Solving the Duality of Natural Language Processing with MLNLP, Multi-Layer Natural Language Processing

Kathy Brown, PhD
Chief Scientist & VP Speech Sciences
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Multi-Layer Natural Language Processing

**Smarter:** Employs advanced NLP technologies to understand open ended, mixed initiative responses

**Conversational:** Allow users to express intents using multiple inputs collected through a series of dialog turns enabled through NL conversational dialog trees

**Predictive:** Allows users to seamlessly move to/fro across channels, modalities meeting the needs of the multi-device, multi-app, multi-channel user

**More productive:** Design and deliver intent-driven experiences that save customers time and increase self-service rates up to 25%
What is Natural Language?

A collection of techniques intended to understand a wide range of caller requests:

- Large vocabulary speech recognition
- Open-ended prompting (“how may I help you?”)
- Handles Disfluencies
- Solves the Front Door Challenge
Standard Natural Language Architecture

Traditional IVR Menus are deep, requiring multiple turns... and go directly to the “Destinations”: IVR Self-Service, FAQs, Transactions, Agent Groups
Limitations of Standard Single Node and Channel Natural Language Architecture

User input is frequently vague or ambiguous dropping the user into the IVR tree
The Broken User Experience

User is unaware they have moved from an articulate, intelligent agent with a vocabulary of 50K+ words to an inarticulate agent with the vocabulary of a toddler (10-12 words)

Hi Mary, How can I help you today?

Natural Language Understanding

A

B

C

You can say make a payment, balance, payment status, or something else
Standard NL intent distribution

Vague, agent, and out-of-domain intents are not *actionable* intents
Limitations of standard single node NL architecture

30-40% failure rate in identifying actionable intent

Single node NL hits a wall on containment rate improvements

Move beyond single node to MLNLP Conversational models
## Impact to User and Automation

<table>
<thead>
<tr>
<th>Menu</th>
<th>No Match</th>
<th>Rep</th>
<th>Hang-up</th>
</tr>
</thead>
<tbody>
<tr>
<td>NL Main Fallback Menu</td>
<td>28.75%</td>
<td>58.28%</td>
<td>4.56%</td>
</tr>
<tr>
<td>Payments Disambig Menu</td>
<td>21.39%</td>
<td>17.85%</td>
<td>1.42%</td>
</tr>
<tr>
<td>PIN Disambig Menu</td>
<td>35.09%</td>
<td>14.04%</td>
<td>1.75%</td>
</tr>
<tr>
<td>Security Disambig Menu</td>
<td>27.66%</td>
<td>8.51%</td>
<td>2.13%</td>
</tr>
<tr>
<td>Activate Disambig Menu</td>
<td>15.58%</td>
<td>1.30%</td>
<td></td>
</tr>
<tr>
<td>Travel Disambig Menu</td>
<td>30.82%</td>
<td>8.49%</td>
<td>1.89%</td>
</tr>
<tr>
<td>Rewards Disambig Menu</td>
<td>27.78%</td>
<td>18.38%</td>
<td>0.43%</td>
</tr>
<tr>
<td>Card Disambig Menu</td>
<td>18.58%</td>
<td>64.17%</td>
<td>1.44%</td>
</tr>
<tr>
<td>Insurance Sub Menu</td>
<td>22.37%</td>
<td>15.77%</td>
<td>2.30%</td>
</tr>
</tbody>
</table>
[24]7 Multi-Layer Natural Language Processing
Natural Language Processing

Standard NLP

- Syntactic

Multi-layer NLP

- Multi-layer Conversational
- User Profile
- Chat Context
- IVR Context
- Online Context
- Syntactic

Syntactic NLP

Multi-layer NLP
NLP Conversational Tree
Conversational Multi-Layer Model Training Process

<table>
<thead>
<tr>
<th>Time</th>
<th>Speaker</th>
<th>Chat Lines</th>
</tr>
</thead>
<tbody>
<tr>
<td>04/09 18:27:12</td>
<td>Opener</td>
<td>Opener: Hello! How may I help you today?</td>
</tr>
<tr>
<td>04/09 18:28:13</td>
<td>Customer</td>
<td>hello</td>
</tr>
<tr>
<td>04/09 18:28:13</td>
<td>Agent</td>
<td>Agent ‘jg116y’ enters chat (as John-G.)</td>
</tr>
<tr>
<td>04/09 18:28:24</td>
<td>Agent-Freehand</td>
<td>Hi there! : )</td>
</tr>
<tr>
<td>04/09 18:28:25</td>
<td>Customer</td>
<td>I have a question about my plan</td>
</tr>
<tr>
<td>04/09 18:28:49</td>
<td>Customer</td>
<td>Hi John</td>
</tr>
<tr>
<td>04/09 18:29:18</td>
<td>Agent-Freehand</td>
<td>:) hi. How can I help you with your plan?</td>
</tr>
<tr>
<td>04/09 18:29:41</td>
<td>Customer</td>
<td>I have the 300mb plan, but am going over.</td>
</tr>
<tr>
<td>04/09 18:30:22</td>
<td>Customer</td>
<td>If I switch to 1GB will the plan increase?</td>
</tr>
<tr>
<td>04/09 18:31:04</td>
<td>Agent-Freehand</td>
<td>Good question! Let me look that up.</td>
</tr>
<tr>
<td>04/09 18:31:20</td>
<td>Customer</td>
<td>yes, I am looking at options to change the plan</td>
</tr>
<tr>
<td>04/09 18:31:23</td>
<td>Customer</td>
<td>plan</td>
</tr>
<tr>
<td>04/09 18:31:55</td>
<td>Agent-Freehand</td>
<td>: ) okay then, if you dont mind, let’s look together: )</td>
</tr>
<tr>
<td>04/09 18:33:22</td>
<td>Agent-Freehand</td>
<td>Opening up the account now.</td>
</tr>
<tr>
<td>04/09 18:36:06</td>
<td>Agent-Freehand</td>
<td>Okay, I'm in. 3 active lines on the account.</td>
</tr>
<tr>
<td>04/09 18:36:29</td>
<td>Agent-Freehand</td>
<td>I am running a quote right now on the different plans, okay?</td>
</tr>
<tr>
<td>04/09 18:38:33</td>
<td>Agent-Freehand</td>
<td>Got it. $90 if you switch to 1GB</td>
</tr>
<tr>
<td>04/09 18:41:13</td>
<td>Customer</td>
<td>what is the access fee</td>
</tr>
<tr>
<td>04/09 18:42:10</td>
<td>Agent-Freehand</td>
<td>Good question! An access fee is a fee that local telephone companies charge all cellular customers for the right to connect with the local phone network.</td>
</tr>
<tr>
<td>04/09 18:44:48</td>
<td>Customer</td>
<td>Perfect</td>
</tr>
<tr>
<td>04/09 18:44:52</td>
<td>Customer</td>
<td>thank you John</td>
</tr>
<tr>
<td>04/09 18:45:44</td>
<td>Customer</td>
<td>I am going to change to that plan</td>
</tr>
<tr>
<td>04/09 18:45:55</td>
<td>Agent-Freehand</td>
<td>Do you need help changing plans?</td>
</tr>
<tr>
<td>04/09 18:47:09</td>
<td>Customer</td>
<td>No, I can do it.</td>
</tr>
<tr>
<td>04/09 18:48:39</td>
<td>Agent-Freehand</td>
<td>Good Job! Will there be anything else?</td>
</tr>
<tr>
<td>04/09 18:49:07</td>
<td>Customer</td>
<td>that will be all.</td>
</tr>
<tr>
<td>04/09 18:49:12</td>
<td>Customer</td>
<td>Thank you John</td>
</tr>
<tr>
<td>04/09 18:49:23</td>
<td>Agent-Freehand</td>
<td>: ) Welcome! It was a pleasure assisting you with your service today &amp; Thanks for choosing Future Wireless for your communication needs.</td>
</tr>
<tr>
<td>04/09 18:49:27</td>
<td>Agent-Freehand</td>
<td>Whenever you’re ready, Just select the CLOSE option inside the chat window to end the chat.</td>
</tr>
<tr>
<td>04/09 18:49:58</td>
<td>Customer</td>
<td>Customer exits chat</td>
</tr>
<tr>
<td>04/09 18:49:58</td>
<td>Customer</td>
<td>Customer loses connection</td>
</tr>
<tr>
<td>04/09 18:50:58</td>
<td>Agent</td>
<td>Agent ‘jg116y’ exits chat</td>
</tr>
</tbody>
</table>
Insights and Building Conversation Models from Chat Data

- RESEARCHING - COST / TARIFF: 13%
- PARKING RELATED / PARK & FLY: 7%
- BREAKFAST / TEA / MEALS / MENU / TIMINGS: 7%
- DISCOUNTS / OFFERS: 6%
- CHOOSING PROPERTY BY LOCATION AND DISTANCE: 5%
- FACILITIES RELATED: 5%
- ROOM TYPE / INCLUSIONS: 4%
- CHECKING ROOM AVAILABILITY: 4%
- HOTEL LOCATION / DISTANCE TO SURROUNDING AREAS: 4%
- HH MEMBERSHIP / POINTS RELATED: 4%
- ASSISTANCE IN RESERVATION / BOOKING: 4%
- TRANSPORTATION / TRANSFERS / SHUTTLE SERVICE: 3%
- SPECIAL REQUESTS: 3%
- EARLY CHECK-IN / LATE CHECK-OUT: 3%
- BEDDING RELATED QUERIES: 3%
- PAYMENT RELATED / PAYMENT OPTIONS: 2%
- AMEND / MODIFY RESERVATION: 2%
- CONTACT NUMBER / EMAIL ADDRESS REQUEST: 2%
- GROUP BOOKINGS & EVENTS: 2%
- CONFIRM RESERVATION / RESERVATION INFO: 2%
- EARLY DISCONNECT: 2%

- Room Tariff – 82%
- Cost comparison with other websites – 8%
- Price Change – 7%

- With a park and fly deal, how much would an additional day parking cost?
- I was actually looking to see if you allow non guests parking?
- how do i add parking..Can you request it in advance?

- how much is breakfast at this hotel?
- what time is breakfast served from in your hotel?
- I would have liked to see a sample menu for your pavilion restaurant
- what is your afternoon tea time?

- was looking to find if you have any special rates/packages for government?
- i am a meber of the parlament in Bremen (MdBB). have you a spezial offer?
- Would you also let me know: Is the AAA discount better than the Senior discount? We qualify for both

- Spa / Spa package enquiry – 37%
- Swimming Pool – 18%
- Restaurant / Bar – 21%
- Gym – 8%
- Laundry – 3%

- Adjoining Rooms – 18%
- Room with a view – 15%
- Handicap accessible – 15%
- Non-Smoking Room – 15%

# of Chats Analysed: 1400
Training the NLP Models

Virtual Assistant

IVR: Welcome to Trust Bank. How may I help you?
Customer: There is a charge on my bill that I didn’t make. I didn’t even use my card last month.

IVR: Dispute charge

Transcribed Speech Data

Chat / Social Text Channels

Agent: Welcome, how may I assist you today?
Customer: I didn’t use my card last month and now my bill is about $****. Can you check it for me?

Agent: Let me check that for you. Okay, to access that information.

Agent: You’ve a transaction of purchases for the amount $****. for the Merchant XYZ.
If it is unrecognized I will help you in disputing the charge.

Customer: Thank you for your help.

Chat Responses

Mobile VA / IVR
Voice / Text data

Click Data

Social / Chat data

Virtual Assistant

Predictive Model
Virtual Agent Employing the MLNLP Conversation Manager

Jim goes on the mobile app and uses the virtual assistant to check on a problem with his order.

<table>
<thead>
<tr>
<th>Mobile App</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jim: “I am having a problem with my recent purchase”</td>
</tr>
<tr>
<td>Virtual Agent: “What is the problem you’re having?”</td>
</tr>
<tr>
<td>Jim: “I want to change the shipping address.”</td>
</tr>
<tr>
<td>Virtual Agent: “No problem, I can do that for you. What’s your order number and what address do you want it shipped to?”</td>
</tr>
<tr>
<td>Jim: “My order number is PXYZ2 and my address is 7 Wagon Trail, Nashua New Hampshire”</td>
</tr>
</tbody>
</table>

- First Level Natural Language
- Second Level Natural Language
- Mixed Initiative Natural Language
Allow information collection in any order

I want to change my shipping address on my iphone order. The order number is PXY789 and I want to change the address to 7 Wagon Trail, New Hampshire CA

Ok! What’s the order number?

The order number is PXY 789

Ok! And what’s the new address?

Please ship it to 7 Wagon Trail, New Hampshire CA
User starts journey on website

**Omnichannel Prediction in Action -- Sales Transformation**

User is evaluated to need assistance completing their purchase

Virtual Agent Offered

37% lift over generic invite

**Intent Evolves at Each step and Next Best Action Predicted**

**Recommended Package**

\[ P(c|d) = \frac{P(c) \prod_{i=1}^{W} P(w_i|c)}{\sum_{c'} P(c') \prod_{i=1}^{W} P(w_i|c')} \]

**Personalized Invite**

\[ P(c|d) = \frac{P(c) \prod_{i=1}^{W} P(w_i|c)}{\sum_{c'} P(c') \prod_{i=1}^{W} P(w_i|c')} \]

**MLNLP**

Order Placed

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Results—The Conversational VA
Conversational Omnichannel NLU Architecture

Omnichannel Conversation Manager

Channel Translation
- Channel TXN 1
- Channel TXN 2
- Channel TXN N

Omnichannel Classifier
- Classifier 1
- Classifier 2
- Classifier N

Score Normalization
- Norm 1
- Norm 2

Multi-Layer NLP

Stateful NLU

Array of Scored Intents
- Intent 1
- Intent 2
- Intent N

Customer Voice

Customer Text / Chat / Social

Channel TXN 1

Channel TXN 2

Channel TXN N

Classifier 1

Classifier 2

Classifier N

Norm 1

Norm 2

Omnichannel Classifier

Array of Scored Intents

Stateful NLU

Multi-Layer NLP
New Application Development SCXML Framework

- Employs the New W3C SCXML standards for channel unification
- Objective – Standardize multi-channel solutions (e.g. online, VA, mobile, IVR) to one common architecture
- Allows mobile apps to seamlessly handle modability shifts
- Employs common omnichannel models
- Results—Build Once, Deploy Many
- Rapid development of additional channels
Voice and digital channels operate as silos today

**Dual effort, zero leverage**
[24]7 unifies customer engagement across channels

One intent model
Shared app logic
Best channeling

Build once, deploy all
Building blocks for accelerating digital transformation

- IVR
- Virtual Agent

Understand intent:
- Omnichannel Prediction
- Unified NLU Model

Provide self-service:
- Multimodal
- MLNLP
- Decisioning Engine

Route to live agent:
- Best Channel Treatment
- Presence Detection

Voice Agent

Chat Agent
Credit tracker VA and IVR
Demo

• VIDEO INSERT
Chat over Facebook Messenger

Notifications: Proactive notifications and messages for key events in the retail consumer journey such as order confirmation, shipping confirmation etc..

Virtual Agent: Engage with your customers with automated Natural Language chat with a virtual agent for common queries.

Chat: Direct and personal support over chat with human agents; retain full context of the interaction within the same message thread.

Advanced Analytics: Chat and virtual agent transcripts are available for advanced text mining of insights.

Eliminates up to 40% of post-order enquiries from other channels
MLNLP Results—Improved Intent Resolution

Non-Conversational

Conversational

Vague Intents
MLNLP Results—Improved Intent Resolution

Bar chart showing comparison between Non-Conversational and Conversational statements in terms of meaningfulness and vagueness.

- Non-Conversational: Orange bar represents meaningful statements, Blue bar represents vague/rep statements.
- Conversational: Orange bar represents meaningful statements, Blue bar represents vague/rep statements.

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MLNLP Results

Successfully predicting intent can drive higher self-service rates

Continual refinement of behavioral models drives rapid, measurable improvement
MLNLP Gets Tasks Done, Quickly

Greeting
Authentication
Verification
Menu Option
Payment Process...

150s AHT
10+ steps
Low Self-service, Negative CSAT

Identity Detection
Intent Prediction
Payment Proactive Question

90s AHT
3-5 steps
Higher Self-service, Leading CSAT
VA Performance

CSAT

NPS

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VA: Performance

Customer Satisfaction - Break up

- Completely Satisfied: 61%
- Very Satisfied: 17%
- Somewhat Satisfied: 9%
- Not very Satisfied: 7%
- Not at all Satisfied: 7%
Advantages of the [24]7 MLNLP Technology

- Big Data Platform can capture all streams of data from online, VA, IVR, chat
- Predictive Models connect the channels to enable seamless transition across channels and modalities
- MLNLP models used to create Virtual Assistants (IVR, online) that can carry on conversations to improve user experience and Automation rates
- SCXML application framework ensures a consistent user experience across channels, improves time to market, lowers TCO
- MLNLP Predictive models improve metrics:
  - CSAT, NPS
  - Automation
  - Incremental sales

- >95% Accuracy
  - NLU Intent Prediction

- +30 NPS lift
  - Transforming customer sentiment

- +38% improved Automation Rates

- +22% Incremental Sales

- +15% Call Deflection

Transforming customer sentiment with accuracy, leading to improved metrics and increased sales.
Questions?