

AI and Natural Language VUI design



Peter Trompetter, VP Global Development GyrusLogic, Inc.
Tuesday, August 21 at 1:30 PM - C202 - "AI & VUI Design"



"Just Say It"





“Just Say It”



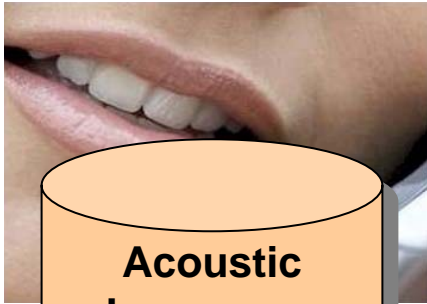
GyrusLogic the Company

GyrusLogic, Inc.

- Phoenix, AZ, USA
- Incorporated in 2001
- Privately funded
- Technology
 - 25,000+ hours of software development
 - University projects
 - **3 Patents granted**
 - *Fuzzy & Exact dialog processing*
 -
 -



<http://GyrusLogic.com> - (+1) 602 - 432 1995 - contact@GyrusLogic.com



Language Processing

Speech Input



GYRUSLogic

Acoustic
Language
Models
Word Lists



Speech
Recognition

What does the speaker
say?

Grammar
Lexical
Meaning



Speech
Analysis

What does the speaker
mean?

Discourse
Context
Knowledge
about Domain
of Discourse



Speech
Under-
standing

What does the speaker
want?

Unambiguous
Understanding in the
Dialog Context

The Right Answer

Reduction of Uncertainty





Challenges with Open Ended Dialogs

- Conversations and human responses can be unpredictable
 - In many cases, it is impossible to design a dialog flow that anticipates all user's responses.
 - Case statements, if-then-else and mix-initiative will not do the trick.
- Phrases must be well understood
 - Just picking up keywords doesn't do the trick. The meaning of the phrase must be captured.
- Must recognize the difference between a question and a response.
- Distinguishing between exact questions and vague questions
- Find the single best response to the question
- Must keep track of the context of the conversation.
 - What were we talking about, and is the user now talking about something different?
- Finish the transaction on what information we need.
- Keep the development effort to the minimum.



An Artificial Intelligence (AI) Solution

- Conversations and human responses can be unpredictable
 - Use AI techniques to build the dialog on the fly, rather than attempting to script the dialog.
- Phrases must be well understood
 - Use a combination of semantics and syntax with computational linguistics.
- Distinguish between a question and a response.
 - Use multiple engines: answer engine and a response engine.
 - A broker must recognize which engine to use
- Distinguish between exact questions and vague questions
 - Use multiple grammars: user defined grammars and universal grammars that define as a vague question what it is not precisely defined in the user grammar.
- Find the single best response to the question
 - Perform computational linguistics for matching the semantics of the question with the semantics of the database repository.
 - Perform AI search techniques with heuristics for sorting through possible answers



"Just Say It"



Natural Language Understanding

- Traditional approaches for Natural Language Understanding (NLU)
 - Statistical Language Modeling (SLM)
 - Statistical Semantic Modeling (SSM)
 - *"Say Anything"* , *"Speak Freely"*
 - Transcription of 20 - 30,000 utterances
 - Procedural developments
- **GyrusLogic Platica approach for Natural Language Understanding**
 - **Robust Linguistic** approach coupled with Artificial Intelligence (no SLM)
 - **Full conversational capabilities** (no transcriptions)
 - Easy **industry standard** solution (no proprietary scripting)
 - Interfacing existing "Voice" environments (IVR, ASR, TTS, VoiceXML)
 - Declarative developments
 - **Significant less effort, with additional operational savings and more application functionality**



Typically Two Types of Requests

- *A Fuzzy request:*

- They can be **spontaneous**, arbitrary, ad-hoc, and/or vague
- The majority of user queries are **fuzzy** questions
- The best approximation to satisfy the request
- User expected accuracy, completeness and an **answer the first time**

- **Do I have some bucks in my account?**
- **How much money do I have?**
- **What is the amount of the last deposit?**

- *An Exact request:*

- **Specific transactions** don't allow for fuzzy approach, but they can still be spontaneous. (**expanded directed dialog**)

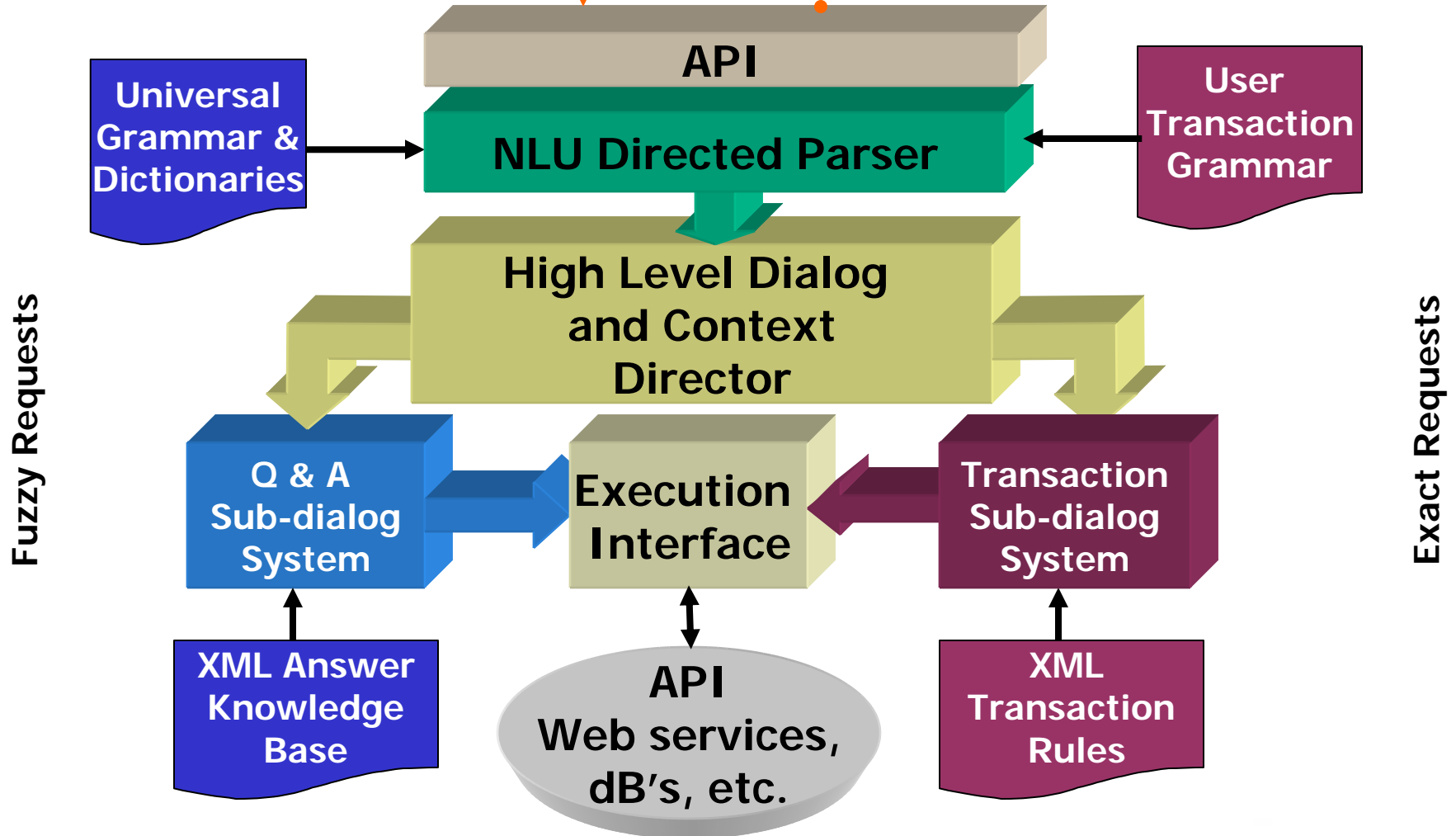
- **Transfer \$100 from checking to savings**
- **Did check number 123 clear on July 1st.?**
- **I want to travel at 3pm today from Phoenix to Burbank**



Platica Server Architecture



N-best input  Prompts to play (TTS and/or Audio) 





Typical Dialog with GyrusLogic

System: How can we help you?

User: I would like to transfer funds from my checking to my savings.

System: How much money do you want to transfer?

User: How much money do I have in my savings account?

System: The balance in your savings account is 4000 dollars.

I apologize for asking again, how much did you want to transfer?

User: Five hundred.

System: Ok, let's review this transaction, you want to transfer 500 dollars from your checking to your savings, is this correct?

User: No, actually transfer a thousand bucks from savings!

System: Ok, let's review this transaction, you want to transfer 1000 dollars from your savings to your checking, is this correct?

User: Yes

System: How else can we help you?

User: What are the last five transactions in my checking?

System: The last three transactions in your checking account are....

Note how the user can be spontaneous and say as much as he wants

Interruption of dialog with any question, even if it was unrelated

The system resumes the previous dialog and requests the missing information

User can make a correction on the fly at any point in time

The system still handles the question effectively without coding of business rules



XML Transaction Rules Example



REQUEST is activated when certain information **IS** provided

STATE is activated when a piece of information **IS NOT** provided.

CONFIRMATION is activated when information for all states is provided.

OBJECT invokes user's backend API

XML Transaction Rules only apply for **Exact Requests**

```
<REQUEST name="transfer" type="action">
  <STATE type="AMOUNT">
    <PROMPT>how much would you like to transfer? </PROMPT>
  </STATE>
  <STATE type="ORIGIN">
    <PROMPT>from which type of account would you like to transfer?</PROMPT>
  </STATE>
  <STATE type="DESTINATION">
    <PROMPT>to what type of account would you like to transfer? </PROMPT>
  </STATE>
  <CONFIRMATION>You want to transfer AMOUNT dollars, from your ORIGIN to your DESTINATION. Is this correct? </CONFIRMATION>
  <OBJECT name="com.gyruslogic.GyrusExamples.BankingDemo">
    <METHOD name="transfer">
      <PARAM>AMOUNT</PARAM>
      <PARAM>ORIGIN</PARAM>
      <PARAM>DESTINATION</PARAM>
      <RESULT>ACTION_MESSAGE</RESULT>
    </METHOD>
  </OBJECT>
</REQUEST>
```



XML Answer Knowledge Base Example

<GYRUS>

OBJECT invokes user's backend API

<OBJECT name="com.api.BankingDemo">

<METHOD name="queryDatabase">

<PARAM>ACCOUNT</PARAM>

</METHOD>

<METHOD name="getBalanceSav">

<RESULT>SAVEBALANCE</RESULT>

</METHOD>

</OBJECT>

<ANSWER_TEMPLATE>

<ANSWER>The current balance in your savings account is SAVEBALANCE dollars </ANSWER>

<ANSWER>There are no fees with your existing accounts. </ANSWER>

<ANSWER>There is no debit or credit limit with your existing accounts. </ANSWER>

</ANSWER_TEMPLATE>

</GYRUS>

XML Answer Knowledge Base only applies for **Fuzzy Requests**

Retrieves data value and **populates** the variable in the answer.

The system determines which answer to return depending on the context of the user's question



No Dialog Flow Development or Maintenance

- The user application does not need a specification for how the logic of the dialog should look like.
- GyrusLogic's inference engines mimic human's reasoning and **build the dialog on the fly**, thereby delivering a natural conversation.
- It is a **true conversational** AI system and a true AI **declarative paradigm**.
- It allows the user to be **spontaneous** and to **interrupt** a dialog with questions outside the ongoing dialog.
- It allows the user to make **any correction** to a specific transaction, either implicit or explicit.



VoiceXML Mixed Initiative Example

- GyrusLogic Platica more spontaneous out of the box!
- Automatic dialog interruption and implicit correction
- Exponential savings for more complex applications

10 + times
less effort

Agent: Thanks for calling Acme Travel Company. How can I help you today?

Caller: I'd like to book a flight.

Agent: Okay. What is your point of origin, and where are you going?

Caller: I wanna fly to Boston, Massachusetts.

Agent: You want to fly to Boston, Massachusetts. Where are you flying from?

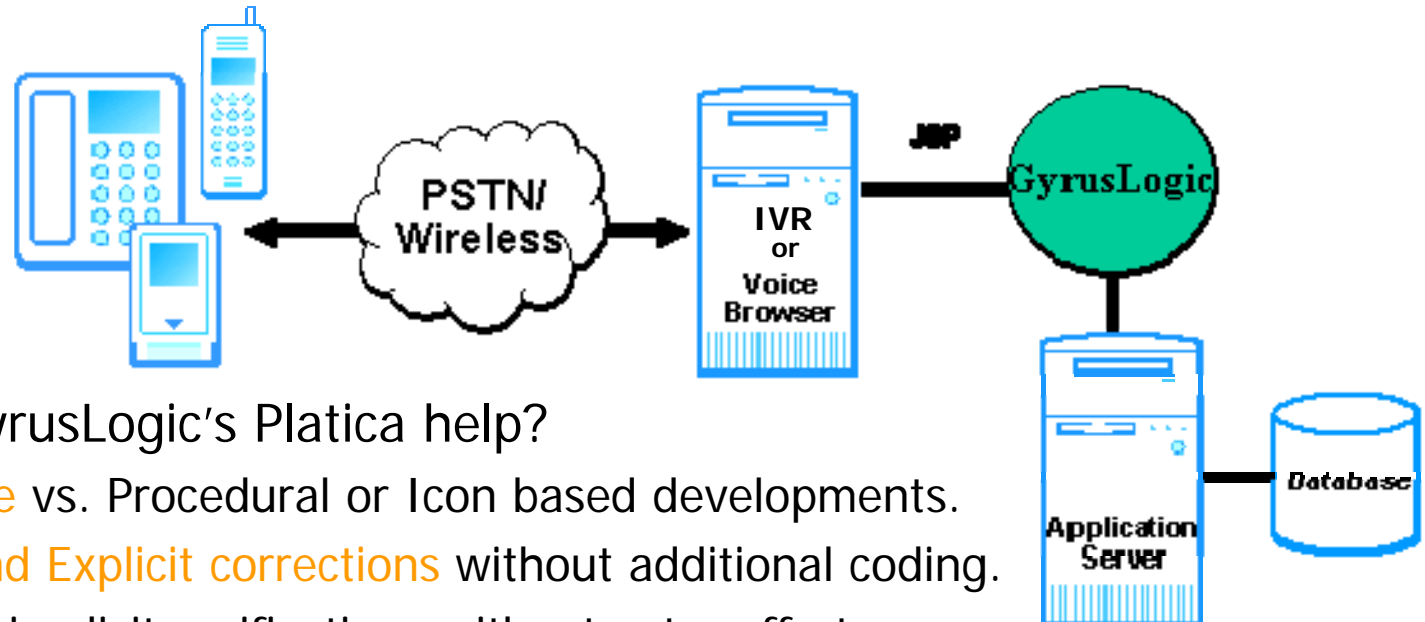
Caller: From San Francisco, California.

Agent: Okay, you'll be traveling from San Francisco, California to Boston, Massachusetts. Is that correct?

Caller: Yes.



GyrusLogic Platica



- How does GyrusLogic's Platica help?
 - **Declarative** vs. Procedural or Icon based developments.
 - **Implicit and Explicit corrections** without additional coding.
 - Automatic implicit verifications without extra effort.
 - **Spontaneous user interruptions** in call flow without additional development effort.
 - **Context and semantics** recognition.
 - Significant **savings in time and money** with the deployment of Speech related applications.
 - The same application can be used for **Chat, Web and SMS**.



VoiceXML - JSP Example



No Dialog Flow to develop

No Exceptions to develop

Send the text phrase we received from the ASR

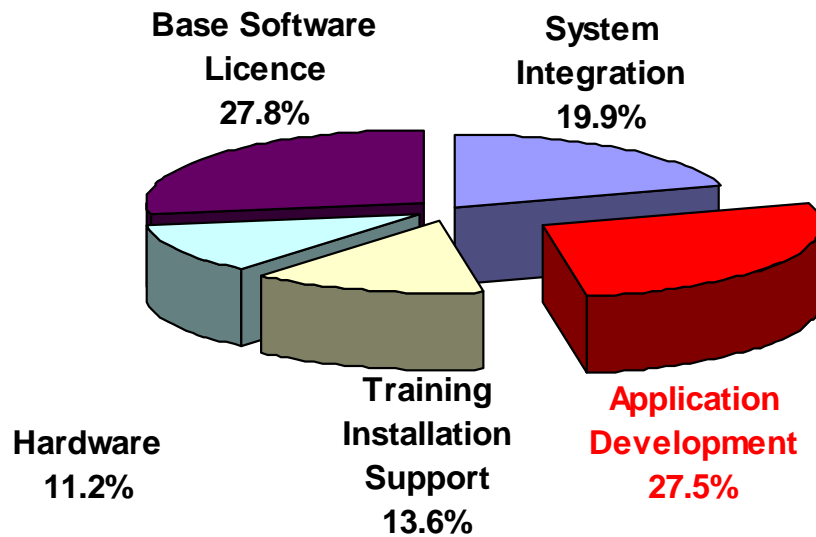
Receive the prompt or audio prompt identifier to play

```
<%@ page import="com.gyruslogic.gyrusserver.*" %>
<%! GyrusSession gs = new GyrusSession(); Client cl = new Client(); %>
<?xml version="1.0"?>
<vxml version="2.0? >
  <form >
    <% gs.setAccount(request.getParameter("account")) %>
      <field name="phrase">
        <grammar src="Gyrus.gram" />
        <%
          if ( request.getParameter("phrase") != null ) {
            gs.addQuestion(request.getParameter("phrase"));
            GyrusResponse gr = cl.ask(gs);
            session = gr.getNewSession();
          }
        %>
        <prompt>
          <%=gr.getFullPrompt() %>
        </prompt>
      </field>
    </form>
    <disconnect />
  </vxml>
```

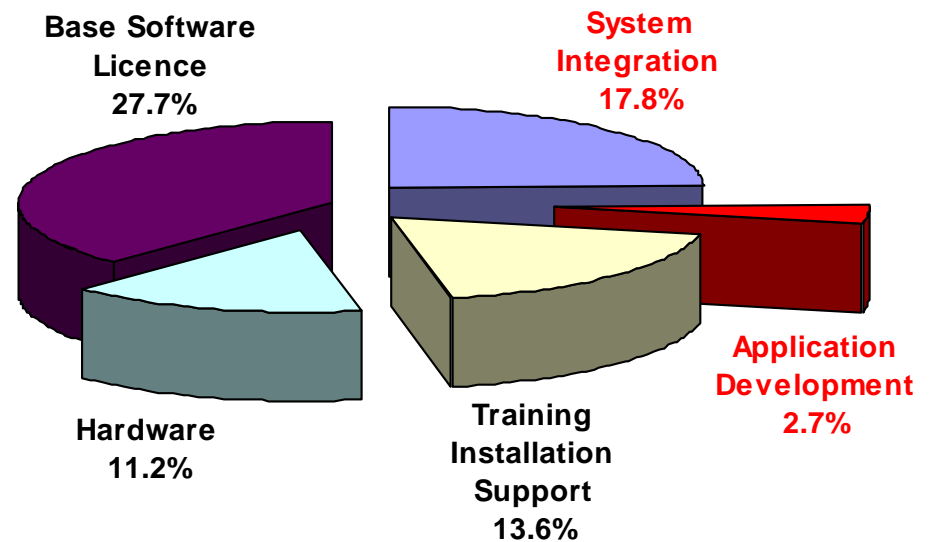


Average Speech project deployment costs

Average Project Costs Today



Average Project Costs with GyrusLogic NLU > 27% project costs savings



Source: Voice Information Associates, ASR in Telephony Applications, the World Market



Operational savings with Conversational Natural Language Systems

- Directed Dialog
 - 1:48 avg. call
- Conversational Dialog
 - 0:57 avg. call
- Savings
 - **51 seconds per call saved**
 - Avg. 50,000 calls / day
 - Initial 20% use of conversational dialog
 - **Over 3.1 million minutes saved in initial year**





Summary of an AI based GyrusLogic Implementation



- **Fully conversational dialog system**, based upon industry standards
- Flexible answers with enterprise variables in **XML knowledge base**
- Powerful **implicit and explicit corrections, implicit confirmation**
- **No dialog design**, minimal grammar development
- **Natural language** with context, semantics and meaning understanding
- **Spontaneous user interruptions** without additional development effort
- **Improved "recognition rates"** by resolving false positives
- Easy, XML based, implementation of a transactional dialog
- Automatic parsing for corpus development
- Back-end database and application support
- **ASR & IVR independent, VoiceXML 2.0 support**
- New language Universal Grammar development can be completed in several days
- **First contact customer resolution** for improved customer satisfaction
- **Significant savings in development and total cost of ownership**
- **Declarative paradigm**, the typical developments will be **significantly less error prone**
Patented context and semantics recognition and parsing technology.





“Just Say It”

Thank You!

questions or demo, visit us @ booth 214

<http://GyrusLogic.com> - (+1) 602 - 432 1995 - contact@GyrusLogic.com