

## Appendix E. Hyperparameters

**Table E1.** Logistic Regression Hyperparameters for 6-Month Feature Window with No Class Weight

Experiment Description	Hyperparameters	
(1) 6-Month Feature Window	Algorithm	Logistic Regression
(2) 6-Month Label Period	C	0.02026512613
(3) Class Weight = False	_tuning_objective_metric	logloss

**Table E2.** Logistic Regression Hyperparameters for 6-Month Feature Window with Balanced Class Weight

Experiment Description	Hyperparameters	
(1) 6-Month Feature Window	Algorithm	Logistic Regression
(2) 6-Month Label Period	C	0.8570141068
(3) Class Weight = ‘Balanced’	_tuning_objective_metric	logloss

**Table E3.** Logistic Regression Hyperparameters for 12-Month Feature Window with No Class Weight

Experiment Description	Hyperparameters	
(1) 6-Month Feature Window	Algorithm	Logistic Regression
(2) 12-Month Label Period	C	0.016211470933
(3) Class Weight = False	_tuning_objective_metric	logloss

**Table E4.** Logistic Regression Hyperparameters for 12-Month Feature Window with Balanced Class Weight

Experiment Description	Hyperparameters	
(1) 6-Month Feature Window	Algorithm	Logistic Regression
(2) 12-Month Label Period	C	0.3067285731
(3) Class Weight = ‘Balanced’	_tuning_objective_metric	logloss

**Table E5.** Random Forest Hyperparameters for 6-Month Feature Window with No Class Weight

Experiment Description	Hyperparameters	
(1) 6-Month Feature Window	Algorithm	Random Forest
(2) 6-Month Label Period	max_depth	34
(3) Class Weight = False	max_features	sqrt
	min_samples_leaf	0.01312516945
	min_samples_split	0.02433359158
	n_estimators	179
	_tuning_objective_metric	logloss

**Table E6.** Random Forest Hyperparameters for 6-Month Feature Window with Balanced Class Weight

Experiment Description	Hyperparameters	
(1) 6-Month Feature Window	Algorithm	Random Forest
(2) 6-Month Label Period	max_depth	45
(3) Class Weight = 'Balanced'	max_features	sqrt
	min_samples_leaf	0.01080793404
	min_samples_split	0.02292190939
	n_estimators	178
	_tuning_objective_metric	logloss

**Table E7.** Random Forest Hyperparameters for 12-Month Feature Window with No Class Weight

Experiment Description	Hyperparameters	
(1) 6-Month Feature Window	Algorithm	Random Forest
(2) 12-Month Label Period	max_depth	3
(3) Class Weight = False	max_features	sqrt
	min_samples_leaf	0.01922263426
	min_samples_split	0.3559709992
	n_estimators	2476
	_tuning_objective_metric	logloss

**Table E8.** Random Forest Hyperparameters for 12-Month Feature Window with Balanced Class Weight

Experiment Description	Hyperparameters	
(1) 6-Month Feature Window	Algorithm	Random Forest
(2) 12-Month Label Period	max_depth	37
(3) Class Weight = 'Balanced'	max_features	sqrt
	min_samples_leaf	0.03121276193
	min_samples_split	0.02509906959
	n_estimators	4985
	_tuning_objective_metric	logloss

**Table E9.** XGBoost Hyperparameters for 6-Month Feature Window (scale\_pos\_weight = 0)

Experiment Description	Hyperparameters	
(1) 6-Month Feature Window	Algorithm	XGBoost
(2) 6-Month Label Period	alpha	133.0250002
(3) scale_pos_weight = 0.0	eta	0.4211384155
	min_child_weight	58.79764688
	num_round	2739
	subsample	0.7904002172
	_tuning_objective_metric	logloss

**Table E10.** XGBoost Hyperparameters for 6-Month Feature Window (scale\_pos\_weight Parameter Set)

Experiment Description	Hyperparameters	
(1) 6-Month Feature Window	Algorithm	XGBoost
(2) 6-Month Label Period	alpha	199.348282
(3) scale_pos_weight hyperparameter is set to the ratio of negative class samples to positive class samples	eta	0.3541172461
	min_child_weight	65.6
	num_round	1219
	scale_pos_weight	1
	subsample	0.7960763019
	_tuning_objective_metric	logloss

**Table E11.** XGBoost Hyperparameters for 12-Month Feature Window (scale\_pos\_weight = 0)

Experiment Description	Hyperparameters	
(1) 6-Month Feature Window	Algorithm	XGBoost
(2) 12-Month Label Period	alpha	198.6956382
(3) scale_pos_weight = 0.0	eta	0.1235904851
	min_child_weight	77.62037067
	num_round	4000
	subsample	0.994975244
	_tuning_objective_metric	logloss

**Table E12.** XGBoost Hyperparameters for 12-Month Feature Window (scale\_pos\_weight Parameter Set)

Experiment Description	Hyperparameters	
(1) 6-Month Feature Window	Algorithm	XGBoost
(2) 12-Month Label Period	alpha	329.4528475
(3) scale_pos_weight hyperparameter is set to the ratio of negative class samples to positive class samples	eta	0.3600617842
	min_child_weight	15.7
	num_round	908
	scale_pos_weight	0.9076821565
	subsample	0.8555105875
	_tuning_objective_metric	logloss

**Table E13.** Object2Vec with Pooled Embeddings for 6-Month Feature Window

Experiment Description	Hyperparameters	
(1) 6-Month Feature Window	Algorithm	Object2Vec
(2) 6-Month Label Period	Network	Pooled
	_kvstore	device
	_num_gpus	auto
	_num_kv_servers	auto
	_tuning_objective_metric	validation:cross_entropy
	bucket_width	0
	dropout	0.06966670733
	early_stopping_patience	2
	early_stopping_tolerance	0.01945223862
	enc0_cnn_filter_width	3
	enc0_layers	auto
	enc0_max_seq_len	13
	enc0_network	pooled_embedding
	enc0_token_embedding_dim	286
	enc0_vocab_size	61
	enc1_cnn_filter_width	3
	enc1_layers	auto
	enc1_max_seq_len	114
	enc1_network	pooled_embedding
	enc1_token_embedding_dim	98
	enc1_vocab_size	4010
	enc_dim	16

	epochs	13
	learning_rate	2.84E-06
	mini_batch_size	32
	mlp_activation	relu
	mlp_dim	512
	mlp_layers	1
	num_classes	2
	optimizer	adam
	output_layer	softmax

**Table E14.** Object2Vec with Pooled Embeddings for 12-Month Feature Window

Experiment Description	Hyperparameters	
(1) 6-Month Feature Window	Algorithm	Object2Vec
(2) 12-Month Label Period	Network	Pooled
	_kvstore	device
	_num_gpus	auto
	_num_kv_servers	auto
	_tuning_objective_metric	validation:cross_entropy
	bucket_width	0
	dropout	0.0
	early_stopping_patience	2
	early_stopping_tolerance	0.007217989221
	enc0_cnn_filter_width	3
	enc0_layers	auto
	enc0_max_seq_len	13

	enc0_network	pooled_embedding
	enc0_token_embedding_dim	70.0
	enc0_vocab_size	61
	enc1_cnn_filter_width	3
	enc1_layers	auto
	enc1_max_seq_len	147
	enc1_network	pooled_embedding
	enc1_token_embedding_dim	258
	enc1_vocab_size	3687
	enc_dim	14
	epochs	32
	learning_rate	1.81E-05
	mini_batch_size	32
	mlp_activation	relu
	mlp_dim	512
	mlp_layers	3
	num_classes	2
	optimizer	adam
	output_layer	softmax



**Table E15.** Object2Vec with HCNN for 6-Month Feature Window

Experiment Description	Hyperparameters	
(1) 6-Month Feature Window	Algorithm	Object2Vec
(2) 6-Month Label Period	Network	HCNN
	_kvstore	device
	_num_gpus	auto
	_num_kv_servers	auto
	_tuning_objective_metric	validation:cross_entropy
	bucket_width	0
	dropout	0.1
	early_stopping_patience	3
	early_stopping_tolerance	0.002042551795
	enc0_cnn_filter_width	3
	enc0_layers	auto
	enc0_max_seq_len	13
	enc0_network	hcnn
	enc0_token_embedding_dim	260
	enc0_vocab_size	61.0
	enc1_cnn_filter_width	3
	enc1_layers	auto
	enc1_max_seq_len	114
	enc1_network	hcnn
	enc1_token_embedding_dim	179
	enc1_vocab_size	4010
	enc_dim	52

	epochs	29
	learning_rate	5.92E-06
	mini_batch_size	32
	mlp_activation	relu
	mlp_dim	512
	mlp_layers	9
	num_classes	2
	optimizer	adam
	output_layer	softmax

**Table E16.** Object2Vec with HCNN for 12-Month Feature Window

Experiment Description	Hyperparameters	
(1) 6-Month Feature Window	Algorithm	Object2Vec
(2) 12-Month Label Period	Network	HCNN
	_kvstore	device
	_num_gpus	auto
	_num_kv_servers	auto
	_tuning_objective_metric	validation:cross_entropy
	bucket_width	0
	dropout	0.1
	early_stopping_patience	1
	early_stopping_tolerance	0.02273117174
	enc0_cnn_filter_width	3
	enc0_layers	auto
	enc0_max_seq_len	13

	enc0_network	hcn
	enc0_token_embedding_dim	31.0
	enc0_vocab_size	61
	enc1_cnn_filter_width	3
	enc1_layers	auto
	enc1_max_seq_len	147
	enc1_network	hcn
	enc1_token_embedding_dim	275
	enc1_vocab_size	3687
	enc_dim	2131
	epochs	61
	learning_rate	9.31E-05
	mini_batch_size	32
	mlp_activation	relu
	mlp_dim	512
	mlp_layers	7
	num_classes	2
	optimizer	adam
	output_layer	softmax

**Table E17.** Object2Vec with BiLSTM for 6-Month Feature Window

Experiment Description	Hyperparameters	
(1) 6-Month Feature Window	Algorithm	Object2Vec
(2) 6-Month Label Period	Network	BiLSTM
	_kvstore	device
	_num_gpus	auto
	_num_kv_servers	auto
	_tuning_objective_metric	validation:cross_entropy
	bucket_width	0
	dropout	0.0
	early_stopping_patience	1
	early_stopping_tolerance	0.007401905414
	enc0_cnn_filter_width	3
	enc0_layers	auto
	enc0_max_seq_len	13
	enc0_network	bilstm
	enc0_token_embedding_dim	167.0
	enc0_vocab_size	61
	enc1_cnn_filter_width	3
	enc1_layers	auto
	enc1_max_seq_len	114
	enc1_network	bilstm
	enc1_token_embedding_dim	122
	enc1_vocab_size	4010
	enc_dim	11

	epochs	2.90E+01
	learning_rate	6.71E-06
	mini_batch_size	32
	mlp_activation	relu
	mlp_dim	512
	mlp_layers	6
	num_classes	2
	optimizer	adam
	output_layer	softmax