

BAB V

PENUTUP

A. Kesimpulan

Berdasarkan hasil penelitian yang telah dilakukan mengenai Penerapan Algoritma *K-Nearest Neighbor* (KNN) dengan *K-Fold Cross Validation* untuk Diagnosa Risiko Diabetes Mellitus, dapat diperoleh kesimpulan sebagai berikut:

1. Penerapan Algoritma KNN Algoritma *K-Nearest Neighbor* (KNN) berhasil diterapkan untuk mendiagnosa risiko diabetes dengan memanfaatkan variabel kesehatan seperti tekanan darah, gula darah sewaktu, IMT, usia, dan lingkar perut. Proses penelitian meliputi tahap pembersihan data, transformasi ke bentuk numerik, normalisasi menggunakan *StandardScaler*, serta validasi menggunakan *Stratified K-Fold Cross Validation*. Hasil perhitungan manual jarak Manhattan menunjukkan bahwa algoritma KNN mampu menentukan kelas data berdasarkan kedekatan jarak antar data, sehingga mekanisme kerja algoritma dapat dipahami secara sistematis dan jelas.
2. Hasil evaluasi model menggunakan metode *Stratified 5-Fold Cross Validation* menunjukkan bahwa algoritma *K-Nearest Neighbor* (KNN) memiliki kinerja yang baik dan relatif stabil dalam mengklasifikasikan status gula darah pasien. Nilai akurasi pada setiap fold berada pada kisaran 0,84 hingga 0,89, dengan akurasi tertinggi sebesar 0,8912 pada fold ketiga dan akurasi terendah sebesar 0,8385 pada fold kelima. Berdasarkan hasil tersebut, diperoleh nilai rata-rata akurasi sebesar 0,8755 (87,55%), yang menunjukkan bahwa model KNN mampu melakukan klasifikasi dengan tingkat ketepatan yang cukup tinggi dan konsisten.

B. Saran

Penelitian mengenai Penerapan Algoritma *K-Nearest Neighbor* (KNN) dengan *K-Fold Cross Validation* untuk Diagnosa Risiko Diabetes Mellitus masih dapat dikembangkan lebih jauh. Beberapa rekomendasi untuk penelitian berikutnya antara lain:

1. Menggunakan kumpulan data yang lebih luas dan bervariasi dari berbagai pusat layanan kesehatan agar model dapat mempelajari pola yang lebih

beragam, sehingga meningkatkan akurasi serta kemampuan model dalam melakukan generalisasi.

2. Menambahkan variabel kesehatan lain seperti riwayat keluarga, kebiasaan makan, tingkat aktivitas fisik, dan parameter klinis tambahan untuk memperkaya informasi yang digunakan model sehingga hasil prediksi menjadi lebih tepat dan komprehensif.
3. Melakukan penyempurnaan model KNN dengan menguji berbagai nilai K, mencoba metode perhitungan jarak lainnya, serta menerapkan teknik pemilihan fitur. Selain itu, perbandingan performa KNN dengan algoritma lain seperti SVM atau *Random Forest* dapat dilakukan untuk menemukan metode klasifikasi risiko diabetes yang lebih optimal.



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	A	B	C	D	E	F	G	H	I	J	K	L	M	R	S
111	AMRULLAH	0	37	1	130	80	2	332	3	27.358845457	1	111	0	1	0
112	MUSTAINA	1	18	0	110	70	2	400	0	19.756467309	0	67	1	0	0
113	SUKMA	1	40	0	110	70	2	262	0	23.942457625	1	81	0	0	0
114	ABD HAMID	0	24	2	140	80	2	346	1	15.3787005	0	70	1	0	0
115	INDO LIFE	1	64	2	120	80	2	211	1	17.313019391	1	96	1	0	1
116	RUA	1	58	2	140	80	2	206	3	30.530500723	1	94	1	0	0
117	BUTTENG	1	72	2	150	100	2	354	0	23.19109462	0	71	1	0	1
118	RISNA	1	36	2	140	80	2	302	0	22.222222222	1	93	0	0	0
119	NUR INTANG	1	33	2	140	80	2	360	3	70.058524495	1	84	0	0	0
120	RUCI	1	58	0	110	70	2	339	3	23.242108636	1	101	1	1	0
121	HARTATI	1	46	2	140	80	2	262	0	21.333333333	1	81	1	0	0
122	MARWIYAH	1	63	2	180	100	2	231	3	27.358845457	0	80	1	1	1
123	TUTI	1	45	2	140	80	2	328	0	21.333333333	1	81	1	0	0
124	RANLAH	1	51	2	140	80	2	500	0	18.858821981	0	74	1	0	0
125	RANAH	1	44	2	140	80	2	313	2	26.353516613	1	93	0	0	0
126	SUWARNI	1	41	2	160	90	2	357	2	25.417574437	0	78	1	0	0
127	UMING	1	53	2	130	80	2	468	2	25.1171675	1	100	1	1	0
128	KABI	1	52	0	110	70	2	267	0	21.727839335	0	76	1	0	0
129	CORA	1	75	2	180	90	2	350	0	22.666666667	1	82	1	1	1
130	TUO	1	84	2	190	80	2	228	0	23.78121042	1	91	1	1	1
131	TUO	1	85	2	190	90	2	503	3	19.777638667	1	90	1	1	1
132	HATIMANG	1	76	2	150	90	2	218	0	23.872798523	1	84	1	1	1
133	SYAMSIH	1	77	2	150	80	0	188	3	23.72528616	1	108	1	1	1
134	ENGKA	1	74	2	180	90	2	272	2	25.777777777	1	92	1	0	1
135	KAMBU	1	75	2	170	80	2	244	3	43.529877325	1	87	0	1	1
136	RUKKA	1	75	2	160	90	2	205	0	23.495236875	1	89	1	1	1
137	TIMANG	1	74	2	180	90	2	272	2	25.777777777	1	92	1	1	1
138	JUNAEDAH	1	71	2	170	100	0	113	0	19.227687871	1	87	1	1	1
139	TENE	1	70	2	140	80	2	360	3	70.058524495	1	84	1	0	1
140	MMANG	1	68	2	170	100	2	273	0	24.238227147	1	87	1	0	1
141	KAMBU	1	67	2	130	80	2	201	0	20.828841532	1	81	1	1	1
142	AMINA	1	67	0	90	80	0	92	0	23.30905307	1	90	1	1	1
143	KASMA	1	45	1	130	80	2	235	0	13.3605375	0	75	1	0	0
144	MULATI	1	36	1	130	80	2	273	0	24.132231405	1	90	0	0	0
145	NADIMAN	1	66	2	160	80	2	242	3	30.5608385	1	90	1	1	1
146	MURNATI	1	54	1	130	80	2	430	1	17.076374554	0	76	1	1	0
147	MISRAWATI	1	37	0	110	70	2	232	3	27.449822904	1	90	0	0	0

	A	B	C	D	E	F	G	H	I	J	K	L	M	R	S
148	HANJUN	1	65	2	200	110	2	310	3	28.841531806	1	84	1	0	1
149	HANJUNG	1	60	2	200	100	2	310	0	21.620647719	1	84	1	1	1
150	LIFE	1	49	2	150	80	2	357	3	105.916727536	1	148	1	1	0
151	JUMARNI	1	36	2	170	100	2	300	0	23.805401662	0	60	1	1	0
152	PETTA HAFE	1	62	1	130	90	1	198	2	24.8888888	1	89	1	0	1
153	MURHAYATI	1	61	2	170	100	2	531	0	24.854832347	1	93	1	1	1
154	Hanise	0	59	2	160	90	0	120	0	23.1	1	94	1	1	0
155	MUHAMMAD RAIS	0	36	1	130	80	2	226	0	20.703125	0	80	1	0	0
156	CAME	1	66	2	190	100	2	211	0	18.536308442	0	68	1	0	1
157	DARMI	1	37	1	130	80	2	201	0	23.805401662	0	86	1	0	0
158	ISA	1	33	2	130	81	2	239	3	31.20256367	1	99	1	0	0
159	MURBAETI	1	45	1	130	82	2	211	1	17.527943098	0	71	1	0	0
160	NAISAH	1	57	2	140	90	2	352	3	23.319856487	1	101	1	0	0
161	NAPISAH	1	56	1	130	80	2	398	3	28.7890625	1	104	1	0	0
162	MURBAYA	1	57	2	170	90	2	292	3	27.555555556	1	101	1	1	0
163	LIFE	1	46	2	160	90	2	396	0	23.401922753	1	82	1	0	0
164	HASMA	1	55	2	110	70	2	600	1	18.222222222	1	82	1	1	0
165	SUHAEMA	1	43	2	130	80	2	233	0	24.6530311	1	92	1	0	0
166	FHAMANG	0	66	0	110	70	2	500	1	17.625380640	0	52	1	1	1
167	SURIANI	1	41	1	120	80	2	247	3	27.21756162	0	58	1	0	0
168	DINANG	0	59	2	140	80	2	311	0	21.09375	0	80	1	0	0
169	ENGKA	1	53	2	170	100	2	200	3	36.747580353	1	91	1	0	1
170	TUBA	0	38	0	110	60	2	263	0	19.97888345	0	75	1	0	0
171	RONO	0	81	2	130	100	2	281	0	23.422368362	0	80	1	1	1
172	SYARFUDDIN	0	52	1	120	80	2	201	3	1953.125	0	79	1	1	0
173	BACO	0	83	2	170	100	2	264	0	20.775623265	0	81	1	1	1
174	BECCO	1	69	2	160	100	2	207	0	20	0	75	1	1	1
175	MURAEANA	1	52	2	130	90	2	390	0	22.617876921	1	83	1	0	0
176	PETTA JAMA	0	68	2	140	80	2	261	0	21.03375	0	81	1	0	1
177	JUHRAH	1	50	2	180	100	2	400	3	28.946038855	1	102	1	0	0
178	ABDUL KAHAR	0	55	1	130	80	2	201	0	21.484375	0	85	1	1	0
179	MURLINDA	1	49	0	90	70	2	364	3	43.529877325	1	84	0	1	0
180	LINI	1	45	2	140	80	2	207	3	33.155655533	1	89	1	0	0
181	DINDA	0	78	2	170	100	2	273	0	24.24318475	0	87	1	1	1
182	BASIR HAERUDDIN	0	71	2	150	80	2	218	0	21.03375	0	82	1	1	1
183	SYAMSIH	1	52	0	110	60	2	225	0	22.074099723	1	85	0	1	0
184	SARKASMAN	0	54	2	140	80	2	207	0	23.046875	0	89	1	1	0

	A	B	C	D	E	F	G	H	I	J	K	L	M	R	S
185	FITRIANI	1	50	1	130	70	2	200	0	24.94009487	1	97	1	0	0
186	JAMALUDDIN B	0	59	2	140	80	2	217	0	20.3125	0	80	1	1	0
187	ASRI	0	48	0	100	70	2	237	0	20.832529605	0	82	1	1	0
188	APPE	1	62	2	160	100	2	218	0	20.829995193	0	80	1	1	1
189	IBRAHIM	0	73	2	170	100	2	254	0	21.35991456	0	81	1	1	1
190	MINA	1	76	0	100	70	2	302	0	21.333333333	0	76	1	0	1
191	HUSNA	1	59	2	130	90	2	281	2	25.969529086	1	90	1	0	0
192	ROSNI	1	52	1	120	70	2	340	0	24.557752341	1	84	1	0	0
193	JUHAEDA	0	74	1	130	80	2	332	3	27.358845457	1	111	1	0	1
194	Nisra	1	59	2	140	70	0	121	0	23.8	1	87	1	1	0
195	DOLLAR	0	54	2	170	100	2	208	0	24.77679525	0	88	1	0	0
196	CAME	1	66	2	180	100	2	206	0	21.777777778	0	74	1	0	1
197	ROSDIANA	1	50	1	130	80	2	266	0	24.835646457	1	91	0	0	0
198	INTAN	1	83	2	160	90	2	211	0	20.81854527	0	79	1	0	1
199	MURWAHDAH	1	26	1	120	80	2	201	0	21.35930825	0	80	1	0	0
200	INDAH	1	37	1	130	70	2	216	2	26.037493991	1	91	1	0	0
201	RAFIDA	1	37	2	120	90	2	213	0	20.81854527	0	79	1	0	0
202	BABA	0	48	1	130	80	2	201	0	21.35930825	0	80	1	1	0
203	RISNA RAHAYU	1	32	2	170	80	2	244	1	18.31533888	0	60	1	0	0
204	ECCE	1	40	0	110	70	2	339	3	23.242108636	1	101	1	1	0
205	MARHUMA	1	50	1	120	60	2	309	0	22.942130454	1	83	0	1	0
206	DAHLAN	0	36	2	140	90	2	201	0	21.484375	0	80	1	0	0
207	KRAM	0	35	2	150	90	2	284	0	22.222222222	0	78	1	0	0
208	IDA	1	54	2	180	100	2	268	0	20.544182841	0</				

	A	B	C	D	E	F	G	H	I	J	K	L	M	R	S
1005	JUMRIA	1	61	1	120	60	2	356	0	18.765246763	1	92	1	0	1
1006	KADIR	0	54	2	120	70	2	216	0	20.04988019	0	67	1	0	0
1007	NURMATI	1	20	2	100	70	2	328	0	21.33333333	1	81	1	0	0
1008	SUSI	1	54	2	150	80	2	211	0	18.536908442	0	68	1	0	0
1009	MARHUMA TALBE	1	48	2	130	80	2	395	0	20.613131003	1	86	1	1	0
1010	RAHMA	1	50	2	140	80	2	227	0	22.769438354	0	76	1	0	0
1011	SURIANI	1	27	2	100	70	2	216	2	26.037430991	1	91	1	0	0
1012	MARNI	1	46	2	150	80	2	222	3	31.229454306	1	98	1	1	0
1013	HASMA	1	50	2	140	80	2	211	1	16.171224732	0	79	1	1	0
1014	MISMAH	1	83	2	160	80	2	200	0	24.94009487	1	97	1	0	1
1015	MISMAWATI	1	67	2	150	80	2	236	0	23.7332384	1	82	1	0	1
1016	MULIATI	1	51	2	150	80	2	339	3	23.24208636	1	101	1	1	0
1017	ERNAWATI	1	52	2	170	80	2	300	1	18.314255383	0	77	1	0	0
1018	NAHRA	1	54	2	180	100	2	222	3	31.229454306	1	98	1	1	0
1019	HASNATI	1	41	2	150	80	2	333	0	21.750196677	1	88	1	1	0
1020	MURANI	1	60	2	170	80	2	345	0	23.73956172	1	82	1	1	1
1021	H. KURNIA	1	56	2	180	100	2	211	0	18.536908442	0	68	1	0	0
1022	MURBAYA	1	76	2	180	100	2	262	0	23.942457623	1	81	1	0	1
1023	JUNAEDAH	1	70	0	110	70	2	227	0	22.769438354	0	76	1	0	1
1024	MURDIN	0	73	2	130	86	2	243	3	27.167058125	1	94	1	0	1
1025	JUMIATI	1	55	2	150	90	2	264	0	22.22222222	0	78	1	1	0
1026	MURHAYATI	1	55	2	120	70	2	395	0	20.613131003	1	86	1	1	0
1027	MURHAYATI	1	51	2	140	70	2	282	0	20.239500755	1	86	1	0	0
1028	MURJANNAH	1	57	0	110	70	2	204	2	25.33308313	1	94	1	0	0
1029	ONNANG	0	58	2	140	50	2	245	3	70.058524495	1	88	1	1	0
1030	PETTA SITI	1	60	2	170	100	2	345	0	23.73956172	1	82	1	1	1
1031	ROSMATI	1	52	2	140	80	2	206	3	30.53000723	1	94	1	0	0
1032	ROSMATI	1	55	2	160	90	2	450	0	21.516944594	1	91	1	0	0
1033	SAHYA	1	66	2	130	81	2	380	0	19.628264701	1	82	1	1	1
1034	SAKKA	1	61	2	140	80	2	255	0	23.19109462	1	82	1	0	1
1035	SULLE	1	62	2	180	90	2	321	1	17.77777778	0	76	1	0	1
1036	SALMA	1	53	2	200	100	2	310	0	21.620647713	1	84	1	1	0
1037	SALMAH AMR	1	63	2	130	90	2	312	0	19.53125	1	81	1	0	1
1038	SUFANAH	1	60	2	120	80	2	1109	2	25.915127956	1	90	1	0	1
1039	SUKAENA	1	66	2	110	80	2	262	0	23.942457623	1	81	1	0	1
1040	UFE	1	49	2	140	90	2	204	2	25.299375945	1	93	1	0	0
1041	SALMA	1	36	2	140	80	2	232	2	26.895180742	1	99	1	0	0

	A	B	C	D	E	F	G	H	I	J	K	L	M	R	S
222	ANDISUKAWATI	1	51	2	180	90	2	248	1	16.339100346	1	90	1	0	0
223	KARTIM	1	52	2	140	80	2	359	0	24.034407151	1	81	1	0	0
224	BECCO	1	72	2	130	80	2	267	1	17.604748252	0	70	1	0	1
225	MENONG	1	54	2	150	80	2	201	2	25.631875	1	90	1	0	0
226	SURITO	0	69	2	150	80	2	201	0	22.626880936	0	80	1	0	1
227	SUMIATI	1	48	2	140	90	2	211	0	20.81654527	0	79	1	0	0
228	JUMIATI	1	66	2	140	90	2	202	3	33.783787894	1	92	1	0	1
229	KAMBE	1	51	2	150	80	2	237	3	27.581100487	1	105	1	0	0
230	MARTA BETTA	1	58	1	130	70	2	200	0	24.94009487	1	97	1	0	0
231	ESSE	1	53	2	140	50	2	390	0	24.973905432	1	88	1	1	0
232	Fera Cella	1	79	2	140	70	0	162	3	26.3	1	86	1	1	1
233	KAURE	1	67	1	120	60	2	367	0	23.633004602	1	82	0	1	1
234	BUNGA	1	72	2	170	70	2	377	3	27.555555556	1	100	1	1	1
235	FAJRI	0	37	2	140	80	2	211	3	308.33333333	0	79	1	0	0
236	ITTE	1	70	2	220	120	1	157	0	20.429418362	1	90	1	1	1
237	NURLIA	1	52	0	110	70	2	232	3	27.449822904	1	90	1	0	0
238	ERIN	1	41	2	110	70	2	201	0	20.504334	0	80	1	1	0
239	ALMUDDIN	0	54	2	130	90	2	206	0	24.688888889	0	74	1	0	0
240	SAKKA	0	49	2	150	80	2	201	3	562.130177516	0	80	1	0	0
241	MUHANSAR B	0	65	2	140	80	2	211	0	21.051708258	0	79	1	0	1
242	NISE	1	57	2	150	80	2	282	0	24.266666667	1	89	1	1	0
243	MAPRI	1	55	1	120	70	2	222	3	31.229454306	1	90	1	1	0
244	KARDI	0	20	2	140	80	2	237	3	44.20057918	1	132	1	0	0
245	MARIANI	1	55	2	140	80	2	208	3	29.591836735	1	97	1	0	0
246	MARIANI	1	60	0	110	70	2	557	0	21.333333333	1	68	1	0	1
247	A. LINGKAR	0	58	2	150	60	2	413	0	23.612750885	0	87	1	0	0
248	BULAN	1	46	1	120	70	2	318	0	22.432302516	1	86	1	0	0
249	BULAN	1	50	1	120	70	2	318	0	22.432302516	1	86	1	1	0
250	Bulan	1	47	1	130	70	2	389	0	22.7	1	86	1	1	0
251	ERNAWATI	1	49	1	120	80	2	206	0	19.227687871	1	83	1	0	0
252	MUSI	1	53	1	130	70	2	395	0	20.613131003	1	86	1	1	0
253	NAJEMIA	1	53	2	200	90	2	200	1	18.395083102	0	78	1	0	0
254	GANING	0	78	2	200	100	2	200	2	25.687573964	0	90	1	1	1
255	MUSNANG	1	54	1	130	80	2	395	0	20.613131003	1	87	1	0	0
256	FIANI	1	51	1	120	70	2	298	0	23.19109462	1	83	1	0	0
257	CADDI	1	78	2	170	100	2	219	0	21.00973046	0	79	1	1	1
258	PADU	0	59	2	160	80	2	219	0	22.65625	0	88	1	1	0

	A	B	C	D	E	F	G	H	I	J	K	L	M	R	S
259	MURHAYATI	1	45	2	180	90	2	396	0	23.401922753	1	82	1	0	0
260	SINGGING	0	61	2	140	80	2	276	0	21.2	0	85	1	0	1
261	HJ. JWA	1	78	0	120	80	0	123	0	22.476586885	1	85	1	1	1
262	MINA	1	28	2	170	100	2	272	2	25.777777778	1	92	1	1	0
263	KARTINI	1	55	0	110	70	2	255	0	24.034609836	1	85	1	0	0
264	INDAPE	1	67	0	110	70	2	212	0	23.555555556	1	83	1	0	1
265	HASMA	1	46	2	170	80	2	257	0	19.705532421	0	80	1	0	0
266	NORMA	1	64	1	130	70	2	200	0	24.94009487	1	97	1	1	1
267	ROSTIAH	1	45	2	220	100	2	220	3	30.039175707	1	87	1	0	0
268	SUTARNI	1	58	2	120	70	2	216	0	20.04988019	0	67	1	0	0
269	MURLINDA	1	36	2	100	70	2	328	0	21.333333333	1	81	0	0	0
270	SITTI MURNIATI	1	51	2	150	80	2	211	0	18.536908442	0	68	1	0	0
271	A. HAPMING	1	59	2	180	100	2	201	0	23.805401662	0	86	1	1	0
272	A. NUR AZINZAH	1	36	2	140	80	2	239	3	31.20256367	1	99	0	1	0
273	HASMAWATI	1	70	2	130	80	2	211	1	17.527943098	0	71	1	0	1
274	SAWALENG	1	57	2	140	80	2	367	0	23.63040235	1	95	1	0	0
275	SALE	1	61	1	120	80	2	255	0	23.19109462	1	82	1	0	1
276	ST SULAHA A	1	49	2	140	90	2	211	0	23.72528616	0	89	1	0	0
277	BUATANG	1	46	2	140	80	2	212	3	33.155655533	1	89	1	0	0
278	KARTINI	1	44	2	150	80	2	201	0	23.805401662	0	86	1	0	0
279	MURNI	1	47	2	190	100	2	326	3	32.7794010	1	80	1	1	1
280	MURWAHDIAH	1	66	2	140	80	2	434	0	22.136785	0	88	1	0	1
281	MURHAYATI	1	52	1	120	60	2	359	0	18.765246763	1	92	1	0	0
282															

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S
296	ANTI	1	47	0	100	70	2	201	0	23.138507104	1	87	1	0	0	0	0	0	0
297	MULIATI	1	45	0	120	80	0	119	1	16.896235078	1	91	0	1	0	0	0	0	0
298	RATNA	1	28	2	220	100	2	400	0	19.758467309	0	67	1	0	0	0	0	0	0
299	A. ROSMA	1	45	2	160	90	2	319	0	22.41123775	1	96	1	1	0	0	0	0	0
300	KARTINI	1	66	2	200	100	2	346	1	15.3787005	0	70	1	0	0	0	0	0	1
301	HASMA	1	46	2	130	80	2	201	0	21.95930625	0	80	1	0	0	0	0	0	0
302	RIANG	1	53	2	210	110	2	392	3	27.76940266	1	98	1	1	0	0	0	0	0
303	SAIDA	1	52	2	170	100	2	213	0	20.81654527	0	79	1	0	0	0	0	0	0
304	SENNANG	1	58	2	160	80	2	201	0	21.95930625	0	80	1	1	0	0	0	0	0
305	FIANI	1	36	2	110	70	2	244	1	18.31533888	0	60	1	0	0	0	0	0	0
306	HASNA	1	56	0	110	70	2	557	0	21.333333333	1	88	1	0	0	0	0	0	0
307	Hayati	1	49	1	130	80	0	122	3	35.2	1	105	1	1	0	0	0	0	0
308	NAPISAH	1	36	2	200	100	2	201	0	21.494375	0	80	1	0	0	0	0	0	0
309	HIDDING	0	70	2	170	100	2	284	0	22.222222222	0	78	1	0	0	0	0	0	1
310	HASNA	1	83	2	190	80	2	268	0	20.544192841	0	72	1	0	0	0	0	0	1
311	NURJANNAH	1	58	2	140	80	2	219	0	20.549886621	1	91	1	0	0	0	0	0	0
312	CADDI	1	65	2	180	100	2	205	0	20.829995193	1	81	1	0	0	0	0	0	1
313	JUNA	1	50	2	140	90	2	292	2	25.39029522	1	100	1	1	0	0	0	0	0
314	SITTI	1	44	2	190	100	2	272	2	25.777777776	1	92	0	1	0	0	0	0	0
315	MARHUMA	1	48	1	130	80	2	217	2	28.761416	1	96	1	0	0	0	0	0	0
316	MURAEIDA	1	48	0	130	80	0	130	0	19.333729923	1	96	0	0	0	0	0	0	0
317	JUMARA	1	66	2	130	82	2	257	0	19.705532421	0	80	1	0	0	0	0	0	1
318	HASMA	1	46	2	140	70	2	433	3	27.141582391	1	103	0	1	0	0	0	0	0
319	HASMA	1	47	2	140	70	2	433	3	27.141582391	1	103	1	1	0	0	0	0	0
320	BECCE	1	60	2	110	70	2	216	0	20.04988019	0	67	1	0	0	0	0	0	1
321	RATNA	1	54	2	100	70	2	490	2	25.299375945	1	96	1	0	0	0	0	0	0
322	HASMAH	1	67	2	190	90	2	211	0	18.936308442	0	68	1	0	0	0	0	0	1
323	MARDIANA	1	54	2	190	80	2	201	0	23.805401662	0	86	1	1	0	0	0	0	0
324	HASNAH	1	51	2	160	80	2	223	0	23.936062315	1	93	1	1	0	0	0	0	0
325	MARIANI	1	65	2	120	80	2	211	1	17.527943098	0	71	1	0	0	0	0	0	1
326	HASNAH	1	52	2	200	100	2	243	0	20.51914093	1	99	1	0	0	0	0	0	0
327	SAKINAH	1	63	2	190	100	2	249	0	22.832819979	1	89	0	1	0	0	0	0	1
328	SNARA	1	55	2	110	80	2	211	0	23.72528616	0	89	1	0	0	0	0	0	0
329	SARSINA M	1	48	1	130	70	0	124	3	27.555555555	1	80	0	1	0	0	0	0	0
330	LATIF	0	68	2	12	80	2	201	0	23.805401662	0	86	1	0	0	0	0	0	1
331	MERE	1	65	2	170	100	2	200	3	36.717590353	1	91	0	0	0	0	0	0	1
332	SUDARNI	1	71	2	160	100	2	434	0	22.2136785	0	88	1	0	0	0	0	0	1

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S
333	ATI	1	47	2	150	80	2	1103	2	25.915127956	1	90	1	0	0	0	0	0	0
334	MULI	1	50	2	150	80	2	217	0	23.495236875	1	83	1	0	0	0	0	0	0
335	NURUNG	1	54	2	120	80	2	201	0	18.545346017	0	64	1	0	0	0	0	0	0
336	ANKA	1	59	2	130	80	2	346	1	15.3787005	0	70	1	0	0	0	0	0	0
337	NAJIA	1	48	2	170	100	2	301	0	18.549346017	0	64	1	1	0	0	0	0	0
338	SULA	1	51	2	200	100	2	208	0	23.733956172	1	85	1	0	0	0	0	0	0
339	PETTAMAIN	0	73	2	170	100	2	227	0	22.769438354	0	76	1	0	0	0	0	0	1
340	NKMAH	1	46	2	130	90	2	261	2	25.969529086	1	90	1	0	0	0	0	0	0
341	NURHAYATI	1	55	0	100	70	2	218	2	28.397146254	1	95	1	0	0	0	0	0	0
342	KABI	1	54	2	130	80	2	211	1	16.171224732	0	79	1	0	0	0	0	0	0
343	NURHAYATI	1	46	0	110	70	2	204	2	25.33308313	1	94	1	0	0	0	0	0	0
344	RUHA	1	40	2	170	100	2	255	0	23.18109462	1	82	0	0	0	0	0	0	0
345	SAKKA	1	50	2	170	100	2	284	0	22.222222222	0	78	1	0	0	0	0	0	0
346	NURHIDAYAH	1	55	2	160	110	2	202	3	30.536721702	1	107	1	1	0	0	0	0	0
347	RAHMATA	1	57	1	130	70	2	380	0	19.628264701	1	82	1	0	0	0	0	0	0
348	RAHMATA	1	58	2	140	80	2	301	1	17.96875	1	86	1	0	0	0	0	0	0
349	RAHMATA	1	59	1	120	70	2	316	0	22.432302576	1	86	0	0	0	0	0	0	0
350	ARINA	1	53	1	130	80	2	376	3	27.555555555	1	109	1	0	0	0	0	0	0
351	DARMA	1	41	2	180	100	2	203	0	24.143654746	1	81	0	0	0	0	0	0	0
352	MULIATI	1	58	2	150	80	2	357	3	105.916727536	1	148	1	1	0	0	0	0	0
353	MINA	1	77	0	100	60	2	297	0	22.506925206	0	80	1	1	0	0	0	0	1
354	BABA	0	76	1	130	80	2	430	1	18.426534209	0	76	1	0	0	0	0	0	1
355	RAHMAWATI	1	50	2	170	100	2	345	0	23.739956172	1	82	1	1	0	0	0	0	0
356	MAPPI	0	60	1	120	80	2	272	2	28.359072022	0	90	1	0	0	0	0	0	1
357	RAHMAWATI AMIR	1	49	2	170	100	2	345	0	23.739956172	1	82	1	1	0	0	0	0	0
358	CAHYA	1	47	0	110	70	2	458	3	38.736933822	1	86	1	1	0	0	0	0	0
359	CAYA	1	48	1	120	70	2	322	0	20.324438255	1	81	1	1	0	0	0	0	0
360	ANDI ATI	1	70	2	190	100	2	405	0	20.538901658	0	79	1	0	0	0	0	0	1
361	BAHTIAR	0	53	1	130	80	2	206	0	21.380177695	0	74	1	0	0	0	0	0	0
362	NAISYA	1	47	2	160	100	2	206	0	23.372576177	1	83	1	1	0	0	0	0	0
363	RUHA	1	64	2	160	90	2	326	3	31.32906055	1	107	1	1	0	0	0	0	1
364	MUNAWARAH	1	49	1	120	60	2	309	0	22.942130454	1	83	0	1	0	0	0	0	0
365	MARIAN	1	51	2	140	70	2	282	0	20.239500755	1	86	1	0	0	0	0	0	0
366	HARTATI	1	52	2	160	90	2	227	0	24.447278512	1	103	1	0	0	0	0	0	0
367	ASYA	0	76	2	190	70	2	205	0	18.918066754	0	90	1	1	0	0	0	0	1
368	TUD	1	72	2	140	80	2	268	0	23.111111111	0	78	1	1	0	0	0	0	1
369	TATTI	1	51	2	160	90	2	236	3	23.094282341	1	106	0	0	0	0	0	0	0

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S
370	NIAN	1	61	2	140	90	2	319	0	21.208448753	0	79	1	0	0	0	0	0	1
371	NURINTANG	1	34	2	150	90	2	237	0	23.925699623	1	84	0	0	0	0	0	0	0
372	BUATANG	1	62	0	110	70	2	242	1	17.444925772	0	75	1	0	0	0	0	0	1
373	MUSLIMIN	0	68	2	160	80	2	267	0	19.537131053	0	84	1	0	0	0	0	0	0
374	TUO	1	71	2	140	70	2	272	0	22.367440025	1	100	1	1	0	0	0	0	0
375	HANIA	1	47	2	150	80	2	282	0	24.266666667	1	89	1	0	0	0	0	0	0
376	SUARNI	1	57	2	120	90	2	260	3	27.767098125	1	96	1	0	0	0	0		

Lampiran 2. Source Code

```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import os

from sklearn.model_selection import StratifiedKFold
from sklearn.preprocessing import StandardScaler, LabelEncoder
from sklearn.neighbors import KNeighborsClassifier
from sklearn.metrics import accuracy_score

# =====
# LOAD DATA
# =====
file_path = "Data DM puskesmas lappae - Copy.xlsx"

if not os.path.exists(file_path):
    raise FileNotFoundError(f"File tidak ditemukan: {file_path}")

df = pd.read_excel(file_path)

# =====
# FITUR & TARGET
# =====
fitur = [
    'Usia',
    'Hasil - Tekanan Darah (Sistol)',
    'Hasil - Tekanan Darah (Diastol)',
    'Hasil - Gula Darah Sewaktu',
    'Hasil - IMT',
    'Hasil - Lingkar Perut'
]

label_col = 'Status - Gula Darah Sewaktu, NORMAL, PRE-HIPERGLIKEMIK,
HIPERGLIKEMIK'

# =====
# PREPROCESSING
# =====
df_fitur = df[fitur + [label_col]].copy()

for col in fitur:
    df_fitur[col] = pd.to_numeric(df_fitur[col], errors='coerce')
```

```

df_clean = df_fitur.dropna()

X = df_clean[fitur]
y = df_clean[label_col]

le = LabelEncoder()
y_enc = le.fit_transform(y)

# =====
# DISTRIBUSI TARGET
# =====
plt.figure()
y.value_counts().plot(kind='bar')
plt.title('Distribusi Kelas Status Gula Darah')
plt.xlabel('Kelas')
plt.ylabel('Jumlah Data')
plt.tight_layout()
plt.savefig('distribusi_target.png')
plt.close()

# =====
# FEATURE IMPORTANCE (KORELASI)
# =====
df_corr = X.copy()
df_corr['Target'] = y_enc
korelasi = df_corr.corr()

importance =
korelasi['Target'].drop('Target').abs().sort_values(ascending=False)

plt.figure()
importance.plot(kind='bar')
plt.title('Feature Importance Berdasarkan Korelasi')
plt.ylabel('Nilai Korelasi Absolut')
plt.tight_layout()
plt.savefig('feature_importance.png')
plt.close()

# =====
# K-FOLD CROSS VALIDATION
# =====
kfold = StratifiedKFold(n_splits=5, shuffle=True, random_state=42)

hasil_fold = []
akurasi = []

```

```

print("\n=== HASIL AKURASI K-FOLD ===")

fold = 1
for train_idx, test_idx in kfold.split(X, y_enc):
    X_train, X_test = X.iloc[train_idx], X.iloc[test_idx]
    y_train, y_test = y_enc[train_idx], y_enc[test_idx]

    # NORMALISASI DI DALAM FOLD
    scaler = StandardScaler()
    X_train_scaled = scaler.fit_transform(X_train)
    X_test_scaled = scaler.transform(X_test)

    model = KNeighborsClassifier(
        n_neighbors=5,
        metric='manhattan'
    )

    model.fit(X_train_scaled, y_train)
    y_pred = model.predict(X_test_scaled)

    acc = accuracy_score(y_test, y_pred)
    akurasi.append(acc)

    hasil_fold.append({
        'Fold': fold,
        'Akurasi': acc
    })

    # TAMPIL DI TERMINAL
    print(f"Fold {fold} : Akurasi = {acc:.4f}")

    fold += 1

rata_akurasi = np.mean(akurasi)

print("-" * 35)
print(f"Rata-rata Akurasi : {rata_akurasi:.4f}")
print("-" * 35)

df_hasil_fold = pd.DataFrame(hasil_fold)
df_rata = pd.DataFrame({
    'Rata-rata Akurasi': [rata_akurasi]
})

```

```

# =====
# GRAFIK AKURASI K-FOLD
# =====
plt.figure()
plt.plot(df_hasil_fold['Fold'], df_hasil_fold['Akurasi'],
marker='o')
plt.title('Akurasi K-Fold Cross Validation')
plt.xlabel('Fold')
plt.ylabel('Akurasi')
plt.tight_layout()
plt.savefig('akurasi_kfold.png')
plt.close()

# =====
# SIMPAN KE EXCEL
# =====
output_file = 'Hasil_Tabel_Preprocessing_dan_KFold.xlsx'

with pd.ExcelWriter(output_file, engine='openpyxl') as writer:
    df.to_excel(writer, sheet_name='1_Data_Awal', index=False)
    df_fitur.to_excel(writer, sheet_name='2_Seleksi_Fitur',
index=False)
    df_clean.to_excel(writer, sheet_name='3_Data_Cleaning',
index=False)
    X.to_excel(writer, sheet_name='4_Data_Fitur', index=False)
    korelasi.to_excel(writer, sheet_name='5_Korelasi_Fitur')
    df_hasil_fold.to_excel(writer, sheet_name='6_Hasil_KFold',
index=False)
    df_rata.to_excel(writer, sheet_name='7_Rata_Akurasi',
index=False)

print("\n☑ Program selesai dijalankan dengan sukses")

```

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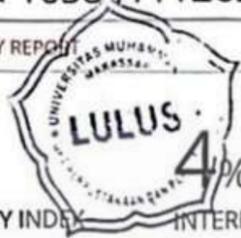
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