STREAMLINE Training Summary Report: 2022-06-15 03:39:38.304325

General Pipeline Settings:

Data Path: /home/ryanurb/idata/datasets/HCC_UCI
Output Path: /home/ryanurb/idata/output
Experiment Name: HCC_PipeTest_FullRep
Class Label: Class
Instance Label: InstanceID
Ignored Features: None
Specified Categorical Features: None
CV Partitions: 3
Partition Method: S
Match Label: None
Categorical Cutoff: 10
Statistical Significance Cutoff: 0.05
Export Feature Correlations: True
Export Univariate Plots: True
Random Seed: 42
Run From Jupyter Notebook: False
Use Data Scaling: True
Use Data Imputation: True
Use Multivariate Imputation: True
Use Mutual Information: True
Use MultiSURF: True
Use TURF: False
TURF Cutoff: 0.5
MultiSURF Instance Subset: 2000
Max Features to Keep: 2000
Filter Poor Features: True
Top Features to Display: 40
Export Feature Importance Plot: True
Overwrite CV Datasets: False
Primary Metric: balanced_accuracy
Training Subsample for KNN,ANN,SVM,and XGB: 0
Uniform Feature Importance Estimation (Models): True
Hyperparameter Sweep Number of Trials: 50
Hyperparameter Timeout: None
Export Hyperparameter Sweep Plots: True
Export ROC Plot: True
Export PRC Plot: True
Export Metric Boxplots: True
Export Feature Importance Boxplots: True
Metric Weighting Composite FI Plots: balanced_accuracy
Top Model Features To Display: 40

ML Modeling Algorithms:

Naive Bayes: True
Logistic Regression: True
Decision Tree: True
Random Forest: True
Gradient Boosting: True
Extreme Gradient Boosting: True
Light Gradient Boosting: True
Category Gradient Boosting: True
Support Vector Machine: True
Artificial Neural Network: True
K-Nearest Neightbors: True
Genetic Programming: True
eLCS: False
XCS: False
ExSTraCS: True

LCS Settings (eLCS,XCS,ExSTraCS):

Do LCS Hyperparameter Sweep: False
nu: 1
Training Iterations: 200000
N (Rule Population Size): 2000
LCS Hyperparameter Sweep Timeout: 1200

Datasets:

D1 = hcc-data_example
D2 = hcc-data_example_no_covariates

Univariate Analysis of Each Dataset (Top 10 Features for Each)

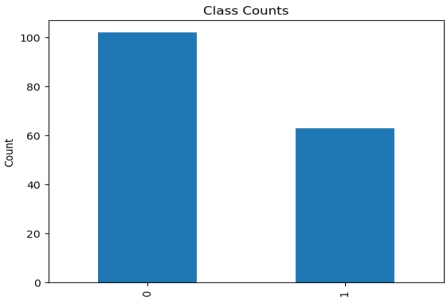
D1 = hcc-data_example

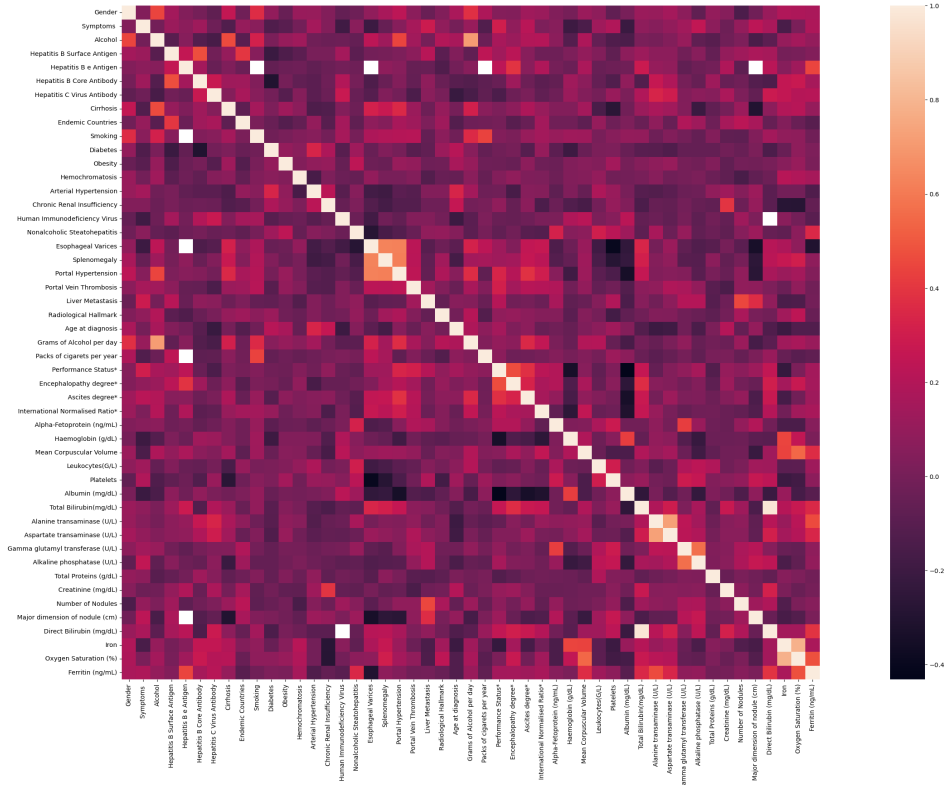
Feature: P-Value
Performance Status*: 3.2548676278782114e-05
Symptoms : 0.0006092985105592
Liver Metastasis: 0.0029935882248699
Ascites degree*: 0.0038134308539161
Portal Vein Thrombosis: 0.0117430411554256
Age at diagnosis: 0.035683237512087
Encephalopathy degree*: 0.0367398682254197
Diabetes: 0.2071781828192029
Hepatitis C Virus Antibody: 0.2152844001545551
Endemic Countries: 0.3741454960813042

D2 = hcc-data_example_no_covariates

Feature: P-Value
Performance Status*: 3.2548676278782114e-05
Symptoms : 0.0006092985105592
Liver Metastasis: 0.0029935882248699
Ascites degree*: 0.0038134308539161
Portal Vein Thrombosis: 0.0117430411554256
Encephalopathy degree*: 0.0367398682254197
Diabetes: 0.2071781828192029
Hepatitis C Virus Antibody: 0.2152844001545551
Endemic Countries: 0.3741454960813042
Chronic Renal Insufficiency: 0.3855402814015594

Dataset and Model Prediction Summary: D1 = hcc-data_example

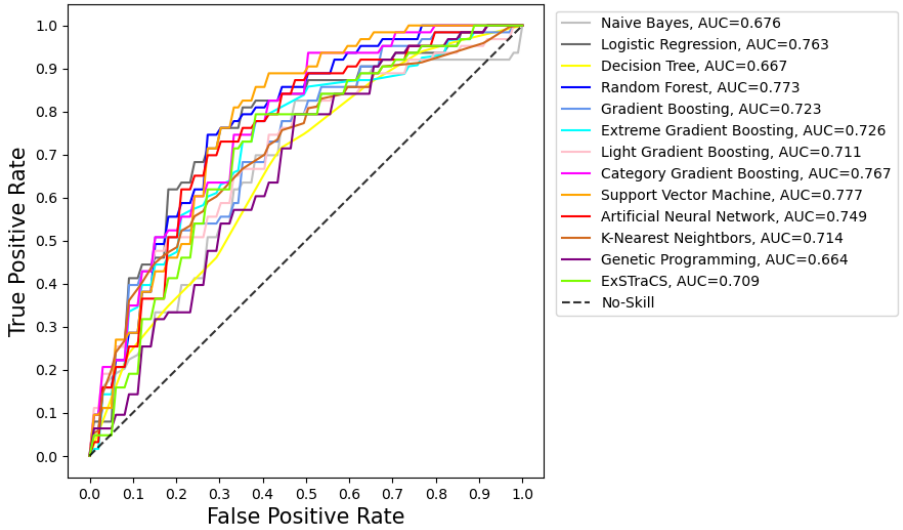


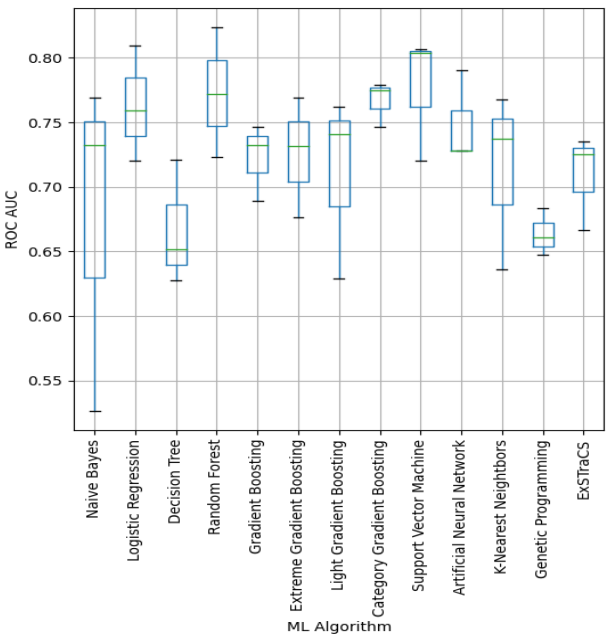


Dataset Counts Summary:
instances: 165.0
features: 49.0
categorical_features: 27.0
quantitative_features: 22.0
missing_values: 826.0
missing_percent: 0.10216

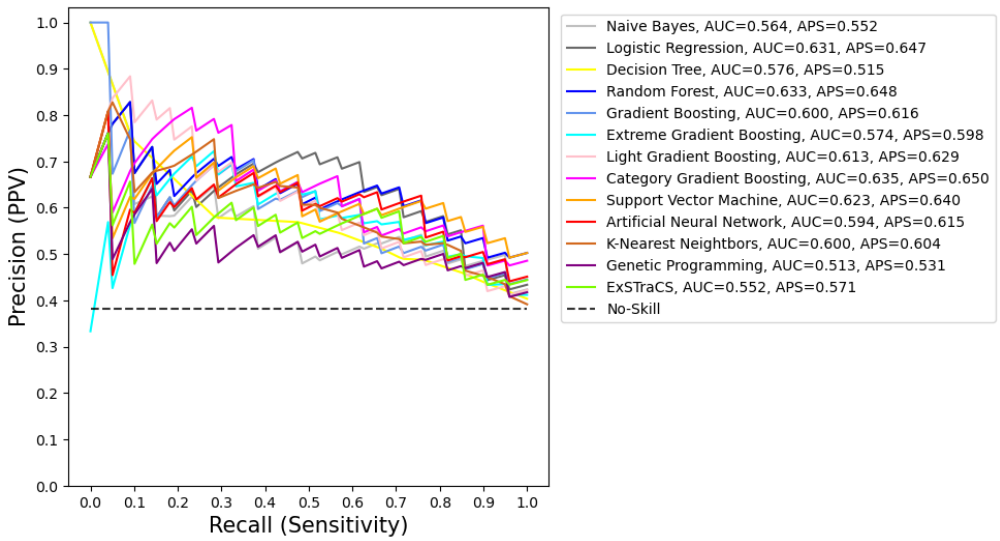
Top ML Algorithm Results (Averaged Over CV Runs):
Best (ROC_AUC): Support Vector Machine = 0.777
Best (Balanced Acc.): Random Forest = 0.724
Best (F1 Score): Random Forest = 0.662
Best (PRC AUC): Category Gradient Boosting = 0.635
Best (PRC APS): Category Gradient Boosting = 0.650

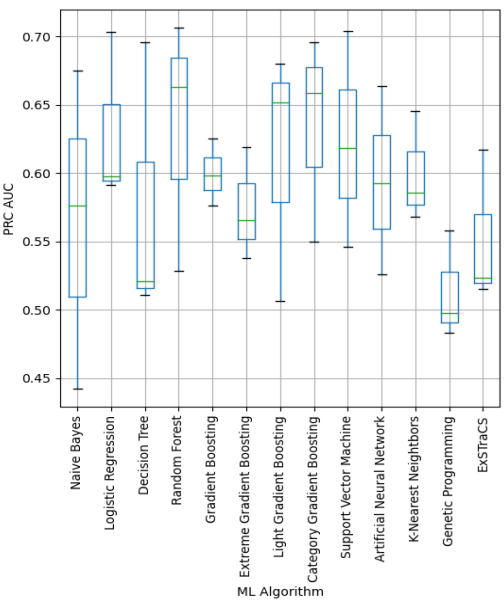
ROC





PRC





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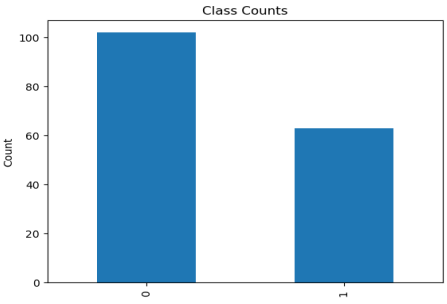
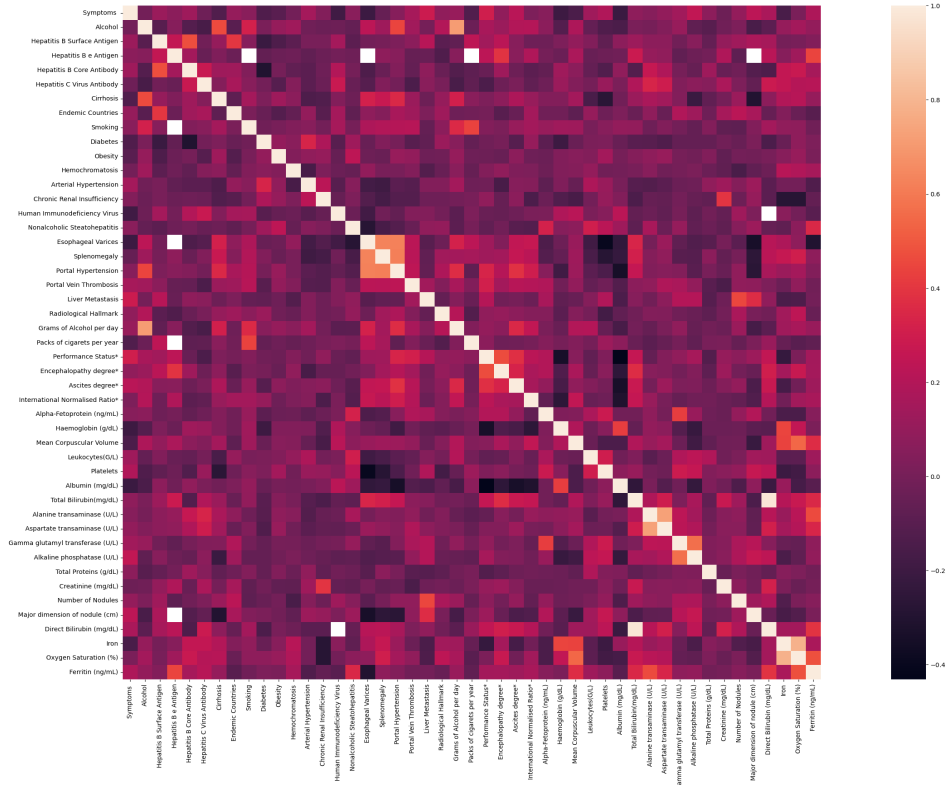
Dataset and Model Prediction Summary: D2 = hcc-data_example_no_covariates

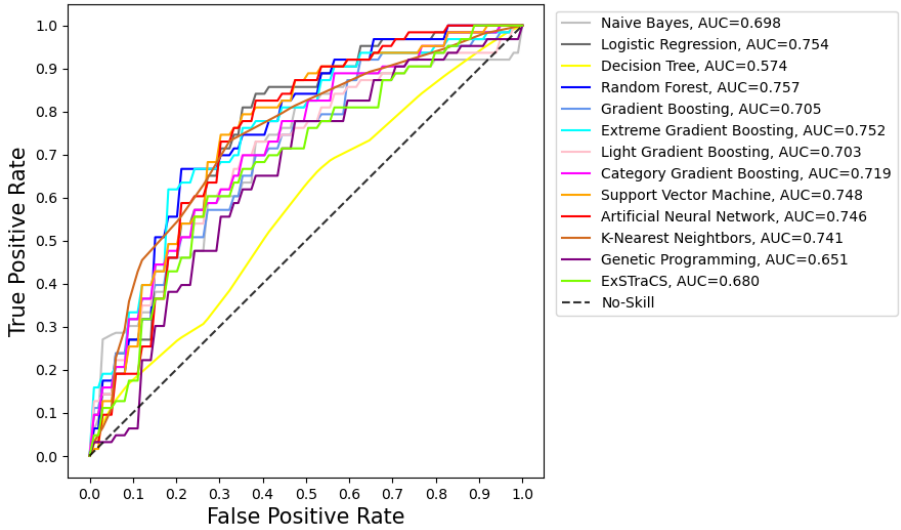


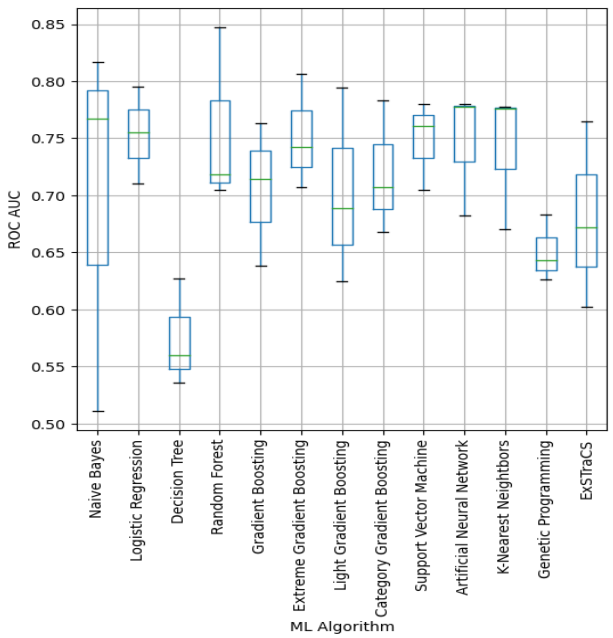


Dataset Counts Summary:
instances: 165.0
features: 47.0
categorical_features: 26.0
quantitative_features: 21.0
missing_values: 826.0
missing_percent: 0.10651

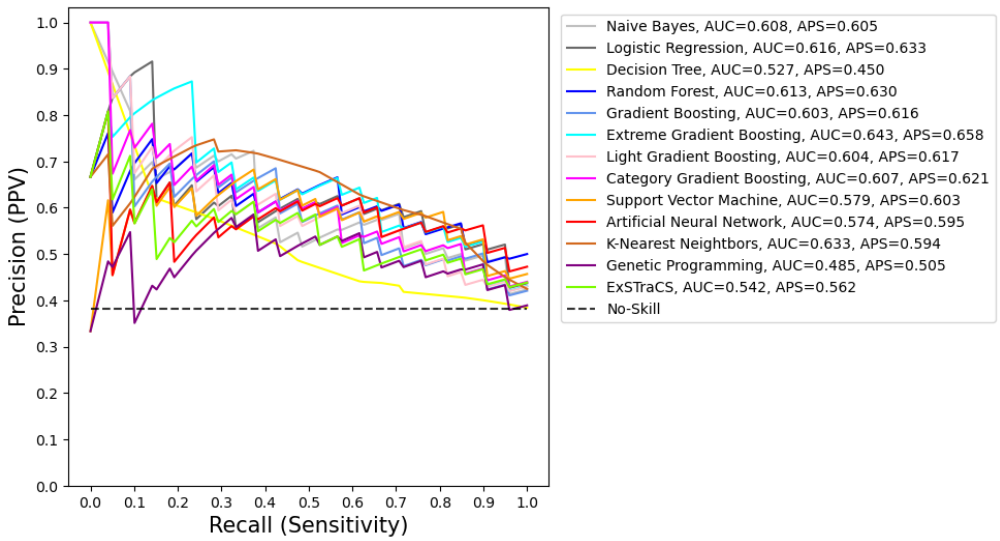
Top ML Algorithm Results (Averaged Over CV Runs):
Best (ROC_AUC): Random Forest = 0.757
Best (Balanced Acc.): Random Forest = 0.691
Best (F1 Score): Random Forest = 0.630
Best (PRC AUC): Extreme Gradient Boosting = 0.643
Best (PRC APS): Extreme Gradient Boosting = 0.658

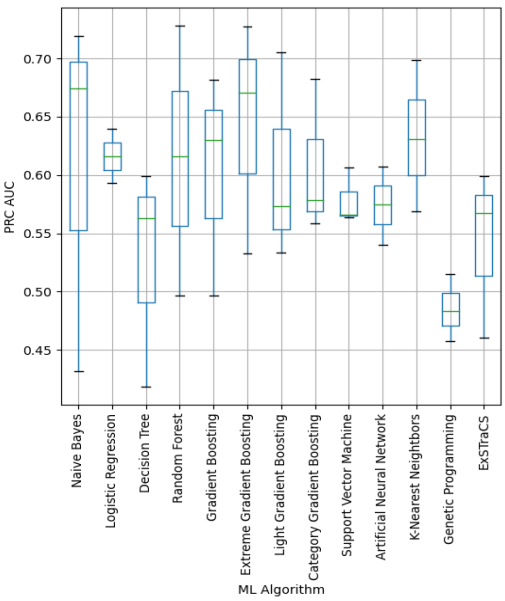
ROC





PRC





Generated with the URBS-Lab STREAMLINE: (https://github.com/UrbsLab/STREAMLINE)

Average Model Prediction Statistics (Rounded to 3 Decimal Points)

D1 = hcc-data_example

ML Algorithm	Balanced Accuracy	Accuracy	F1 Score	Sensitivity (Recall)	Specificity	Precision (PPV)	TP	TN	FP	FN	NPV	LR+	LR-	ROC AUC	PRC AUC	PRC APS
Naive Bayes	0.545	0.558	0.445	0.492	0.598	0.579	10.333	20.333	13.667	10.667	0.522	3.67	2.66	0.676	0.564	0.552
Logistic Regression	0.719	0.727	0.656	0.683	0.755	0.632	14.333	25.667	8.333	6.667	0.795	2.788	0.42	0.763	0.631	0.647
Decision Tree	0.651	0.655	0.586	0.635	0.667	0.556	13.333	22.667	11.333	7.667	0.746	2.159	0.551	0.667	0.576	0.515
Random Forest	0.724	0.733	0.662	0.683	0.765	0.649	14.333	26.0	8.0	6.667	0.797	3.112	0.413	0.773	0.633	0.648
Gradient Boosting	0.66	0.685	0.575	0.556	0.765	0.598	11.667	26.0	8.0	9.333	0.735	2.557	0.589	0.723	0.6	0.616
Extreme Gradient Boosting	0.658	0.697	0.553	0.492	0.824	0.636	10.333	28.0	6.0	10.667	0.725	2.968	0.618	0.726	0.574	0.598
Light Gradient Boosting	0.633	0.667	0.528	0.492	0.775	0.578	10.333	26.333	7.667	10.667	0.713	2.375	0.658	0.711	0.613	0.629
Category Gradient Boosting	0.655	0.697	0.546	0.476	0.833	0.639	10.0	28.333	5.667	11.0	0.72	2.961	0.631	0.767	0.635	0.65
Support Vector Machine	0.718	0.715	0.659	0.73	0.706	0.606	15.333	24.0	10.0	5.667	0.814	2.496	0.377	0.777	0.623	0.64
Artificial Neural Network	0.714	0.721	0.651	0.683	0.745	0.622	14.333	25.333	8.667	6.667	0.793	2.698	0.428	0.749	0.594	0.615
K-Nearest Neightbors	0.527	0.618	0.158	0.143	0.912	0.176	3.0	31.0	3.0	18.0	0.638	0.607	0.926	0.714	0.6	0.604
Genetic Programming	0.607	0.63	0.512	0.508	0.706	0.517	10.667	24.0	10.0	10.333	0.699	1.744	0.699	0.664	0.513	0.531
ExSTraCS	0.624	0.667	0.484	0.444	0.804	0.57	9.333	27.333	6.667	11.667	0.711	2.177	0.679	0.709	0.552	0.571

D2 = hcc-data_example_no_covariates

ML Algorithm	Balanced Accuracy	Accuracy	F1 Score	Sensitivity (Recall)	Specificity	Precision (PPV)	TP	TN	FP	FN	NPV	LR+	LR-	ROC AUC	PRC AUC	PRC APS
Naive Bayes	0.558	0.57	0.463	0.508	0.608	0.599	10.667	20.667	13.333	10.333	0.53	3.876	2.632	0.698	0.608	0.605
Logistic Regression	0.68	0.691	0.611	0.635	0.725	0.59	13.333	24.667	9.333	7.667	0.762	2.362	0.506	0.754	0.616	0.633
Decision Tree	0.556	0.564	0.477	0.524	0.588	0.442	11.0	20.0	14.0	10.0	0.667	1.289	0.809	0.574	0.527	0.45
Random Forest	0.691	0.697	0.63	0.667	0.716	0.599	14.0	24.333	9.667	7.0	0.774	2.644	0.479	0.757	0.613	0.63
Gradient Boosting	0.637	0.661	0.547	0.54	0.735	0.556	11.333	25.0	9.0	9.667	0.722	2.039	0.626	0.705	0.603	0.616
Extreme Gradient Boosting	0.669	0.703	0.573	0.524	0.814	0.635	11.0	27.667	6.333	10.0	0.735	2.814	0.585	0.752	0.643	0.658
Light Gradient Boosting	0.654	0.685	0.558	0.524	0.784	0.599	11.0	26.667	7.333	10.0	0.728	2.523	0.61	0.703	0.604	0.617
Category Gradient Boosting	0.633	0.655	0.544	0.54	0.725	0.55	11.333	24.667	9.333	9.667	0.718	1.99	0.635	0.719	0.607	0.621
Support Vector Machine	0.635	0.673	0.52	0.476	0.794	0.607	10.0	27.0	7.0	11.0	0.713	2.638	0.654	0.748	0.579	0.603
Artificial Neural Network	0.678	0.685	0.614	0.651	0.706	0.586	13.667	24.0	10.0	7.333	0.764	2.381	0.5	0.746	0.574	0.595
K-Nearest Neightbors	0.552	0.648	0.182	0.143	0.961	0.25	3.0	32.667	1.333	18.0	0.65	1.619	0.886	0.741	0.633	0.594
Genetic Programming	0.623	0.642	0.536	0.54	0.706	0.533	11.333	24.0	10.0	9.667	0.712	1.889	0.656	0.651	0.485	0.505
ExSTraCS	0.597	0.648	0.449	0.381	0.814	0.556	8.0	27.667	6.333	13.0	0.682	2.035	0.759	0.68	0.542	0.562

Median Model Prediction Statistics (Rounded to 3 Decimal Points)

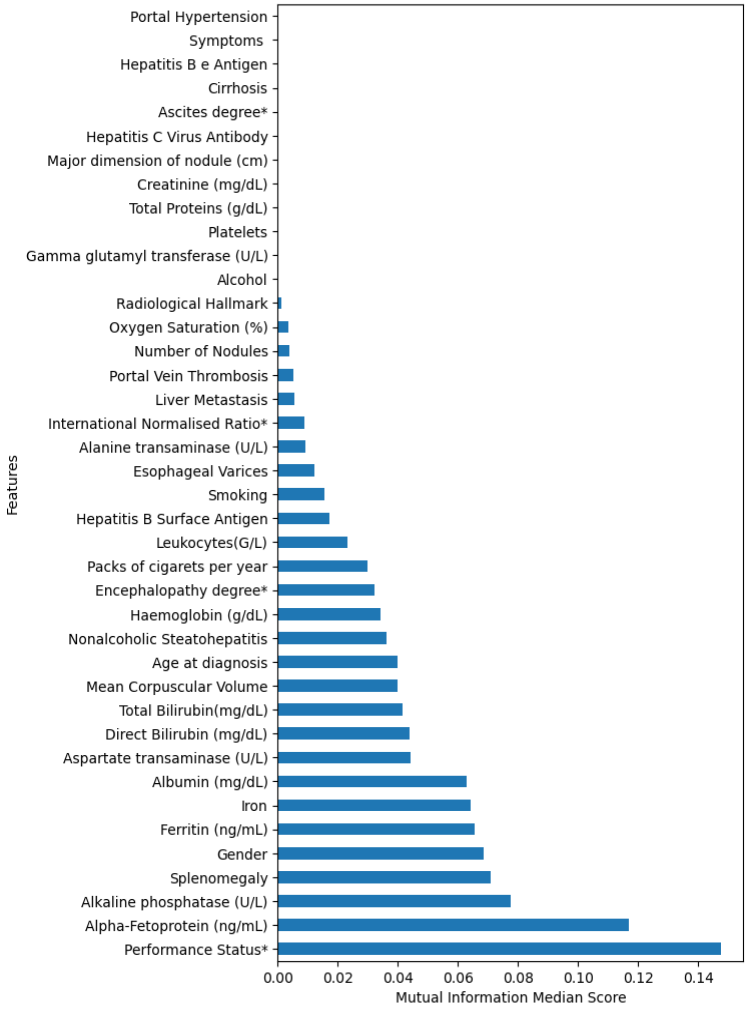
D1 = hcc-data_example

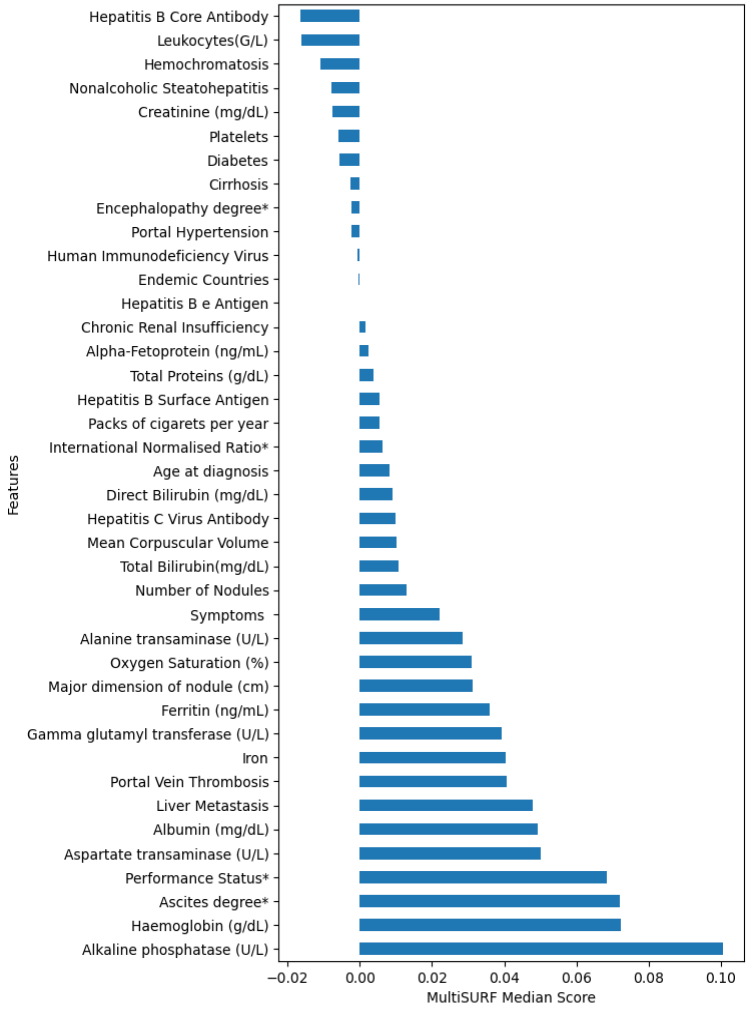
ML Algorithm	Balanced Accuracy	Accuracy	F1 Score	Sensitivity (Recall)	Specificity	Precision (PPV)	TP	TN	FP	FN	NPV	LR+	LR-	ROC AUC	PRC AUC	PRC APS
Naive Bayes	0.604	0.655	0.479	0.429	0.794	0.562	9.0	27.0	7.0	12.0	0.673	2.082	0.785	0.732	0.576	0.539
Logistic Regression	0.725	0.727	0.667	0.714	0.765	0.625	15.0	26.0	8.0	6.0	0.806	2.698	0.389	0.759	0.597	0.622
Decision Tree	0.627	0.618	0.571	0.667	0.588	0.5	14.0	20.0	14.0	7.0	0.741	1.619	0.567	0.652	0.521	0.48
Random Forest	0.725	0.727	0.667	0.714	0.735	0.625	15.0	25.0	9.0	6.0	0.8	2.698	0.405	0.772	0.663	0.676
Gradient Boosting	0.659	0.691	0.564	0.524	0.794	0.611	11.0	27.0	7.0	10.0	0.73	2.544	0.6	0.732	0.598	0.616
Extreme Gradient Boosting	0.679	0.709	0.571	0.476	0.794	0.632	10.0	27.0	7.0	11.0	0.732	2.776	0.594	0.732	0.566	0.583
Light Gradient Boosting	0.639	0.655	0.558	0.524	0.765	0.545	11.0	26.0	8.0	10.0	0.727	1.943	0.607	0.741	0.652	0.664
Category Gradient Boosting	0.665	0.709	0.556	0.476	0.853	0.667	10.0	29.0	5.0	11.0	0.725	3.238	0.614	0.775	0.659	0.674
Support Vector Machine	0.695	0.709	0.638	0.714	0.676	0.619	15.0	23.0	11.0	6.0	0.793	2.631	0.422	0.804	0.618	0.646
Artificial Neural Network	0.701	0.709	0.636	0.667	0.735	0.609	14.0	25.0	9.0	7.0	0.781	2.519	0.453	0.728	0.592	0.609
K-Nearest Neightbors	0.5	0.618	0.0	0.0	0.971	0.0	0.0	33.0	1.0	21.0	0.618	0.0	1.0	0.737	0.586	0.608
Genetic Programming	0.615	0.636	0.524	0.524	0.706	0.524	11.0	24.0	10.0	10.0	0.706	1.781	0.675	0.661	0.498	0.515
ExSTraCS	0.578	0.636	0.412	0.333	0.824	0.545	7.0	28.0	6.0	14.0	0.667	1.943	0.81	0.725	0.523	0.541

D2 = hcc-data_example_no_covariates

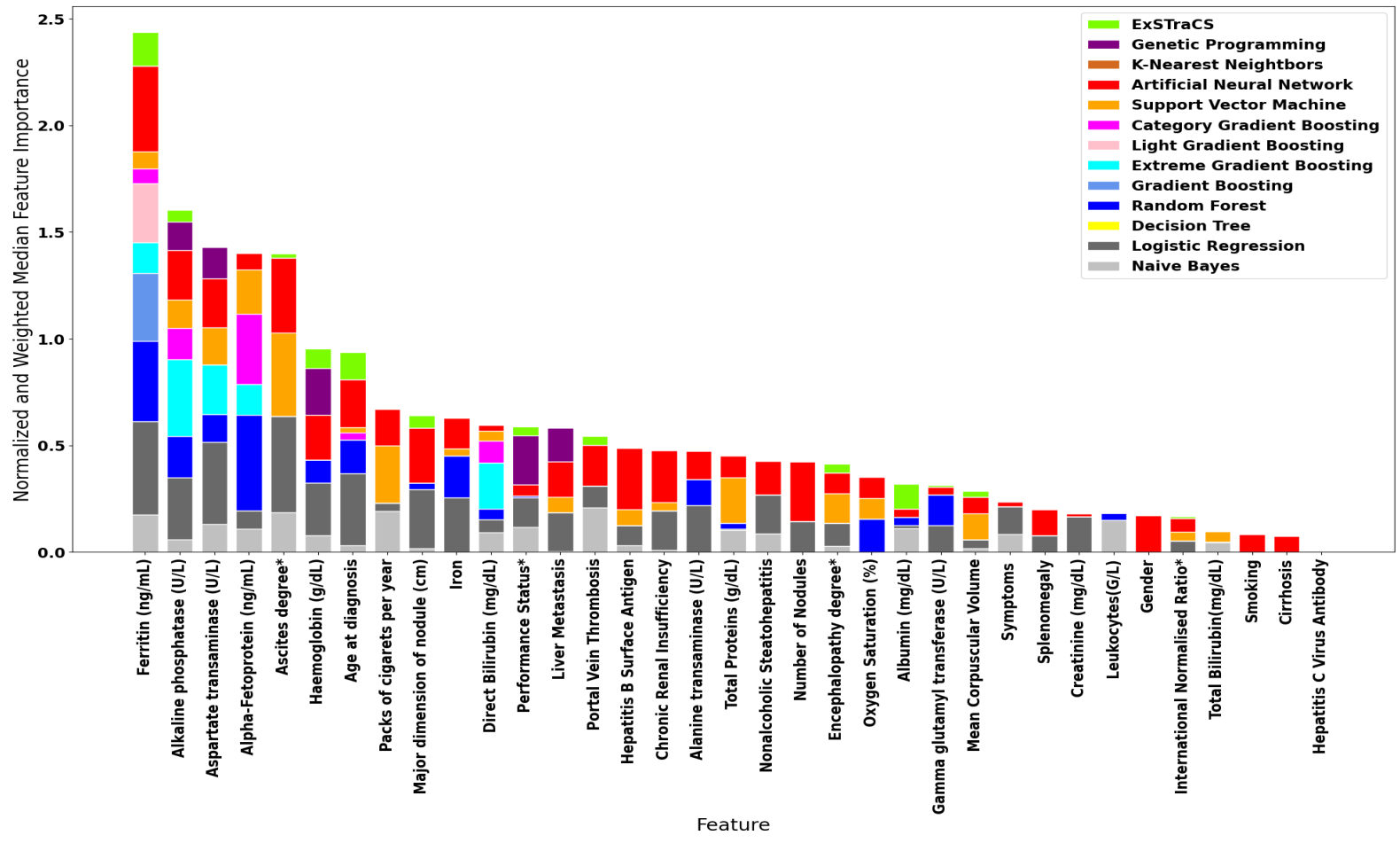
ML Algorithm	Balanced Accuracy	Accuracy	F1 Score	Sensitivity (Recall)	Specificity	Precision (PPV)	TP	TN	FP	FN	NPV	LR+	LR-	ROC AUC	PRC AUC	PRC APS
Naive Bayes	0.604	0.691	0.479	0.476	0.824	0.625	10.0	28.0	6.0	11.0	0.673	2.698	0.785	0.768	0.674	0.685
Logistic Regression	0.677	0.691	0.605	0.619	0.735	0.591	13.0	25.0	9.0	8.0	0.758	2.339	0.518	0.755	0.616	0.644
Decision Tree	0.56	0.545	0.476	0.476	0.588	0.433	10.0	20.0	14.0	11.0	0.676	1.238	0.774	0.56	0.563	0.414
Random Forest	0.686	0.691	0.622	0.667	0.706	0.583	14.0	24.0	10.0	7.0	0.774	2.267	0.472	0.718	0.616	0.632
Gradient Boosting	0.63	0.655	0.537	0.524	0.735	0.55	11.0	25.0	9.0	10.0	0.714	1.979	0.648	0.714	0.63	0.642
Extreme Gradient Boosting	0.674	0.709	0.579	0.524	0.824	0.632	11.0	28.0	6.0	10.0	0.737	2.776	0.578	0.742	0.671	0.679
Light Gradient Boosting	0.63	0.655	0.537	0.524	0.794	0.562	11.0	27.0	7.0	10.0	0.714	2.082	0.648	0.689	0.573	0.587
Category Gradient Boosting	0.63	0.655	0.545	0.524	0.735	0.55	11.0	25.0	9.0	10.0	0.719	1.979	0.634	0.707	0.579	0.596
Support Vector Machine	0.63	0.673	0.537	0.524	0.735	0.571	11.0	25.0	9.0	10.0	0.714	2.159	0.648	0.761	0.566	0.595
Artificial Neural Network	0.701	0.709	0.634	0.667	0.735	0.609	14.0	25.0	9.0	7.0	0.771	2.519	0.48	0.777	0.575	0.604
K-Nearest Neightbors	0.5	0.618	0.0	0.0	0.971	0.0	0.0	33.0	1.0	21.0	0.618	0.0	1.0	0.776	0.631	0.605
Genetic Programming	0.6	0.618	0.512	0.524	0.676	0.5	11.0	23.0	11.0	10.0	0.697	1.619	0.704	0.643	0.483	0.508
ExSTraCS	0.588	0.636	0.444	0.381	0.794	0.545	8.0	27.0	7.0	13.0	0.675	1.943	0.78	0.672	0.567	0.58

Feature Importance Summary: D1 = hcc-data_example





Composite Feature Importance Plot (Normalized and Performance Weighted)



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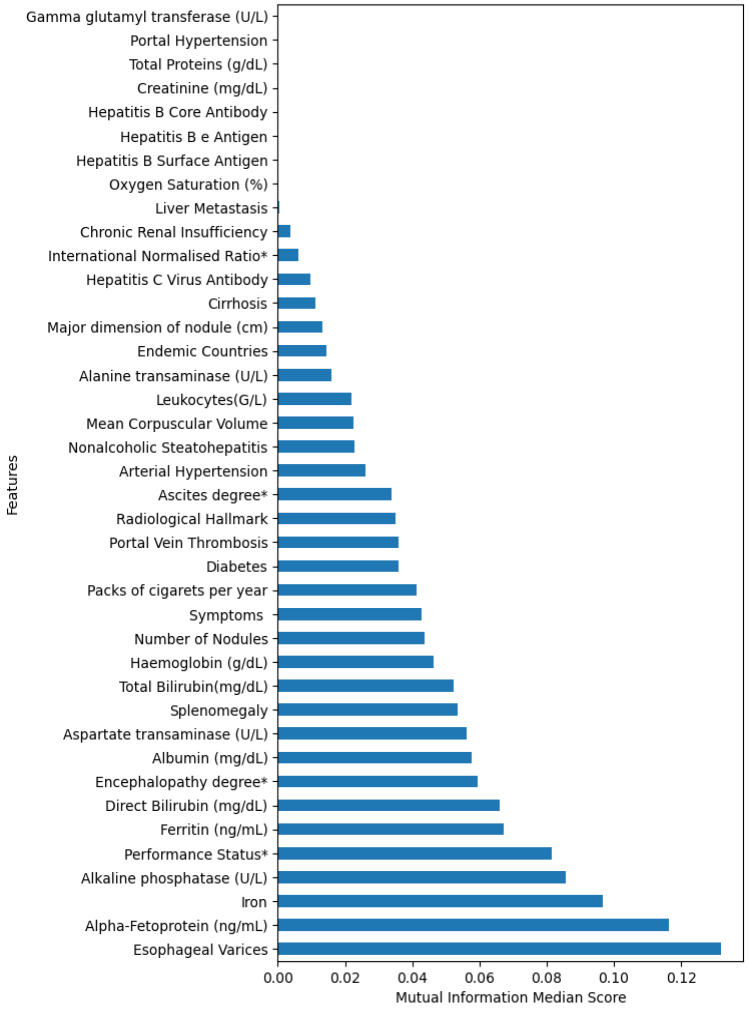
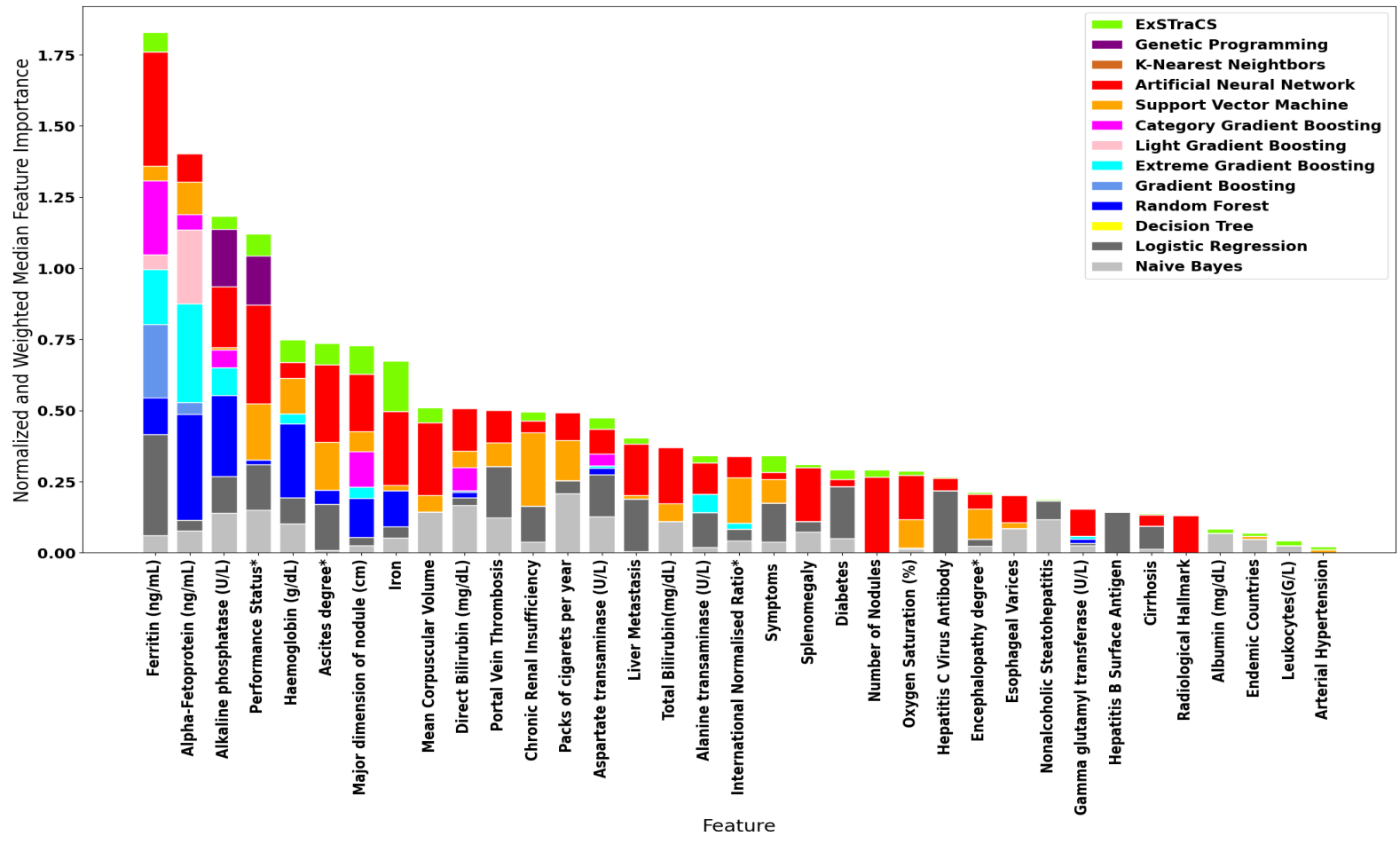
Feature Importance Summary: D2 = hcc-data_example_no_covariates

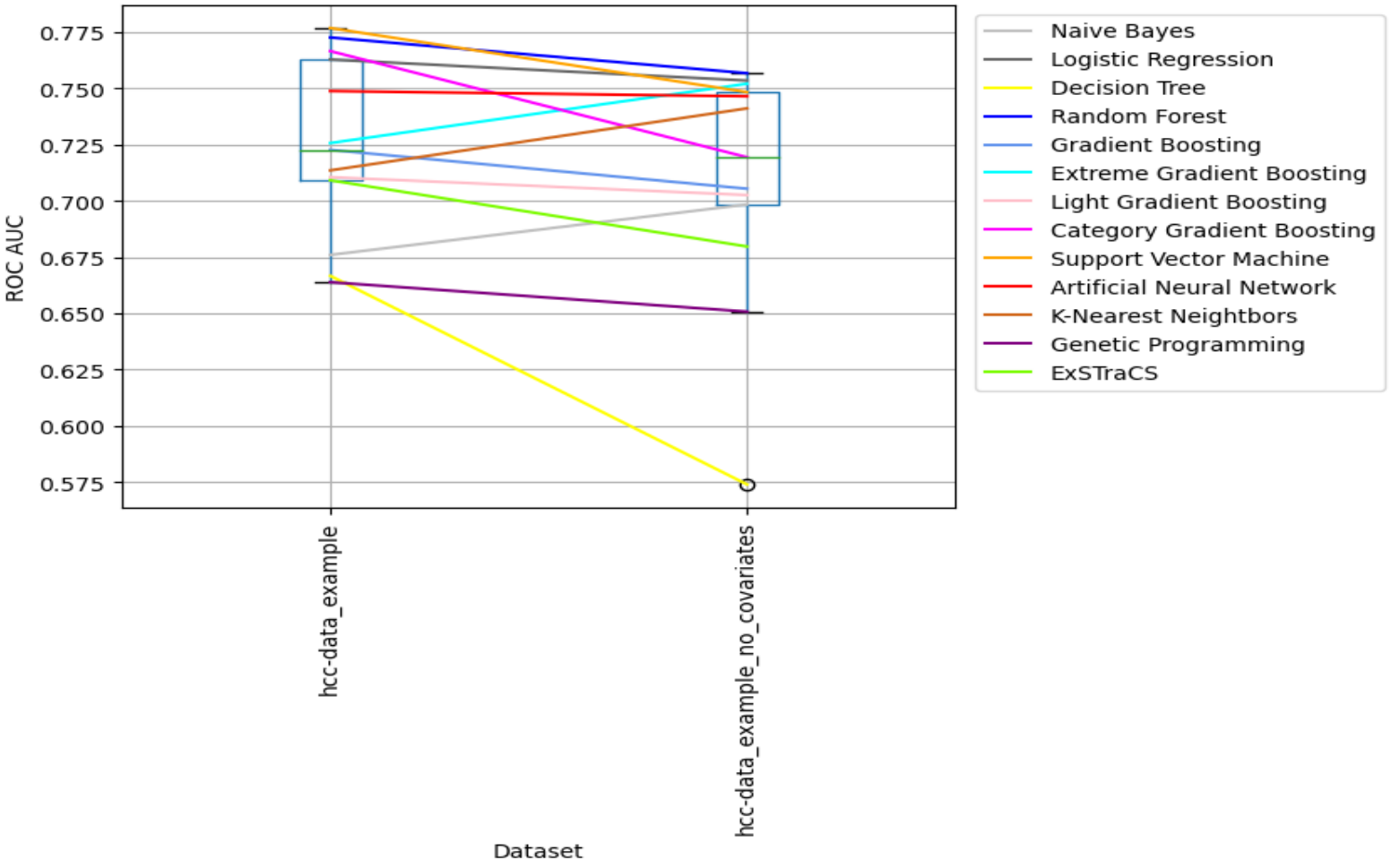


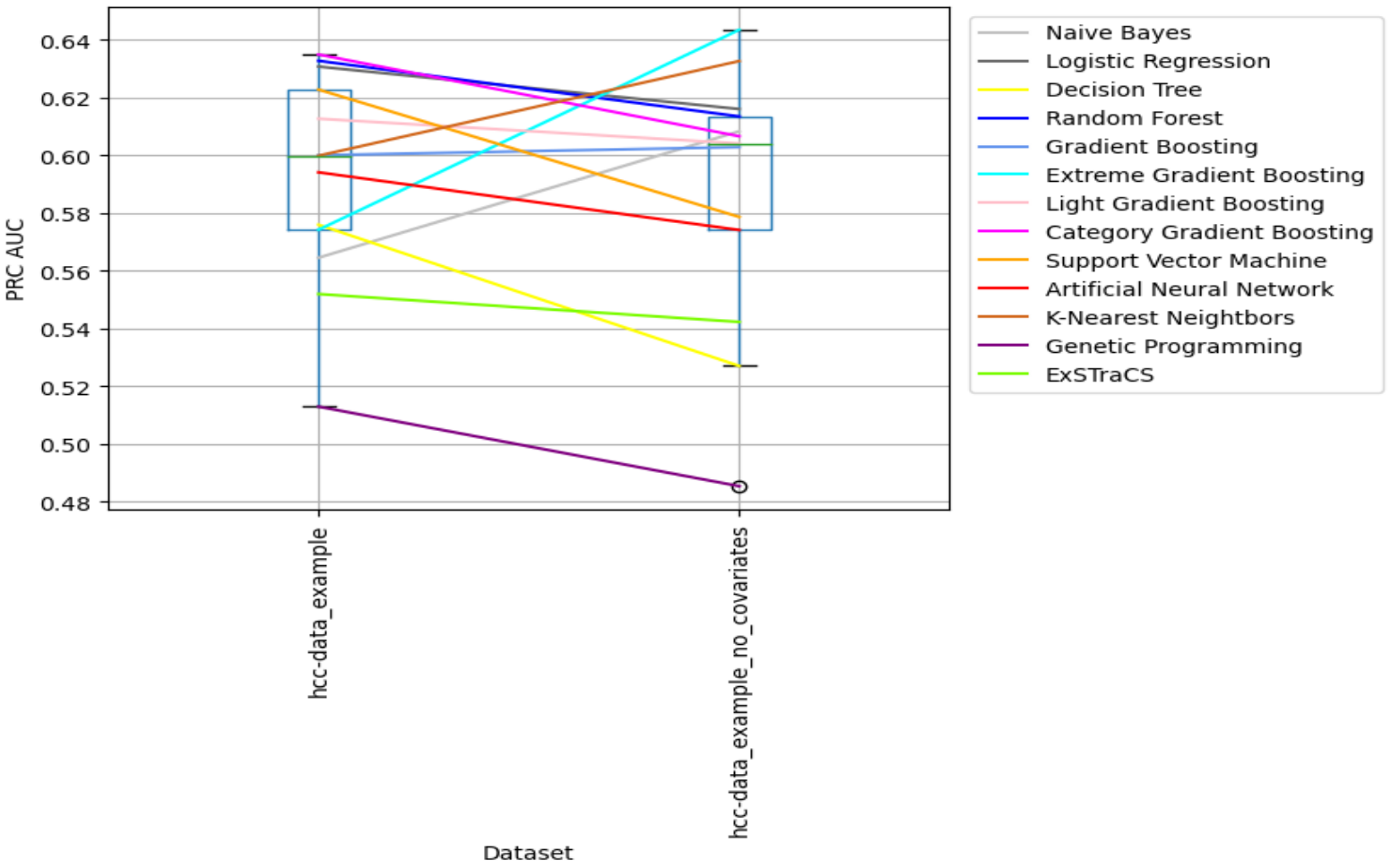
Composite Feature Importance Plot (Normalized and Performance Weighted)



Generated with the URBS-Lab STREAMLINE: (https://github.com/UrbsLab/STREAMLINE)

Compare ML Performance Across Datasets





Using Best Performing Algorithms (Kruskall Wallis Compare Datasets)

Datasets:

D1 = hcc-data_example

D2 = hcc-data_example_no_covariates

index	P-Value	Best_Alg_D1	Median_D1	Best_Alg_D2	Median_D2
Balanced Accuracy	0.2752	Logistic Regression	0.7248	Artificial Neural Network	0.701
Accuracy	0.1046	Logistic Regression	0.7273	Extreme Gradient Boosting	0.7091
F1 Score	0.2752	Logistic Regression	0.6667	Artificial Neural Network	0.6341
Sensitivity (Recall)	0.6374	Logistic Regression	0.7143	Random Forest	0.6667
Specificity	0.8222	K-Nearest Neightbors	0.9706	K-Nearest Neightbors	0.9706
Precision (PPV)	0.5127	Category Gradient Boosting	0.6667	Extreme Gradient Boosting	0.6316
TP	0.6374	Logistic Regression	15.0	Random Forest	14.0
TN	0.8222	K-Nearest Neightbors	33.0	K-Nearest Neightbors	33.0
FP	0.4867	Decision Tree	14.0	Decision Tree	14.0
FN	1.0	K-Nearest Neightbors	21.0	K-Nearest Neightbors	21.0
NPV	0.8273	Logistic Regression	0.8065	Random Forest	0.7742
LR+	0.5127	Category Gradient Boosting	3.2381	Extreme Gradient Boosting	2.7755
LR-	0.8222	K-Nearest Neightbors	1.0	K-Nearest Neightbors	1.0
ROC AUC	0.2752	Support Vector Machine	0.8039	Artificial Neural Network	0.7773
PRC AUC	0.8273	Random Forest	0.6629	Naive Bayes	0.6741
PRC APS	0.8273	Random Forest	0.676	Naive Bayes	0.685

Pipeline Runtime Summary

hcc-data_example

Pipeline Component	Time (sec)
Exploratory Analysis	2.14
Preprocessing	0.29
Mutual Information	0.21
MultiSURF	0.89
Feature Selection	0.88
Naive Bayes	0.67
Logistic Regression	9.41
Decision Tree	7.2
Random Forest	365.77
Gradient Boosting	98.35
Extreme Gradient Boosting	365.23
Light Gradient Boosting	26.81
Category Gradient Boosting	11323.96
Support Vector Machine	8.69
Artificial Neural Network	62.35
K-Nearest Neightbors	29.69
Genetic Programming	42909.72
ExSTraCS	2410.9
Stats Summary	23.99

hcc-data_example_no_covariates

Pipeline Component	Time (sec)
Exploratory Analysis	2.06
Preprocessing	0.4
Mutual Information	0.2
MultiSURF	0.87
Feature Selection	0.84
Naive Bayes	0.65
Logistic Regression	7.73
Decision Tree	7.06
Random Forest	390.68
Gradient Boosting	83.98
Extreme Gradient Boosting	412.68
Light Gradient Boosting	28.49
Category Gradient Boosting	6587.46
Support Vector Machine	8.14
Artificial Neural Network	49.54
K-Nearest Neightbors	22.34
Genetic Programming	48627.69
ExSTraCS	2377.18
Stats Summary	23.09