Comp349: Spoken Language Dialogue Systems
Week 9

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Outline

• A Review of the Tutorial Task
• Speech Recognition: How It Works
General Problems:
Read the Tutorial Specification!

- You were asked to provide a sample dialog for each application, and some people did not.
- Some people did not use the notational conventions:
  - Non-recognition states are in white boxes, recognition states in grey boxes
  - Label arcs with an indication of the utterance that causes that arc to be traversed
Why Sample Dialogs Are Important

• Forces you to think through the call flow
• Easier to see what happens in typical use cases
• Forces you to pay attention to prompt design:
  – There isn't sufficient space in the call flow diagram for details
  – Encourages you to think about what the prompts sound like
• Forces you to pay attention to possible user responses:
  – There's only space in the call flow diagram for an 'indicative' response
The Application Types

- Auto attendants
- Stock quotes and stock trading
- Flight information and flight reservations
- Email access
- Calendar managers
Common Problem #1: Don't Blame the Caller!

Who would you like to speak to?

-〈NAME〉
- No recognition

Okay, connecting you to 〈NAME〉.

That's not a valid name.
Common Problem #1: Don't Blame the Caller!

Who would you like to speak to?  

〈NAME〉  

Okay, connecting you to 〈NAME〉.  

No recognition  

That's not a valid name.
Common Problem #1: Don't Blame the Caller!

Who would you like to speak to?

〈NAME〉  No recognition

Okay, connecting you to 〈NAME〉.

Sorry, I didn't recognize that name.
An Aside:
Consider Variant Reprompts

S: Who would you like to speak to?
U: [Mumble]
S: Sorry, I didn't catch that name. Please say the name of the person you would like to speak to.
An Aside: Consider Using Confidence Measures

Who would you like to speak to?

〈NAME〉: C > 70

Okay, connecting you to 〈NAME〉.

〈NAME〉: C < 70

I think you asked for 〈NAME〉. Is that right?

No recognition

Sorry, I didn't catch that name.

Yes

Oh, sorry.
An Aside: Escalating To An Operator

S: Who would you like to speak to?
U: [Mumble]
S: Sorry, I didn't catch that name. Please say the name of the person you would like to speak to.
U: [Mumble]
S: Sorry, I'm still not getting it. I'll pass you to reception.
Auto Attendants

Common Problems

- It's unlikely that your grammar will contain names of people not in the organisation.
- That means you can't tell the difference between:
  - a failure to correctly recognize a known name, and
  - an unknown name.
- The most you can say definitively is that the recognizer did not match the user's utterance with a name it knows.
Auto Attendant: One Solution

Name = "", Ext = 0

Welcome to the Automated Telephone Attendant.

Please say the name of the person you want to be transferred to.

"Title Firstname Lastname"

No Input or No Match

Say for example: “Mr John Smith”

"Title Firstname Lastname" No Input or No Match

Name = "Title Firstname Lastname"

You want to be transferred to <Name>, is that correct?

Yes

Name exists in Database

Ext = GetExt(<Name>)

Ok, transferring you to <Name> on extension <Ext>. Have a nice day.

No

I am sorry, <Name> is not listed.

No

Yes

Ext = GetExt(<Name>)

Ok, transferring you to <Name> on extension <Ext>. Have a nice day.
Welcome to the Automated Telephone Attendant.

Please say the name of the person you want to be transferred to.

"Title Firstname Lastname"

No Input or No Match

Say for example: “Mr John Smith”

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Name = “Title Firstname Lastname”

You want to be transferred to <Name>, is that correct?

Yes

I am sorry, <Name> is not listed.

No

Name exists in Database

Yes

Ext = GetExt(<Name>)

Ok, transferring you to <Name> on extension <Ext>. Have a nice day.

No
Auto Attendant: Good Points

Welcome to the Automated Telephone Attendant.

Please say the name of the person you want to be transferred to.

"Title Firstname Lastname"

No Input or No Match

Say for example: "Mr John Smith"

"Title Firstname Lastname" No Input or No Match

Name = "Title Firstname Lastname"

You want to be transferred to <Name>, is that correct?

Yes

Name exists in Database

Yes

Ext = GetExt(<Name>)

Ok, transferring you to <Name> on extension <Ext>. Have a nice day.

No

I am sorry, <Name> is not listed.
Auto Attendant: Good Points

Name = "", Ext = 0
Welcome to the Automated Telephone Attendant.

Please say the name of the person you want to be transferred to.

"Title Firstname Lastname"

No Input or No Match

Say for example: "Mr John Smith"

"Title Firstname Lastname" No Input or No Match

Name = "Title Firstname Lastname"
You want to be transferred to <Name>, is that correct?

Yes
Name exists in Database

No
I am sorry, <Name> is not listed.

Yes
Ext = GetExt(<Name>)

Ok, transferring you to <Name> on extension <Ext>. Have a nice day.
Auto Attendant: Good Points

Name = "", Ext = 0
Welcome to the Automated Telephone Attendant.

Please say the name of the person you want to be transferred to.

"Title Firstname Lastname"

No Input or No Match

Say for example: "Mr John Smith"

"Title Firstname Lastname"

No Input or No Match

Name = "Title Firstname Lastname"

You want to be transferred to <Name>, is that correct?

Yes

Name exists in Database

Yes

Ext = GetExt(<Name>)

Ok, transferring you to <Name> on extension <Ext>. Have a nice day.

No

I am sorry, <Name> is not listed.

Yes

Variation in reprompt

Provides confirmation

Provides caller's extension as additional information

Very clear first prompt
Good Points in This Solution

- Very clear first prompt
- Variation in reprompt
- Provides confirmation
- Provides caller's extension as additional information
Auto Attendant: Weaknesses

Name = "", Ext = 0

Welcome to the Automated Telephone Attendant.

Please say the name of the person you want to be transferred to.

"Title Firstname Lastname"

No Input or No Match

Say for example: “Mr John Smith”

"Title Firstname Lastname" No Input or No Match

Name = “Title Firstname Lastname”

You want to be transferred to <Name>, is that correct?

Yes

Name exists in Database

Ext = GetExt(<Name>)

Ok, transferring you to <Name> on extension <Ext>. Have a nice day.

No

I am sorry, <Name> is not listed.

Yes

Restricted to 'Title FirstName SecondName' form for input
Auto Attendant: Weaknesses

Restricted to 'Title FirstName SecondName' form for input

Welcome to the Automated Telephone Attendant.

Please say the name of the person you want to be transferred to.

"Title Firstname Lastname"

No Input or No Match

Say for example: "Mr John Smith"

"Title Firstname Lastname" No Input or No Match

You want to be transferred to <Name>, is that correct?

Yes

I am sorry, <Name> is not listed.

No

I am sorry, <Name> is not listed.

Name exists in Database

Yes

Ext = GetExt(<Name>)

Ok, transferring you to <Name> on extension <Ext>. Have a nice day.

No

Unlikely to be able to recognize a name if it isn’t in the directory
Weaknesses in This Solution

- Restricted to 'Title FirstName SecondName' form for input
- Unlikely to be able to recognize a name if it isn’t in the directory
- Callers may request a function or department rather than a name
General Issues with Call Flow Design

1. The set of exits from a state should cover all circumstances
2. You can only recognize what is in your grammar
3. Modularise logically and aesthetically
Stock Quotes and Trading

• Think about the problem:
  – If the system allows stock trading then it has to rely on the user having an account, so you might as well collect this first, even if the caller just wants quotes

• Think of the overall structure in terms of top-down design
Stock Quotes and Trading

Login Subdialog

[Success]

Please select quotes or trading.

Quotes Subdialog

Trading Subdialog

[Failure]

Exit

Yes

Quotes

Do you want to do something else?

No

Ok, thanks for using the stocks service.
Welcome to the ANZ Self Service Stocks System. To use this system...

Please enter your account number using the keypad.

Sorry, that account number and password do not match. Let’s try again.

Please enter your PIN using the keypad.

Check account # and PIN

Yes

[Invalid]

[Valid]

Success Exit
Stock Quotes and Trading: Quotes Subdialog

Say the name or spell out the stock code of the stock whose price you want to know.

〈STOCK〉

[No Rec]

Sorry, I didn't get that.

Ok, finding price for 〈STOCKNAME〉.

Bid price for 〈STOCKNAME〉 is ...
Offer price for 〈STOCKNAME〉 is ...

Do you want another quote?

Yes

No

Exit
Stock Quotes and Trading: Trading Subdialog

Trading

Do you want to hear a summary of your portfolio?

No

Yes

Ok, your current holdings are …

Do you want to buy or sell?

Yes

No

Buy Subdialog

Sell Subdialog

Another trade?

Yes

No

Exit
Stock Quotes and Trading: Buy Subdialog

- **Buy.**
  - **Yes:** Say the name or spell out the stock code of the stock you want to buy.
  - **No:** Sorry, I didn't get that.

- **Do you want to make another purchase?**
  - **Yes:** [No Rec]
  - **No:** Exit

- **How many shares of STOCKNAME do you want to buy?**
  - **Ok, (NUM) shares of STOCKNAME will cost you $.$ Do you want to go ahead?**
  - **No:** Sorry, I didn't get that.
  - **Yes:** Ok, purchase confirmed.
Stock Quotes and Trading:

Buy Subdialog

Say the name or spell out the stock code of the stock you want to buy.

Do you want to buy or sell?

No

Yes

Yes

No

Another trade?

Buy Subdialog

Exit

Ok, your current holdings are …
A Look at Sample Solutions

- Auto attendants
- Stock quotes and stock trading
- Flight information and flight reservations
- Email access
- Calendar managers
Stock quotes and stock trading – sample dialog

- System: You have reached Ameritrade’s automated Stock broker service
- System: Please select either quotes or trade
- User: I want quotes
- System: Please spell your stock symbol
- User: BUD
- System: Sorry, I didn’t recognize your ticker. Please try again or say help for assistance.
- User: help
- System: Please say the name of the company and I will try to provide the ticker.
- User: Buddha Air
- System: I have the ticker: BUDA for Buddha Air would you like a quote for BUDA?
- User: yes, please
- System: BUDA is bid at 2.76, ask at 2.79 and last at 2.91
- User: Do you want another quote, trade or quit
- User: I want to trade
You have reached Ameritrade's automated stock broker service.

Please select either quotes or trade.

Your selection is not recognized.

Quotes sub-dialog

Quotes sub-dialog
Stocks quotes and trading
Quotes sub-dialog

Please spell your stock symbol

Not recognized

Sorry, I didn’t recognize your stock symbol. Please try again or say help for assistance

Do you want:

another quote or quit

Sorry, I didn’t recognize your stock symbol. Please try again or say help for assistance

help

help sub-dialog

trade

trade sub-dialog

Exit
I have the "stock symbol" for "company name" would you like a quote for "st sy"?
Stock quotes and stock trading – sample dialog

- System: For trading the system requires your eight digit account nr:
- User: six seven three seven nine seven zero four
- System: I got: sex seven three seven nine seven zero four. Is that right?
- User: Yes it is.
- System: Welcome Mrs. Scutts, would you like to buy or sell?
- User: I want to buy stock
- System: State your: ticker, number of stocks and bid value per stock
- User: BUDA, 100 stocks at 2.77
- System: Do you want to make a bid on: BUDA 100 stocks at 2.77 User: That’s what I want
- System: Your bid has been entered with a day limit.
- System: Would you like to continue buying, sell, get a quote or quit?
- User: I would like to quit for now
- System: Thank you for calling Ameritrade’s automated Stock broker service. Goodbye
Stock quotes and trading
Trade sub-dialog, account info

Please state your account

user of this account is “name”
If this is correct please provide verification
Otherwise say no or quit

verified

Welcome “name” would you like to buy or sell stocks

Buy

Sell

exit

quit

no
Stock quotes and trading
Trade sub-dialog, buy

State your:
1. stock symbol
2. number of stocks
3. bid value per stock

You want to buy “stock name”
X number of stock
at “n value”
For the total amount of nn
Is this correct

Within purchase capability

Trade can not be submitted
Insufficient funds

Trade submitted

Value stock symbol not valid
Value number is not valid
Value bid is not valid

Input valid

yes

no

yes

no

yes

no

yes

no

yes

no

yes
Stock quotes and trading
Trade sub-dialog, sell

State the:
1. stock symbol
2. number of stocks
3. bid value per stock

Input valid & ownership verified

You want to sell “stock name”
X number of stock at “n value”
For the total amount of nn
Is this correct

Conditions of sale approved

Trade submitted

Trade can not be submitted due to technical reasons

Value stock symbol not valid
Value number is not valid
Value bid is not valid
Stock Quotes and Trading

System: Welcome to VeStock, the voice enabled stock quoting and trading service. Would you like to browse or trade stock?
User: I’d like to browse stock.
System: For a list of commands say list.
User: Next.
System: AGK AGL ENERGY $16.35 up $0.28
User: Next.
System: AIO ASCIANO $9.16 up $0.09
User: Next.
System: ALL ARISTOCRAT $13.84 down $0.17
User: Back 2
System: AGK AGL ENERGY $16.35 up $0.28
User: End.
System: Would you like to trade stock?
User: No, thanks.
System: Thank you for using VeStock.
Stock Quotes and Trading

“Welcome to VeStock, the voice enabled stock quoting and trading service”

Browse

“Would you like to browse or trade stock?”

“Stock is listed by code, company name, share price and price change respectively”

Quote Stock

“Would you like to trade stock?”

Yes

No

Trade

“Our stock trading service is currently unavailable. We apologize for the inconvenience.”

“No

“Would you like to contact a brokerage?”

Yes

“Please chose discount or premium”

Broker = discount

discount

premium

Broker = premium

Please say one of the following …

“You are now being transferred to ….”

“Thank you for using VeStock”
Stock Quote Dialogue

“For a list of commands say list”

Information for selected stock

More Info. for selected stock

read

end

next ...

traverse ..

Information for selected stock

back ...

traverse -..
System: Welcome to the Automated Stock Trading Agent. Please say your account name.
User: John Smith
System: Your name is John Smith, is that correct?
User: Yes
System: Your 4 digit code?
User: 1234
System: Account Verified. Do you want to check your portfolio, get a stock quote or trade?
User: Check my portfolio.
System: Your portfolio contains the following stock. Telstra, 1000. Do you want your stocks listed again?
User: No.
System: Do you want another service?
User: No.
System: Ok, thankyou for using the Automated Stock Trading Agent. Goodbye.
Welcome to the Automated Stock Trading Agent.

Account = "", InquiryType = ""

Do you want to use another service?

Yes
InquiryType = ""

No

Portfolio Subdialog

Do you want to check your portfolio, get a stock quote or trade?

Portfolio
Quote
Trade

InquiryType = "Portfolio"

InquiryType = "Quote"

InquiryType = "Trade"

Ok, thankyou for using the Automated Stock Trading Agent. Good bye.

Portfolio Subdialog

StockQuote Subdialog

Trade Subdialog
Your portfolio contains the following stock.

Stocks = GetStocks(<AccountName>)

Do you want your stocks listed again?

No

Yes

Account Verified.
Stock: Call Flow Diagrams

Stock Quote Subdialog

1. StockName = ""
2. Please say the name of the stock you want a quote for?
3. If StockName ≠ "", go to step 4; otherwise, set StockName = "StockName"
4. You want a quote for <StockName>, is that correct?
   a. If Yes, set StockPrice = getPrice(<StockName>)
   b. The current list price for <StockName> is <StockPrice>.

Trade Subdialog

1. Go to step 2.
2. Go to step 3.
4. Go to step 5.
5. Go to step 6.
7. Go to step 8.
Welcome to VoiceXML Stock Agent.

For stock quotes, say quote, for stock trading, say trading.

Do you want to make another enquiry?

Yes

No

Goodbye
Invalid stock code.

Recognised / Not recognised

Retry

Exit subdialog

Stock code for a price quote?

Not recognised

Recognised

Bid "price1" / Offer "price2"

Another quote?

Yes

price1 = 0, price2 = 0

Enter subdialog

No
Invalid CRN.

Retry

Your account is suspended. Please contact nearest branch.

Please enter your password.

Incorrect > 3

Your account balance is ""

Stock code?

Stock code, stock name, bid, offer, current holding

Enter subdialog

Buy/sell subdialog

Stock (trading subdialog)
Stock (buy/sell subdialog)

Enter subdialog → Buy/sell?

Buy

Stock code, name, offer

Number of shares to buy?

Stock code, name, offer, Buyshares

Confirm?

currBalance >= offer * Buyshares

Yes

Trading price, Buyshares currHolding, currBalance

Yes

No

Exit subdialog
Buy/sell?

Yes

Enter subdialog

No

Number of shares to sell?

Insufficient shares to sell.

currHolding > SellShares

Yes

Trading price, Sellshares, currBalance

No

Stock code, name, bid, SellShares

Exit subdialog

currHolding, currBalance

Exit subdialog

Enter subdialog

sell
User: Hello?
System: Hello, this is the QuickTrade telephone trading system.
    One of your stock alarms has gone off.
    Please say your userid and enter your pin number to log into the system.
U: ryan99 45992 (using phone keypad)
S: Thank you Ryan. You have 1 stock alarm info waiting.
    What would you like to do? For a list of options, say options
U: Stock alarm please.
S: Microsoft Incorporated stock, symbol MSFT, has fallen over 2 dollars,
    from 31.87 on October 7th to 29.84 as of 4pm today.
    Would you like to hear this again?
U: No thanks.
S: would you like to erase this alarm?
U: yes.
S: Ok. What would you like to do? For a list of options, say options.
U: please give me a stock quote on apple and ibm.
S: You want to hear quotes for Apple INC, symbol AAPL, and
    International Business Machines, symbol IBM. Is this correct?
U: yes
S: Apple INC is currently valued at 161.45, up 5.21 since Friday, October 5th.
    International Business Computers is currently valued at 116.30, up 0.61 since Friday, October 5th.
    Would you like more information about these stocks?
U: no thank you
System: Ok. What would you like to do? For a list of options, say options.
User: sell microsoft shares and buy shares in apple
S: You have 400 shares in microsoft. How many would you like to sell?
U: all of them
S: You want to sell 400 shares of microsoft, is this correct?
U: yes
S: you have sold 400 shares of microsoft at 29.84 for a total of 11936 dollars.
    your account balance is now 211936 dollars.
    how many shares in Apple would you like to buy?
U: 10,000 dollars worth.
S: sorry, the system didn't understand your response, please say something like
    400 shares.
U: uh... 61 shares please.
S: You want to buy 61 shares in Apple Incorporated, symbol AAPL at 161.45 a share
    for a total of 9848.45. Is this correct?
U: yes
S: Transaction completed. Your account balance is now 202087.55.
    Can I help you with anything else?
U: no thanks
S: ok, thank you for using the quicktrade telephone trading system. Please
    hangup to exit the system.
Welcome to the system. User id and password please.

STOR USER_ID, PASSWORD

Hello <USER_ID>.

What do you want to do? For options, say options.

You have stock alarm news.

stock_alarm_count > 0 You have stock alarm news.

What do you want to do? For options, say options.

You have stock alarm news.

What do you want to do? For options, say options.

You have stock alarm news.

Do something else?

yes

no

Thank you for using Quicktrade. Goodbye.

Buy or sell

Transactions Subdialog

Stock alarms

Stock Alarms Subdialog

Stock quotes

Stock Quote Subdialog

Stock alarms

Stock Alarms Subdialog

Stock quotes

Stock Quote Subdialog

Transactions Subdialog

Do something else?

yes

no

Thank you for using Quicktrade. Goodbye.
Stock Quotes - Stock Alarm Subdialog

Stock Alarm news contents.
Eg. <company_name>, symbol <stockmarket_symbol> has fallen over 2 dollars from 22.50 to 19.89.
Hear this again?

no  yes

Erase this alarm?

yes

no

Erase stock alarm
STORE stock_list

You want to hear quote(s) for {company_name}, symbol {stockmarket_symbol} Is this correct?

yes

stocks = load_from_db(stock_list)
Index = 0

no

<stocks[index].company_name> is currently valued at <stocks[index].value>, <stocks[index].change_info>.

Index += 1

Index < stocks.length

yes

no
Lessons Learned #1: General Presentational Aspects

- Pay attention to the aesthetics of your call flow layouts
  - Use consistently-sized boxes
  - Use a consistent font size
  - Line things up – PowerPoint makes this easy
  - Make sure arrows are distinct from each other – use different connection points so they are not confused
- Make sure every subdialog has one entry point and one exit point
Lessons Learned #2: Prompts and Recognitions

- Pay close attention to the precise wording of your prompts: this is crucial for a successful voice application
  - Use terminology consistently
  - Use terminology that is meaningful to the user
  - Make clear to the user what they can say
  - Avoid prompts that encourage multiple answers
- You can't recognize something that isn't in the grammar …
- Having users spell things out is fraught with difficulty
Lessons Learned #3: Dialog Complexity Issues

- The stock quotes application has fairly high dialog complexity:
  - it already stretches the limits of simple finite state dialog models
  - you need to cater for multiple possible return values from subdialogs
  - it's difficult to maintain modularity at the same time as making the user experience fluid
Lessons Learned #4: Key Design Decisions

- Every application involves key design decisions: here --
  - User login before anything happens, or only if specific functions are requested?
  - How is user authentication carried out?
  - Stocks requested by ticker code or name or both?
  - How much mixed initiative should be allowed in collecting the information required for buying or selling?
  - How do you interleave information and transaction dialogs?
  - How do you provide help information?
A Look at Sample Solutions

- Auto attendants
- Stock quotes and stock trading
- Flight information and flight reservations
- Email access
- Calendar managers
Flight information and flight reservation – sample dialog

• System: You have reached Buddha Air’s automated flight information and reservation system.
• System: Would you like to get flight information?
• User: Yes
• System: Please say: flight number
• User: BU 9 to Dhangadi
• System: BU 9 is delayed thirty minutes, estimated landing time is 17:40
• System: Would you like to hear that again?
• User: No
• System: Would you like to get flight information?
• User: no
• System: Would you like our reservation system?
• User: yes
• System: What is your travel route?
• User: I want to go from Khatmandu to Dhangadi
You have reached Buddha Air’s automated flight information and reservation system. You can quit any time by saying exit.

Please select either Flight information or Flight reservation.

Your selection is not recognized.

Flight Information sub-dialog

Flight reservation sub-dialog
Flight information and flight reservation
- information sub-dialog

This system will give information on Buddha Air flights and affiliate airlines today

Please state flight number
Say help if required

If you require further assistance
say either information or reservation otherwise “exit”

If your flight number was not recognized

recognized

Flight status

„Flight Number”
Departure “Departure time”
ETA “Estimated arrival Time”

„Flight Number” has landed

„Flight Number” has been cancelled

help
Flight information and flight reservation
- information - help sub-dialog

Welcome to Buddha air flight listings system.
Please say cancel at any time to exit

Read details for flight = fx

Do you want more

Fx = next flight in list
Exit
Welcome to Buddha air reservation system. Please say cancel at any time to exit.

Please provide information on travel route in the following format:
- From “airport” to “airport”
- or sightseeing

Buddha air flies from/to:
- Kathmandu
- Biratnagar
- Dhangadi
- Nepalgunj
- Birgunj
- Pokhara
- and sightseeing to
  - Mt. Everest
  - Chitwan

Sightseeing continued Sub-dialog

We have flights on day 1 2 3 4 5 6 7
Do you want this translated into day names?

- Sunday
- Tuesday
- Wednesday
- Friday

Go to travel date selection
Flight information and flight reservation
Reservation sightseeing sub-dialog

We have sightseeing flights to Mt Everest everyday and flights to Chitwan on Mondays and Wednesdays. You can cancel with “exit”

Please select your sightseeing flight

Number of seats required

Please select your travel date

Seats available

I am sorry but the flight requested is fully booked

Do you want me to reserve your seats

I need the passenger details

Please choose Mr. Mrs. Miss or Child

Choose reservation or exit

Price list is as follows.
Adult fare = x
Child fare (for children below the age of 12) = x-15%
Flight information and flight reservation

Reservation contact details sub-dialog

Please provide Name, ID number and telephone number

Thank you for visiting Buddha Air

Tickets have to be paid 1 day in advance of travel

Name blacklisted

Telephone not valid

Name & ID not valid

Exit

Before your reservation is finalized I need your contact details

Reservation contact details sub-dialog

Flight information and flight reservation
Flight information and flight reservation
Reservation regular flight sub-dialog

What is the requested travel date

- valid
- not valid

Number of seats required

- not valid
- valid

Seats available

- yes
- no

I am sorry but the flight requested is fully booked

Do you want to enquire about a different date or exit

Choose reservation or exit

You have selected flight “x” on “x”day the x-date.
Price list is as follows.
Adult fare = x
Child fare (for children below the age of 12) = x-15%

Do you want me to reserve your seats

- yes
- no

I need the passenger details

Name of passenger

- not valid
- valid

Please choose Mr. Mrs. Miss or Child

Passenger>No of seats

Contact details

Exit
Flight information and flight reservation – sample dialog

• System: I understand you want to go from Kathmandu to Dhangadi. Is that right?
• User: right
• System: For how many persons is your reservation?
• User: Just me
• System: Do you want a reservation for one person?
• User: Sure
• System: When would you like to go?
• User: I want to fly as early as possible.
• System: I have a flight tomorrow at: 05.00 and at 16.00? Would you like the 05.00, 16.00 or get further flight schedules?
• User: Let’s see, I’ll take the five o’clock one
• System: I understand you want to book one seat on the 05.00 o’clock flight from Kathmandu to Dhangadi on 08.11.2007. Is that right?
Flight information and flight reservation – sample dialog

- User: yeah
- System: Please say your last name:
- User: Scutts
- System: What is your first name initial?
- User: J
- System: Please choose one: Mr., Mrs. Miss child
- User: Mr. of course
- System: Would you like to fly: Business or regular class?
- User: the class, uhh, regular
- System: The ticket is for: Mr. J. Scutt, regular class?
- User: Yes
- System: Your reservation has been made. Thank you and have a pleasant flight. (no payment here. Needs to talk about that?)
Flight information and reservations

System: Welcome to MacAir automated domestic flight booking and enquiry service.
You can book a ticket, enquire about prices and flight times.
Please say either booking, times or prices.

User: Booking.

System: Please say and then spell your full name.

User: Barry White BARRYWHITE.

System: Was that Barry White BARRYWHITE?

User: Yes.

System: Please say your suburb or postcode.

User: West Ryde.

System: Was that Ryde?

User: No.

System: Please say your suburb or postcode.

User: 2114.

System: Was that 2114?

User: Yes.

System: Would you like to travel from Sydney Domestic Airport?

User: Yes.

System: What city or airport would you like to travel to?

User: Melbourne.

System: Is Melbourne Airport ok?

User: Yeah.

System: On what date would you like to depart Sydney Domestic Airport?
Flight information and reservations

User: Wednesday the 10th of December.
System: At what time would you like to leave?
User: Ah, 2pm.
System: There is a flight at 4:20pm. Is that ok?
User: Sure.
System: Would you like a return ticket?
User: Yes, please.
System: On what date would you like to return?
User: Sunday, the 15th of January.
System: At what time would you like to leave?
User: Hmm, 9am
System: There is a flight at 9:20am. Is that ok?
User: Sure.
System: You are traveling to Melbourne Airport on 10th December at 4:20pm.
Returning on the 15th of January at 9:20am.
Is that correct?
User: Yes
System: Your reference number is 654321. You will need it to purchase your ticket.
Would you like your reference number repeated?
User: No
System: Remember to purchase your ticket with the next …days from your local travel agent.
Thank you for using MacAir. Please call again.
Flight information and reservations

"Welcome to MacAir automated domestic flight booking and enquiry service"

"You can book a ticket, enquire about prices and flight times."

"Please say either booking, times or prices"

Booking

"Please say and then spell your full name"

Time

Table

Prices

"Was that …?"

No

"Thank you for using MacAir. Please call again."

Yes

Flight booking

"Was that …?"

No

"Please say your suburb or postcode"

Yes

"Would you like to purchase your ticket now?"

Yes

Purchase Ticket

No

"Remember to purchase your ticket with the next …days from your local travel agent."

No

"Was that …?"
Flight Booking Dialogue

- "Would you like to travel from ….?"
  - Yes: current = to
  - No: "From which city or airport would you like to travel from?"

- "What city or airport would you like to travel to?"
  - Airport rec.

- "Would you like a return ticket?"
  - Yes: ticketType = return
  - No: "Would your like your ref. no. repeated?"
    - Yes: Reference number
    - No: "Your reference number is … You will need it to purchase your ticket."

- "Would you like your ref. no. repeated?"
  - Yes: Reference number
  - No: Is that correct?
    - Yes: You are traveling to … on … at …
    - No: Operator

- You are traveling to … on … at …
  - Return date & time
  - "Your reference number is … You will need it to purchase your ticket."
Flights: Example Dialogue

System: Welcome to the Automated Airline Ticket Agent. Which cities do you want to fly to and from?
User: Adelaide to Sydney
System: What date and time do you want to fly?
User: the 12th of October 2007 at 7 pm.
System: Flight 123 from Adelaide to Sydney on the 12th October 2007 at 7:15pm is available, do you want to make a booking?
User: Yes
System: Please state the name of the person the booking is for?
User: John Smith.
Flights: Call Flow Diagram

Main Dialog

Welcome to the Automated Airline Ticket Agent.

ToFrom Subdialog

DateTime Subdialog

<FlightNo> from <Origin> to <Destination> on <Date> at <Time> is available, do you want to make a booking?

Yes

Please state the name of the person the booking is for.

Name

Name = “Name”


ToFrom Dialog

Which cities do you want to fly from and to?

Origin and Destination

No Input or No Match

Which city are you flying from?

Origin = “Origin”

Origin = “Origin”

Which city are you flying to?

Destination = “Destination”

Destination = “Destination”

Origin not equal Destination

Yes

Origin and destination cities cannot be the same.
Flights: Call Flow Diagram

DateTime Dialog

What date and time do you want to fly?

Date = "Date"

What time do you want to fly?

Time = "Time"

Date = getFlightNo(Origin, Dest, Date, Time)

No Input or No Match

Date and Time

Date = "Date", Time = "Time"
Welcome to VoiceXML Flight Agent.

Please choose flight information or reservations.

Information Subdialog

Reservation Subdialog

Do you want to make another enquiry?

Yes

No

Goodbye
Flight (information subdialog)

Enter subdialog

What is your origin, and where are you going?

On what date and time do you want to arrive "to"?

There is a flight arrived "to" at "time" .......................

Do you want to find another flight?

Next Flight?

Exit subdialog

Retry

Flight exists?

Correct

Incorrect name of route

Sorry, there are no flight available on "date" at "time".

Yes

No

Yes

No
Flight (reservation subdialog)

Enter subdialog

Your name?

What is your origin, and where are you going?

On what date and time do you want to depart “origin”?

How many tickets?

There is a flight departs at “time”. Price

Do you want to book this flight?

Would you like a first, business or economy class?

Flight exists

Sorry, there are no flight available on “date” at “time”.

You have booked this flight.

Exit subdialog
System: Hello, welcome to Prism Automated Flight Reservation Service. Where do you want to go?
User: from Seoul to Vancouver
S: round trip?
U: yes please
S: Departing from Seoul on what date?
U: december 15th
S: Would you like to leave in the morning or afternoon?
U: evening please
S: I'm sorry there are no available evening flights. Please choose either morning or afternoon.
U: afternoon
S: There is a flight on Singapore airlines priced at 1000 dollars. The flight departs from Incheon International airport at 3pm. Would you like more information about this flight?
U: Yes.
S: This is a non-stop flight from Seoul to Vancouver. Total Flying time is 9 hours. 7 seats are currently available. Tax is not included. Would you like to hear this again?
U: No
S: Select this flight?
U: Yes
System: Ok. Departing from Vancouver on what date?
User: january 22nd evening please
S: There is a flight leaving Vancouver International Airport at 8pm. Would you like to hear more information about this flight?
U: yes.
S: This is a non-stop flight from Seoul to Vancouver. Total Flying time is 10 hours and 30 minutes. 27 seats are currently available. Tax is not included.
Would you like to hear this again?
U: no
S: Select this flight?
U: yes
S: You have chosen a flight on Singapore Airlines departing from Incheon International Airport in Seoul on December 15th at 3pm. You have chosen a return flight departing from Vancouver International airport in Vancouver on January 22nd at 8pm. Would you like to book this flight?
U: yes
S: What is the name of the person who will be travelling?
U: Stephen Bodnar
S: Ok, the reservation for Stephen Bodnar has been confirmed. Thank you for using Prism. Goodbye.
Lessons Learned

• Think about use cases: how do you interleave information and transaction dialogs?

• Look at web sites for ideas on how to integrate information and transaction dialogs – but ideas may not be transferrable …

• Scope for negotiation over complex information objects makes these dialogs potentially very complex

• Recognising the names of unregistered users is a problem

• Don’t lead the user down the garden path! Think carefully about the order in which information is gathered
A Look at Sample Solutions

• Auto attendants
• Stock quotes and stock trading
• Flight information and flight reservations

• Email access
• Calendar managers
Email access – sample dialog

- System: Welcome to Buddha-mail’s automated email access services.
- System: You need to start by logging into the system with your username and password. If you don’t already have an account please visit our website or call: 800 888

- System: Username?
- User: Scutts
- System: Password?
- User: 5 2 9 A 7 Y 2
- System: Sorry, the password for Scutts is not correct. It must be at least 8 digits long. Please try again:

- System: Password?
- User: 5 2 9 A 7 7 Y 2
- System: You have two new messages
- System: Do you want me to read them for you?
- User: yes
- System: You can go through your messages by saying next or previous. You can say delete if you want to delete the message. Say help if you need more help.
Welcome to Buddha-mail’s automated email access services. You can leave at any time by saying exit.

If you don’t already have an account please visit our website or call: 800888. If you have an account login with your user name.

Say Password

Valid

Not valid

User name is not valid

Not valid

Password is not correct for account “username”. Note! Passwords have to be 8 letter/digits long.

Do you want me to read your messages?

Yes

No

Exit

Valid

You have “n” unread messages. The system can read your unread messages. When message has been read you may “delete” “reply” and/or request for “next” message.

Do you want next message?

Yes

No

Are you sure?

Yes

Your message is deleted.

No

Your message is sent.

Are more?

Yes

What do you want to do now?

No

You have no more messages.

You can read a simple message.

Your message is sent.
Email access – sample dialog

- System: E-mail from: AA Subject: xxx Email: xxxxx
- User: next
- System: E-mail from: AA Subject: xxx Email: xxxxx
- User: Delete
- System: Are you sure you want me to delete the message from: AA
- User: Yes, please delete it.
- System: You don’t have any more unread messages. Thank you for calling.
Email Access

System: Welcome to VeMail, your secure and convenient email reader. Are you a registered user?
User: Yes.
System: Please say your 10 digit login id.
User: 0298741504
System: Please say 5 random digits.
User: Welcome Isacc.
System: You have 2 new messages.
Say list to get a list of commands.
User: Next.
System: Subject You read too much
I’m worried about your health Asi. You need some fresh air.
User: Next.
System: Subject You spend too much time writing
Maybe you should have a break.
User: Sort by Subject
Next.
System: Subject Albatrosses a danger from above.
Date 25/3/05
Watch out from above.
User: HUNG UP
“Welcome to VeMail, your secure and convenient email reader.”

Are you a registered user?

Yes

“Please say your 10 digit login id”

Id exists?

No

“Welcome …”

voice does not match

Yes

“Pleases say five random digits”

voice matches

No

New Messages?

Yes

New Messages?

No

“Say list to get a list of commands”

Say list to get a list of commands

Command list

Would you like to sort by subject, name, or date?

Sort by …

Sort by …

Traverse messages in direction

direction = next
direction = back

total = 0?

No

“Subject … date …” Message

Yes

“No message available”
System: Welcome to the Automated Email Agent. Please state which email box you want to review inbox or outbox?
User: Inbox
System: State the date you want review mail for.
User: Today
System: You have 1 email for today. Do you want more information?
User: Yes
System: Email received from Jane Smith at 12 pm with subject Lunch. Message reads Hi John, see you in the cafeteria for lunch tomorrow. Would you like to start again?
User: No.
System: Thankyou for using Automated Email Agent. Bye.
Email: Call Flow Diagram

Main Dialog

Name = "", BoxType = ""

Welcome to the Automated Email Agent.

Please state which email box you want to review inbox or outbox?

Review

ReviewEmail Subdialog

Would you like to start again?

Yes

No

Thankyou for using Automated Email Agent. Bye.

ReviewEmail Subdialog

Date = ""

State the date you want review mail for.

Date

Date = "Date", NoEmails = getNoEmails(Date), Emails = getEmails(Date)

You have 1 email for <date>. Do you want more information?

Yes

Email received from <FromAddress> at <Time> with subject <Subject>. Message reads <Body>.
Email Access

Welcome to VoiceXML Email.

Please say your email address.

Correct

Valid email and password

Yes

Check Email Subdialog

Goodbye

No

Nomatch = 0

Sorry, invalid email.

Please say your username followed by a domain.

Nomatch += 1

Nomatch = 2

Sorry, I still don’t understand.
Let’s take this step by step.

Please say your password.

Please say your email domain. For example, yahoo.

Please say your username.
Enter subdialog

Unread=0, order ="
Check unread mail

Unread+=1, order ="first"

You have no new mail.

You have “unread” of unread mail.

Do you want to read the “order” mail from “sender”?

No

You have no more unread mail.

Mail title, from, body

More?

order="next"

Yes

No

Exit subdialog
System: Welcome to Mmail. Userid please.
User: super underscore cat
S: Please enter your secret pin number using your phone's keypad.
U: 12341234
S: Hello Super Cat. You have 2 new messages.
   The first 3 messages in your inbox are:
   One. New Message from Jackie with subject: what's going on?
   Two. New Message from Carol with subject: have you made plane reservations?
   Three. Mail from KTF with subject: Your October phone bill is due.
   To hear the contents of one of these messages, say the message number.
   To hear the next three messages, say next.
U: number one
S: Mail from Jackie. Hi Steve, I'm going to be in Seoul next Friday and I
   thought we might hangout if you've got time. Send me an email and
   let me know. Jackie.
   End of mail.
   Do you want to hear this again?
U: no
S: Ok. Hear message descriptions again?
U: yes
Email Access – contd.

System: You have 1 new message.
The first 3 messages in your inbox are:
One. New Message from Carol with subject: have you made plane reservations?
Two. Mail from Jackie with subject: what's going on?
Three. Mail from KTF with subject: Your October phone bill is due.
To hear the contents of one of these messages, say the message number.
To hear the next three messages, say next.
User: one
S: Mail from Carol. Hi Steve, It's Mum. Just wondering whether you've
booked plane tickets for Christmas or not yet. We're trying to get
everybody's schedule sorted out. Anyway get back to me when you
have time alright?
End of mail.
Do you want to hear this again?
U: no
S: Ok. Hear mail descriptions again?
U: no
S: What would you like to do?
U: logout
S: Ok Super Cat, you've been logged out of the system. You may now hang up.
Welcome to Mmail. Userid please.

STORE USER_ID

Please key in PIN?

STORE PIN

Load next 3 messages

The first/next 3 messages in your inbox are:
One. New mail from <sender> with subject <subject1>.
Two. New mail from <sender> with subject <subject2>.
Three. Mail from <sender> with subject <subject3>.

To hear a mail's contents, say read and the mail number.
To hear the next three messages, say next.

STORE ACTION

read

Mail from <sender>. <Mail contents>. End of Mail. Hear this again?

yes

no

next

logout

That was the last message in your mailbox. Would you like to start over?

yes

no

Ok, you've been logged out. Have a nice day.

yes

no
Lessons Learned

• Key design decisions:
  – How do you deal with sending emails?
  – How do you deal with reading long emails?
  – How do you deal with navigating large email folders?
A Look at Sample Solutions

- Auto attendants
- Stock quotes and stock trading
- Flight information and flight reservations
- Email access
- Calendar managers
Calender manager – sample dialog

- System: This is the automated Calendar Manager service.
- System: You need to give me your login information to start with.
- System: Login name?
- User: scutts
- System: Password?
- User: A 5 4 3 9 Y X
- System: You can get your scheduled events, add a new event or edit an event. Please choose one of: schedule, add or edit
- User: I need my schedule
- System: For which date do you want your schedule?
- User: tomorrow
- System: You have two scheduled events for tomorrow.
- System: At 8.00 o’clock, meeting Mr. John no venue given
- System: At 16.00 o’clock birthday, Comment: remember cake
Calender manager – sample dialog

- System: You have no more scheduled events for tomorrow.
- System: Do you want to hear that again?
- User: no
- System: Do you want to get a schedule, add, edit or quit?
- User: quit
- System: Thank you for calling, goodbye
This is Calendar manager
Your friendly automated Organizer
You can leave the system at any time by saying exit

Log in with user name and password

Username or password not valid

You can get your scheduled events, add a new event or edit an existing event. Please choose one of: schedule, add or edit

For which date do you need your schedule

For which date do you want to add an event

For which date do you want to edit an event

For "date" you have N scheduled events
1. "time" with "name" at "venue" remark "x"
   n. "time" with "name" at "venue" remark "x"

You have no more events

For "date" you have N scheduled events
1. "time" with "name" at "venue" remark "x"
   n. "time" with "name" at "venue" remark "x"

Your event has been saved

For which date do you want to edit an event

Which event do you want to edit

Change time
Change whom
Change venue

Which time
With whom
Remarks

Time changed
Whom changed
Venue changed
Calendar Manager

System: Welcome to VeCal, the convenient and secure voice-enabled calendar manager. Are you a registered user.
User: Yeah.
System: Please say your 10 digit login id.
User: 0295311726
System: Please say 5 random digits.
User: 54321
System: Welcome Albert.
Godel’s birthday in 2 weeks.
Conference meeting on atomic energy in 4 days.
Would you like to browse?
User: Yes.
System: The selected date is 8th of October 2007.
Say list to get a list of commands.
User: Next 10 days.
System: The selected date is 18th of October 2007.
User: Add.
System: Please say either event, birthday, holiday or note.
User: Note.
System: Say the note when your ready.
User: It is easier to denature plutonium than the evil spirit of man.
End.
System: Would you like to customize?
User: No.
System: Thank you for using VeCal.
"Welcome to VeCal, the convenient and secure voice-enabled calendar manager"

"Are you a registered user?"

Yes

"Welcome…"

voice matches

"Please say five random digits"

voice does not match

"Welcome…"

No

"Please say your 10 digit login id"

id exists?

Yes

"You can browse, add calendar entries or customize VeCal"

"Would you like to browse?"

Yes

"Load personal settings"

"Would you like to customize?"

Yes

"To add or edit entries first browse to the date of interest."

No

"Would you like to customize?"

No

"List first … b’days"

"show reminders?"

Yes

"Thank you for using VeCal"

No

"Would you like to browse?"

No

"show b’days?"

Yes

"Are you a first use?"

No

"Voice Print Registration"

Yes

"Show b’days?"
Browse Dialogue

Select last date chosen after login?

- Yes
  - The selected date is...
  - Select today's date
  - "Say list to get a list of commands"
- No

Date selected after login?

- Yes
  - Select today's date
  - "Say list to get a list of commands"
- No

Entry at selected date

Delete entry at selected date

Go to entry at current date

Entry at current date

Save recording at entry

Each entry has a type to help identify it.

Please say either event, birthday, holiday or note first use?

- No
  - "Say the... when you are ready"
- Yes

Read entry

Delete entry

End entry
Welcome to VoiceXML Calendar Manager.

Please say your username.

Do you want to manage your calendar?

Today Event?

Your today event is ......

Yes

No

Please enter your password.

Invalid username/password

Retry

Calendar management subdialog

Goodbye.

Calendar managers
Calendar (management subdialog)

Enter subdialog

Would you like to edit or check your calendar?

Edit subdialog

Check subdialog

Exit subdialog
Would you like to add, change or delete your schedule?
Calendar (Add subdialog)

Event exists

Do you want to hear all events in this period?

Yes

"Event"

Do you want to add another?

No

A new event is added on date at time.

Exit subdialog

Add

Enter subdialog

From date & time?

To date & time?

Please say your event description.

Yes

No

No

Yes

No
Enter subdialog

Date & time?

Do you want to hear the events in this period?

Yes

“Event”

Do you want to delete this event?

Yes

A event has been deleted on date at time.

No

No event on date at time.

No event on date at time.

No

No event on date at time.

No

No event on date at time.

No

Exit subdialog

delete

Calendar (Delete subdialog)
Calendar (Check subdialog)

- Date & time?
  - Event exists
    - Yes
      - "Event"
      - Exit subdialog
    - No
      - No event on date at time.
  - Check
Calendar Managers

System: Welcome to PlanIt Calendar Service. Please say your name and password to login to the system.
User: Bill Robson, 3 m o n k y 1 3 2
S: Thank you Bill. Today is Monday, October 8th. The time is 5:30am. Do you want to hear about today's schedule?
U: yes please
S: Today you have 2 appointments, at 9am and 1pm. Which appointment would you like to hear about?
U: all of them
S: at 9 o'clock this morning you have a Google job interview. Hear notes about this?
U: yes
S: Job interview with Google downtown at Coffee Bean. Take red subway line to Jamsil, transfer to green line. get off at Kangnam station. Informal. bring code sample. Would you like to hear this again?
U: no thanks
S: at 1pm you have lunch with Jaewoo. Hear notes about this?
U: no thanks
S: That was the last appointment scheduled for today. What would you like to do?
U: birthdays please.
S: There is one upcoming birthday.
   Bianca has a birthday next Wednesday, on October 17th.
   That was the last upcoming birthday.
   What would you like to do?
U: what are my schedules for October 17th?
S: you have 1 appointment scheduled for Wednesday, October 17th.
   at 10am, Golf with Marcus.
   Hear notes about this?
U: no thanks.
S: That was the last appointment for October 17th.
   What would you like to do?
U: move October 17th 10am appointment to the next day.
S: You want to move Golf with marcus, scheduled at
   10am on October 17th to 10am on Thursday, October 18th. Is this correct?
U: yes
S: Ok. The appointment has been rescheduled.
   What would you like to do?
U: make an appointment for this saturday at 1pm
S: A new appointment for October 13th at 1pm. Is this correct?
U: yes
S: Please describe the appointment in one brief sentence.
U: buy Bianca birthday present
S: Would you like to add some notes?
U: no
S: buy Bianca birthday present has been scheduled for Saturday October 13th at 1pm.
  What would you like to do?
U: I'm finished
S: Thank you for using PlanIt Calendar Service. Goodbye.
Lessons Learned

• Key design decisions:
  – What are typical use cases?
  – How do you deal with adding new events?
  – How do you deal scheduling conflicts?
Application Complexity: Auto Attendant

- Recognition Vocabulary:
  - Potentially large, depends on specific instance of use
- Dialog Complexity
  - Simple
- Dialog Initiative
  - Can be retained by the system
- Syntactic Complexity and Grammar Coverage
  - Simple
- Personalisation
  - Not much opportunity
Application Complexity: Stock Quotes and Trading

- Recognition Vocabulary
  - Large: depends on size of stock exchange
- Dialog Complexity
  - Very complex if trading is included
- Dialog Initiative
  - User experience much improved if the user can take initiative
- Syntactic Complexity and Grammar Coverage
  - Moderately complex, particularly if mixed initiative is permitted
- Personalisation
  - Some scope based on user portfolio and history
Application Complexity: Flight Information and Reservations

- Recognition Vocabulary
  - Very large, mostly because of large number of destinations
- Dialog Complexity
  - Very complex, because of scope for negotiation over complex information objects
- Dialog Initiative
  - User experience much improved if the user can take initiative; difficult to achieve transactional processing without user initiative
- Syntactic Complexity and Grammar Coverage
  - High, particularly because of time and date negotiations
- Personalisation
  - Some scope based on user profile and history
Application Complexity: Email Management

- Recognition Vocabulary
  - Small vocab if email reading only; very large vocab if email sending functionality required
- Dialog Complexity
  - Complex because of need for list management and navigation
- Dialog Initiative
  - Can be mostly system-driven
- Syntactic Complexity and Grammar Coverage
  - Relatively simple for email reading
- Personalisation
  - Scope for making use of user preferences
Application Complexity: Calendar Management

- Recognition Vocabulary
  - Small vocab if calendar interrogation only; very large vocab if calendar content update required
- Dialog Complexity
  - Potentially very complex if scheduling conflicts need to be handled
- Dialog Initiative
  - Can be system-driven but user experience will be improved with some mixed initiative
- Syntactic Complexity and Grammar Coverage
  - Moderate complexity for calendar interrogation
- Personalisation
  - Scope for making use of user preferences and history
Application Complexity: Recognition Vocabulary

- Email management:
  - Small for reading email: 100-200 words; very large for recognizing email: 100s of thousands of words

- Calendar management:
  - Small for reading email: 100-200 words; very large for recognizing email: 100s of thousands of words

- Auto attendant:
  - Potentially large, depends on specific instance of use; ~100s of entries

- Stock quotes and trading:
  - Large: depends on size of stock exchange; ~1000s of entries

- Flight information and reservations:
  - Very large, mostly because of large number of destinations: ~tens of thousands?
Application Complexity: 
Dialog Complexity

• Auto attendant:
  – Simple
• Calendar management:
  – Potentially very complex if scheduling conflicts need to be handled
• Email management:
  – Complex because of need for list management and navigation
• Stock quotes and trading:
  – Very complex if trading is included
• Flight information and reservations:
  – Very complex, because of scope for negotiation over complex information objects
Application Complexity: Dialog Initiative

- Auto attendant:
  - Can be retained by the system
- Email management:
  - Can be mostly system-driven
- Calendar management:
  - Can be system-driven but user experience will be improved with some mixed initiative
- Stock quotes and trading:
  - User experience much improved if the user can take initiative
- Flight information and reservations:
  - User experience much improved if the user can take initiative; difficult to achieve transactional processing without user initiative
Application Complexity: Syntactic Complexity and Grammar Coverage

- Auto attendant:
  - Simple
- Email management:
  - Relatively simple for email reading
- Calendar management:
  - Moderate complexity for calendar interrogation
- Stock quotes and trading:
  - Moderately complex, particularly if mixed initiative is permitted
- Flight information and reservations:
  - High, particularly because of time and date negotiations
Application Complexity: Personalisation

- Auto attendant:
  - Not much opportunity
- Flight information and reservations:
  - Some scope based on user profile and history
- Email management:
  - Scope for making use of user preferences
- Stock quotes and trading:
  - Some scope based on user portfolio and history
- Calendar management:
  - Scope for making use of user preferences and history
Relative Complexity:
This is NOT Scientific …

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<td>Attendant: 7</td>
<td>3</td>
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• A Review of the Tutorial Task
• Speech Recognition: How It Works
Context: The Architecture of an SLDS

- Speech Recognition
  - Language Understanding
  - Dialog Management
  - Database
  - Language Generation
  - Speech Synthesis
Today’s Focus: From Acoustic Signal to Word Sequence

Phoneme Sequence

you’re standing on my foot

Word Sequence
Outline

- Describing Speech Using Phonemes
- Acoustic Models
- The Lexicon
Speech vs Text

- **Sentences** consist of sequences of words; in text these are delimited by spaces (to a first approximation)
- When we produce speech, there are no markers for word boundaries
Example

- It's easy to recognize speech
- It’s easy to wreck a nice beach
Describing Speech

• **Speech** can be described as a sequence of **phonemes** or phonetic segments

• To identify words, we need to search for an interpretation within the phoneme sequence
The Recognition Task

1. Work out what sequence of phonemes has been spoken
   • Uses an acoustic model

2. Segment this sequence of phonemes into words
   • Uses a lexicon and a language model
Terminology

- **Phonetics:**
  - deals with the production of speech sounds by humans, often without prior knowledge of the language being spoken

- **Phonology:**
  - is about patterns of sounds, especially different patterns of sounds in different languages
What is a Phoneme?

- A phoneme is the smallest segment of sound that can distinguish two words.
- Phonemes are mental abstractions: a phoneme is a family of speech sounds (phones) that we think of, and usually hear as, a single sound.
- If you change a phoneme within a word, you get a different word:
  
  /kat/ → /mat/
How Many Phonemes are There?

- Depends on the language
  - English has 40–45 phonemes
  - Pirahã (spoken by the Pirahã people in Brazil) has 10
  - !Xóõ (spoken in Botswana and Namibia) has 141
- Depends on the dialect
  - In some US English variants, 'merry', 'marry' and 'Mary' are phonetically indistinct
Some Phonemes

• Vowels
  – monophthongs (hat, bet, sit, pot, cut)
  – diphthongs (height, eye)

• Consonants
  – Stops (pat bat cat tat)
  – Fricatives (fat sat shat)
  – Nasals (mean, nose)
  – Flaps (rider)
  – Glides (window, yacht)
Phonetics

• Phonemes provide a categorical description of speech sounds.

• In real speech, there are no hard boundaries between the categories: we use context to disambiguate.
  
    He was a good cook.
    
    We knew he could cook.

• Each phoneme can be realised in different ways depending on context and speaker: these are called allophones.
How Do We Write Phonemes?

- IPA: the International Phonetic Alphabet

- See the Wikipedia entry for more information including audio files of phonemes
<table>
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<tr>
<th>Phonetic Category</th>
<th>Phoneme</th>
<th>Example</th>
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<td>s</td>
<td>sit</td>
<td>z</td>
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Variability in Speech

• The main problem for speech recognition is coping with the variability of the speech signal
• Phonemes vary with context, speaking rate, accent …
• Words have alternate pronunciations and pronunciations can change based on speaking rate:
  Photograph: /fotograf/ or /fod@graf/
• Individual speakers vary in their physiology, accent, state of health
• All of this combines to mean that no two utterances of a word or phrase will look exactly alike
Outline

• Describing Speech Using Phonemes
• Acoustic Models
• The Lexicon
Feature Extraction

• Spoken speech converted to frames of a few milliseconds each
• Frames converted to digital form via feature extraction
• Each frame represented as a feature vector, containing frequency and energy information: eg one vector of 30 numbers every 100ms
• The goal of feature extraction is to:
  – remove the parts of the signal that don’t contribute to phonetic identity (e.g. pitch, transmission line noise)
  – reduce the amount of data that the pattern matcher has to process
The Elements of Speech Recognition: Building Acoustic Models

- Signal Capture
- Feature Extraction
- Model Generation
- Acoustic Models
The Elements of Speech Recognition: Using Acoustic Models

- Signal Capture
- Feature Extraction
- Pattern Matching
- Result Processing
- Language Model
- Model Generation
- Acoustic Models
Pattern Matching

- Compare the input signal with a number of stored acoustic models to see which fits best
- The models need to be able to cope with different lengths of input sequence and variation in the production of sounds
- The models used are statistical pattern matchers called Hidden Markov Models
- Given an input sequence, a trained HMM can tell you the probability that the sequence matches those it was trained on
- Typically, HMMs are built for each phoneme plus silence/noise
Acoustic Models

- A different acoustic model set will be required for each different dialect.
- Acoustic models available via the Nuance web site:
  - North American English, UK English, Australian/NZ English, Singapore English, South African English, French, German, Portuguese for Brazil, Swedish, Japanese, Mandarin/Taiwan, Swiss German, Cantonese, Canadian French, Norwegian, Spanish American, Italian, Czech, ...
- Warning — Nuance generally uses the term 'Language Model' instead of 'Acoustic Model'.
Outline

- Describing Speech Using Phonemes
- Acoustic Models
- The Lexicon
The Lexicon

- Lexicon = Dictionary File
- Defines the mapping between orthographic words and phoneme sequences
- The recognizer:
  - hypothesises phoneme sequences on the basis of the acoustic model
  - uses the lexicon to map the hypothesized phoneme sequence to a hypothesized word
A Sample Dictionary File

able  e b ^ l
adam  a ! m
agent  e dZ n t
alive  l aj v
aphid  e f d
apple  a p l
asked  a s k t
ball   b O l
bird   b *r d
book   b U k
bought b O t
butter b ^ ! r
cat    k a t
cought k O t
child  tS aj l d
ccoat  k o t
compass k ^ m p s
confuse k * n f j u z
cow    k aw
ccry   k r aj
dogs   d A g z
dogs   d O g z
echo   E k o
even   i v n
father f A D *r
focus  f o k * s
golf   g A l f
grammar g r a m *r
hotel  h o t E l
india  I n d i *
iraq   * r A k
iraq   I r A k
iraq   aj r A k
A Fragment of a Suburbs Dictionary

abbotsbury  a b * t s b r i
abbotsbury  a b * t s b * r i
abbotsford   a b * t s f * d
abbotsford   a b * t s f O d
acacia_gardens  * k e s i * g A d * n z
acacia_gardens  * k e S i * g A d * n z
acacia_gardens  * k e S * g A d * n z
acacia_gardens  * k e S i * g A d n z
acacia_gardens  * k e S i * g A d n z
acacia_gardens  * k e S * g A d n z
How Many Words?

- A typical desk dictionary contains around 50000–150000 entries.
- In 44 million words of Associated Press newswire text collected over 10 months, there were 300000 different word types.
- It has been suggested that by age 17 we know 80000 words.
- Your active vocabulary may be ~20000 words while your passive vocabulary is ~100000 words.
- It has been estimated that foreign students need more than 20000 words as passive vocabulary and at least 10000 as active vocabulary to attend college in an American university.
Take-home Messages

• Speech contains variability from many sources, most of which make ASR more difficult

• ASR uses acoustic models: statistical models of phonemes which are combined into networks corresponding to words and phrases

• A lexicon maps phoneme sequences to orthographic words

• Next: Using a language model to constrain what words we consider as possibilities