“Sorry, could you please repeat that?”

“Sorry, I can’t help you with that.”

Marie Meteer
Senior Research Scientist
Pryon
Explosion of “things” you can talk to
Speech Recognition > NLU
Goals of the Major Dialog Toolkits

• Provide a console for developers to create dialog systems
• Remove the “pain points” in dialog development
  • Only a few examples needed for ML classification
  • Frequently used types (e.g. dates, currency) predefined and carefully tuned
  • Console integrates design, training and testing
• Reduce the amount of code required
  • “Fulfillment” and responses associated directly with intents
  • “One-click” integrations with communications platforms such as Slack, Facebook, Twitter, Skype ...
Natural Language Understanding

• Intent: What question is the user asking?
  • Classification based on training examples
  • Define term, recognize threat, Procedure_Delete, ...

• Entities: What objects does the user include to get the specific answer
  • Mac OS vs. Windows 10

• Examples
  • All the ways a question can be asked
  • Synonyms for entities

• Modeling and run time is a black box

NLP Toolkits

User utterance

Intents
Entities
Examples

Intent + entities
And then come the users

• How does the user know what the app can do?
• If I can ask about the fees on my retirement fund, why can’t I ask my contributions?
• And then there are the devils in disguise
What information do we have?

<table>
<thead>
<tr>
<th></th>
<th>Positive</th>
<th>Negative</th>
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<tbody>
<tr>
<td>True</td>
<td>😊</td>
<td>😞</td>
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<td>False</td>
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I think you said “string”. Is that right?

With a confidence score

PRYON
Recognizing when to “Reject”

• Out of Domain
  • Different domain
    • Weather or cafeteria menu
  • Adversarial: Non-cooperative user
    • Can I eat VPN?
    • Do you love me?

• Out of Scope
  • User believes this question can be answered
    • “How do I get a VPN account” vs. “How do I get a Jira account”

• Rejection using Confidence
  • Rejection below 50% significantly improves performance
  • Actual threshold will be tuned and likely to be tool dependent
Using Confidence

- Using confidence to find a threshold
  - Goal is to minimize “False Accept”, that is providing an incorrect answer
  - Performance falls off steeply over 90% rejection accuracy

- **False Positives**: When rejection fails
  - **User**: what are the signs of a **flu virus**
  - **System**: Here are the most frequent warning signs your computer is infected with a **virus** or malware: ...
  - **User**: ?? **No**, I want to know if I have the **flu**

- **Challenge**:
  - User’s reply would not be understood. Can’t even pick out “No” to understand it was the wrong answer
Using the functionality we have

- **Intents**: Utterance classification
- **Entities**: Match synonyms or entity detection based on context

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<th>Required entities not found</th>
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</tr>
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<td>I think you’re asking about [entity] but I didn’t get your question</td>
<td>Request specific entities (Can use frames)</td>
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**PRYON**
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<tr>
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- **Intent Confidence ~ θ**
- **Intent Confidence ↓θ**
“Reprise Clarification”

• Repeat the part of the utterance that is understood
  • **User:** Is my weekly report **company confidential information**
  • **System:** I think you’re asking about **company confidential information**, but I don’t know the answer to the question. I can help you with sending or storing confidential information

• **User:** How do I get access to that system for my courses?
  • **System:** I think you’re asking **about system access**. I can help you with access to the Sage for recording grades or the Latte system for course information. Which would you like?

• Recognize ambiguity
  • **User:** Where do I get my **NUID**?
  • **System:** Are you asking about your **NUID number** or **your NUID Card**?

• Recognize new entities
  • **User:** Is there a company wide **Jira license**?
  • **System:** I’m sorry, I don’t know about “**Jira**”

Comparison

**Dialogflow**
- Associates all dialog structure with specific intents
- Allows the correct interpretation of answers based on what question was asked

**Watson Assistant**
- Provides a separate “Dialog” interface to create a dialog tree
- Allows the reuse of intents in multiple dialog contexts

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**Example Interaction**

**User (U):** Send me that listing.

**System (S):** Would you like me to text it?

**User (U):** Yes

**User (U):** Find listings in Arlington.

**System (S):** There are 43 listings.

**User (U):** How about Lexington.

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**Diagram Example**

- Goodbye
- Info request
- Info request - no
- Info request - yes
- Show Listings
- AddSearchFilters

---

**Diagram Example**

- Welcome
- Log in
- Search for listings
- Filter listings

---

**Diagram Example**

- Welcome
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**Diagram Example**

- Welcome
- Log in
- Search for listings
- Filter listings
Requirements for effective reprise clarification

- Access to **confidence** of the intent
Access to the **n-best** list

**Intents**
- Welcome
  - response: welcome
- #order
  - response: order
- #return
  - response: return

**Entities**
- None

**Dialog**

**ElectronicsV2**

**Welcome**
- response: welcome
  - 1. Response / 2 Context set / 1 Slot / Does not return

**disambiguate**
- response: disambiguate
  - intents[0].confidence > 0.4 and intents[1].confidence > 0.4
  - 1. Response / 0 Context set / Does not return

**If bot recognizes:**
- intents[0].confidence > 0.4 and intents[1].confidence > 0.4

**Then respond with:**
- 1. Sorry, I can only handle one request at a time. Would you like to order or return an item?
  - Add a variation to this response

**And finally**
- Wait for user input
Counter: Need to know whether you’ve already asked a clarifying question
How can we do better?

• Early focus and app design
• “Understand” the answers, not just the questions
• Analysis of content
  • Both targeted content and ”backup content”
• Model the dialog context
Initial Customer Engagement & Model Design

- User discovery
  - Personas
  - Use cases

- Data model
  - Types
  - Slots
  - Instances

Diagram:
- Account
  - Value
  - Fees
  - Beneficiaries
  - Vest data
  - Monetary value
  - List of names
  - Date

- Investment account
  - Preservation fund
  - Retirement annuity
  - Wealth Creator

- Bank Account
  - Checking
  - Savings
  - CD

- Navigation
  - Information access
  - Data manipulation
  - Explanation and advice

- Asset Classes
  - Bonds
  - Cash
  - Equity
  - Alternative

- Novice ↔ App familiarity → Expert
- Light ↔ Usage → Heavy
- Novice ↔ Domain knowledge → Expert

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Diagram elements:
- Novice
- Expert
- Light
- Heavy
- Novice
- Domain knowledge
- Expert

Pryon
Action-entity analysis

- Desired action
  - Get_Value
  - Get_information
  - Get_Date
  - Beneficiaries
  - Procedure_contact

- Information type
  - Total Value
  - Fees
  - Beneficiaries
  - Vesting_Date
  - Money_Amount

- Entities
  - Portfolio
    - preservation pension fund
    - personalized portfolio plan
    - member contributions pension funds
    - wealth creator
    - retirement annuity
  - InvestmentAccount
    - checking
    - savings
    - money market
    - certificates of deposit
  - BankAccount
    - cash
    - alternative funds
    - property
    - equities
    - Bonds
  - AssetClass
  - FinancialAdvisor
  - Time_Interval
    - last month
    - last quarter
    - last year

- Caution: Where are the gaps?
  - You can ask for the asset class distribution for the portfolio, but not individual accounts
  - You can’t ask which accounts
    - are still getting contributions
    - have the highest fees
    - increased the most
    - are vesting the soonest
  - How do you communicate where the line is?
Intents & Entities

**Intents**
- Query total
  - Identify_AssetClass
  - Identify_CurrentWealth
- Query individual accounts
  - Identify_Beneficiaries
  - Identify_Fees
  - Identify_MoreInfo
  - Identify_VestingDate
  - Identify_WealthChange
- General info
  - Procedure_Contact
  - Transfer
- Cancel
- Help
- None of the above

**Entities**
- Portfolio
- InvestmentAccount
  - preservation pension fund
  - personalized portfolio plan
  - member contributions pension funds
  - wealth creator
  - retirement annuity
- BankAccount
  - checking
  - savings
  - money market
  - certificates of deposit
- AssetClass
  - cash
  - alternative funds
  - property
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  - Bonds
- FinancialAdvisor
- Time_Interval
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### Analyze answers for follow up questions

<table>
<thead>
<tr>
<th>Question</th>
<th>Answer</th>
<th>Follow up</th>
</tr>
</thead>
<tbody>
<tr>
<td>If I did not enroll in health insurance when I was hired, can I change my mind later?</td>
<td>Employees have 60 days from their date of hire to enroll. After that time period, employees may only enroll during the annual open enrollment period or when they experience a <strong>qualifying status change (QSC)</strong>.</td>
<td>What counts as a QSC?</td>
</tr>
<tr>
<td>When can I get my NCard</td>
<td>When your appointment is entered into the HR System, your NUID is created. Your department will provide you with an NCard Form, which you can take to the <strong>NCard Office</strong> to get your physical card. You must present a government-issued ID to claim your NCard.</td>
<td>Where is the <strong>N CARD</strong> office?</td>
</tr>
</tbody>
</table>
Target your information and
Know your boundaries

Adversarial

In domain

Out of scope

Out of domain
Thanks!

P.S. My other hat is as an adjunct professor in Brandeis University’s MS in Computational Linguistics

See me if you’re looking to hire interns or full time employees who can jump right into this work.
Bioagent Dialog System, BoB

When the goal is depth of knowledge

Handling of a clarification question

User: What transcription factors does miR-200c regulate?

BOB: By miR-200c, do you mean miR-200C-3P or miR-200C-5P?

User: “miR-200C-3P” or “the first one” or ...


From DARPA “Communicating with Computers”