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Boris Galitsky

Artificial Intelligence for Customer Relationship Management

Solving Customer Problems

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Preface to Volume 2

The second volume of the book on Artificial Intelligence for Customer Relationship Management presents a broad spectrum of application domains with a focus on solving customer problems. We design a chatbot to specifically address issues customer experiences, as well as a system that tries to understand the customer complaint, his mood, and what can be done to resolve an issue with the product or service.

In the first volume of the book, we addressed the key issues of modern CRM systems, which frequently cannot handle the high volume of calls and chats. The main limitations of CRM today is a lack of machine understanding of what a customer is trying to say, what are the issues he is trying to communicate or attempts to conceal. To attack these limitations, we proposed a number of Natural Language Understanding (NLU) techniques with the focus on deep language analysis and reasoning.

Nothing repels customers as much as irrelevant, annoying, intrusive answers and low-quality content. The inability to find information users need is a major reason they are unsatisfied with a producer of a provider. In the first volume, we shared the evaluations of question-answering components, verified their explainability features and observed a satisfactory lab performance for major CRM tasks. We concluded that keeping the customers informed is key to their acquisition and retention. For example, in Fig. 1, fast access to information on who owns the bird is critical for a smooth transaction.

In this second volume, we make the next step to the heart of the customer retention issue: solving a customer problem. Now just understanding what the customer is saying is not enough anymore: we need to involve a formalized knowledge about a product and reason about it. To solve a customer problem efficiently and effectively, we focus on dialogue management. A dialogue with the customer is maintained in such a way so that the problem can be clarified and multiple ways to fix it can be sought.

If the CRM is not intelligent enough, it is not very usable. In particular, CRMs are used by people who sell, and as such, they are often traveling to customer sites, away from their desk, in front of clients, and are paid to generate sales, so communication with a CRM is often an afterthought. Salespeople are not hired for their computer or data entry skills but instead for their ability to sell. If they close a significant deal and

Fig. 1 Communicating specific features of products with a buyer

Catcher In The Sky

PET STORE | DETROIT, MI, USA | **RIGHT** | DECEMBER 28, 2009

Customer: "How much is this bird?"

Me: "Sir, how did you get the bird out of the cage? The cage was locked."

Customer: "Oh, I got this one from the birds you have outside by the door."

Me: "Those aren't our birds."

Customer: "What?"

Me: "Sir, you picked up a wild bird. But congratulations, because I can't imagine it was a simple task."

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Fig. 2 Charles Fillmore's example for joint sentence discourse

- Please use the toilet
- NOT the pool
- Pool for members only



never entered it into the CRM, something may be said after the congratulations on the sale, but no one would complain about not using the CRM. The general consensus among sales representatives is simple: no one likes dumb CRM. They are frequently overly-complex, clunky systems without a conversational interface that do not help them sell and even obstruct the sales process. So the personnel may use unintelligent CRM as little as possible. More than a third of businesses face low adoption rates of CRM systems.

Our dialogue management is based on discourse analysis, a systematic linguistic way to handle the thought process of an author. Discourse analysis is a method for studying the natural language in relation to its social context. Discourse analysis tracks how language is used in real-life situations. A well-known American linguist Charles Fillmore demonstrates that two sentences taken together as a single discourse can have meanings different from each one taken separately (Fig. 2).

The objects of discourse analysis (texts, conversations, communicative events) are defined in terms of coherent sequences of sentences, propositions and speech acts. Sometimes discourse analysis even helps to get a consumer out of trouble by making a conversation convincing (Fig. 3). A dialogue structure can take a peculiar form for a conversation between two apple maggots (Fig. 4).

Fig. 3 Finding a contradiction in customer's request and communicating it

Mixing In Danger Costs Extra

ICE CREAM SHOP **RIGHT** | JUNE 8, 2009

Customer: "Hi, I'd like vanilla ice cream with peanut butter cups mixed in, please."

Me: "OK, is that all for you?"

Customer: "Yes, and just so you know, I'm allergic to peanuts. Can you make sure it's nut-free?"

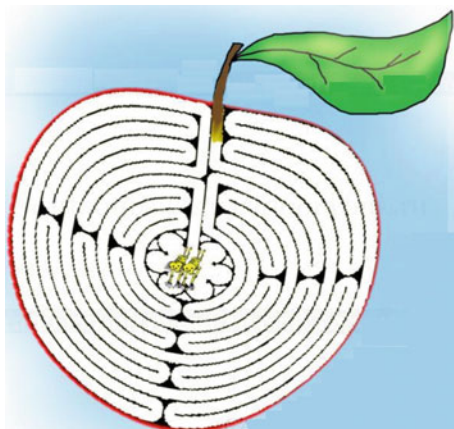
Me: "Uh...you just ordered PEANUT butter cups for your ice cream..."

Customer: "I thought you guys could do allergy safe ice cream. The sign says you can make sure my food is allergy safe!"

Me: "Well, yes...but you need to order food without peanuts in it first..."

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Fig. 4 A conversational structure of two apple maggots



We demonstrate how a dialogue structure can be built from an initial utterance. We also introduce real and imaginary discourse trees as a means to represent an explicit and implicit discourse of text. A problem of involving background knowledge on-demand, answering questions is addressed as well. We outline the *Doc2Dialogue* algorithm for converting a paragraph of text into a hypothetical dialogue based on an analysis of a discourse tree for this paragraph. This technique allows for a substantial extension of chatbot training datasets in an arbitrary domain.

Fig. 5 An example of
hypocrisy

How About A Side Of Hypocrisy

FAST FOOD, RESTAURANT | **RIGHT** | JULY 13, 2009

Me: *preparing a gyro wrap for a customer*
"Would you like cheese on it?"

Customer: "Oh my God, no! I'm a VEGAN! Don't you know what they do to cows in those horrible farms? They force them to get pregnant all the time, and then they take away their babies and kill them so we humans can steal their milk! Dairy products are cruelty! "

Me: "Okay, okay. No cheese. Moving along. What sauces would you like on that?"

Customer: "Tzatziki sauce, please."

(Note: the particular brand of tzatziki we purchased included both yogurt and sour cream.)

Me: "Ah, I'm afraid that's a dairy prod—"

Customer: "I DON'T CARE! PUT IT ON!"
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We compute user sentiments and personal traits to tailor dialogue management and content to individual customers. We also design several dialogue scenarios for CRM with replies following certain patterns and propose virtual and social dialogues for various modalities of communication with a customer.

To detect fake content, deception and hypocrisy (Fig. 5), we need to analyze associated discourse patterns, which turned out to differ from the ones for genuine, honest writing. With discourse analysis, we can zoom in further and characterize customer complaints with respect to the best way to resolve them. We simulate the mental states, attitudes and emotions of a complainant and try to predict his behavior. Having suggested graph-based formal representations of complaint scenarios, we machine-learn them to identify the best action the customer support organization can choose to retain the complainant as a customer.

Customer complaints are classified as valid (requiring some kind of compensation) or invalid (requiring reassuring and calming down) the customer. Scenarios are represented by directed graphs with labeled vertices (for communicative actions) and arcs (for temporal and causal relationships between these actions and their parameters). The classification of a scenario is computed by comparing a partial matching of its graph with graphs of positive and negative examples. We illustrate machine learning of graph structures using the Nearest

Neighbor approach as well as concept learning, which minimizes the number of false negatives and takes advantage of a more accurate way of matching sequences of communicative actions.

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Contents

1	Chatbots for CRM and Dialogue Management	1
1.1	Introduction: Maintaining Cohesive Session Flow	1
1.1.1	Current State-of-the-Art: Not Good for CRM	4
1.2	Chatbot Architectures and Dialogue Manager	7
1.3	Building Dialogue Structure from a Discourse Tree of an Initial Question	9
1.3.1	Setting a Dialogue Style and Structure by a Query	11
1.3.2	Building a Dialogue Structure in Customer Support Dialogues	12
1.3.3	Finding a Sequence of Answers to be in Agreement with a Question	15
1.3.4	Searching for Answers with Specified RR for Dialogue Construction	17
1.3.5	Datasets for Evaluation	18
1.3.6	Evaluation of the Dialogue Construction from the First Query	19
1.4	Dialogue Management Based on Real and Imaginary Discourse Trees	22
1.4.1	Answering Questions via Entities and Discourse Trees	23
1.4.2	Question Answer Filtering Algorithm	26
1.4.3	Experiments with Answering Convergent Questions	27
1.5	Dialogue Management Based on Lattice Walking	28
1.5.1	Formal Concept Analysis	30
1.5.2	Lattice Walker Example	30
1.5.3	Lattice Navigation Algorithm	31
1.6	Automated Building a Dialogue from an Arbitrary Document	34
1.6.1	Forming a Dialogue from a Discourse Tree of a Text	35
1.6.2	Question Formation and Diversification	36
1.6.3	System Architecture	37

1.6.4	Evaluation of the Dialogue Builder	38
1.6.5	Rhetorical Map of a Dialogue	40
1.6.6	Evaluation of Chatbot Performance Improvement Building Datasets on Demand	41
1.7	Open Source Implementation	44
1.8	Related Work	44
1.9	Conclusions	52
1.9.1	Conclusions on Building a Dialogue	54
	References	57
2	Recommendation by Joining a Human Conversation	63
2.1	Introduction	63
2.2	Slot-Filling Conversational Recommendation Systems	67
2.3	Computing Recommendation for a Dialogue	68
2.4	Assuring the Recommendation is Persuasive and Properly Argued For	70
2.5	Continuing Conversation with RJC Agent	73
2.6	System Architecture	75
2.7	Evaluation	78
2.8	Related Work and Discussion	83
	References	89
3	Adjusting Chatbot Conversation to User Personality and Mood ...	93
3.1	Introduction	93
3.2	Recognizing Personality	98
3.3	Models of Emotions	100
3.4	Transitions Between Emotions	104
3.5	Emotion Recognition Datasets	109
3.6	Emotional Selection System Architecture	111
3.7	Evaluation	111
3.8	Emotional State Transition Diagram in CRM	116
3.9	Related Work and Conclusions	119
	References	124
4	A Virtual Social Promotion Chatbot with Persuasion and Rhetorical Coordination	129
4.1	Introduction	129
4.2	Conducting Virtual Dialogue	131
4.2.1	A Session with Virtual Dialogue	131
4.2.2	A Persuasive Dialogue	132
4.2.3	Dialogue Management	133
4.2.4	Dialogue Construction from Plain Text	134
4.2.5	Evaluation of Dialogue Effectiveness and Coverage	135
4.3	Coordinating Questions and Answers	136

4.3.1	Learning Coordination Between a Request or Question and a Response	140
4.3.2	Computing Similarity Between Communicative Actions in Questions and Answers	143
4.4	A Social Promotion Chatbot	144
4.4.1	Communicating with Friends on Behalf of a Human Host	144
4.4.2	The Domain of Social Promotion	147
4.4.3	The Chatbot Architecture	147
4.4.4	Use Cases of CASP	150
4.4.5	Evaluation	150
4.5	Improving Discourse Parsing	159
4.5.1	Syntactic Generalization of a Sentence Being Parsed and an AMR Template	162
4.5.2	Rhetorical Relation Enhancement Algorithm	167
4.5.3	Generalization Levels: From Syntax to Semantics to Discourse	169
4.5.4	Evaluation	169
4.6	Related Work and Conclusions	172
4.6.1	Constructing Dialogues from Plain Text	173
4.6.2	Conclusions on CASP	174
	References	176
5	Concluding a CRM Session	181
5.1	Concluding a Question Answering Session	181
5.1.1	Building a Structure of Conclusive Answer	182
5.1.2	Content Compilation Algorithm	188
5.1.3	A Log of Answer Generation	192
5.1.4	Modeling the Content Structure of Texts	194
5.1.5	Building Answer Document Based on Similarity and Compositional Semantics	196
5.2	Defeating Conclusion of a Support Session	197
5.2.1	Introducing Defeating Reply	197
5.2.2	An Algorithm for Identifying Answers with Defeating Arguments	201
5.2.3	Representing Nested Arguments by R-C Framework	203
5.2.4	Reasoning with Arguments Extracted from Text	209
5.2.5	Adjusting Available Discourse Parsers to Argumentation Domain	210
5.2.6	Evaluation	212
5.3	Discussion and Conclusions	216
	References	220

6	Truth, Lie and Hypocrisy	223
6.1	Anatomy of a Lie	224
6.1.1	Introduction: A Discourse of a Lie	224
6.1.2	Example of Misrepresentation in User-Generated Content	225
6.1.3	Example of Misrepresentation in Professional Writing	226
6.1.4	Background and Related Work	228
6.1.5	Dataset Description	232
6.1.6	Communicative Discourse Trees to Represent Truthfulness in Text	234
6.1.7	Evaluation	236
6.1.8	Two Dimensions of Lie Detection	238
6.1.9	Fact-Checking Tools	241
6.1.10	Conclusions	241
6.2	Detecting Hypocrisy in Company and Customer Communication	242
6.2.1	Introducing Hypocrisy	242
6.2.2	Hypocrisy in Customer Complaints	244
6.2.3	Building a Dataset of Sentences with Hypocrisy	244
6.2.4	Templates for Sentences with Hypocrisy	245
6.2.5	Assessing Coordination of Prominent Entities	249
6.2.6	Hypocrisy in Tweets	251
6.2.7	Expressing Hypocrisy in a Dialogue	253
6.2.8	System Architecture	255
6.2.9	Evaluation	259
6.2.10	Related Work and Discussions	261
6.2.11	Hypocrisy versus Controversy Stance, Sarcasm, Sentiments	263
6.2.12	Measuring Contention Between <i>Say</i> and <i>Do</i> Parts	265
6.2.13	Hypocrisy and Opinion Formation	267
6.2.14	Conclusions	270
6.3	Detecting Rumor and Disinformation by Web Mining	271
6.3.1	Introduction	271
6.3.2	Definitions and Examples	273
6.3.3	Examples of Disinformation as Entity Substitutions	274
6.3.4	Disinformation and Rumor Detection Algorithm	275
6.3.5	Evaluation	276
6.3.6	Related Work and Conclusions	279
6.3.7	Corruption Networks	280
6.3.8	Lying at Work	281
	References	283

7	Reasoning for Resolving Customer Complaints	289
7.1	Introduction	289
7.1.1	Why Are Both the Deductive and Inductive Components Required?	291
7.1.2	Statistical or Deterministic Machine Learning?	294
7.2	The System Architecture	296
7.3	Inductive Machine Learning as a Logic Program	297
7.4	Merging Deductive and Inductive Reasoning About Action	300
7.5	Predicting Inter-Human Interactions in Customer Complaints	303
7.5.1	Introducing the Domain of Customers' Complaints	305
7.5.2	Selecting the Features, Fluents and Actions	306
7.5.3	Setting the Learning Environment	312
7.5.4	Further Classification of Complaint Scenarios	313
7.5.5	Applying Semantic Templates	316
7.5.6	Evaluation of Prediction Results	318
7.6	Conclusions	320
	References	321
8	Concept-Based Learning of Complainants' Behavior	325
8.1	Introduction	325
8.2	Logical Simulation of the Behavior	328
8.3	Complaint Validity, Complaint Management and CRM	330
8.4	Complaint Scenario and Communicative Actions	331
8.5	Formalizing Conflict Scenarios	332
8.6	Semantics of Communicative Actions	335
8.7	Defining Scenarios as Graphs and Learning Them	342
8.8	Assigning a Scenario to a Class	345
8.9	JSM Learning in Terms of Formal Concept Analysis	347
8.10	Finding Similarity Between Scenarios	348
8.11	Scenarios as Sequences of Local Logics	349
8.12	Evaluation	351
8.12.1	Assessing Validity of Banking Complaints	352
8.13	Assessing Validity of Travelers' Complaints	355
8.14	Using <i>ComplaintEngine</i>	359
8.15	Selecting Products by Features Using Customer Feedback	361
8.16	Discussion and Conclusions	362
	References	366
9	Reasoning and Simulation of Mental Attitudes of a Customer	371
9.1	Introduction	371
9.1.1	The Task of the ToM Engine	372
9.2	A Model of a Mental Attitude of a Customer	374
9.2.1	Mental States and Actions	374
9.2.2	An Example of a Definition of a Mental Action	378
9.2.3	Derived Metapredicates	379

9.2.4	Handling Multiple Meanings	381
9.2.5	Representing Emotions	383
9.3	Simulating Reasoning About the Mental States	386
9.4	Implementation of Simulation	389
9.4.1	Choosing the Best Action Taking into Account Yourself Only	389
9.4.2	Choosing the Best Action Considering an Action Selection by Others	392
9.4.3	The Repository of Behaviors	392
9.5	Evaluation of the ToM Engine	398
9.5.1	Evaluation of Precision	399
9.5.2	Evaluation of Completeness	401
9.5.3	Evaluation of Complexity	402
9.6	Introduction to Meta-Reasoning and Introspection of ToM Engine	404
9.6.1	Meta-Interpreter of NL	406
9.6.2	Metaprogramming Tricks for Q/A	407
9.7	ToM Engine Support for Customer Complaint Processing	408
9.7.1	Linked Subscenarios	411
9.8	Front End of ToM Engine	413
9.8.1	Related Systems	415
9.9	Discussion and Conclusions	423
	References	425
10	CRM Becomes Seriously Ill	429
10.1	Introduction	429
10.2	Defining DI	431
10.3	Companies Sick with Distributed Incompetence	432
10.3.1	Managing Distributed Incompetence Organizations	432
10.3.2	Whistleblowing in Distributed Incompetence Organizations	434
10.3.3	The Financial Crisis and Distributed Incompetence Organizations	434
10.3.4	Distributed Incompetence and Competitive Rating	438
10.3.5	Irrationality of Agents Under Distributed Incompetence	439
10.3.6	Aggressive DI	441
10.3.7	Machine Learning of DI	446
10.4	Detecting DI in Text	448
10.4.1	Distributed Incompetence and Rhetorical Relations	449
10.4.2	Semantic Cases of Distributed Incompetence	450
10.4.3	A Detection Dataset	452
10.4.4	Discourse-Level Features	453

- 10.4.5 Implementation of the Detector of Distributed Incompetence 454
 - 10.4.6 Detection Results 455
 - 10.5 Customer Service and Covid-19 456
 - 10.6 Conclusions: Curing Distributed Incompetence 456
 - References 458
- 11 Conclusions 461**