

Process Mining and Intelligence Project

Emotion Based Music Selection

Ettore Ricci

Francesco Boldrini

Paolo Palumbo

Zahra Omrani

January 21, 2025

Contents

1	BPMN modeling	2
1.1	Process landscape	2
1.2	Process model	2
1.2.1	Prepare session	2
1.2.2	Generate learning sets	2
1.2.3	Develop classifier	2
1.2.4	Classify session	2
1.2.5	Evaluate classifier performance	2
1.2.6	Configure systems	2
2	Task level modeling	2
2.1	Segregation system	2
2.1.1	Check data balancing	2
2.1.2	Check input coverage	3
2.2	Development system	5
2.2.1	Set iteration number	5
2.2.2	Check learning report	5
2.2.3	Check validation report	6
2.2.4	Check test results	8
2.3	Evaluation system	9
2.3.1	Evaluate classifier performance	9

1 BPMN modeling

1.1 Process landscape

1.2 Process model

1.2.1 Prepare session

1.2.2 Generate learning sets

1.2.3 Develop classifier

1.2.4 Classify session

1.2.5 Evaluate classifier performance

1.2.6 Configure systems

2 Task level modeling

Position	Description	Salary	Normalized Salary
Clerk		\$52,000.00	1.00
ML engineer		\$130,000.00	2.50
Data scientist		\$123,000.00	2.37
Domain expert (Neurologist)		\$267,000.00	5.13
Minimum		\$52,000.00	1.00

Table 1: Salary and normalized salary for each position

2.1 Segregation system

2.1.1 Check data balancing

The task is performed by a Data scientist.

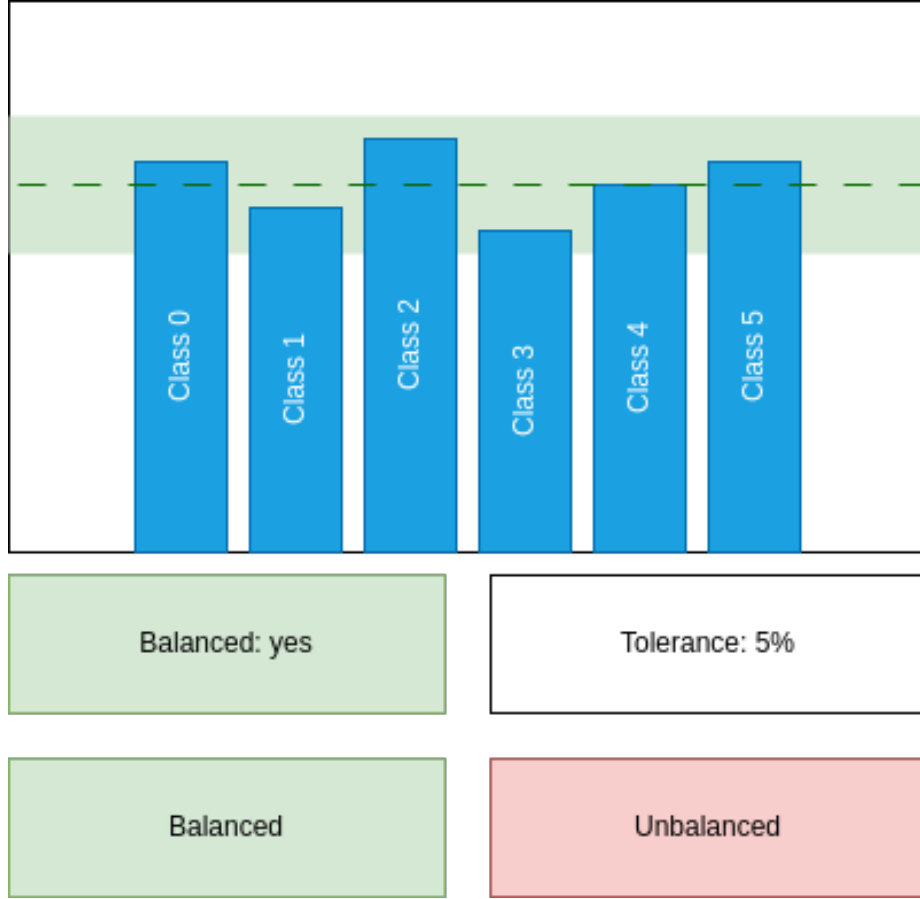


Figure 1: "Check data balancing" mock-up form

Step	O	CL	S	SC
1 ACTOR opens "Check data balancing" form.	1	1	2.37	2.37
2 SYSTEM shows the report.				
3 SYSTEM shows a hint whether the data is balanced or not.				
4 ACTOR checks threshold in the UI.	1	2	2.37	4.74
5 FOR EACH column in the report:	5			
5.1 IF the column is not within the displayed threshold.	4			
5.1.1 THEN the data is not balanced.	4			
6.1 IF the data is balanced.	0.2			
6.1.1 ACTOR clicks "Balanced" button.	0.2	1	2.37	0.47
6.2 ELSE	0.8			
6.2.1 ACTOR clicks "Unbalanced" button.	0.8	1	2.37	1.90
7 SYSTEM shows a confirmation dialog.				
8 ACTOR closes the form.	1	1	2.37	2.37
Human task cost				11.85

Table 2: Detailed use case for "Check data balancing" task

O - Occurrence, CL - Cognitive Level, S - Normalized Salary, SC - Step Cost

2.1.2 Check input coverage

The task is performed by a Data scientist.



Figure 2: "Check input coverage" mock-up form

Step	O	CL	S	SC
1 ACTOR opens "Check input coverage" form.	1	1	2.37	2.37
2 SYSTEM shows a radar scatter plot of the input distribution.				
3 FOR EACH radius in the radar scatter plot:	5			
3.1 IF the distribution is not uniform as expected.	3.33	4	2.37	31.57
3.1.1 THEN the input coverage is not satisfied.	3.33			
4.1 IF the input coverage is satisfied.	0.33			
4.1.1 ACTOR clicks "Accept" button.	0.33	1	2.37	0.79
4.2 ELSE	0.66			
4.2.1 ACTOR clicks "Reject" button.	0.66	1	2.37	1.57
5 SYSTEM shows a confirmation dialog.				
6 ACTOR closes the form.	1	1	2.37	2.37
Human task cost				38.68

Table 3: Detailed use case for "Check input coverage" task

O - Occurrence, CL - Cognitive Level, S - Normalized Salary, SC - Step Cost

2.2 Development system

2.2.1 Set iteration number

The mock-up form is a rectangular dialog box with a title bar at the top containing the text "Set Iteration Number" and a close button (X) on the right. Inside the dialog, the text "Current Iteration Number" is followed by the value "10". Below this, the text "Enter New Iteration Number:" is followed by a text input field. At the bottom center, there is a "Submit" button. At the very bottom of the dialog, the text "Iteration number updated successfully!" is displayed.

Figure 3: "Set iteration number" mock-up form

Step	O	CL	S	SC
1 ACTOR opens "Set Iteration Number" form.				
2 SYSTEM displays the current iteration number.				
3 ACTOR inputs the desired number of iterations.				
4 ACTOR clicks "Submit" button to confirm the iteration number.				
5 SYSTEM shows a confirmation dialog.				
6 ACTOR closes the form.				
Human task cost				

Table 4: Detailed use case for "Set iteration number" task

O - Occurrence, CL - Cognitive Level, S - Normalized Salary, SC - Step Cost

2.2.2 Check learning report

The task is performed by a ML engineer.



Figure 4: "Check learning report" mock-up form

Step	O	CL	S	SC
1 ACTOR opens "Check training report" form.	1	1	2.50	2.50
2 SYSTEM shows the training loss curve.				
3.1 IF the loss is flat for at least half of the iterations:	0.4	3	2.50	3.00
3.1.1 THEN ACTOR clicks "Overfit" button.	0.4	1	2.50	1.00
3.2 IF the loss is not flat at the end of the iterations:	0.4	3	2.50	3.00
3.2.1 THEN ACTOR clicks "Underfit" button.	0.4	1	2.50	1.00
3.3 ELSE	0.2	3	2.50	1.50
3.3.1 ACTOR clicks "Approved" button.	0.2	1	2.50	0.50
4 SYSTEM shows a confirmation dialog.				
5 ACTOR closes the form.	1	1	2.50	2.50
Human task cost				15.00

Table 5: Detailed use case for "Check training report" task

O - Occurrence, CL - Cognitive Level, S - Normalized Salary, SC - Step Cost

2.2.3 Check validation report

This task is performed by a ML engineer.

	ID	Depth	Neurons	Train MSE	Valid MSE	Delta MSE
1	954	3	4000	0.13	0.14	0.01
2	321	4	3000	0.23	0.24	0.01
3	5	3	1000	0.35	0.35	0.00
4	764	2	2000	0.24	0.45	0.21
5	202	3	2500	0.20	0.47	0.27
Reject						
Overfitting Tolerance:						0.10

Figure 5: "Check validation report" mock-up form

Step	O	CL	S	SC
1 ACTOR opens "Check validation report" form.	1	1	2.5	2.5
2 SYSTEM shows the best 5 models sorted by increasing Validation Loss.				
3 FOR EACH model in the list:	5			
3.1 IF the model Validation Loss minus the Training Loss is less than the Overfitting Tolerance and the Best Model is not selected.	1	2	2.5	5
3.1.1 THEN select the model as the Best Model.	1	1	2.5	2.5
4 FOR EACH model in the list:	4			
4.1 IF the model is not the Best Model and the Validation Loss minus the Training Loss is less than the Overfitting Tolerance and the Second Best Model is not selected.	1	2	2.5	5
4.1.1 THEN select the model as the Second Best Model.	1	1	2.5	2.5
5.1 IF the Best Model is not selected.	0.05	1	2.5	0.125
5.1.1 ACTOR clicks "Reject" button.	0.05	1	2.5	0.125
5.2 ELSE IF the Second Best Model is not selected or the Validation Loss of the Second Best Model is one order of magnitude greater than the Validation Loss of the Best Model.	0.3	3	2.5	2.25
5.2.1 ACTOR clicks on the Best Model.	0.3	1	2.5	0.75
5.3 ELSE	0.65	3	2.5	4.875
5.3.1 ACTOR clicks on the least complex model among the Best Model and the Second Best Model.	0.65	3	2.5	4.875
6 SYSTEM shows a confirmation dialog.				
7 ACTOR closes the form.	1	1	2.5	2.5
Human task cost				32.91

Table 6: Detailed use case for "Check validation report" task
O - Occurrence, CL - Cognitive Level, S - Normalized Salary, SC - Step Cost

2.2.4 Check test results

This task is performed by a ML engineer.

ID	Depth	Neurons	Valid MSE	Test MSE	Delta MSE
954	3	4000	0.14	0.15	0.01

Overfitting Tolerance:

0.10

Accept

Reject

Figure 6: "Check test results" mock-up form

Step	O	CL	S	SC
1 ACTOR opens "Check test results" form.	1	1	2.5	2.5
2 SYSTEM shows the test results.				
3 ACTOR checks if the difference between the test results and the validation results is within overfitting tolerance.	1	2	2.5	5
4.1 IF the test results is not satisfactory.	0.01			
4.1.1 ACTOR clicks "Reject" button.	0.01	1	2.5	0.025
4.2 ELSE	0.99			
4.2.1 ACTOR clicks "Approve" button.	0.99	1	2.5	2.475
5 SYSTEM shows a confirmation dialog.				
6 ACTOR closes the form.	1	1	2.5	2.5
Human task cost				12.5

Table 7: Detailed use case for "Check test results" task

O - Occurrence, CL - Cognitive Level, S - Normalized Salary, SC - Step Cost

2.3 Evaluation system

2.3.1 Evaluate classifier performance

×

Evaluate Classifier Performance

Session ID	Expert Label	Classifier Label	Error
0	1	2	Yes
1	1	3	Yes
2	2	1	Yes
3	3	3	No

Max number of errors tolerated (th1): 4
Max number of consecutive error tolerated (th 2) :2

th1 satisfied
 $3 < 4$

th 2 exceeded
 $3 > 2$

Pass

Fail

Figure 7: "Evaluate Classifier Performance" mock-up form

Step	O	CL	S	SC
1 ACTOR opens the "Evaluate Classifier Performance" form.				
2 SYSTEM displays a table of sessions with Expert Label (ground truth) and Classifier Label (predicted label). The difference between the labels (if any) represents an error.				
3 ACTOR reviews the table.				
3.1 IF the total errors or consecutive errors exceed their respective thresholds:				
3.1.1 ACTOR clicks the "Fail" button.				
3.2 ELSE				
3.2.1 ACTOR clicks the "Pass" button.				
4 SYSTEM shows a confirmation dialog.				
5 ACTOR closes the form.				
Human task cost				

Table 8: Detailed use case for "Evaluate Classifier Performance" task

O - Occurrence, CL - Cognitive Level, S - Normalized Salary, SC - Step Cost