Topics

- Formal definitions
- Numeric Computation
- Text Manipulation

Upcoming

† Catch up on reading

Grammar

- English and other natural languages have structure

\[
\begin{align*}
\langle S \rangle & \Rightarrow \langle \text{NOUN-PHRASE} \rangle \; \langle \text{VERB-PHRASE} \rangle \\
& \Rightarrow \langle \text{NOUN} \rangle \; | \; \langle \text{ARTICLE} \rangle \; \langle \text{NOUN} \rangle \; | \; \langle \text{PP} \rangle \\
\langle \text{VERB-PHRASE} \rangle & \Rightarrow \langle \text{VERB} \rangle \; | \; \langle \text{VERB} \rangle \; \langle \text{NOUN-PHRASE} \rangle \\
\langle \text{NOUN} \rangle & \Rightarrow \text{DOG} \; | \; \text{FLEAS} \; | \; \text{PERSON} \; | \; \ldots \\
\langle \text{VERB} \rangle & \Rightarrow \text{RAN} \; | \; \text{BIT} \; | \; \ldots
\end{align*}
\]

- Process of taking sentence and fitting it to grammar is called parsing

DOG BIT PERSON

\[
\langle \text{NOUN} \rangle \; \langle \text{VERB} \rangle \; \langle \text{NOUN} \rangle
\]

\[
\langle \text{NOUN-PHRASE} \rangle \; \langle \text{VERB-PHRASE} \rangle
\]

\[
\langle S \rangle
\]

- Parsing English is complex because of context dependence

Formal specifications

- Need a precise notation of syntax of a language
- Grammars can be used for generation and also can be used
- Context-free grammars

\[
\begin{align*}
\langle \text{name} \rangle & \Rightarrow \text{sequence of letters and/or digits that begins with a letter} \\
\langle \text{name} \rangle & \Rightarrow \text{guessB} \\
\langle \text{name} \rangle & \Rightarrow \text{msg42}
\end{align*}
\]

- Substitute as many times as necessary. All legal statements can be generated this way

† Want \text{person} = \text{firstn} + " " + \text{lastn};

† How do we get this from our grammar?

Random Sentence Generator

- Constructs sentences, paragraphs, and even papers that fit a prescribed format.
- The format is specified by a set of rules called a grammar
- A grammar consists of a set of definitions
- Each definition is a set of productions
- Examples of grammars

† Extension request
† College rejection
† Poem

† \text{http://www.cs.duke.edu/courses/fall01/cps001/code/grammars/}

- Natural languages have grammars

\[
\begin{align*}
\langle S \rangle & \Rightarrow \langle \text{NP} \rangle \; \langle \text{VP} \rangle
\end{align*}
\]
Poem Grammar

- All grammars begin with start rule

```
<start>
The <object> <verb> tonight. ;
```

- Nonterminals are indicated by angle brackets

```
<object>
waves ;
big yellow flowers ;
slugs ;
```

More on the poem grammar

- Nonterminals can refer to other nonterminals

```
<verb>
sigh <adverb> ;
portend like <object> ;
```

```
<adverb>
warily ;
grumpily and <adverb> ;
```

Generating a poem

- All sentences start with <start>

```
<start>
The <object> <verb> tonight.
```

- There is only one production in the definition of <start>

```
The <object> <verb> tonight.
```

- Expand each grammar element from left to right

```
"The" is a terminal, so it is simply printed –
<object> is a non-terminal, so it must be expanded
```

- Choose one:
  - waves
  - big yellow flowers
  - slugs

- Suppose that 'slugs' is chosen

Generating a poem

```
The slugs <verb> tonight.
```

- "<verb> is a non-terminal, so it must be expanded –

```
Choose one:
1. sigh <adverb>
2. portend like <object>
```

```
The slugs sigh <adverb> tonight.
```

- <adverb> is a non-terminal, so it must be expanded

```
1. warily
2. grumpily
```

```
The slugs sigh grumpily tonight.
```

- "tonight," is a non-terminal so it is simply printed

```
There are no more non-terminals to expand!
```

The grammar has generated a complete poem
Dealing with numbers

- **Primitive data type: int**
  - Does not require a new statement to create
  - Primitive types not classes
  - Must declare
  - Should initialize (Java sets to 0)
- **Other primitive types include:** boolean, char, double
- **Operations using integers**
  - +, -, *, /, %
  - Operator Precedence

Dealing with text

- **Strings are a class and not a primitive datatype**
- **Declaration:**
  ```java
  String message;
  ```
- **String Constants**
  ```java
  "Good Morning World!"
  ```
- **String Assignment**
  ```java
  message = "It's Friday";
  ```

Manipulating Strings

- **Methods for manipulation**
  ```java
  int length()
  int indexOf(String st)
  String substring(int start, int end)
  ```
- **Getting String Data from user**
  ```java
  message = mg.getText();
  ```
  where mg is a TextField and message is a String

Analog vs. Digital

- **Digital**
  - On or off
  - Computer is made up of millions of “switches” or transistors
- **Analog**
  - Continuously varying
  - Analog vs. Digital clocks
- **What does it mean to have digital music/video?**
  - CDs/DVDs vs. records/VHS tapes
Advantages of digital media

- “Lossless” copying
- Current event:
  - Apple has introduced new computer with DVD writing ability
  - No DVD copying ability however
  - Limit technology so that people cannot even attempt to copy data that may or may not be legal
- Copying copyrighted material for sale vs. “time-shifting”
- Napster
- Audio Home Recording Act of 1992
  - Serial Copy Management Systems
  - Opinions?