Classification Assignment

1. Problem Statement

Predict the Chronic Kidney Disease (CKD) on the several parameters.

2. Dataset Information

Dataset contains 27 columns and 400 rows of data values including header

3. Data Preprocessing

In the given dataset, there are twelve columns contains string values. Since Python AI models cannot directly handle categorical data, so those column's values will be converted into meaningful numerical data.

4. R&D on Model Selection

a. Logistics Regression

The Mean test score value obtained in the Logistics Regression model is **0.96**

SI No	mean_f it_time	std_fit_ time	mean_s core_ti me	std_sco re_time	param_ penalty	param_ solver	params	split0_t est_sco re	split1_t est_sco re	split2_t est_sco re	split3_t est_sco re	split4_t est_sco re	mean_t est_sco re	std_tes t_score	rank_te st_scor e
0	0.0132 01	0.0016 21	0.0029 09	0.0009 71	12	lbfgs	{'penalt y': 'l2', 'solver': 'lbfgs'}	0.8518 52	0.9421 66	0.9251 46	0.8867 92	0.9618 26	0.9135 57	0.0395 13	4
1	0.0055 97	0.0023 73	0.0016 53	0.0007 28	12	liblinea r	{'penalt y': 'l2', 'solver': 'liblinea r'}	0.9629 63	0.9810 14	0.9625 73	0.9436 51	0.9618 26	0.9624 05	0.0118 21	3
2	0.0334 14	0.0043 42	0.0025 43	0.0021 02	12	newton -cg	{'penalt y': 'l2', 'solver': 'newto n-cg'}	0.9815 69	0.9810 14	0.9625 73	0.9622 64	0.9618 26	0.9698 49	0.0093 47	1
3	0.0047 49	0.0034 65	0.0012 14	0.0001 88	12	newton - cholesk y	{'penalt y': 'l2', 'solver': 'newto n- cholesk y'}	0.9815 69	0.9810 14	0.9625 73	0.9622 64	0.9618 26	0.9698 49	0.0093 47	1
4	0.0069 82	0.0017 05	0.0011 39	0.0000	12	sag	{'penalt y': 'l2', 'solver': 'sag'}	0.4865 32	0.5014 1	0.4778 41	0.4778 41	0.4778 41	0.4842 93	0.0091 96	5
5	0.0064 13	0.0016 74	0.0011 85	0.0001 37	12	saga	{'penalt y': 'l2', 'solver': 'saga'}	0.4865 32	0.5014 1	0.4778 41	0.4778 41	0.4778 41	0.4842 93	0.0091 96	5

b. K-Neighbors Classifier

The Mean test score value obtained in the Logistics Regression model is $\underline{\textbf{0.75}}$

SI No	mean_fit _time	std_fit _time	mean _scor e_tim e	std_sc ore_ti me	param_a lgorithm	param_w eights	params	split0_t est_sc ore	split1_t est_sc ore	split2_t est_sc ore	split3_t est_sc ore	split4_t est_sc ore	mean_t est_sc ore	std_tes t_score	rank_te st_scor e
							{'algorith m':								
	0.00373	0.001	0.004	0.001			'auto', 'weights':	0.7444	0.6854	0.6640	0.7027	0.6775	0.6948	0.0277	
0	0.00373	524	948	698	auto	uniform	'uniform'}	23	0.6854 91	16	0.7027	0.6775 27	0.6948	76	5
							{'algorith m':								
							'auto',								
		0.000	0.004	0.002			'weights': 'distance	0.7062	0.6854	0.7013	0.7584	0.7380	0.7179	0.0264	
1	0.00317	541	565	366	auto	distance	'}	69	91	48	32	11	1	83	1
							{'algorith m':								
							'ball_tree								
		0.001	0.003	0.001			, 'weights':	0.7444	0.6854	0.6640	0.7027	0.6775	0.6948	0.0277	
2	0.00223	132	722	195	ball_tree	uniform	'uniform'}	23	91	16	07	27	33	76	5
							{'algorith m':								
							'ball_tree								
							'weights':								
3	0.00245 7	0.000 773	0.002 859	0.000 892	ball_tree	distance	'distance '}	0.7062 69	0.6854 91	0.7013 48	0.7584 32	0.7380 11	0.7179 1	0.0264 83	1
							{'algorith								
							m': 'kd_tree',								
4	0.00120 3	0.000 063	0.002 294	0.000 052	kd tree	uniform	'weights': 'uniform'}	0.7444 23	0.6854 91	0.6640 16	0.7027 07	0.6775 27	0.6948 33	0.0277 76	5
	<u> </u>	000	234	032	Ku_ticc	unioni	{'algorith	20	31	10	07	27	33	70	3
							m': 'kd_tree',								
							'weights':								
5	0.00137 2	0.000 474	0.001 644	0.000 289	kd tree	distance	'distance '}	0.7062 69	0.6854 91	0.7013 48	0.7584 32	0.7380 11	0.7179 1	0.0264 83	1
							{'algorith								
							m': 'brute',								
6	0.00148 8	0.000 376	0.002 854	0.000 568	brute	uniform	'weights': 'uniform'}	0.7444 23	0.6854 91	0.6640 16	0.7027 07	0.6775 27	0.6948 33	0.0277 76	5
	0	370	004	300	Diute	unioni	{'algorith	20	- 51	10	- 07	21	- 55	,0	3
							m': 'brute',								
							'weights':								
7	0.00095 2	0.000 097	0.001 455	0.000 047	brute	distance	'distance '}	0.7062 69	0.6854 91	0.7013 48	0.7584 32	0.7380 11	0.7179 1	0.0264 83	1

c. Naive Bayes - GaussianNB

The GaussianNB model is **0.98**

	precision	recall	f1-score	support
0	0.94	1.00	0.97	51
1	1.00	0.96	0.98	82
accuracy			0.98	133
macro avg	0.97	0.98	0.98	133
weighted avg	0.98	0.98	0.98	133

d. Naive Bayes - MultinomialNB

The MultinomialNB model is **0.83**

	precision	recall	f1-score	support
0	0.69	0.98	0.81	51
1	0.98	0.73	0.84	82
accuracy			0.83	133
macro avg	0.84	0.86	0.83	133
weighted avg	0.87	0.83	0.83	133

e. Naive Bayes - ComplementNB

The ComplementNB model is **0.95**

	precision	recall	f1-score	support
0 1	0.89 1.00	1.00 0.93	0.94 0.96	51 82
accuracy macro avg weighted avg	0.95 0.96	0.96 0.95	0.95 0.95 0.96	133 133 133

f. Random Forest

The Mean test score value obtained in the Logistics Regression model is **0.98**

('class_weight': 'balanced', 'criterion': 'gini', 'max_features': 'log2')

							param_m									
SINo	mean_fit_ time		mean_sc ore_time	std_score time	param_cla ss_weight		ax_featur es	params	split0_tes t score	split1_tes t score	split2_tes t score	split3_tes t score	split4_tes t score	mean_tes t score	std_test_ score	rank test score
ot no	time	IIIC	ore_time	_time	33_WCIGIT	terion	C3	{'class_weight': 'None', 'criterion':	t_3core	t_3core	t_Score	1_30010	t_3core	t_3core	30010	Tunk_test_score
0	0.00111	0.00013	0	0	None	gini	sqrt	'gini',	NaN	NaN	NaN	NaN	NaN	NaN	NaN	13
								('class_weight': 'None', 'criterion':								
1	0.00103	4.6E-05	0	0	None	gini	log2	'gini',	NaN	NaN	NaN	NaN	NaN	NaN	NaN	13
								{'class_weight': 'None', 'criterion':								
2	0.00136	0.00081	0	0	None	entropy	sqrt	'entropy	NaN	NaN	NaN	NaN	NaN	NaN	NaN	13
								{'class_weight': 'None', 'criterion':								
3	0.00081	1.8E-05	0	0	None	entropy	log2	'entropy	NaN	NaN	NaN	NaN	NaN	NaN	NaN	13
١.	0 00005	0.00045	0					{'class_weight': 'None', 'criterion':		N - N	NaN	N - N -	N - N			40
4	0.00095	0.00015	0	0	None	log_loss	sqrt	'log_los	NaN	NaN	NaN	NaN	NaN	NaN	NaN	13
5	0.00399	0.00379	0	١ ,	None	log_loss	log2	{'class_weight': 'None', 'criterion': 'log_los	NaN	NaN	NaN	NaN	NaN	NaN	NaN	13
- 3	0.00399	0.00379	0	0	None	iog_ioss	l0g2	{'class_weight': 'balanced',	INDIN	INdin	IValV	Ivaiv	IValV	IValV	INdin	13
6	0.18961	0.02127	0.01077	0.00657	balanced	gini	sart	'criterion': 'gin	0.98138	0.96176	0.98122	0.96226	0.98103	0.97353	0.00941	11
	0.20002	0.0222	0.02077	0.00007	- Latanious	8	54.1	('class_weight': 'balanced',	0.00200	0.0027	0.00111	0.00220	0.00100	0.07000	0.000.12	
7	0.15735	0.02623	0.01112	0.0053	balanced	gini	log2	'criterion': 'gin	1	0.98101	0.98122	0.98103	1	0.98865	0.00927	1
								('class_weight': 'balanced',								
8	0.14445	0.01607	0.0066	0.00289	balanced	entropy	sqrt	'criterion': 'ent	0.96296	0.96176	0.98122	0.96226	1	0.97364	0.01508	10
								('class_weight': 'balanced',								
9	0.17056	0.0095	0.00901	0.00275	balanced	entropy	log2	'criterion': 'ent	1	0.98101	0.98122	0.96226	1	0.9849	0.01412	4
								('class_weight': 'balanced',								
10	0.20649	0.07015	0.00841	0.00231	balanced	log_loss	sqrt	'criterion': 'log	0.96296	0.98101	0.98122	0.96226	1	0.97749	0.01397	8
					l	l		('class_weight': 'balanced',	l .				١.			
11	0.19106	0.05033	0.00838	0.00515	balanced	log_loss	log2	'criterion': 'log	1	0.98101	0.98122	0.98103	1	0.98865	0.00927	1
12	0.2075	0.03173	0.00646	0.00336	balanced_	dini.	sgrt	('class_weight': 'balanced_subsample', 'criter	0.98138	0.98101	0.98122	0.98103	1	0.98493	0.00754	3
12	0.2075	0.03173	0.00646	0.00336	Datanceu_:	giiii	Sqit	('class weight':	0.96136	0.96101	0.96122	0.96103	1	0.96493	0.00754	3
13	0.24024	0.01989	0.00861	0.00507	balanced	gini	log2	'balanced_subsample', 'criter	1 1	0.98101	0.98122	0.98103	0.98103	0.98486	0.00757	5
	012-102-1	0.01000	0.00001	0.00007	Dutanoou_	B	to gr	{'class_weight':	-	0.00101	OIGGILL	0.00100	0.00100	0.00400	0.00707	
14	0.22418	0.02325	0.00753	0.00516	balanced_	entropy	sqrt	'balanced_subsample', 'criter	0.96296	0.98101	0.98122	0.96226	1	0.97749	0.01397	8
								('class_weight':								
15	0.28915	0.07733	0.01403	0.0069	balanced_:	entropy	log2	'balanced_subsample', 'criter	0.98138	0.98101	0.98122	0.96226	1	0.98118	0.01193	6
								('class_weight':								
16	0.27892	0.01557	0.00954	0.00321	balanced_:	log_loss	sqrt	'balanced_subsample', 'criter	0.98138	0.94217	0.98122	0.96226	0.98103	0.96961	0.01556	12
								{'class_weight':								
17	0.22345	0.02496	0.01034	0.00111	balanced_	log_loss	log2	'balanced_subsample', 'criter	0.96328	0.98101	0.98122	0.96226	1	0.97756	0.0139	7

g. Random Forest

The Mean test score value obtained in the Logistics Regression model is **0.95**

('criterion': 'gini', 'max_features': 'sqrt', 'splitter': 'random')

3 0.0035 0.0005 0.003419 0.000678 gini log2 random 'fcriterion': 'gini', 'max_features': 'log2', 1 0.981014 0.925524 0.962264 0.962573 0.966275 0.024678 (*Criterion': 'entropy', 'max_features': 'log2', 1 0.981014 0.925524 0.962264 0.962573 0.966275 0.024678 (*Criterion': 'entropy', 'max_features': 'sqrt 0.92657 0.92351 0.887719 0.943093 0.961826 0.928543 0.024557 1 0.90000000000000000000000000000000000					i				İ								
SL No			- 4 - 4 - 4 - 4 - 4 - 4 - 4 - 4 - 4 - 4														
Criterion: Igni; Igni															_		
0 0.0587 0.0205 0.016717 0.006859 gini sqrt best max_features': 'sqrt', 0.94471 0.981014 0.924528 0.962264 0.981031 0.958709 0.021784 1 0.0301 0.0207 0.021218 0.016879 gini sqrt random max_features': 'sqrt', 1 1 0.962573 0.981031 0.981031 0.984927 0.014032 2 0.0069 0.0038 0.003922 0.000934 gini log2 best max_features': 'log2', 0.9451 0.981014 0.832761 0.981031 0.981217 0.944225 0.057448 1 3 0.0035 0.0005 0.003419 0.000678 gini log2 random max_features': 'log2', 1 0.981014 0.925524 0.962264 0.962573 0.966275 0.024678 4 0.0033 0.0002 0.003099 0.0005 entropy sqrt best max_features': 'sqrt 0.92657 0.92351 0.887719 0.943093 0.961826 0.928543 0.024557 1 5 0.003 0.0004 0.003083 0.000548 entropy sqrt random max_features': 'sqrt 0.98157 0.943699 0.981217 1 1 0.981297 0.020558 6 0.0027 9E-05 0.002763 0.000144 entropy log2 best max_features': 'log2 0.96328 0.962264 0.981217 0.981217 0.981217 0.981217 0.97384 0.00941 6 0.0020 0.0032 0.00054 0.00326 log1oss sqrt	SL NO	it_time	ume	re_ume	ume	erion	x_reatures		l'	St_Score	_score	_score	score	score	_score	score	core
1 0.0301 0.0207 0.021218 0.016879 gini sqrt random (criterion: 'gini', max_features: 'sqrt', 1 1 0.962573 0.981031 0.981031 0.984927 0.014032 2 0.0069 0.0038 0.003922 0.000934 gini log2 best 'max_features: 'log2', 0.9451 0.981014 0.925524 0.96264 0.962573 0.96425 0.057448 1 3 0.0035 0.0005 0.003419 0.000678 gini log2 random 'max_features: 'log2', 1 0.981014 0.925524 0.962264 0.962573 0.966275 0.024678 4 0.0033 0.0002 0.003099 0.0005 entropy sqrt best 'max_features: 'sqrt 0.92657 0.92351 0.887719 0.943093 0.961826 0.928543 0.024557 1 5 0.003 0.0004 0.003083 0.000548 entropy sqrt random 'max_features: 'sqrt 0.98157 0.943699 0.981217 1 1 0.981297 0.020558 6 0.0027 9E-05 0.002763 0.000144 entropy log2 best 'max_features: 'log2 0.98138 0.885265 0.907035 1 0.961826 0.94710 0.043861 7 0.003 0.0005 0.003275 0.000987 entropy log2 random 'max_features: 'log2 0.98138 0.885265 0.907035 1 0.981217 0.981217 0.97384 0.009041 8 0.004 0.0013 0.002946 0.000326 log_loss sqrt random 'max_features: 'sqr 1 0.924528 0.92554 0.981031 0.943093 0.95169 0.00868 9 0.0053 0.0016 0.005112 0.001687 log_loss sqrt random 'max_features: 'sqr 1 0.924528 0.925524 0.981031 0.943093 0.95189 0.00868 10 0.0029 0.0005 0.00293 0.000267 log_loss log2 best 'max_features: 'sqr 1 0.924528 0.925524 0.981031 0.943093 0.95189 0.00868 10 0.0029 0.0005 0.00293 0.000267 log_loss log2 best 'max_features: 'sqr 1 0.924528 0.925524 0.981031 0.943093 0.954835 0.030468 (criterion: 'log_loss', fortierion: 'lo									, ,								
1 0.0301 0.0207 0.021218 0.016879 gini sqrt random 'max_features': 'sqrt', 1 1 0.962573 0.981031 0.981031 0.984927 0.014032 2 0.0069 0.0038 0.003922 0.000934 gini log2 best 'max_features': log2', 0.9451 0.981014 0.832761 0.981031 0.981217 0.944225 0.057448 1 3 0.0035 0.0005 0.003419 0.000678 gini log2 random 'max_features': log2', 1 0.981014 0.925524 0.962264 0.962573 0.966275 0.024678 4 0.0033 0.0002 0.003099 0.0005 entropy sqrt best 'max_features': log2', 0.92657 0.92351 0.887719 0.943093 0.961826 0.928543 0.024557 1 5 0.003 0.0004 0.003083 0.000548 entropy sqrt random 'max_features': 'sqrt 0.98157 0.943699 0.981217 1 1 0.981297 0.020558 6 0.0027 9E-05 0.002763 0.000144 entropy log2 best 'max_features': 'log2 0.98138 0.885265 0.907035 1 0.961826 0.947101 0.043861 7 0.003 0.0005 0.003275 0.000987 entropy log2 random 'max_features': 'sqrt 0.98157 0.944023 0.962264 0.981217 0.981217 0.981217 0.97384 0.009041 8 0.004 0.0013 0.002946 0.000326 log_loss sqrt best 'max_features': 'sqr 0.94471 0.961755 0.944023 0.962264 0.943093 0.951869 0.00868 9 0.0053 0.0016 0.005112 0.001687 log_loss sqrt random 'max_features': 'sqr 1 0.924528 0.925524 0.981031 0.943093 0.954835 0.030468 10 0.0029 0.0005 0.00293 0.000267 log_loss log2 best 'max_features': 'log 0.92657 0.962264 0.962573 0.966085 0.962264 0.943951 0.023467 1	0	0.0587	0.0205	0.016717	0.006859	gini	sqrt	best	'max_features': 'sqrt',	0.94471	0.981014	0.924528	0.962264	0.981031	0.958709	0.021784	6
1 0.0301 0.0207 0.021218 0.016879 gini sqrt random 'max_features': 'sqrt', 1 1 0.962573 0.981031 0.981031 0.984927 0.014032 2 0.0069 0.0038 0.003922 0.000934 gini log2 best 'max_features': log2', 0.9451 0.981014 0.832761 0.981031 0.981217 0.944225 0.057448 1 3 0.0035 0.0005 0.003419 0.000678 gini log2 random 'max_features': log2', 1 0.981014 0.925524 0.962264 0.962573 0.966275 0.024678 4 0.0033 0.0002 0.003099 0.0005 entropy sqrt best 'max_features': log2', 0.92657 0.92351 0.887719 0.943093 0.961826 0.928543 0.024557 1 5 0.003 0.0004 0.003083 0.000548 entropy sqrt random 'max_features': 'sqrt 0.98157 0.943699 0.981217 1 1 0.981297 0.020558 6 0.0027 9E-05 0.002763 0.000144 entropy log2 best 'max_features': 'log2 0.98138 0.885265 0.907035 1 0.961826 0.947101 0.043861 7 0.003 0.0005 0.003275 0.000987 entropy log2 random 'max_features': 'sqrt 0.98157 0.944023 0.962264 0.981217 0.981217 0.981217 0.97384 0.009041 8 0.004 0.0013 0.002946 0.000326 log_loss sqrt best 'max_features': 'sqr 0.94471 0.961755 0.944023 0.962264 0.943093 0.951869 0.00868 9 0.0053 0.0016 0.005112 0.001687 log_loss sqrt random 'max_features': 'sqr 1 0.924528 0.925524 0.981031 0.943093 0.954835 0.030468 10 0.0029 0.0005 0.00293 0.000267 log_loss log2 best 'max_features': 'log 0.92657 0.962264 0.962573 0.966085 0.962264 0.943951 0.023467 1																	
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{criterion: 'log_loss',									{'criterion': 'log_loss',								
	10	0.0029	0.0005	0.00293	0.000267	log_loss	log2	best	'max_features': 'log	0.92657	0.962264	0.962573	0.906085	0.962264	0.943951	0.023467	11
11 0.0025 0.0002 0.002837 0.000495 log_loss log2 random max_features': log 1 0.922185 0.981217 0.962264 0.981217 0.969377 0.026442									{'criterion': 'log_loss',								
	11	0.0025	0.0002	0.002837	0.000495	log_loss	log2	random	'max_features': 'log	1	0.922185	0.981217	0.962264	0.981217	0.969377	0.026442	4

In the above experiment, based on the accuracy score, the **Random Forest** ('class_weight': 'balanced', 'criterion': 'gini', 'max_features': 'log2') model appears to be the best-performing model.