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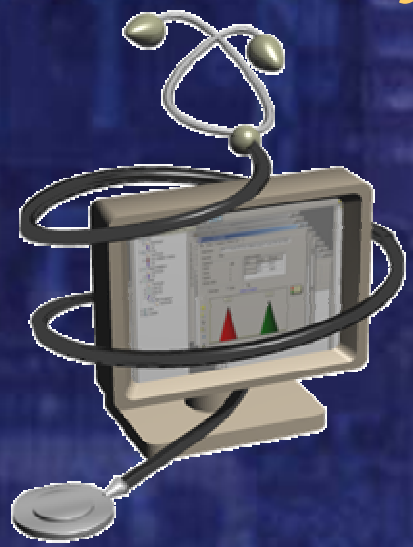
GhostMiner's application in life sciences



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Example: Gestational Diabetes Mellitus prediction

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Gestational Diabetes Mellitus

background

- *third type of diabetes mellitus*
- *defined as any carbohydrates intolerance recognized first time during pregnancy*
- *occurs in about 3% to 12% of pregnancies*
- *women with gestational diabetes have significantly different pregnancy characteristics and outcomes: intrauterine fetal death, fetal macrosomia and growth disorder, neonatal hypoglycemia ie.*

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Gestational Diabetes Mellitus

risk factors

- *obesity or overweight*
- *maternal age*
- *history of miscarriages*
- *life style*
- *family history of diabetes*

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Gestational Diabetes Mellitus

prediction - today

- *regional experts and scientific organizations recommend **screening** as a good clinical practice. For example Experts Committee of Polish Diabetes Association recommends fasting glucose blood concentration measurements in all pregnant women during first visit in consulting room*
- *disadvantages – price and onerousness as well as for women and health specialists*

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Gestational Diabetes Mellitus

prediction – tomorrow?

- *tools: computer-based, intelligent, problem-specific, able to learn and available both for patients and healt specialists*
- *advantages – easy to use and cost-effective methods*

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prediction – tomorrow?

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Gestational Diabetes Mellitus

project aim

to use novel modeling techniques as flexible and advanced methods helpful in GDM prediction based on simple demographic information

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data

- *epidemiological databases obtained from National Center for Health Statistics (NCHS)*
- *main database - BRFSS database (Behavioral Risk Factor Surveillance System)*
- *BRFSS is an ongoing data collection program designed to measure behavioral risk factors in the adult population (18 years of age or over) living in households*
- *GDM prediction inclusion criteria - at least one pregnancy in last 5 years, no other type of diabetes diagnosed*

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data

- *2551 records*
- *91 women were diagnosed with gestational diabetes*
- *selection of crucial factors governing analyzed problem based on an expert opinion and professional literature - **8 variables** from ca. 200 were selected to the investigation*
- *label 1 denoted diagnosed diabetes and label 0 lack of diabetes*

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data preprocessing

due to specific structure of native dataset (unequal distribution of cases, it was necessary to alter learning datasets; two different ways of datasets modification were tested:

- ***„balance minus"*** *– randomly chosen records from more frequently represented class were removed from learning dataset*
- ***„balance plus"*** *- randomly chosen records from less frequently represented class from learning dataset were duplicated*

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No of variable	Description	All patients	GDM positive	GDM negative
1	**High blood pressure**	2551	91	2460
	YES	298	17 (6%)	281 (94%)
	NO	2253	74 (3%)	2179 (97%)
2	**High cholesterol (YES/NO)**			
	YES	223	8 (4%)	215 (96%)
	NO	1281	39 (4%)	1242 (96%)
	REFUSED	1047	44 (4%)	1003 (96%)
3	**Do you now smoke cigarettes**			
	EVERYDAY	575	12 (2%)	563 (98%)
	SOME DAYS	118	7 (6%)	111 (94%)
	NOT AT ALL	321	14 (4%)	307 (96%)
	REFUSED	1537	58 (4%)	1479 (96%)
4	**Age in years (18 - 44)**	30,00 (SD = 6,01)	34,11 (SD = 5,60)	30,00 (SD = 6,02)
5	**Race**			
	CAUCASIAN	2023	76 (4%)	1947 (96%)
	BLACK	396	12 (3%)	384 (97%)
	ASIAN	32	2 (6%)	30 (94%)
	AMERICAN INDIAN	35	0 (0%)	35 (100%)
	OTHER	65	1 (2%)	64 (98%)
6	**Weight [kg]**	67,69 (SD = 15,22)	69,34 (SD = 14,99)	67,63 (SD = 15,23)
7	**Height [cm]**	165,00 (SD = 6,89)	163,70 (SD = 7,69)	165,04 (SD = 6,86)
8	**Are you eating fewer fat to lower your risk of developing heart disease or stroke**			
	YES	867	30 (3%)	837 (97%)
	NO	468	17 (4%)	451(96%)
	REFUSED	1216	44 (4%)	1172 (96%)

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modeling methods

- *Support Vector Machine (SVM)*
- *Separability of Split Value (SSV) decision trees*
- *k-nearest-neighbors algorithm (kNN)*
- *ANN algorithms (IncNET, FSM)*

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results

- *„global" - percentage of all positive model answers*
- *„0" - percentages of correctly classified patients without*
- *„1" - percentages of correctly classified patients with GDM*
- *10-fold cross validation technique was applied*

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results

Nr	Modeling method	Dataset	Generalization test results		
			0	1	Global
1	SSV Tree	bal-	**59.6**	**55.6**	**57.8**
2	FSM	bal-	**47.85**	**49.9**	**48.1**
3	kNN	bal-	76.1	27.8	52.3
4	IncNET	bal-	**74.6**	**36.65**	**56.4**
5	kNN	bal+	12.50	96.0	94.0
6	IncNET	bal+	37.50	58.0	57.0
7	SVM	bal+	12.50	97.0	94.0

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*comparison with **logistic regression***

- *classical modeling method when binary outcome is observed*
- *in this study logistic regression analysis was used to predict incidence of GDM on the basis of 8 chosen inputs and „balance plus" data sets due to better results than other modeling methods*
- *the dependent variable was the dichotomized GDM diagnosis value*
- *the independent variables entered into the analysis were the same as for other modeling techniques*

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comparison with logistic regression

Test file	Global	0	1	Threshold
1	59.19	59.54	50.00	
2	59.93	60.15	54.55	
3	56.62	56.76	53.85	
4	59.19	59.54	50.00	
5	54.41	54.75	50.00	
6	56.99	57.03	62.50	0.5
7	51.84	52.26	40.00	
8	57.35	57.98	50.00	
9	57.35	57.92	50.00	
10	51.47	51.34	60.00	
Mean	**56.43**	**56.73**	**52.09**	

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practical application

prediction - today

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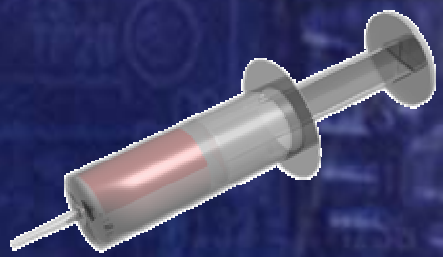
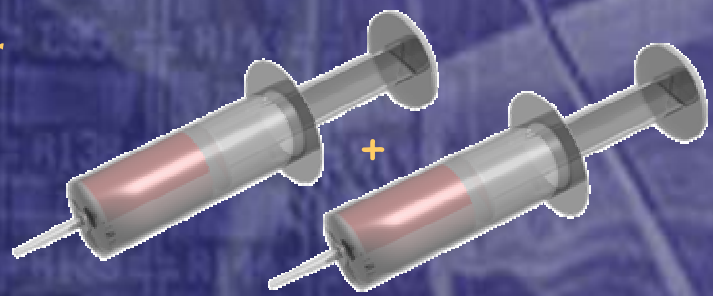


or



or even

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practical application

prediction – tomorrow

Internet or locally available

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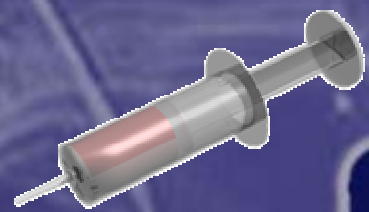
if positive



BASED ON INTELLIGENT TECHNIQUES GDM-SCREENING SYSTEM

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conclusions

- ***GhostMiner*** *software is a good source of novel, easy to use and powerful data-analysis tools*
- *owing to advanced model betterment abilites implemented in* ***GhostMiner*** *software – obtained results are not definitive*
- *further investigations in health science area with intelligent prediction techniques are necessary*

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Any questions left?

Ask us!

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Or visit our webpage

http://www.fqspl.com.pl/GhostMiner

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