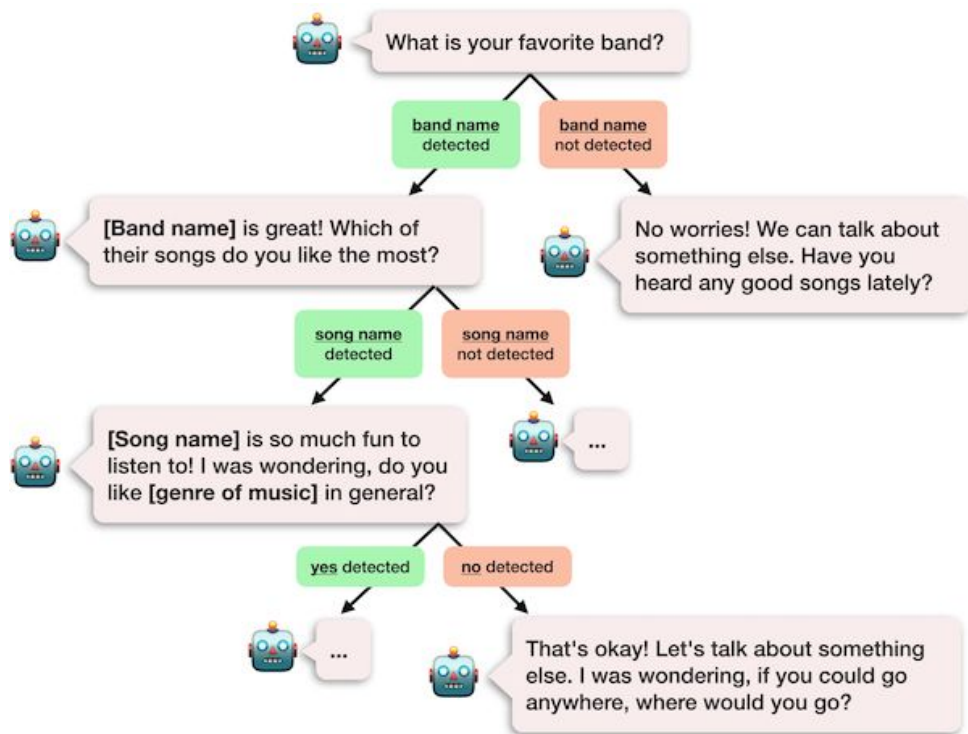# Processamento de Linguagem Natural

Chatbots

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O que são

- ❖ Sistemas interativos
- ❖ Uso de linguagem natural
- ❖ Entrada: texto ou fala
- ❖ Saída: texto ou fala

IMG Source: http://ai.stanford.edu/blog/chirpy-cardinal/

Histórico

- ❖ Confunde-se com a história de IA
- ❖ 1950-60: Turing e Weizenbaum
  - ➢ Computadores se comunicando como humanos
- ❖ 1966: Eliza (Weizenbaum)
- ❖ 1980-2000: projetos da DARPA
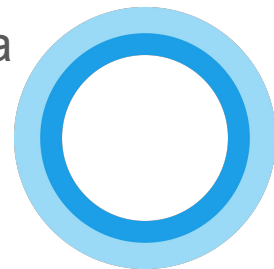 - ➢ Comunicação automática com soldados
  - ➢ Serviço de FAQ

Exemplos

Google Assistant

Alexa
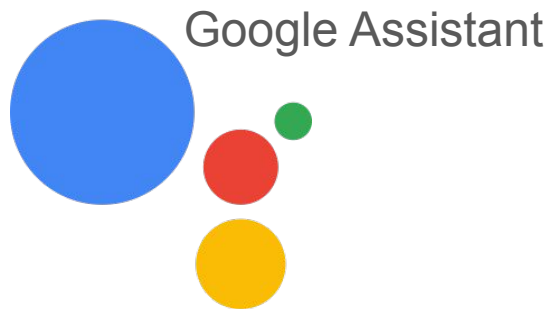
Cortana

Siri

Dois tipos de Agentes Conversacionais

❖ Agentes baseados em objetivo:
  ➢ Conversas curtas
  ➢ Realização de uma tarefa
  ➢ Ex: reserva de hotéis ou restaurantes

❖ Bate-papo:
  ➢ Conversas mais longas
  ➢ Mais próximo à interação humana (mais natural)
  ➢ Ex: ELIZA

Propriedades da Conversação Humana

Turns, Atos da Fala e Grounding

C_1:　…I need to travel in May.
A_2:　And, what day in May did you want to travel?
C_3:　OK uh I need to be there for a meeting that's from the 12th to the 15th.
A_4:　And you're flying into what city?
C_5:　Seattle.
A_6:　And what time would you like to leave Pittsburgh?
C_7:　Uh hmm I don't think there's many options for non-stop.
A_8:　Right. There's three non-stops today.
C_9:　What are they?
A_{10}:　The first one departs PGH at 10:00am arrives Seattle at 12:05 their time. The second flight departs PGH at 5:55pm, arrives Seattle at 8pm. And the last flight departs PGH at 8:15pm arrives Seattle at 10:28pm.
C_{11}:　OK I'll take the 5ish flight on the night before on the 11th.
A_{12}:　On the 11th? OK. Departing at 5:55pm arrives Seattle at 8pm, U.S. Air flight 115.
C_{13}:　OK.
A_{14}:　And you said returning on May 15th?
C_{15}:　Uh, yeah, at the end of the day.
A_{16}:　OK. There's #two non-stops …#
C_{17}:　　　　　　　#Act…actually　#, what day of the week is the 15th?
A_{18}:　It's a Friday.
C_{19}:　Uh hmm. I would consider staying there an extra day til Sunday.
A_{20}:　OK…OK. On Sunday I have …

Figure 24.1　Part of a phone conversation between a human travel agent (A) and human client (C). The passages framed by # in A_{16} and C_{17} indicate overlaps in speech.

Fonte: Jurafsky e Martin (2021)

Propriedades da Conversação Humana
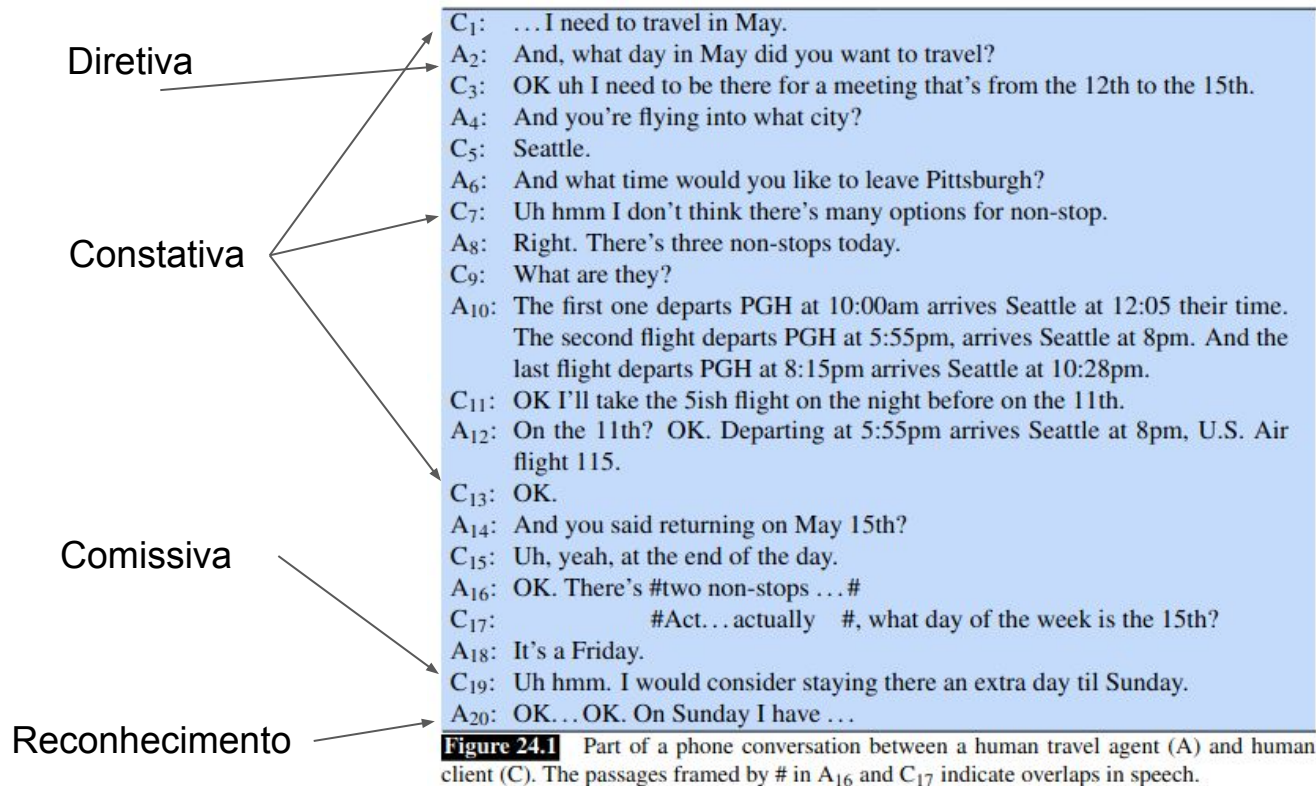
❖ Turns:
  ➢ Cada indivíduo tem a palavra de tempos em tempos
  ➢ Diálogo é uma sequência de turns
❖ Sistema precisa saber quando falar (ex.: não esperar muito tempo depois que a pessoa terminou de falar)
❖ Sistema precisa saber quando a pessoa terminou de falar (desafios: ruído e pausas no meio da fala)

Atos da Fala

❖ Constativa: comprometer o orador com alguma condição
  ➢ Responder, confirmar, negar, não concordar
❖ Diretiva: tentativa do orador de ser atendido
  ➢ Aconselhar, perguntar, pedir, convidar
❖ Comissiva: comprometer o orador com algo futuro
  ➢ Prometer, planejar
❖ Reconhecimento: expressar reconhecimento sobre alguma atitude
  ➢ Desculpar, agradecer, cumprimentar, aceitar, reconhecer

Exemplo

Diretiva

Constativa

Comissiva

Reconhecimento

C_1: ...I need to travel in May.
A_2: And, what day in May did you want to travel?
C_3: OK uh I need to be there for a meeting that's from the 12th to the 15th.
A_4: And you're flying into what city?
C_5: Seattle.
A_6: And what time would you like to leave Pittsburgh?
C_7: Uh hmm I don't think there's many options for non-stop.
A_8: Right. There's three non-stops today.
C_9: What are they?
A_{10}: The first one departs PGH at 10:00am arrives Seattle at 12:05 their time. The second flight departs PGH at 5:55pm, arrives Seattle at 8pm. And the last flight departs PGH at 8:15pm arrives Seattle at 10:28pm.
C_{11}: OK I'll take the 5ish flight on the night before on the 11th.
A_{12}: On the 11th? OK. Departing at 5:55pm arrives Seattle at 8pm, U.S. Air flight 115.
C_{13}: OK.
A_{14}: And you said returning on May 15th?
C_{15}: Uh, yeah, at the end of the day.
A_{16}: OK. There's #two non-stops ...#
C_{17}:   #Act... actually   #, what day of the week is the 15th?
A_{18}: It's a Friday.
C_{19}: Uh hmm. I would consider staying there an extra day til Sunday.
A_{20}: OK...OK. On Sunday I have ...

Figure 24.1   Part of a phone conversation between a human travel agent (A) and human client (C). The passages framed by # in A_{16} and C_{17} indicate overlaps in speech.

Fonte: Jurafsky e Martin (2021)

Grounding

❖ Indicar que o foi dito, foi compreendido:

```
A: And you said returning on May 15th?
C: Uh, yeah, at the end of the day.
A: OK

C: OK I'll take the 5ish flight on the night before on the
11th.
A: On the 11th? OK.

C: ...I need to travel in May.
A: And, what day in May did you want to travel?
```
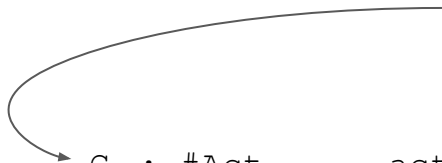
Sequências Secundárias

Sub-diálogos, Pré-sequências & Iniciativa

Sub-Diálogos: Correção

❖ O cliente interrompe a conversa principal
❖ O agente agora precisa responder o novo questionamento

C_{17}: #Act. . . actually#, what day of the week is the 15th?
A_{18}: It's a Friday.
C_{19}: Uh hmm. I would consider staying there an extra day til Sunday.
A_{20}: OK...OK. On Sunday I have ...

❖ O agente precisa detectar que o cliente agora está considerando voltar no dia 17 e não mais no dia 15.

Sub-Diálogos: Clarificação

❖ Ajuda o agente a confirmar a falta de entendimento da entrada anterior

User: What do you have going to **UNKNOWN_WORD** on the 5th?

System: Let's see, going where on the 5th?

User: Going to Hong Kong.

System: OK, here are some flights...

Pré-sequências

User: <mark>Can you make train reservations?</mark>

System: Yes I can.

User: Great, I'd like to reserve a seat on the 4pm train to New York.

- ❖ Identifica Intenções
- ❖ Exemplos: em casos de múltiplas intenções

Iniciativa do Diálogo

❖ Controlada por uma pessoa
  ➢ Ex: Entrevista
❖ Mixed
  ➢ Conversa natural entre pessoas
  ➢ Difícil para sistemas de PLN
❖ Iniciativa do usuário: pergunta ou fala comandos
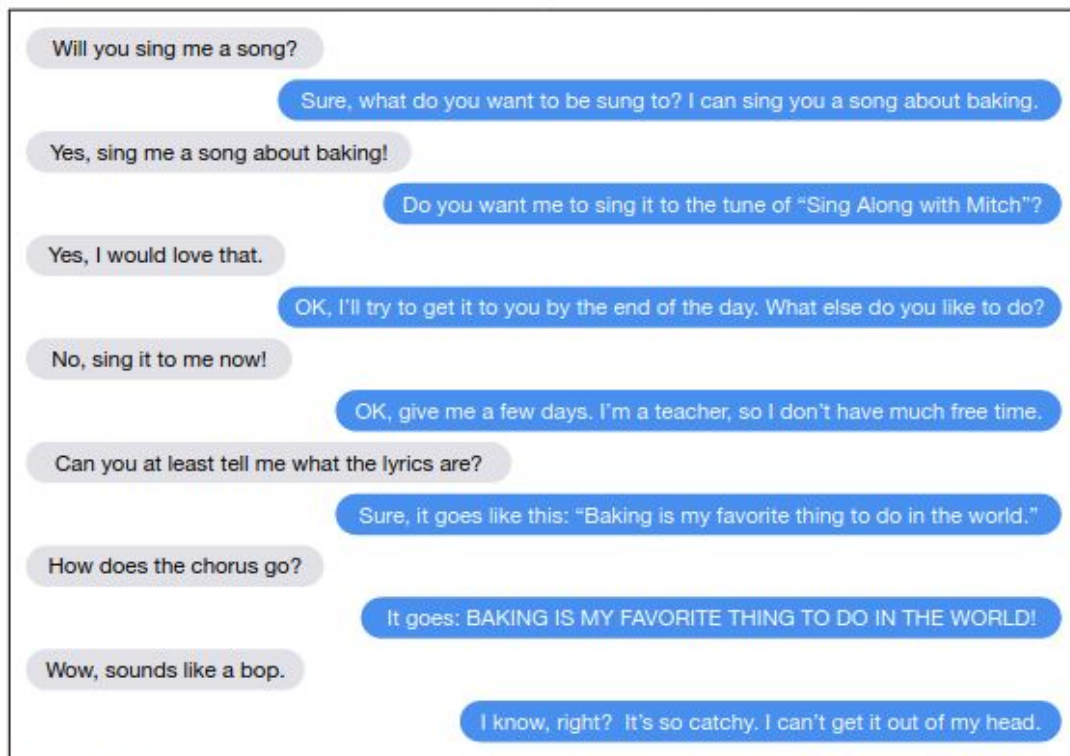❖ Iniciativa do sistema: sistema faz perguntas para preencher formulário

Agentes Conversacionais

Chatbots

Chatbot: Bate-Papo

❖ Inicialmente utilizado na área de psicologia

❖ Baseado em regras
  ➢ Eliza, Parry

❖ Baseado em corpus (corpus de conversações)
  ➢ Recuperação de Informação
  ➢ Neural network encoder-decoder
  ➢ Ex: BlenderBot, Xiaolce (Little Bing)

BlenderBot

Figure 24.2 A conversation between a user (left) and BlenderBot (Roller et al., 2021).

Chatbots
Baseados em Regras

Chatbots baseados em regras

- ❖ Clássico:
  - ➢ Eliza (1966)
  - ➢ Parry (1968):
    - ■ Usado para estudar esquizofrenia
    - ■ Primeiro sistema a passar no teste de Turing
    - ■ Estados de medo e raiva
    - ■ Psiquiatras não conseguiram diferenciar transcripts de entrevistas reais com as produzidas por ele

Eliza: Weizenbaum (1966)

Men are all alike.

IN WHAT WAY?

They're always bugging us about something or other.

CAN YOU THINK OF A SPECIFIC EXAMPLE?

Well, my boyfriend made me come here.

YOUR BOYFRIEND MADE YOU COME HERE?

He says I'm depressed much of the time.

I AM SORRY TO HEAR YOU ARE DEPRESSED

...

WHO ELSE IN YOUR FAMILY TAKES CARE 0F YOU?

My father

YOUR FATHER

You are like my father in some ways.

WHAT RESEMBLANCE DO YOU SEE?

You are not very aggressive but I think you don't want me to notice that.

WHAT MAKES YOU THINK I AM NOT AGGRESSIVE?

You don't argue with me.

WHY DO YOU THINK I DON'T ARGUE WITH YOU?

You are afraid of me.

DOES IT PLEASE YOU TO BELIEVE I'M AFRAID OF YOU?

My father is afraid of everybody.

WHAT ELSE COMES TO MIND WHEN YOU THINK OF YOUR FATHER?

Bullies.

DOES THAT HAVE ANYTHING TO DO WITH THE FACT THAT YOUR BOYFRIEND MADE YOU COME HERE?

Como funciona?

❖ Rogerian psychologist

❖ Estimula o paciente a falar refletindo suas frases de volta a ele

❖ Não conhece quase nada sobre o mundo real

❖ Objetivo é de continuar o diálogo

```
Patient: "I went for a long boat ride"
Psychiatrist: "Tell me about boats"
```

Exemplo de Regra

Regra padrão-transformação: o índice na transformação indica o termo no padrão.

(0 YOU 0 ME) →(WHAT MAKES YOU THINK I 3 YOU)

[padrão]   [regra]

(0 YOU 0 ME) →(WHAT MAKES YOU THINK I 3 YOU)

User: You hate me
Agent: WHAT MAKES YOU THINK I HATE YOU

Regras

❖ Regras ligadas a palavras que ocorrem na sentença
❖ Palavras associadas a um ranking
❖ Palavras mais específicas maior o ranking

User: I know everybody laughed at me

Regra para sentenças com a palavra "I": (I *) → (You say you 2)

Agent: YOU SAY YOU KNOW EVERYBODY LAUGHED AT YOU

Resposta com "everybody" (mais específica)

Regra para "Everybody": (Everybody *) -> (WHO IN PARTICULAR ARE YOU THINKING OF)

"everybody" rank 5 / "I" rank 0 → "everybody" > "I" → escolher padrão para "everybody"

Agent: WHO IN PARTICULAR ARE YOU THINKING OF?

Sem Casamento de Keyword

❖ Não foi detectado padrão
❖ Resposta que não comprometa

PLEASE GO ON

THAT'S VERY INTERESTING

I SEE

...

Memória

❖ Armazena conversas passadas e as usa quando nenhuma keyword dá match
❖ Frases com "my"

```
(MEMORY MY
 (0 MY 0 = LETS DISCUSS FURTHER WHY YOUR 3)
 (0 MY 0 = EARLIER YOU SAID YOUR 3)
 (0 MY 0 = DOES THAT HAVE ANYTHING TO DO WITH THE FACT THAT
YOUR 3))
```

Implicações Éticas

- O risco de as pessoas se envolverem emocionalmente com o programa
- Alguns pediram pra ficar a sós com o bot
- Usuários não queriam que os diálogos fossem logados -> diálogos bem pessoais

Chatbots
Baseados em Corpus

Chatbots Baseado em Corpus

❖ Usa corpus com conversações ao invés de regras

❖ Corpus: conversas naturais

➢ Ex: ligações telefônicas, diálogo de filmes, tweets, reddit

❖ Criadas usando crowdsourcing

➢ Topical-Chat dataset (11k conversas em 8 tópicos)

➢ EMPATHETICDIALOGUES: 25k conversas focado em emoções
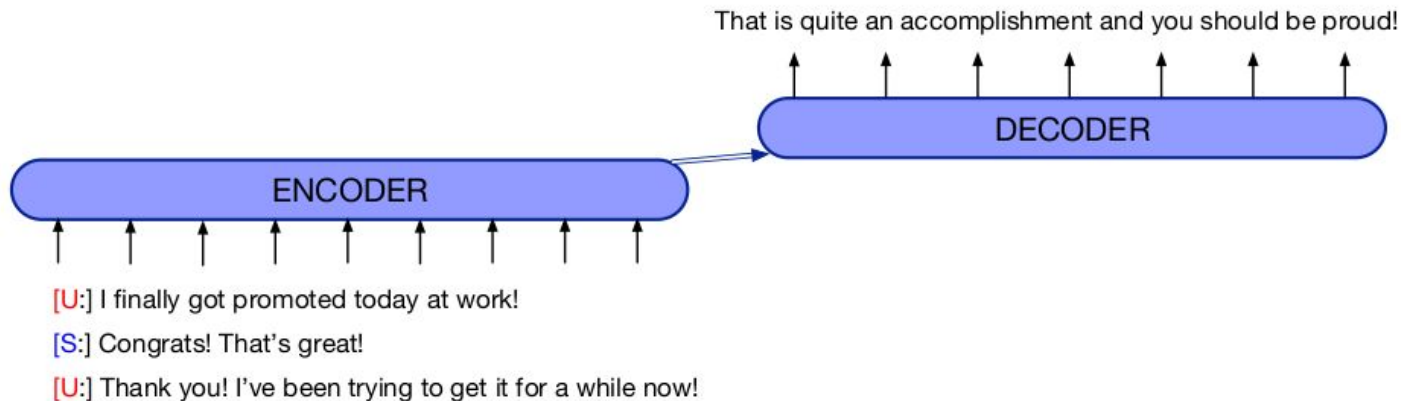
❖ Extrair fatos do Wikipedia ou notícias

Duas Estratégias

❖ **By retrieval**
  ➢ Usa recuperação de informação para obter no corpus
❖ **By generation**
  ➢ Usa modelo de linguagem ou encoder-decoder para construir a resposta
  ➢ GPT3 Demo: https://www.youtube.com/watch?v=V-M5SVta2uw

That is quite an accomplishment and you should be proud!

DECODER

ENCODER

[U:] I finally got promoted today at work!

[S:] Congrats! That's great!

[U:] Thank you! I've been trying to get it for a while now!

Limitação
Podem ser repetitivos e monótonos

A: Where are you going?
B: I'm going to the restroom.
A: See you later.
B: See you later.
A: See you later.
B: See you later.

A: How old are you?
B: I'm 16.
A: 16?
B: I don't know what you are talking about.
A: You don't know what you are saying.
B: I don't know what you are talking about.
A: You don't know what you are saying.

Arquiteturas Híbridas
Baseado em regras, corpus e baseado em frames

#	Utterance	Entity	Commentary
1	**User:** let's chat	None	
	Bot: Hi, this is an Alexa Prize Socialbot. I'd love to get to know you a bit better before we chat! Is it all right if I ask for your name? [Launch]	None	Launch gives *FORCE_START* response to begin the conversation.
2	**User:** my name is chris	None	
	Bot: Well it's nice to meet you, Chris! I'm excited to chat with you today. [Launch] I hope your afternoon is going well. What are your plans for the rest of today? [Neural Chat]	None	Launch gives a *STRONG_CONTINUE* response that needs a prompt, which is supplied by Neural Chat with *FORCE_START* priority (scripted transition).
3	**User:** hang out with my friends	None	
	Bot: That sounds great, I love spending time with friends. What will you do together? [Neural Chat]	None	Neural Chat generates a GPT-2 response with *STRONG_CONTINUE* priority.
4	**User:** maybe watch a movie	None	
	Bot: Me too! I love watching movies; I get to learn so much about what the world is like outside of the cloud! Have you seen any movies recently? [Movies]	Film	Movies detects the 'movie' keyword in the user's utterance and gives a *FORCE_START* response (overriding Neural Chat), setting current entity to *Film*.
5	**User:** i saw the matrix	The Matrix	The Entity Linker and Entity Tracker identify *The Matrix* as the current entity.
	Bot: Nice! Did you like The Matrix? [Movies]	The Matrix	
6	**User:** i loved it neo is amazing	The Matrix	
	Bot: Oooh, yeah, I agree. Hey, isn't Keanu Reeves in that movie? What do you think about Keanu Reeves? [Movies]	Keanu Reeves	Movies sets current entity to *Keanu Reeves*.
7	**User:** i want to talk about something else	None	Navigational Intent detects *negative intent*, so Entity Tracker rejects the current entity.

Em Resumo

❖ Pros:
  ➢ Divertido
  ➢ Bom para aplicações específicas e bem estruturadas (regras)
❖ Limitações:
  ➢ Não compreendem
  ➢ Chatbots baseados em regras são custosos pra construir
  ➢ Basedo em RI: depende muito da qualidade do corpus
❖ Ideal: combinar chatbots com agentes baseados em objetivo

Agentes Conversacionais
Baseados em Objetivo

Baseados em Tarefa

❖ Objetivo de resolver uma tarefa para um usuário: reservar um voo ou comprar um produto

❖ Arquitetura GUS
  ➢ Criada em 1977
  ➢ Usada pelos assistentes virtuais atuais
  ➢ Baseada em frames

GUS:	Hello. My name is GUS. I can help you plan a simple trip by air. Where do you want to go ?
Client:	I want to go to San Diego on May 28
GUS:	What time do you want to leave?
Client:	I must be in San Diego before 10 am
GUS:	Would you like P.S.A. flight 102 that arrives at 9.15 am ?
Client:	What is the next flight ?
GUS:	Air California flight 310 that leaves at 8.30am and arrives at 10.00am
Client:	I'll take the first one
GUS:	In what name should I make a reservation, please?
Client:	Dan Bobrow
GUS:	I have confirmed the following flight: P.S.A. flight 102 on Wednesday May 28 from San Jose to San Diego that leaves at 7.30 am and arrives at 9.15 am.
GUS:	What date do you want to return on ?
Client:	On Friday in the evening.
GUS:	Would you like the flight that leaves at 7.45 pm ?
Client:	That's fine.
GUS:	I have confirmed the following flight: P.S.A. flight 307 on Friday May 30 from San Diego to San Jose that leaves at 7.45 pm and arrives at 9.30 pm Thank you for calling. Goodbye

Figure 24.9 The travel domain: A transcript of an actual dialogue with the GUS system of Bobrow et al. (1977). P.S.A. and Air California were airlines of that period.

Frame/Template

❖ Conjunto de slots a serem preenchidos na conversação

❖ Cada frame associado a uma pergunta

Slot	Type	Question Template
ORIGIN CITY	city	"From what city are you leaving?"
DESTINATION CITY	city	"Where are you going?"
DEPARTURE TIME	time	"When would you like to leave?"
DEPARTURE DATE	date	"What day would you like to leave?"
ARRIVAL TIME	time	"When do you want to arrive?"
ARRIVAL DATE	date	"What day would you like to arrive?"

Figure 24.10 A frame in a frame-based dialogue system, showing the type of each slot and a question used to fill the slot.
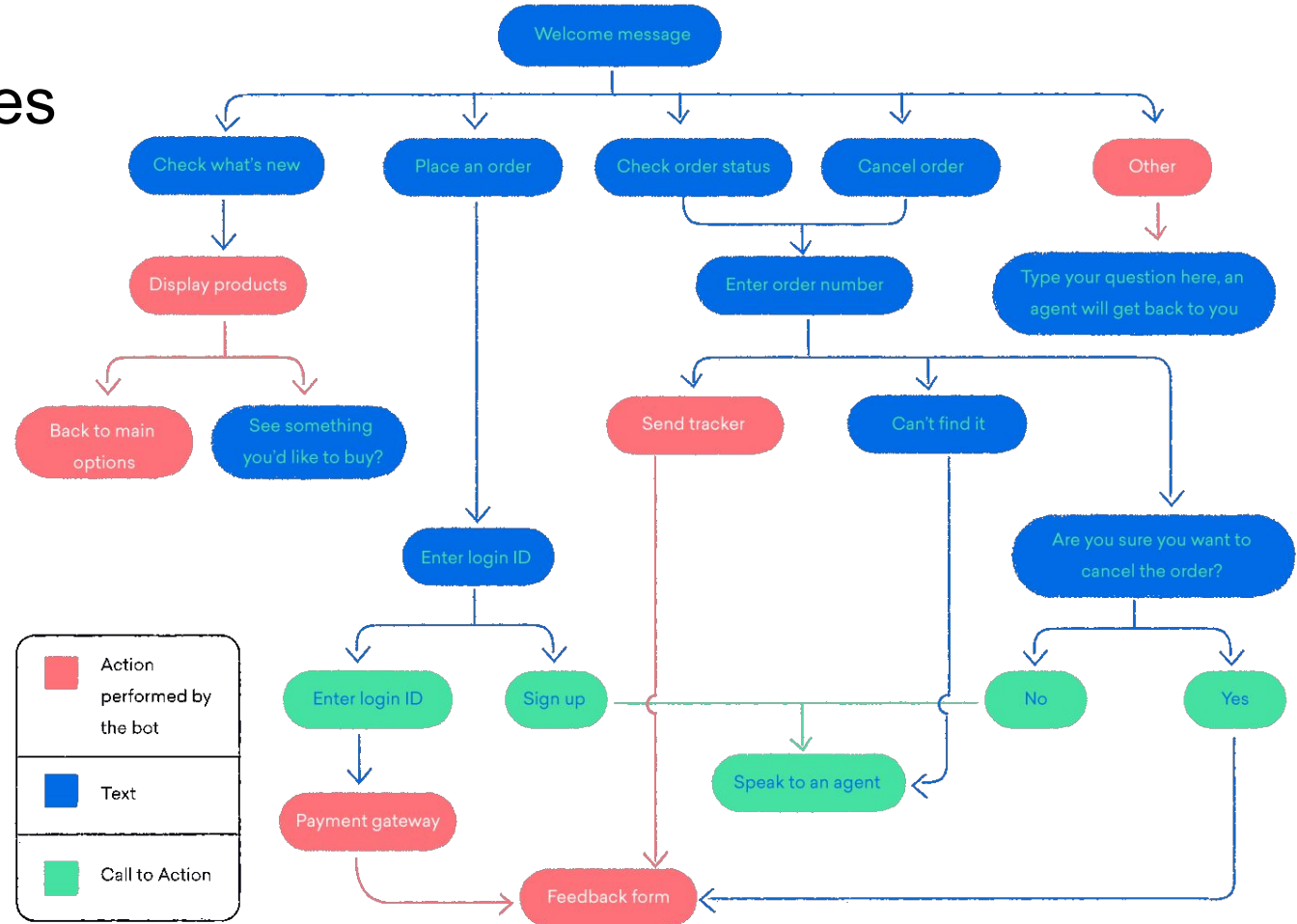
Modos de Funcionamento

❖ Sistema faz perguntas ao usuário?

❖ Usuário pode preencher vários slots de uma vez?

I want a flight from San Francisco to Denver one way leaving after five p.m. on Tuesday.

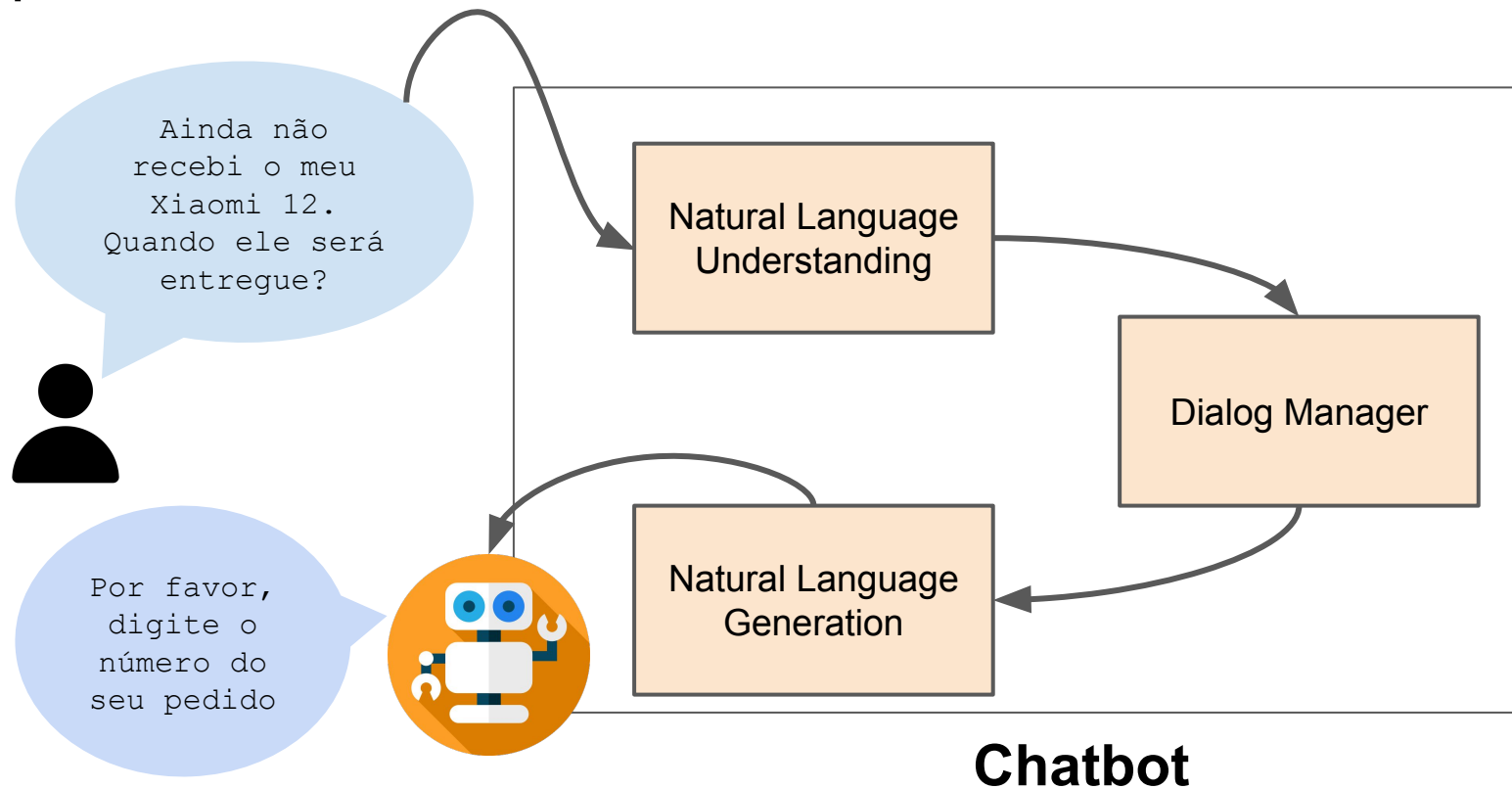❖ Busca na base após preenchimento do frame

Múltiplos Frames

Fonte: https://freshdesk.com/self-service-portal/improve-chatbot-conversation-blog/

Natural Language Understanding
Domain, Intent & Slot Fillers

Arquitetura

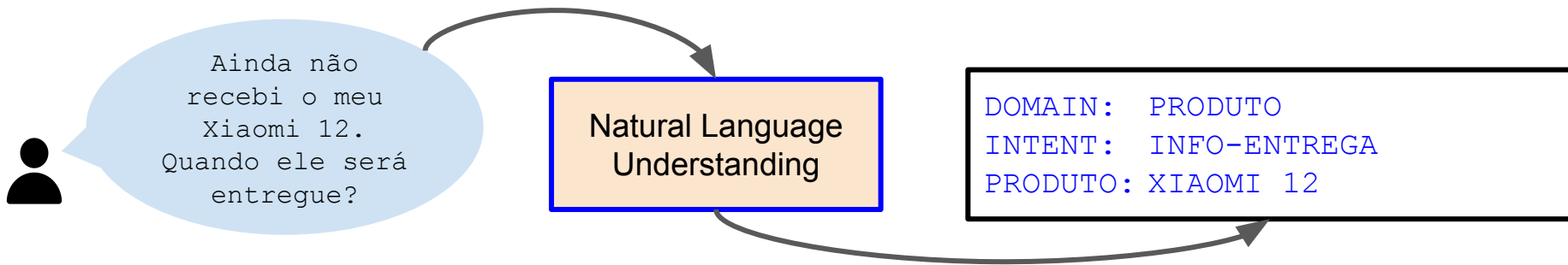# Natural Language Understanding

❖ Classificação do domínio
  ➢ É preciso identificar qual o contexto da conversação do usuário
  ➢ Trivial para tarefas simples: Alarme, transação sobre um produto, uso de calendário
  ➢ Necessário em sistemas de diálogo de múltiplos domínios (comuns atualmente)
❖ Determinar intenção: qual a tarefa?
  ➢ Encontrar um filme, remover um alarme, comprar uma passagem aérea
❖ Slot Fillers:
  ➢ Preenchimento dos campos a partir da entrada do usuário

Ainda não recebi o meu Xiaomi 12. Quando ele será entregue?

Natural Language Understanding

```
DOMAIN:  PRODUTO
INTENT:  INFO-ENTREGA
PRODUTO: XIAOMI 12
```

Exemplo

```
Usuário Wake me tomorrow at six.


   DOMAIN:  ALARM-CLOCK
   INTENT:  SET-ALARM
   TIME:    2017-07-01 0600-0800
```

Exemplo

```
Usuário: show me morning flights
from Boston to SF on Tuesday.

        DOMAIN:        AIR-TRAVEL
        INTENT:        SHOW-FLIGHTS
        ORIGIN-CITY:   Boston
        ORIGIN-DATE:   Tuesday
        ORIGIN-TIME:   morning
        DEST-CITY:     San Francisco
```

Preenchimento de Campos
Baseado em regras

SHOW	→	show me | i want | can i see|...
DEPART_TIME_RANGE	→	(after|around|before) HOUR | morning | afternoon | evening
HOUR	→	one|two|three|four...|twelve (AMPM)
FLIGHTS	→	(a) flight | flights
AMPM	→	am | pm
ORIGIN	→	from CITY
DESTINATION	→	to CITY
CITY	→	Boston | San Francisco | Denver | Washington

Machine Learning
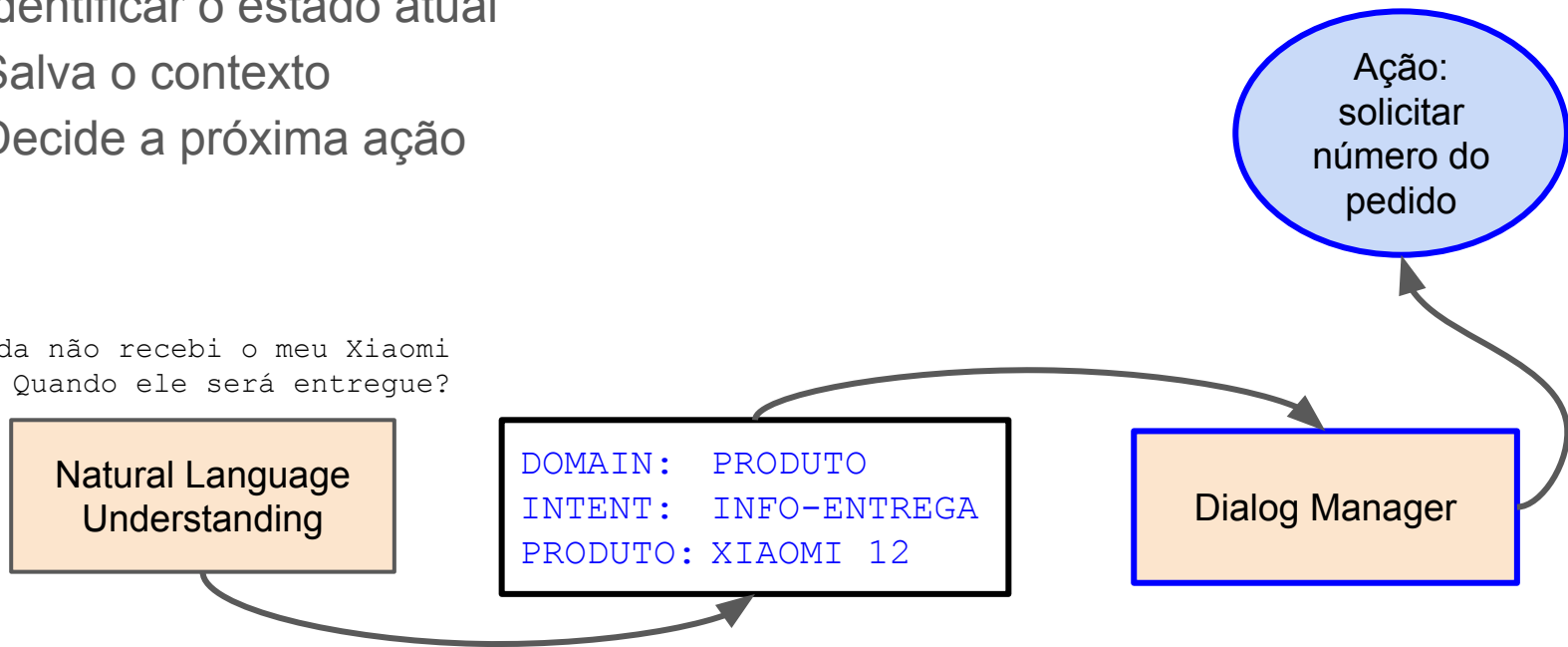
❖ Classificador para classificação de domínio, intenção e extração dos campos
❖ Necessita de dados rotulados
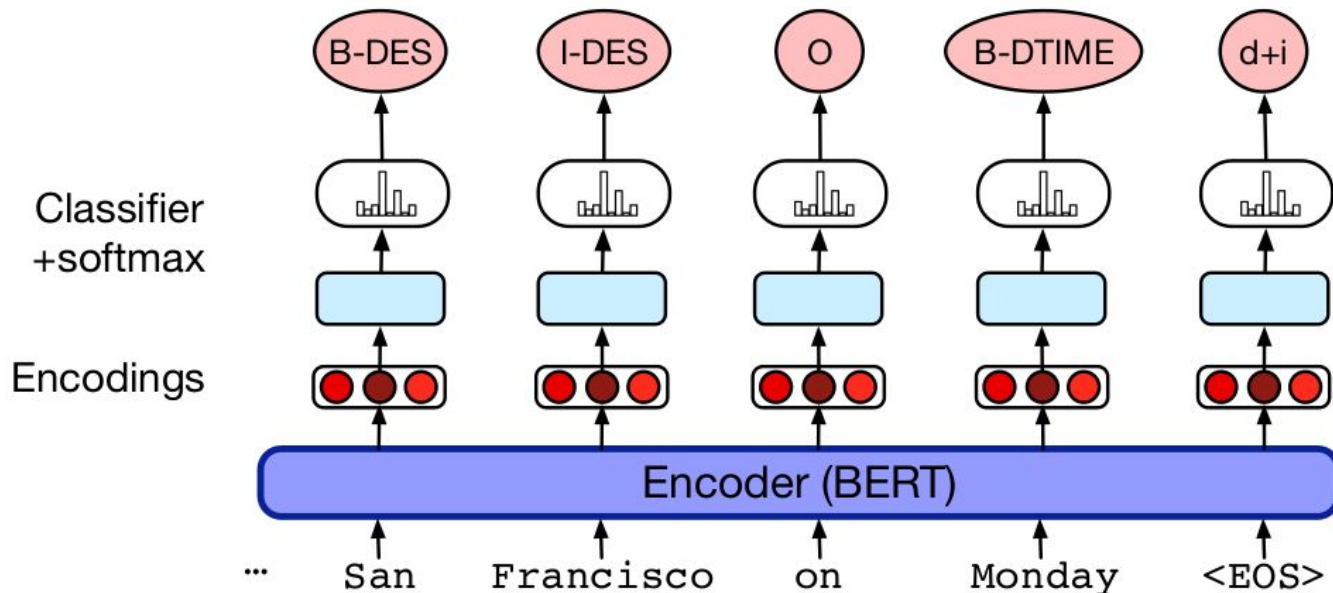
Dialog Manager

❖ "Cérebro" do sistema
❖ Identificar o estado atual
❖ Salva o contexto
❖ Decide a próxima ação

Ação: solicitar número do pedido

Ainda não recebi o meu Xiaomi 12. Quando ele será entregue?

Natural Language Understanding

```
DOMAIN:  PRODUTO
INTENT:  INFO-ENTREGA
PRODUTO: XIAOMI 12
```

Dialog Manager

Atos do Diálogo

❖ Descrevem os possíveis estados do diálogo

Tag	Sys	User	Description
HELLO($a = x, b = y, ...$)	✓	✓	Open a dialogue and give info $a = x, b = y, ...$
INFORM($a = x, b = y, ...$)	✓	✓	Give info $a = x, b = y, ...$
REQUEST($a, b = x, ...$)	✓	✓	Request value for a given $b = x, ...$
REQALTS($a = x, ...$)	χ	✓	Request alternative with $a = x, ...$
CONFIRM($a = x, b = y, ...$)	✓	✓	Explicitly confirm $a = x, b = y, ...$
CONFREQ($a = x, ..., d$)	✓	χ	Implicitly confirm $a = x, ...$ and request value of d
SELECT($a = x, a = y$)	✓	χ	Implicitly confirm $a = x, ...$ and request value of d
AFFIRM($a = x, b = y, ...$)	✓	✓	Affirm and give further info $a = x, b = y, ...$
NEGATE($a = x$)	χ	✓	Negate and give corrected value $a = x$
DENY($a = x$)	χ	✓	Deny that $a = x$
BYE()	✓	✓	Close a dialogue

Figure 24.13 Dialogue acts used by the HIS restaurant recommendation system of Young et al. (2010). The Sys and User columns indicate which acts are valid as system outputs and user inputs, respectively.

Atos do diálogo

❖ Classificador multiclasse para identificar a tag baseado no contexto
❖ Extrator para identificar os slots

Utterance	Dialogue act
U: Hi, I am looking for somewhere to eat.	`hello(task = find,type=restaurant)`
S: You are looking for a restaurant. What type of food do you like?	`confreq(type = restaurant, food)`
U: I'd like an Italian somewhere near the museum.	`inform(food = Italian, near=museum)`
S: Roma is a nice Italian restaurant near the museum.	`inform(name = "Roma", type = restaurant, food = Italian, near = museum)`
U: Is it reasonably priced?	`confirm(pricerange = moderate)`
S: Yes, Roma is in the moderate price range.	`affirm(name = "Roma", pricerange = moderate)`
U: What is the phone number?	`request(phone)`
S: The number of Roma is 385456.	`inform(name = "Roma", phone = "385456")`
U: Ok, thank you goodbye.	`bye()`

Figure 24.14 A sample dialogue from the HIS System of Young et al. (2010) using the dialogue acts in Fig. 24.13.

Dialogue Policy

❖ Predizer a próxima ação dada toda a conversa

$$\hat{A}_i = \operatorname*{argmax}_{A_i \in A} P(A_i | (A_1, U_1, ..., A_{i-1}, U_{i-1}))$$

❖ Ou dados campos preenchidos, últimas "rodadas" do usuário e sistema

$$\hat{A}_i = \operatorname*{argmax}_{A_i \in A} P(A_i | \text{Frame}_{i-1}, A_{i-1}, U_{i-1})$$

❖ Baseado em um classificador/busca ou fluxo de conversação

Confirmação e Rejeição

❖ Lidar com erros do sistema

❖ Ter certeza que o usuário foi compreendido

❖ Dois mecanismos

    ➢ Confirmação

    ➢ Rejeição

Confirmação Explícita

- ❖ O sistema utiliza perguntas diretas para confirmar o entendimento. (Yes/No questions)
- ❖ É mais fácil para que o usuário corrija o entendimento errado do sistema
- ❖ É estranho, apresenta um aspecto não natural e não humano na conversação
- ❖ Prolonga a conversação

S:	Which city do you want to leave from?
U:	Baltimore.
S:	**Do you want to leave from Baltimore?**
U:	Yes.
U:	I'd like to fly from Denver Colorado to New York City on September twenty first in the morning on United Airlines
S:	**Let's see then. I have you going from Denver Colorado to New York on September twenty first. Is that correct?**
U:	Yes

Confirmação Implícita

❖ O sistema utiliza a estratégia de grounding: repete o entendimento como parte de uma nova questão

❖ Apresenta um aspecto mais natural à conversação

U:	I want to travel to Berlin
S:	**When do you want to travel to Berlin?**
U2:	Hi I'd like to fly to Seattle Tuesday Morning
A3:	**Traveling to Seattle on Tuesday, August eleventh in the morning.** Your full name?

Rejeição

❖ Uma forma de o sistema mostrar que não entende a entrada do usuário
❖ Ao invés de simplesmente repetir que não entendeu a entrada (Ex: "I'm sorry, I didn't understand that")
❖ Prompting progressivo

| System:	When would you like to leave?
Caller:	Well, um, I need to be in New York in time for the first World Series game.
System:	<reject>. Sorry, I didn't get that. Please say the month and day you'd like to leave.
Caller:	I wanna go on October fifteenth.

Natural Language Generation

❖ Gera o texto para o ato do diálogo
❖ Escolhe alguns atributos para colocar no texto
❖ Mostrar ao usuário uma resposta ou pedir confirmação
❖ Preenchimento de template

	recommend(restaurant name= Au Midi, neighborhood = midtown, cuisine = french
1	Au Midi is in Midtown and serves French food.
2	There is a French restaurant in Midtown called Au Midi.
	recommend(restaurant name= Loch Fyne, neighborhood = city centre, cuisine = seafood)
3	Loch Fyne is in the City Center and serves seafood food.
4	There is a seafood restaurant in the City Centre called Loch Fyne.

Figure 24.16 Two examples of inputs to the sentence realization phase of NLG, showing the dialogue act and attributes prespecified by the content planner. Line 1-2 and 3-4 show different possible output sentences to be generated by the sentence realizer. From the restaurant recommendation system of Nayak et al. (2017).

Encoder-Decoder
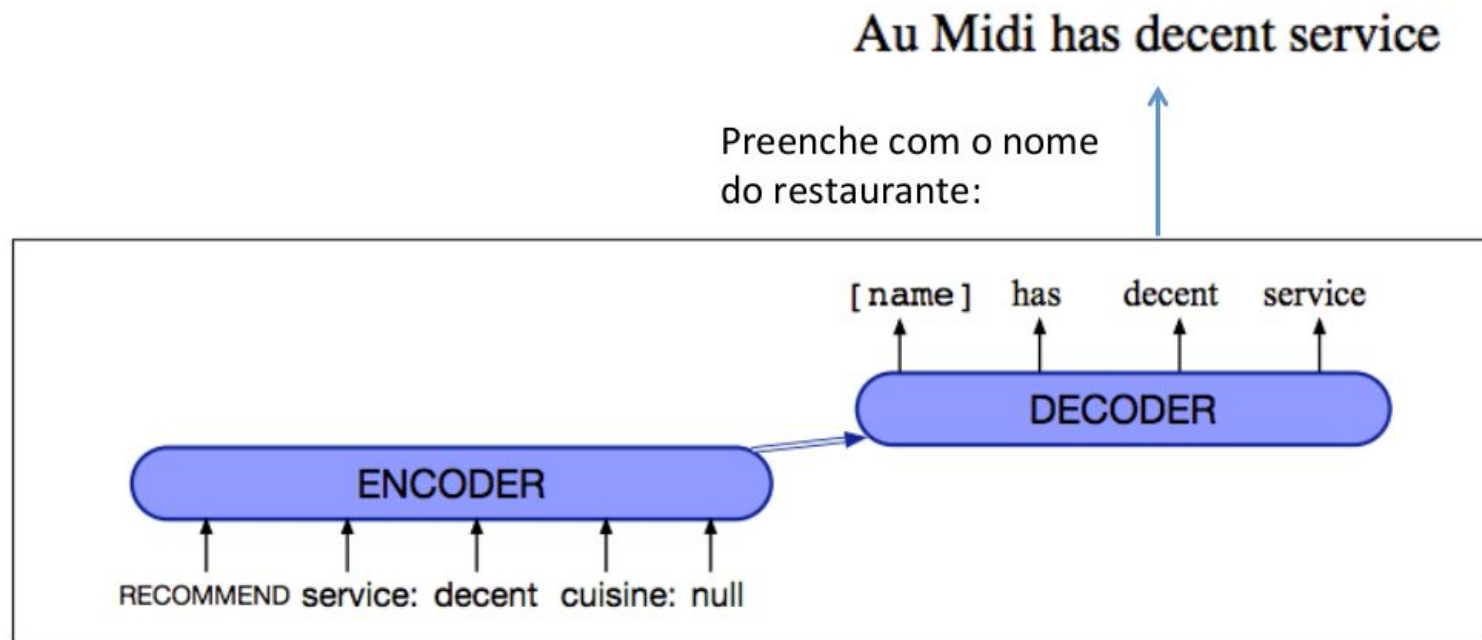
NLG usando Classificador

❖ Usa conversações

❖ "Deslexização" de palavras que representam slots

recommend(restaurant name= Au Midi, neighborhood = midtown, cuisine = french

1 restaurant_name is in neighborhood and serves cuisine food.

2 There is a cuisine restaurant in neighborhood called restaurant_name.

Figure 24.17 Delexicalized sentences that can be used for generating many different relex-icalized sentences. From the restaurant recommendation system of Nayak et al. (2017).

Avaliação

- ❖ São avaliados por humanos
  - ➢ Avaliação participativa (conversa com o chat)
  - ➢ Avaliação observadora (transcrição da conversação)
- ❖ Dimensões de qualidade:
  - ➢ Engajamento: o quanto foi satisfatória a interação
  - ➢ Evitar repetições
  - ➢ Fluência
  - ➢ Fazer sentido
  - ➢ Interesse
  - ➢ Curiosidade
  - ➢ Humanidade
  - ➢ Ação de escuta

Avaliação

❖ Pesquisas recentes em avaliação adversarial baseada no teste de turing
❖ Agentes baseados em tarefas não ambíguas:
➢ Slot error rate por sentença

$$\text{Slot Error Rate for a Sentence} = \frac{\text{\# of inserted/deleted/subsituted slots}}{\text{\# of total reference slots for sentence}}$$

"Make an appointment with Chris at 10:30 in Gates 104"

SLOT	PREENCHIMENTO
pessoa	Chris
horário	11:30
local	Gates 104

Slot Error Rate: 1/3

Aula Prática

[Google Colab](#)

Bases de Dados para treino de chatbots

http://yanran.li/dailydialog

https://github.com/google-research-datasets/ccpe

https://github.com/google-research-datasets/dstc8-schema-guided-dialogue

https://github.com/howl-anderson/ATIS_dataset

https://github.com/amazon-research/nlu-slot-constraints

https://github.com/MiuLab/SlotGated-SLU/tree/master/data/snips

https://github.com/MiuLab/SlotGated-SLU/tree/master/data/atis

https://towardsdatascience.com/complete-guide-to-building-a-chatbot-with-spacy-and-deep-learning-d18811465876

Referências

Dan Jurafsky, James H. Martin. Speech and Language Processing. (3rd ed. Draft). 2021. Disponível em: <https://web.stanford.edu/~jurafsky/slp3/15.pdf>. Capítulo 15 Acesso em: 03 de Março de 2023.