Internet Applications

Lecture 12/13 – VoiceXML 2.0

See: http://www.w3.org/TR/voicexml20

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A Simple Example

namespace specification always required but will not be shown again in following examples

```
<vxml version="2.0" xmlns="http://www.w3.org/2001/vxml">
  <form>
    <field name="service">
       <prompt> Do you want news, sport or weather information? </prompt>
       <grammar src="service.gram" type="application/srgs" />
    </field>
    <block>
      <submit next=http://www.infoworld.com/service.asp />
    </block>
   </form>
</vxml>
```

S: Do you want news, sport or weather information?

U: Hmmm, football please

S: I did not understand you. ← Magic (for now)

S: Do you want news, sport or weather information?

U: Sport

S: [continues in service.asp script]

Goals

Excerpted from the spec

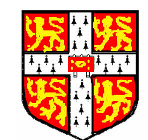
- minimise number of client-server interactions
- shields application authors from low-level platform details
- separates user interaction code (VoiceXML) from service logic
- promote portability by shielding voice dialog authors from specific hardware implementations
- easy to use for simple dialogs, yet capable of supporting complex mixed-initiative dialogs

Features

- recognition of spoken input and dtmf tones
- message output using recorded audio and synthesis
- recording of spoken input
- basic telephony control such as call transfer, disconnect
- dialog state-machine with (state is a <form>)
    - mixed initiative within states
    - user-driven state switching
    - access to ECMAScript (aka Javascript)

Limitations

My analysis



- dialogues are essentially state-based (vs. rule-based), good for system-driven dialogues but tangled for user-driven dialogues
- limited opportunity for implicit correction and recovery
- dialogue designer has limited control over active grammar complexity
- extension to multi-modal mark-up not obvious (but see *XHTML+Voice*)
- very little call control (but see CC-XML)
- no cookies
- proprietary extensions abound

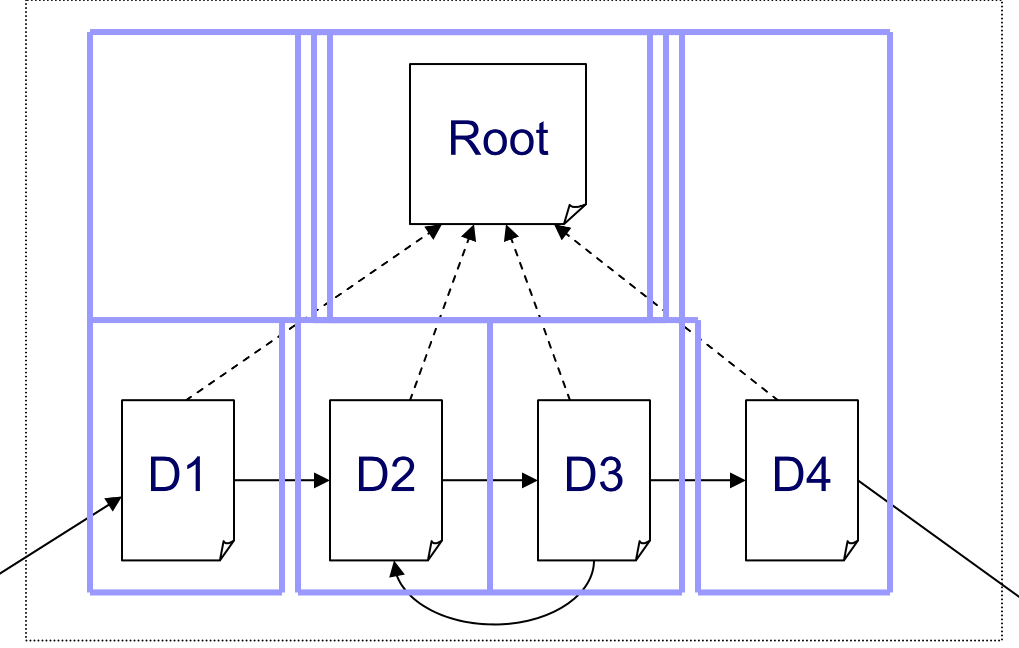
Key message

- despite limitations, broadly welcomed & increasingly deployed

Goal of this lecture

- explain the spec (theory) **and** typical practices (real-world)

VoiceXML Applications & Sessions



x

y

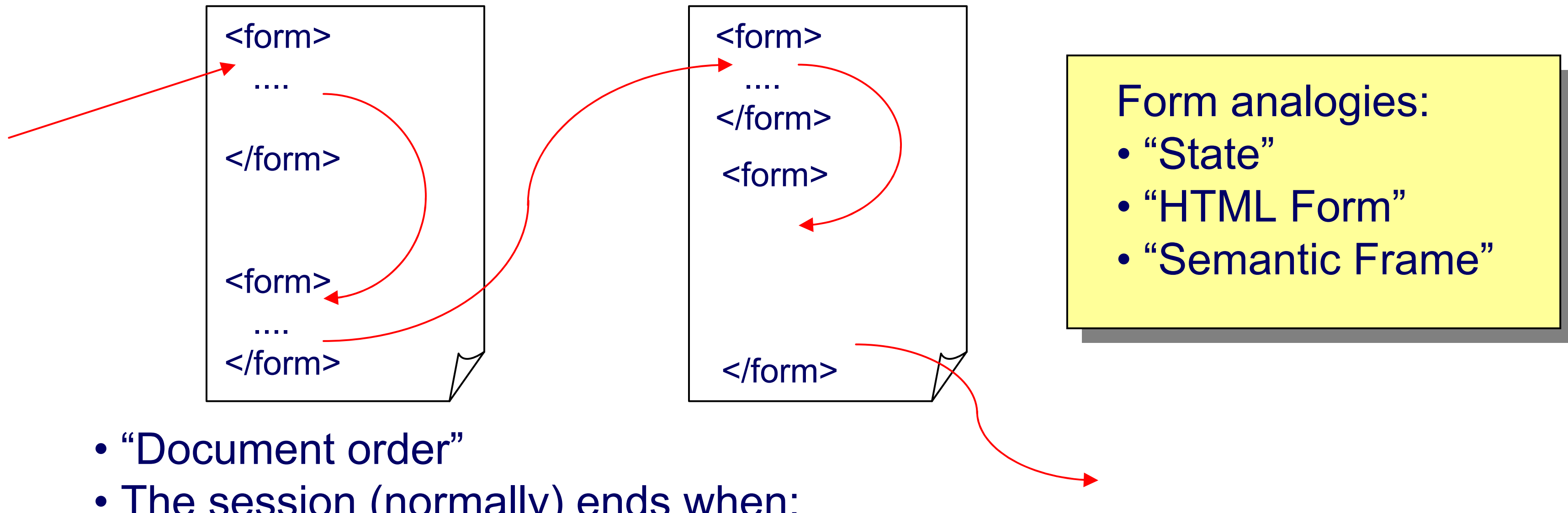
Application consists of a set of VoiceXML documents plus an optional root document which is loaded automatically, and persists until the browser exits the application

Session is the duration of the user interaction (eg a phonecall)

Dialogs

User is always in one conversational state, or "dialog", at a time.

An application consists of a set of dialogs, **each dialog is represented by a <form> element**. Application progresses by making transitions from form to form, both within current document and by loading new documents.



- "Document order"
- The session (normally) ends when:
  - User initiated: Hang-up
  - System initiated: explicit command (e.g., <disconnect/>)
  - System initiated: implicit end – i.e., "Fall off" end of page, or no successor form specified

Forms

Forms are the basic building block of VoiceXML documents

```
<form id="form name">

  <block name="block1">
      Opening prompt
  </block>

  <field name="fieldA">
     <prompt> Prompt user for fieldA  </prompt>
     <grammar src="fieldA.gram" />
     <catch> … handle local dialog problems </catch>
     <filled>  ... execute if fieldA has been filled  </filled>
  </field>

  <field name="fieldB">
     ....
  </field>

  <block name="block2">
     <submit next="nextScript.asp"
          namelist="fieldA fieldB ..." />
  <block>

</form>
```

A form is a sequence of *items*: blocks and fields.

block = output + computation
field = output + recognition

Every item has a variable associated with it which is initially undefined.

Block items are set true on entry to the block.

Field items are set when the user supplies a value.

Form Interpretation Algorithm (FIA)

a) find first undefined item

b) enter it

Repeat until all items defined.

System output (prompts)

- Text between <prompt> ... </prompt> is replayed as given (as TTS)
- The text can be “marked-up” using
  - <break> insert a pause
  - <emphasis> to emphasise something
  - <prosody> to control prosody
  - <say-as> to specify a phone sequence or speak in a particular style
- Variable values can be inserted using the <value expr=“varname”>
- Audio files can be inserted using <audio src=“url”>
  - Audio usually cached in a *prompt cache* to minimize fetches
- Prompts can be selected depending on number of replays
- Barge-in can be turned on and off

```
<prompt bargein=“false”>
    <audio src=“thanksforshopping.wav” >Thanks for shopping with us! </audio>
    I’m sending you <value expr=“qty”> <value expr=“colour”/> TeeShirts
    size <value expr=“size” />.  To check on delivery status, call
    <say-as type=“phone”> 01223 332752 </say-as>
</prompt>
```

(see http://www.w3.org/TR/speech-grammar)

- A VoiceXML interpreter can support a range of grammar formats, however all interpreters must support the standard W3C grammar format "Speech Recognition Grammar Specification" – SRGS.
- SRGS comes in two flavours: *readable ABNF* and *XML compliant*
- Tools exist to map between them ie. they are equivalent.
- The ABNF version is essentially a refinement of the Java Speech Grammar Format JSGF
- Right-branching recursion allowed

ABNF example – header & re-write rules

```
#ABNF 1.0 ISO-8859-1;
language en-GB;
mode voice;
root $top;
$place = London | Manchester | Leeds;
$leavefrom = from $place;
$destination = to $place;
$top = i want to go $leavefrom $destination
```

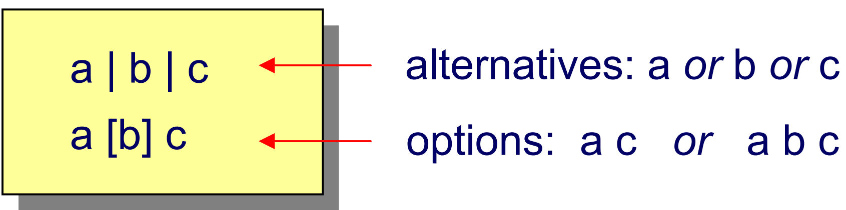
Optional; also: <grammar root="…"> (→ root $top;)

rulename (→ $place)

token (→ Leeds)

ruleref (→ $place)

The usual BNF conventions apply for options and alternatives:



alternatives can also have weights

/0.3/ a | /0.5/ b | /0.2/ c

Rules can be repeated by adding a repeat specifier:

$id = $digit <1-10>;	1 to 10 digits
$amexcard = $digit <15>;	exactly 15 digits
$visacard = $digit <16>;	exactly 16 digits
$password = $letter <6->;	6 or more letters
$number = $digit <1->;	1 or more digits

Rules can reference rules in other grammars via a URL:

$cities = $<http://www.mygrammars.com/world-cities.gram#canada> |
$<http://www.gramsUS.com/US-cities.gram#vermont>

DTMF Grammars

In VoiceXML DTMF tones can also be recognised as an alternative to voice. Usually, a DTMF grammar is placed in parallel with a regular grammar allowing the user the option of either speaking or pressing keys. Eg

```
<grammar mode="speech" type="application/srgs">
    [dark] red {red} | [dark|light] blue {blue} | ......
</grammar>
<grammar mode="dtmf" type="application/srgs">
    1 {red} | 2 {blue} | 3 {green} ......
</grammar>
```

Here the user can either say “red” or press key 1 on telephone, returned value is the same in either case.

A DTMF grammar is similar to a regular grammar except that the only vocabulary “words” allowed are the keys 1, 2, ..., 9, 0, *, #

Field Grammars - three options

1) Specify grammar source in a separate file

eg

```
<grammar src="colour.gram" type="application/srgs"/>
```

2) Specify grammar source in-line grammar, eg

```
<grammar type="application/srgs">
    [dark] red {red} | [dark|light] blue {blue} | ......
</grammar>
```

3) Use one of the built-in field types

• boolean	eg "yes", "no", "true", "that is correct"
• date	eg "tomorrow", "12th June", "next monday"
• digits	eg "two one nine four one"
• number	eg "three thousand six hundred and nine"
• currency	eg "six pounds fifty pence"
• phone	eg "double three two six five four"
• time	eg "twelve thirty pm", "eleven o'clock"

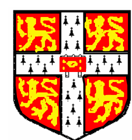
eg

```
<field name="size" type="number">
```

or

```
<grammar src="builtin:grammar/number"/>
<grammar src="builtin:dtmf/number"/>
```

Example: input/output/field grammars



```
<form id="getorder">
  ...
  <field name="size">
     <prompt> What size do you want? </prompt>
     <grammar src="sizes.gram" type="application/srgs"/>
     <filled>
        <prompt>Ok, size <value expr="size$.utterance"/>.
         </prompt> </filled>
  </field>
  <field name="colour" >
  …
  </field>
  <field name="confirm" type="boolean">
     <prompt> Please confirm that you require a
                   <value expr="colour"/> Tee Shirt in size
                   <value expr="size"/>.   </prompt>
     <filled>
        <if cond="confirm">
           <submit next="checkout.asp" namelist="size colour" />
        </if>
        <prompt>Oh, sorry, let me try again.</prompt>
        <clear namelist="colour size confirm" />
     </filled>
  </field>
</form>
```

Reference to grammar source

<filled> executed when its field has been filled.

- **Note: shadow variable**

Field “type” (built-in grammar): No reference to grammar source

If all ok, submit info & move on

Otherwise, clear everything and start again. (**NB: prompt queue**)

Rules can have *semantic interpretation tags*:

```
$time = ($hour $min ) { $.hour = $hour; $.min = $min } |
         ($qual $hour) {$.hour = $hour + $qual.hour; $.min = $qual.min };

$qual = quarter (to {$.hour = -1; $.min = 45} | past {$.hour = 0; $.min = 15}  ) |
          half past { $.hour = 0; $.min = 30 };

$hour = one {1} | two {2} | three {3} | …

$min = [oh] five {5} | ten {10} | fifteen {15};
```

- Every rulename is also a variable referenced implicitly by $ or explicitly via $name
- Rule vars can be simple variables eg $min = 30 or structs eg $.hour = 1
- When no explicit assignment is given, {x} is short-hand for $ = x

When applied to "quarter to six", the above would return

```
{ hour: 5;
  min: 45; }
```

back to the application.

Tag contents a subset of ECMAscript

Binding a *field* grammar semantic tag to its field name

- Grammar tag structure not necessarily congruent with field names
- By default, field name = slot
- However, forcing 1:1 mapping limits re-use of grammars

eg:

Grammar can return:
{ a : ValA } *or*
{ b : ValB } *or*
{ a : ValA, b : ValB}
or something else

- Associate the <field> with a tag using the **slot** attribute

```
<form id="…">
  <field name="myField" slot="…">
  <grammar … />
  …
```

RULES:

1. **If a top-level tag (struct) = "slot" is filled, field = its value.**
2. **If not, field = whole result**

If slot = …	**and *field* gram returns …**	**… then myField =**
a	{ **a : ValA** }	ValA
a	{ **a : ValA**, b : ValB }	ValA
a	{ b : ValB }	{ b : ValB}
X	{ a : ValA, b : ValB }	{ a : ValA, b : ValB }
x.y	{ **x : {y : ValY**, z : ValZ } }	ValY
x	{ x : **{y : ValY, z : ValZ }** }	{y = ValY, z = ValZ } }

Events

Events are provided to handle error and normal situations. They are generated

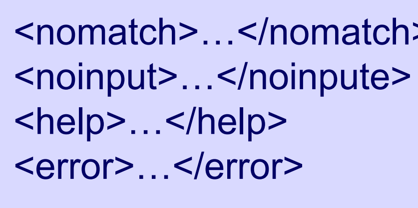
a) by the underlying platform (eg user doesnt respond, or requests help)
b) explicitly by VoiceXML scripts using the <throw> element
c) by the interpreter when errors occur

eg:

noinput	User didn’t say anything before timeout
nomatch	Reco result below confidence threshold
help	User asked for help
connection.disconnect.hangup	User hung up
error.badfetch	Couldn’t load URI
error.semantic	Run-time VoiceXML error

Events are handled by <catch> elements:

```
<catch event="nomatch">…</catch>
<catch event="noinput">…</catch>
<catch event="help">…</catch>
<catch event="error">…</catch>
```



```
<nomatch>…</nomatch>
<noinput>…</noinpute>
<help>…</help>
<error>…</error>
```

Syntactic sugar for commonly-caught events

Example: events

```
 <catch event="maxnoinput">
    <prompt>Sorry I couldn't help you.  Try again later.</prompt>
    <disconnect/>
</catch>
…
<form id="getorder">
<block>
        Welcome to Super-cool Tee-Shirts
   </block>
   <field name="size" type=number>
       <prompt> What size do you want? </prompt>
       <help>Please say the size in range 8 to 16.</help>
       <noinput count="1">
            Sorry, I didn't hear anything. <reprompt/>
       </noinput>
       <noinput count="2">
            Sorry, I still didn't hear anything.  Say a number
            from 8 to 16.
       </noinput>
       <noinput count="3"><throw event="maxnoinput"/> </noinput>
   </field>
   <block>
       <submit next="getsize.asp" namelist="size" />
   <block>
</form>
```

Catches user-defined event raised anywhere on this page. (Could have also put this in the application root document.)

Using <catch> shorthand

Forms & form items maintain counts for each event raised within it. **Count** attribute gives us different handlers depending on how many times we've seen the event in this form item.

Executable Content

VoiceXML supports two compatible scripting environments:

a) a built-in language based on a set of executable tags
b) support for ECMAScript via <script> tags

the built-in language is designed to be highly secure. Implementors wishing to minimise security risks may disable ECMAScript.

The built-in language is based on the following tags:

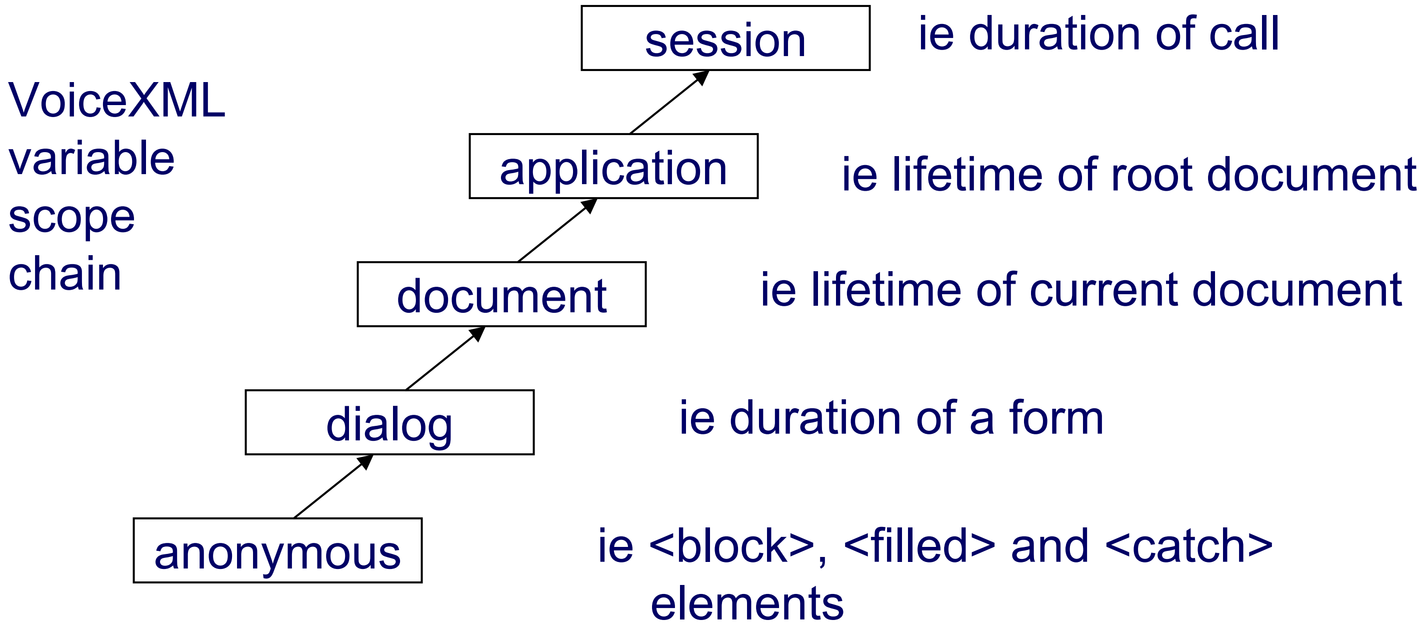
```
<var name=“x[0]” expr=“1”>
<assign name=“x” expr=“y+1”>
<if cond=“x &gt; 10”>... <else/>..</if>
<goto next=“url”>
<return namelist=“x” >
```

```
var x[0] = 1;
x = y+1;
if (x>10) {  } else {  };
goto “url”;
return x;
```

In addition <clear>, <prompt>, <reprompt>, <submit>, <exit> and <disconnect> can appear within executable content.

Variable Scope

The scope of a variable depends on where it is declared. To see if a variable x is in scope from some point, the scope chain is traced back upwards until a declaration for x is found.



if a variable x in a higher layer is hidden by a similar declaration in a lower layer, then the levels can be named explicitly e.g.

document.x, application.x, session.x , etc

Example: Executable content & var scope

```
<script> var size;  </script>

<form id="getsize">
   <field name="size" type="number">
      <prompt> What size? </prompt>
      <filled>
              Got it, size <value expr="size"/>.
              <assign name="document.size" expr="size"/>
              <goto next="#submit"/>
      </filled>
</field>
</form>

<form id="submit">
 <block>
   <prompt>
      Submitting your order for a size
      <value expr="size"/>.
   </prompt>
 </block>
</form>
```

<script> code – initiatlizes document-scope *size*

<field> name is also *size* – hides *document.size*

To access document-scope *size*, need to use *document.size.* Need to store (or submit) value of size in a higher-level scope for it to be available in the next form

When no scope is specified, use the most locally scoped variable.

Adding mixed-initiative behaviour

To this point, the "form" construct has provided little value. The real value of a form lay in creating multi-field, mixed-initiative interactions.

Idea:

- Begin with an open question like "What's your T-Shirt order?"
- Within form, allow a user to drive how we visit <field>'s (e.g., colour, size)

Needs:

- Way of asking an initial question ... **<initial>**
- Specifying a grammar "shared" by several fields … **form-level grammar**
- Algorithm to control how we visit fields … Form Interpretation Algorithm

Proviso: *Multi-field, mixed-initiative dialogs are used very rarely in industry… at least today*

Mixed-initiative Forms

By default, each field of a form is visited in turn, and each field has its own grammar. VoiceXML also allows a form level grammar to be specified

```
<form id="form name">
   <grammar src="form.srgs" />

   <initial>
        <prompt>  "form level prompt"  </prompt >
   </initial>

  <field name="fieldA">
     <prompt> ...    </prompt> <grammar src="fieldA.srgs" />
  </field>

  <field name="fieldB">
     <prompt> ...    </prompt> <grammar src="fieldB.srgs" />
  </field>

  etc

</form>
```

form level grammar allowing user to specify one or more of fieldA, fieldB, etc in a single utterance.

initial element specifies what to say when prompting at form level

Basic operation

1. prompt at form level; and recognise using "form.srgs"
2. if any fields still unfilled, then visit each field in turn using field level prompts & grammars

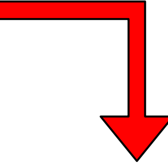
The Form Interpretation Algorithm (FIA)

Field-level AND form-level grammars

1. ***Select phase***: Find the first form item for which guard condition = “false”.
2. ***Collect phase**:* “visit” that item.
   - **<initial> :**
     a. Load & compile grammars at <form> and higher levels
     b. Execute contents in document order (including <prompt>)
     c. Start playing prompt queue & activate recogniser; wait for result or event
   - <block> :
     a. Execute contents in document order (including <prompt>)
     b. *Define* the name of the <block>.
     c. *Go to (1).*
   - <field> :
     a. Load & compile any <grammar>’s within this <field> **and <form> & higher levels**
     b. Play <prompt>’s & activate recogniser; wait for result or event
3. ***Process phase***:
   - If any form or field level grammar item is matched, define the name of <initial>.
   - If a grammar item is matched, execute the contents that or those <field>’s <filled>
     - **May be multiple <field>’s which have been matched**
   - If an event is thrown, handle that event.
   - *Go to (1)*

Tee-Shirt example with mixed-initiative

```
<form id="getorder">
  <grammar src="teeshirt.srgs" type="application/srgs"/>
  <initial>
      <prompt>
          Welcome to Super-cool Tee-Shirts.
          What size and colour do you want?
      </prompt>
  < /initial>
  <field name="size" type=number>
     <prompt> What size do you want? </prompt>
  </field>
  <field name="colour">
     <prompt> What colour do you want? </prompt>
     <grammar src="colour.srgs" type="application/srgs"/>
  </field>
  <block>
     <submit next="checkout.asp" namelist="size colour" />
  <block>
</form >
```



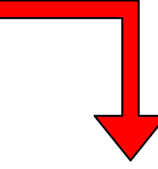
S: Welcome to Super-cool Tee-Shirts
What size and colour do you want?
U: Red in size ten please.
S: [continues in checkout script]

Or

S: Welcome to Super-cool Tee-Shirts
What size and colour do you want?
U: Red please.
S: What size do you want?
U: Ten
S: [continues in checkout script]

Handling failures in mixed-initiative forms

```
<form id="getorder">
  <grammar src="teeshirt.srgs" type="application/srgs"/>
  <initial name="forminit>
       <prompt>
             Welcome to Super-cool Tee-Shirts.
             What size and colour do you want?
       </prompt>
       <nomatch count="1">
            Sorry I didnt understand that.  Please say something like
            "Red size 12" or "Size 10, colour red"
        </nomatch>
        <nomatch count="2">
             Sorry I still dont understand.  I will prompt you
             one item at a time.
             <assign name="forminit" expr="true" />
        </nomatch>
  < /initial>
  <field name="size" type=number>
     <prompt> What size do you want? </prompt>
  </field>
  ....
</form >
```



S: Welcome to Super-cool Tee-Shirts
What size and colour do you want?
U: Errmmm.
S: Sorry I didnt understand that. Please say something like "Red size 12" or "Size 10, colour red"
U: Cool, what do you have?
S: Sorry I still dont understand. I will prompt you one item at a time.
What size do you want?
U: Ten
S: What colour do you want?
U: Red
S: [continues in checkout script]

Binding a *form* grammar semantic tag to a field name

- Still associate the <field> with a tag using the slot attribute
- However, different matching algorithm than field-level grammars!
- An utterance may not fill a particular field

eg:

```
{ drink: "coke",
  pizza: {
    size: "large",
    topping: [“ham", “veg”]
  }
}
```

```
<form id=“…”>
  <grammar … />
  <field name=“myField” slot=“…”>
  …
```

RULES:
1. **If a top-level tag (struct) = “slot” is filled, field = its value.**
2. **If not, field *is not matched***

If utt is as above, and slot = …	**… then myField =**
drink	“coke”
pizza	{size: "large", topping: [“ham", “veg”] }
pizza.size	“large”
pizza.topping	[“ham”,”veg”]
sandwhich, pizza.number, size	***Does not match field***
undefined (ie, name & slot blank)	***Does not match field***

Other tags

- Associate a grammar with a <goto> : **<link next="*URI*">** <grammar … /> **</link>**
- Cause a grammar to fire an event : **<link event=*"eventName"*>** <grammar … /> **</link>**
- Record (don't recognise) an utterance : **<record name="…" … > … </record>**
- A higher-level, simpler version of a <form> for choosing 1 of N options: **<menu>**
  - Choices: **<choice next="*URI*">** *grammar text* ***</choice>***
  - List choices in a prompt: **<enumerate/>**
- Platform-specific components : **<object name="*oName*" classid="…" data="…">**
  - Like sub-dialog, pass in arguments using **<param name="…" expr="…"/>**
  - Result returned in ***oName*** ECMAScript variable
- Control platform features (e.g., timeout) : **<property name="…" value="…"/>**
- Generate a debug message in the log : **<log> … </log>**
- App-specific meta-information : **<meta> … </meta>** *and* **<metadata> … </metadata>**
- Cause <prompt> content to play again after event handler: **<reprompt/>**

APPENDIX

Students are not responsible for new material beyond this point

When is document order important?

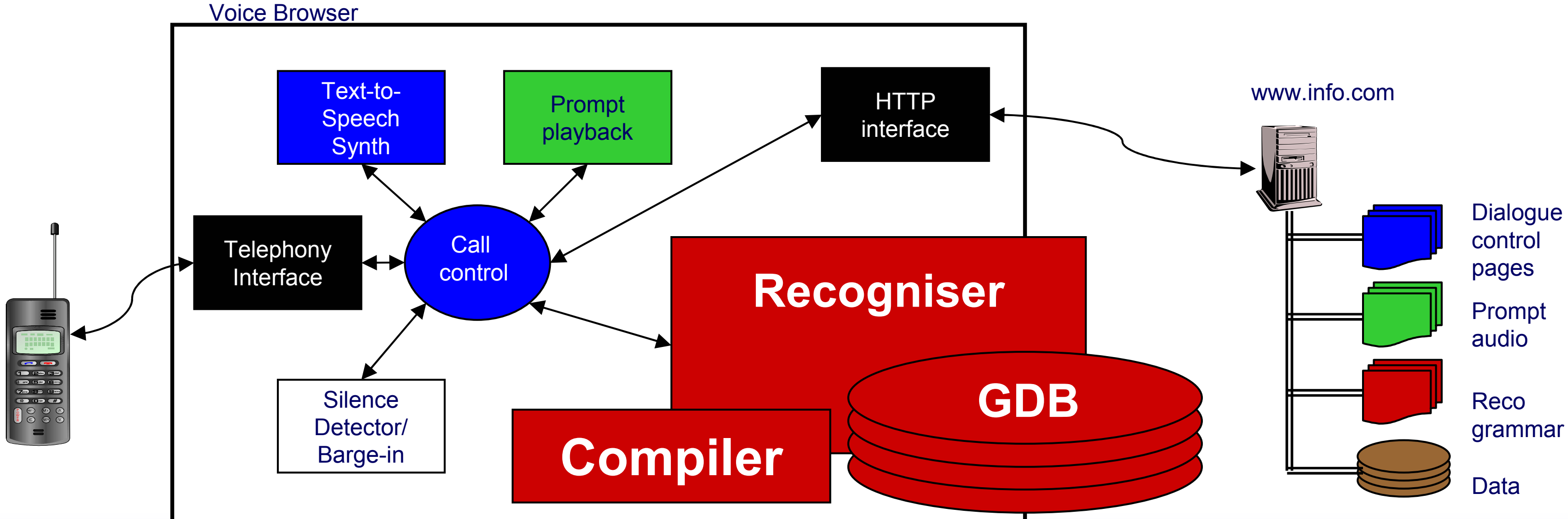
- **<form>'s** : by default, user is in the first <form> on page.
  Override with http://server.com/page.vxml#form2
- **Form items** like <field> and <block> : FIA looks considers these **in document order**
- **Within a <block> and <filled>** : execute code **in document order**
- **Within a <field>** : ordering of **<prompt>** elements with respect to each other *is important.*
- **Within a <field>** : all other ordering is *not important. (FIA looks at WHOLE <field> before launching recognition).* For example, these two fields are equivalent:

```
<field name="number" >
    <prompt>
        What's your account number?
    </prompt>
    <grammar src="accountnum.gram" …>
    <filled>
        <prompt>Got it.</prompt>
        <goto next="#password"/>
    </filled>
</field>
```

```
<field name="number" >
    <filled>
        <prompt>Got it.</prompt>
        <goto next="#password"/>
    </filled>
    <grammar src="accountnum.gram" …>
    <prompt>
        What's your account number?
    </prompt>
</field>
```

Grammars

- Grammar specifies what a user can say at a given time
- To perform recognition, the textual description of a grammar must be *compiled*
- Most VoiceXML grammars are rule-based
  - Platform must support compilation-on-demand for rule-based grammars
  - Most grammars are re-used: cache of compiled grammars (GDB) is crucial
- Proprietary extensions support client-side, pre-compiled SLMs
- Builtin grammars: Pre-compiled; available to all applications; parameterisable



12.8 Mixed-initiative at Document Level

In addition to mixed-initiative within forms, VoiceXML also allows mixed-initiative between forms. Consider

```
<form id="sell">
   <grammar src="items.srgs" scope="document" />
   <field name="mops"> ....
   <field name="buckets"> ....
   <field name="cloths"> ....
   <field name="checkout"> ....
</form>

<form id="checkout">
   <grammar src="checkout.srgs" />
   <field name="card_number"> ....
   <field name="expiry_date"> ....
</form>
```

grammar is active throughout document

In checkout form, both the "items" and the "checkout" grammar are active.

....
S: Any more items to buy?
U: Two mops
S: Any more items to buy?
U: No checkout please
S: What is your card number?
U: Oh, and one bucket.
S: Any more items to buy?
U: No checkout please
S: What is your card number?
.....

Jump back to sell form

Grammar Scope

Root document

```
<form scope="document" >
   <grammar src="global" />
         global
</form>
      global
```

Application Doc 1

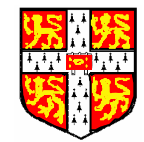
```
<form scope="document">
   <grammar src="doc1" />
   <grammar src="local1" scope="dialog" />
         global + doc1 + local1
</form>
      global + doc1
```

Application Doc 2

```
<form>
   <grammar src="local2" />
         global + local2
</form>
      global
```

Note form scope can be overridden for each grammar

Sub-Dialogs



Dialogs can be structured into sub-dialogs and invoked in a hierarchical fashion as needed.

A subdialog call is represented by a <subdialog> tag and it replaces a <field> element within a form.

```
<form>
   <var name="cardNum">
   <field name="cardType"> ....  </field>

   <subdialog name="result" src="getcardnum.vxml">
      <param name="type" expr="cardType">
      <filled>
            <if cond="result.status == 0">
               <assign name="cardNum" expr="result.value" />
            <else/>
               <throw event="nomatch"/>
            </if>
      </filled>
   </subdialog>

</form>
```

call dialog stored in cardnum.vxml passing value of "cardType" as a parameter

result is returned as an object, with properties set by cardnum

<filled> element checks return values and assigns to form variables as required

Example sub-dialog

Called subdialog collects parameters, and then executes in an environment which is identical to that of the calling <subdialog> element.

getcardnum.vxml

```
<form id="getcardnum">
   <var name="type"/>
   <field name="number"  type="digits">
      <prompt>
            Please give your <value expr="type"/> card number
      </prompt>
      <filled>
          <var name="status"
                expr="CheckNumber(number,type)"/>
          <return namelist="number status"/>
      </filled>
   </field>

</form>
```

set automatically via callers param “type”

Check number is valid for given type of card, return result of check in status

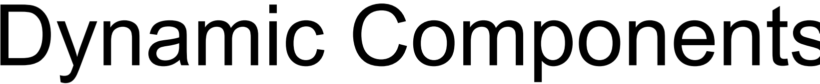
return number and status to the caller

Sub-dialogs are not sub-routines

- Called subdialog collects parameters, and then executes in an environment which is ***completely idependent*** of the calling <subdialog> Element.
  - *Independent* variable space
  - *Independent* event hierarchy
  - *Independent* application root document
  - …
- This means that higher-scope variables are **not** visible, and events are handled **in their own space**.
- This is true ***even if the subdialog & calling form*** are on the same page!

Remember that the user doesn't experience "subdialogs" –
they experience a conversation

Use sub-dialogs with care!



Dynamic Components

A VoiceXML application can access dynamic components using the <Object> tag. This is similar to the <Object> tag in HTML.

```
<object name="objname" classid=" ... " data=" ... " >
   <param name="arg1" expr="val1" />
   ....
</object>
```

Object behaves like a field, it returns a value as field item which can then be used to access the objects properties and methods. For example,

```
<field name="cardNum" type="number">
   <prompt> What is your card number? </prompt>
</field>
<object name="credcard" classid="CLSID:3452 ...">
   <param name="holder" expr="callerName"/>
   <param name="number" expr="cardNum"/>
   <if cond="credcard.valid">
      <goto next="#checkout"/>
   </fi>
   <clear namelist="cardNum credCard" />
</object>
.....
```

NB content of <object> tag is executed cf HTML

Links

Links can be added to a dialogue to allow the user to go to a specific point by a single voice command. They add a further mechanism for the user to take the initiative.

A link consists of a grammar and a target. The scope of the grammar is the same as the scope of the enclosing element. The target can be a URL or an event to “throw”. For example,

root document

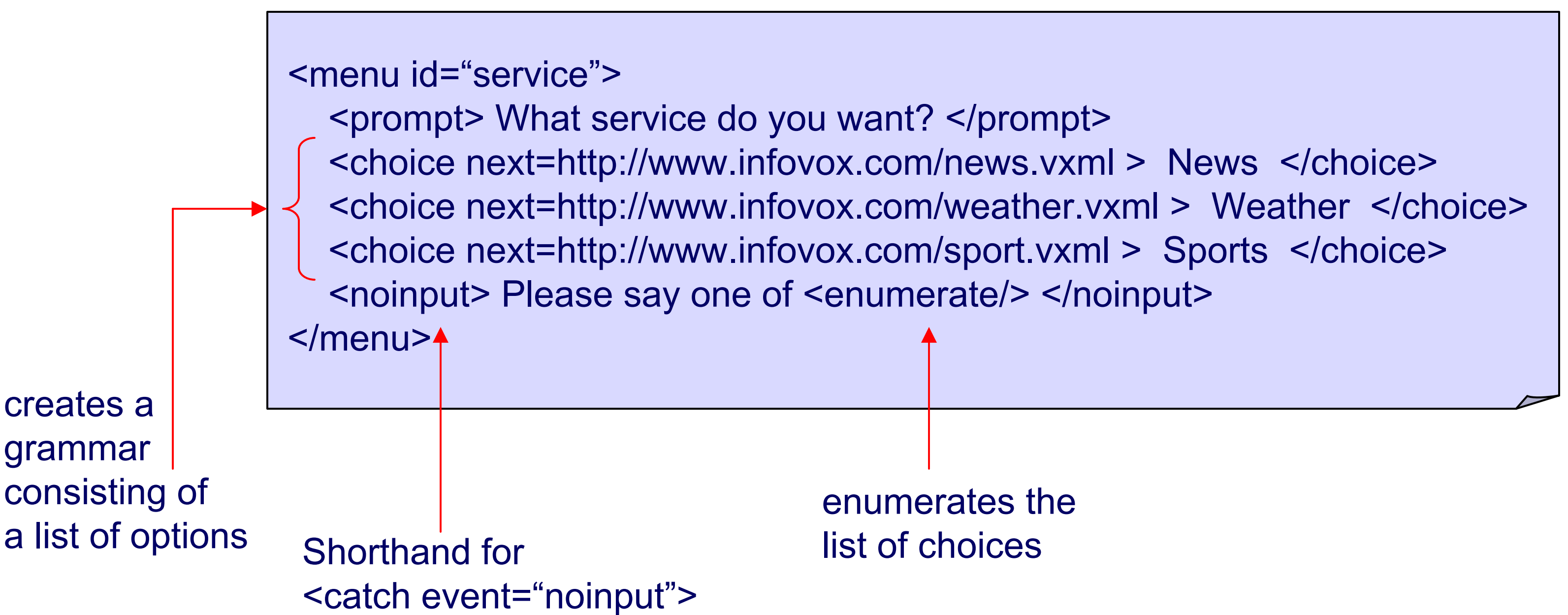
```
<link event=“help”>
   <grammar type=“application/srgs”>
      help [me] | what can I do now | i’m lost | ...
   </grammar>
</link>

<link next=“http://www.cl.cam.ac.uk/cstit”>
   <grammar type=“application/srgs”>
      I need to learn about speech and language |
      what is speech and language |
      what is a hidden markov model
   </grammar>
</link>
```

throw the help event if user appears to be lost

if the user needs educating, jump to a new web site

Menus

Menus are a special type of form consisting of a single anonymous field. They add nothing new to the expressive power of VoiceXML, but are included for convenience. Example,



The Form Interpretation Algorithm (FIA)

Only field-level grammars, including handling of <reprompt>

1. ***Select phase***: Find the first form item for which guard condition = "false".
2. ***Collect phase**:* "visit" that item.
   - If (this item == different item to last visit) {`newitem` = `true`} else {`newitem = false`}
   - <block> :
     a. Execute contents in document order.
        - If (`newitem` || `repromptflag`) { add <prompt>'s to prompt queue }

     b. *Define* the name of the block.
     c. `repromptflag = false`
     d. *Go to (1).*
   - <field> :
     a. If (`newitem` || `repromptflag`) { add <prompt>'s to prompt queue }
     b. `repromptflag = false`
     c. Load & compile any <grammar>'s within this <field>
     d. Start playing prompt queue & activate recogniser; wait for result or event
3. ***Process phase***:
   - If a grammar item is matched, execute the contents of <filled> (if present).
   - If an event is thrown, handle that event.
     a. If a <reprompt/> is present, set `repromptflag = true`
   - *Go to (1)*

The Form Interpretation Algorithm (FIA)

Field & Form level grammars, including handling of <reprompt> tag

1. ***Select phase***: Find the first form item for which guard condition = “false”.
2. ***Collect phase**:* “visit” that item.
   - If (this item == different item to last visit) {`newitem` = `true`} else {`newitem = false`}
   - <initial> :
     - Execute contents in document order.
     - If (`newitem || repromptflag`) { add <prompt>’s to prompt queue }
     - `repromptflag = false`
     - Load & compile grammars at <form> and higher levels
     - Start playing prompt queue & activate recogniser; wait for result or event
   - <block> :
     a. Execute contents in document order.
        - If (`newitem` || `repromptflag`) { add <prompt>’s to prompt queue }

     b. *Define* the name of the <block>.
     c. `repromptflag = false`
     d. *Go to (1).*
   - <field> :
     a. If (`newitem` || `repromptflag`) { add <prompt>’s to prompt queue }
     b. `repromptflag = false`
     c. Load & compile any <grammar>’s within this <field>
        a. Unless <field> has attribute (modal = true), Load & compile grammars at <form> & higher

     d. Start playing prompt queue & activate recogniser; wait for result or event
3. ***Process phase***:
   - If any form or field level grammar item is matched, Define the name of <initial>.
   - If a grammar item is matched, execute the contents that or those <field>’s <filled> (if present; may be multiple <field>’s).
   - If an event is thrown, handle that event.
     a. If a <reprompt/> is present, set `repromptflag = true`
   - *Go to (1)*