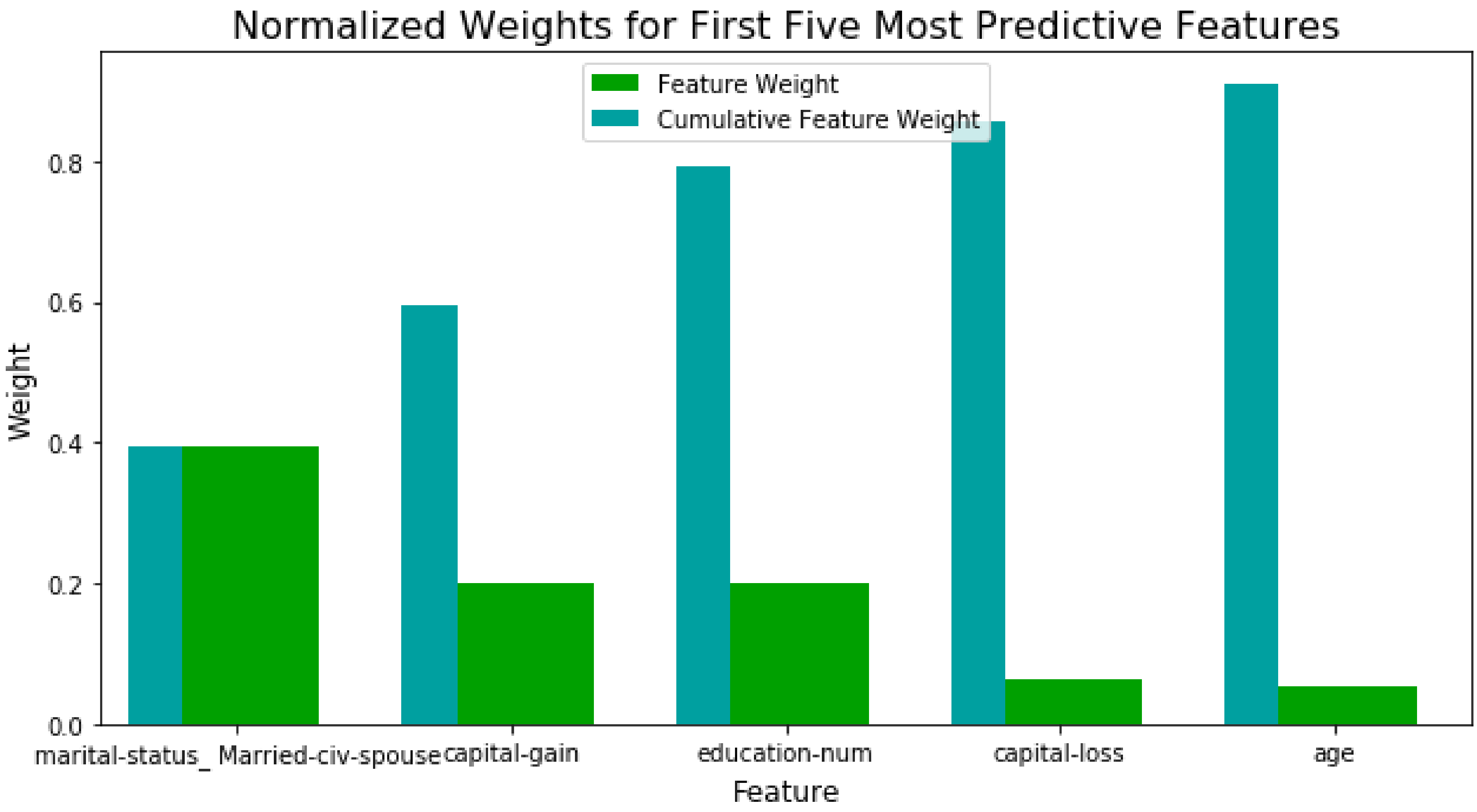
- Encode native country as U.S. and other

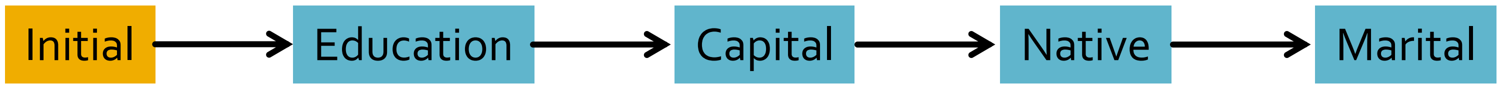
Optimize

- Optimize hyper-parameters

Model Evolution

Accuracy	0.8630
Precision	0.7821
Recall	0.6073

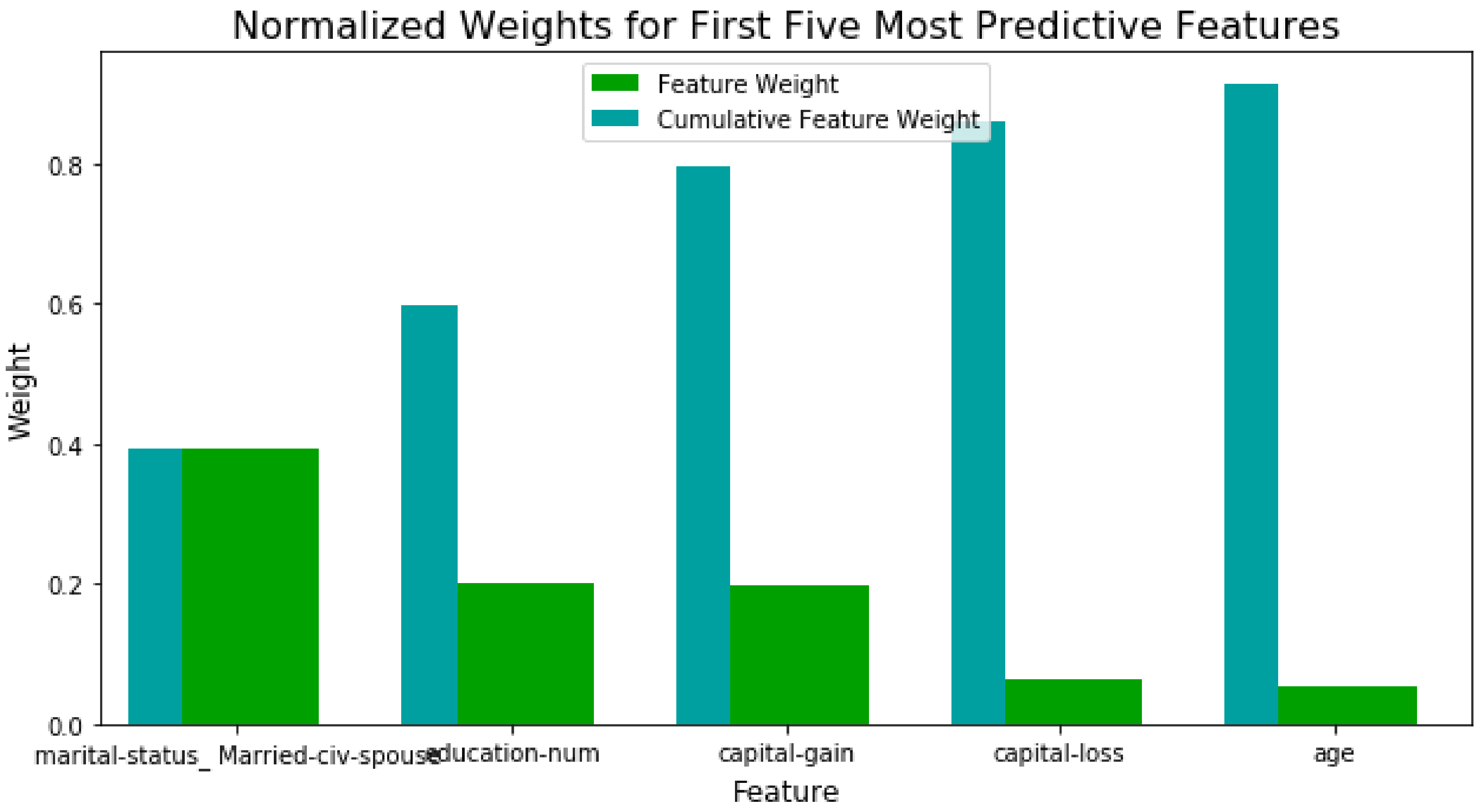




Initial → Education → Capital → Native → Marital

Model Evolution

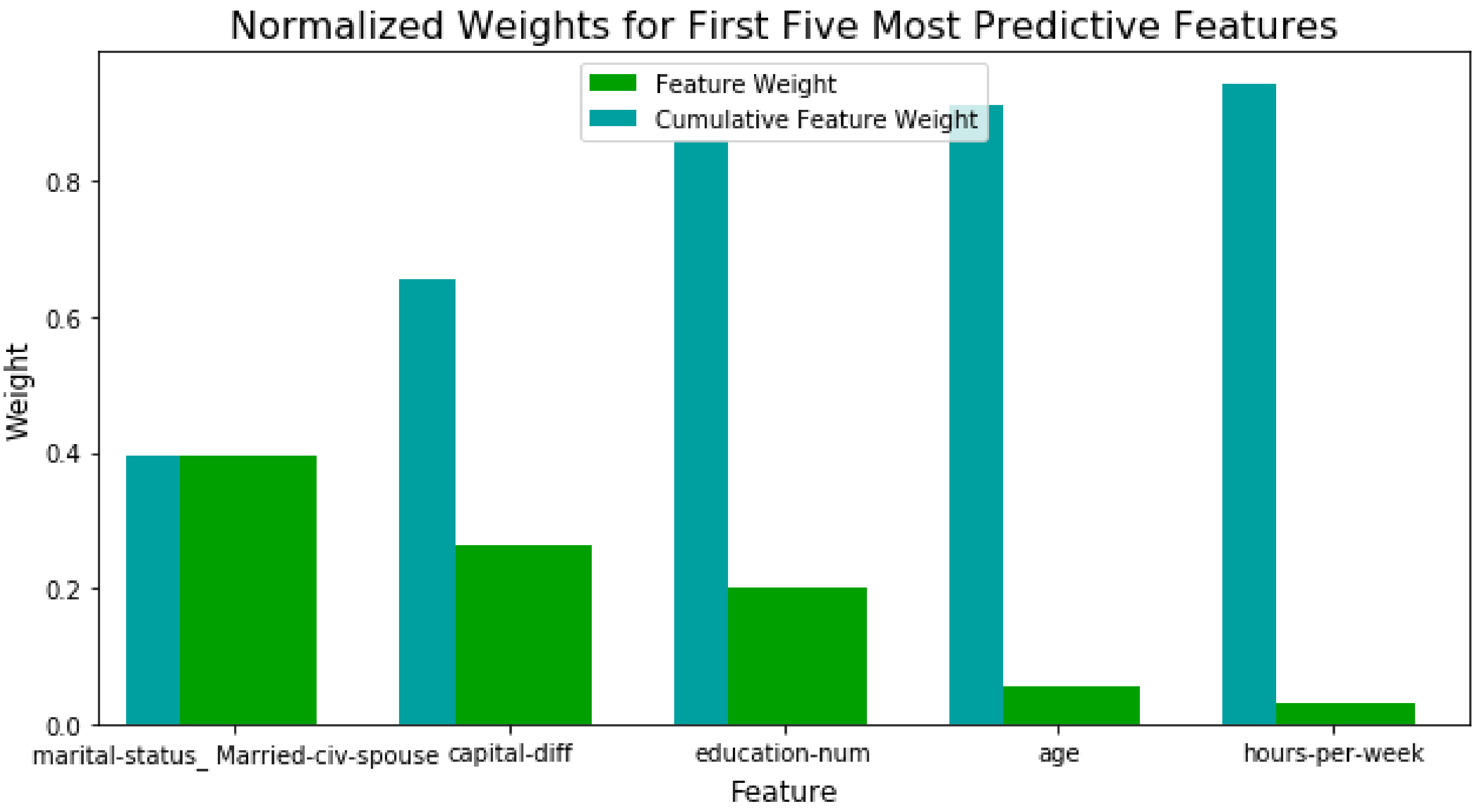
Accuracy	0.8636
Precision	0.7831
Recall	0.6091

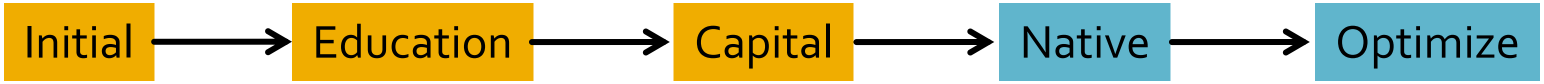


Initial → Education → Capital → Native → Optimize

Model Evolution

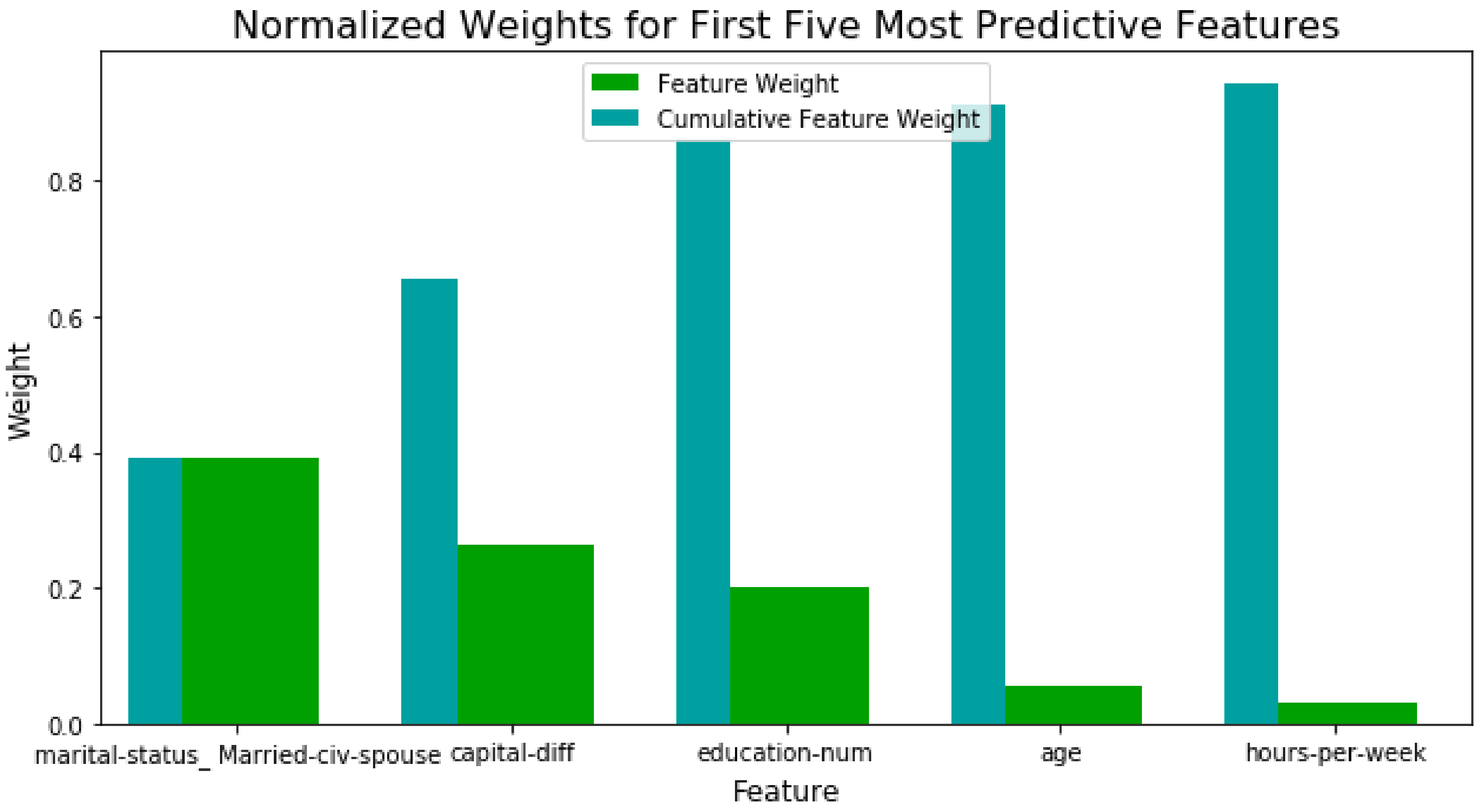
Accuracy	0.8636
Precision	0.7831
Recall	0.6091




Initial → Education → Capital → Native → Optimize

Model Evolution

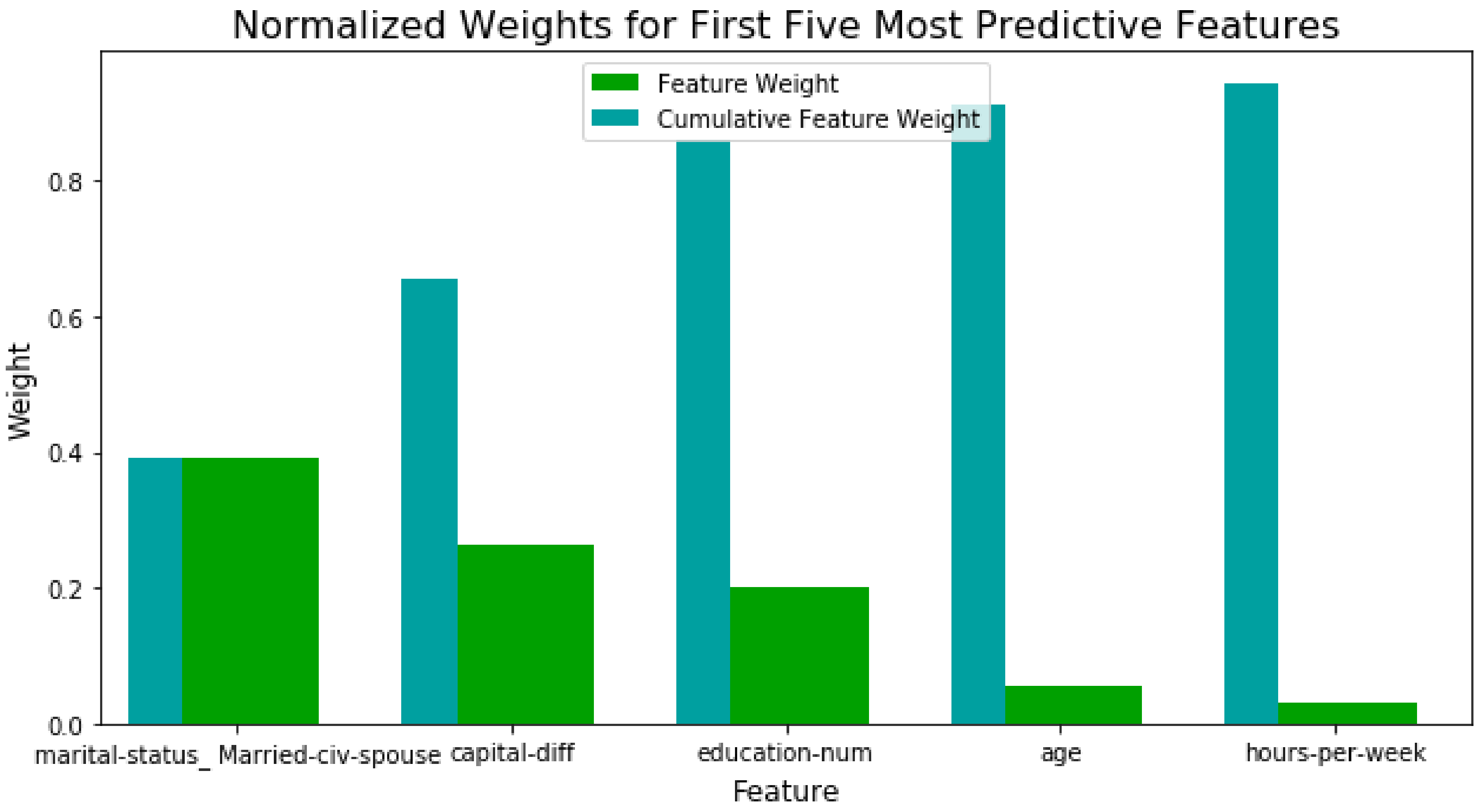
Accuracy	0.8640
Precision	0.7849
Recall	0.6091

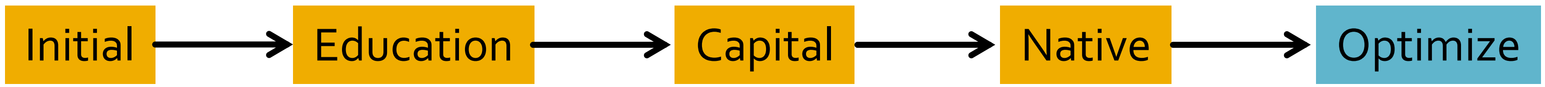


Initial
Education
Capital
Native
Optimize

Model Evolution

Accuracy	0.8714
Precision	0.7853
Recall	0.6503





Summary

- Gradient boosting model is selected based on running time, accuracy, and F score.

- Model is improved/simplified progressively by feature engineering:
  - Discarding education level
  - Combining capital gain & capital loss
  - Encoding of native country