Lecture 5/6: Scripting and Perl

COMP 524 Programming Language Concepts
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Goal of Lecture

- Discuss background on Scripting languages and Perl.

Origin of scripting languages

- Scripting languages originated as job control languages
  - 1960s: IBM System 360 had the “Job Control Language”
  - Scripts used to control other programs
    - Launch compilation, execution
    - Check Return Codes
- Scripting languages became increasingly powerful in UNIX
  - Shell programing, AWK, Tcl/Tk, Perl
  - Scripts used to “glue” applications

System Programming Languages

- System languages (e.g., Pascal, C++, Java) replaced assembly languages.
  - Two main advantages:
    - Hide unnecessary details (high level of abstraction)
    - Strongly Typed.

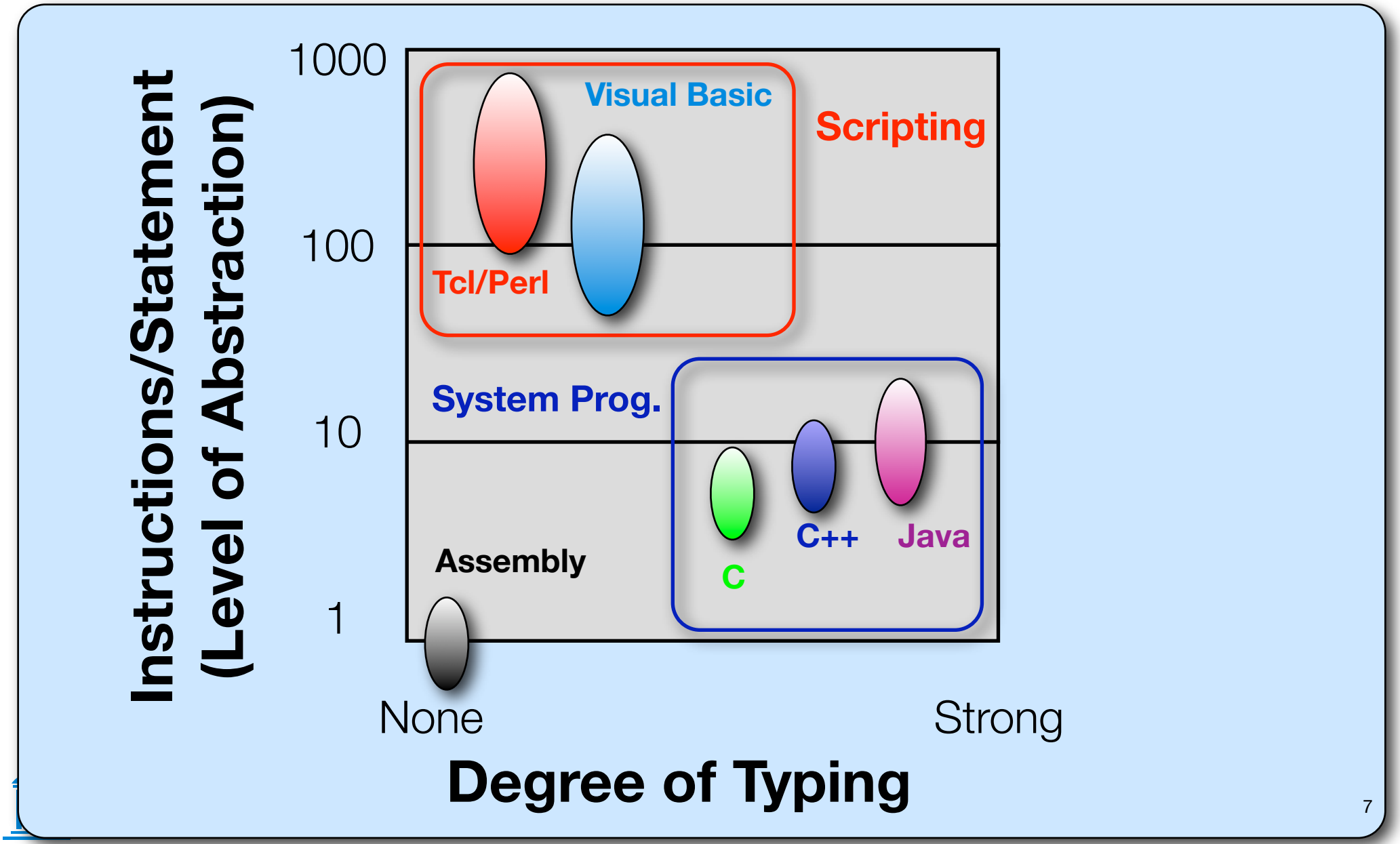
Strongly vs Weakly Typed Langauges

- Under Assembly, any register can take any type of value (e.g., integer, string).
- Under **Strongly Typed languages**, a variable can only take values of a particular type.
  - For example, “int a” can only have values of type “integer”

Strongly vs Weakly Typed Langauges

- Weakly Typed languages infer meaning at run-time
  - **Advantage**: Increase Speed of development.
  - **Disadvantage**: Less error checking at compile time.
- Not appropriate for low-level programming or large programs

Typing and “Degree of Abstraction”



Perl (Practical Extraction and Report Language)

- Larry Wall Created Perl in late 80s
  - Originally designed to be more powerful than Unix scripting.
  - Wanted “naturalness” ... shortcuts, choices, defaults, flexibility.
- Perl is dense and Rich
  - “Swiss-army chainsaw”
  - “Duct tape for Web”
  - “There is more than one way to do it!”
  - Often experienced Perl programmers will need a manual when reading other people’s code.

What Perl Does Well

- String Manipulation
- Text Processing
- File Handling
- Regular Expressions and pattern matching
- Flexible arrays and hashes
- System Interactions (directories, files, processes)
- CGI scripts for Web sites

Perl Overview

- Perl is **interpreted**.
- Every statement ends in a **semicolon**
- Comments **begin with "#"** and **extend one line**
  - We'll see how to do multi-line comments later
- What Perl doesn't do well:
  - Complex algorithms and data structures.
  - Well defined and slowly changing functions.

Built-in Data types

- No type Declarations
- Perl has three types:
  - **Scalar**
  - **Array**
  - **Hash** (Associative Array)
- Integers, float, boolean, etc... are all of type Scalar.

Built-in Data Types: Scalar

- Scalars begin with “$”
- Can take on any integer, real, boolean, and string value

```
$A = 1;
$B = “Hello”;
$C = 3.14;
$D = true;
```

- There is a default variable “$_”

Scalars in Strings

- To use a scalar in a string simple insert it!

```
$A = 1;
print (“A’s value is $A \n”);
```

Addition and Concatenation

- To **add** two scalars together, we use “+”

```
$A = 1;
$B = 2;
$C = $A + $B;
```

- To **concatenate** two strings together, we use “.”

```
$A = “hi”;
$B = “bye”;
$C = $A . $B;
```

Context

- When a scalar is used, the **value is converted to the appropriate context**:

```
$A = “hi”;
$B = 3;
$C = $A . $B; #C = “hi3”
```

```
$A = “hi”;
$B = 3;
$C = $A + $B; #C = “3”
```

```
$A = “4”;
$B = 3;
$C = $A . $B; #C = “43”
```

```
$A = “4”;
$B = 3;
$C = $A + $B; #C = “7”
```

Built in Data type: Array

- Array variables begin with “@”

```
@A;
```

- Using “=(xxx,yyy,zzz,...)” we can define the content of the array

```
@A = (1, “two”, 3.13, true);
```

- Using $foo[xxx] we can access individual elements of the array @foo.

```
print ($A[1]); #Prints “two”
```

Built in Data type: Array

- Using “$#foo” we can get the max index of the array “@foo”

```
@A = (1, “two”, 3.13, true);
print $#A; #Prints 4
```

- There is a default array “@_”

Built in Data Types: Hash

- Hashes are like arrays, except that they are **indexed by any scalar type**, not just integer.
- Hash variables begin with "%"

```
%A
```

- Can be defined as via "('index-1', value-1, 'index-2', value-2,...)

```
%A = ('first', 1, 'junk', 'value', 3.14, true);
```

- Subscripts are accessed by "{}" and can be any scalar

```
print $A(3.14); #Prints "true"
```

Built in Data Types: Hash

- Great for text processing
  - Building tables, lists, etc....
- Built-in function “keys” gets all subscripts.

```
%A = (‘first’, 1, ‘junk’, ‘value’, 3.14, true);
foreach (keys (%A)) { #Loads values in t “$_”
  print “( $A{$_}):$_ \n”;
}
```

Control Flow

```
$b = 3;
if($b < 10){
  $a = 5;
} elseif ($b < 20){
  $a = 15;
} else {
  $a = -3;
}
print($a);
```

```
$c = 3;
print($c >= 10 ? 20 : 10). “\n”;
```

Control Flow

```
while($d<37){
  $d++;
  $sum += $d;
}
```

```
until($d>=37){
  $d++;
  $sum += $d;
}
```

Control Flow

```
do{
  $d++;
  $sum += $d;
} while ($d<37);
```

```
do{
  $d++;
  $sum += $d;
} until ($d>=37);
```

Foreach

```
@group = (“red”, “blue”, “green”, “tan”);
foreach $item(@group){
  print “$item \n”;
}
```

Files and I/O

```
open(INDATA, “index.html”); #reading
```

```
open(INDATA, “>index.html”); #writing
```

```
open(INDATA, “>>index.html”); #appending
```

```
open(INDATA, “index.html”) || die “Error”;
close(INDATA);
```

Files and I/O

```
open(INDATA, “index.html”);
$in = <INDATA>; #Gets one line as a scalar
@all_in = <INDATA>; #Gets all lines as an array
  #all_in[0] = first line
  #all_in[1] = second line
close(INDATA)
```

Files and I/O

```
open(INDATA, "index.html")
foreach $line(<INDATA>) {
   print $n++.": $line";
}
close(INDATA);
```

Files and I/O

```
open(OUTDATA, ">index.html")
print OUTDATA “Out”;
close(OUTDATA);
```

```
print STDOUT “Out”;
```

Subroutines

```
sub aFunc{
  my($a, $b, $c); #makes $a, $b, and $c local
  $a = $_[0]; #Set's a to first input
  $b = $_[1]; #Set's b to second input
  $c = $a + $b;
  print $c . "\n";
  return "done\n";
}
```

Subroutines

```
print &aFunct(12,5);
$retValue = &aFunc(12,5);
aFunc(12,5);
$x = noArgs();
$x = &noArgs;
```

Regular Expressions

```
/.at/ #matches “cat”, “bat”, but not “at”
/[aeiou]/ #matches single character
/[0-9]/ #match one char
/[0-9]*/ #match zero or more chars from range
/[^0-9]/ #match zero or more chars NOT in range
/c*mp/ #“cccmp”, “cmp”, “mp”, NOT “cp”
/a+t/ #“aaat”, “at”, “t”
/a?t/ #zero or one “a”s, “at” or “t” not “aaaat”
/^on/ #start... “on the” NOT “the on”
/on$/ #end... “the on” not “on the”
/cat/i #ignore case
/\*\*/ #match “**”
```

Regular Expressions

- By default, applied to “$_” scalar

```
$_ = “Hello World”;
if (/Hello/) { print (“Hello in $_\n”); }
```

- Can be applied to other scalars via “=~”

```
$a = “Hello World”;
if ($a =~ /Hello/) { print (“Hello in $_\n”); }
```

Regular Expressions

- Replace “foo” with “bar” by “s/foo/bar/”

```
$a = “Hello World World”;
$a =~ s/World/Mars/;
print ($a . “\n”); #Print “Hello Mars World”
```

- Only works for first match.
- To apply to all use “s/foo/bar/g”

```
$a = “Hello World World”;
$a =~ s/World/Mars/g;
print ($a . “\n”); #Print “Hello Mars Mars”
```

Regular Expressions

- Replace regardless of case use “s/foo/bar/i”

```
$a = “Hello World World”;
$a =~ s/world/Mars/i;
print ($a . “\n”); #Print “Hello Mars World”
```

- Combine with “global”

```
$a = “Hello World World”;
$a =~ s/world/Mars/gi;
print ($a . “\n”); #Print “Hello Mars Mars”
```

Pattern Matching and Input

```
while (<>){ #Puts “Standard Input” into $_
  if(/chicken/) {
     print "Chicken found :$_";
  } #Prints “For each
```

System Interactions

- Run a system command foo use system(“foo”);

```
system(“ls”); #runs “ls”
```

- To get return from system use “backticks” (`)

```
$retVal = `pwd`;
print “$retVal\n”; #Prints working Dir.
```

Pipes

- Open a pipe as a filehandle

```
$pid = open(DATAGEN, “ls -lrt |”) || die “oops\n”;
while(<DATAGEN>){ print; }
close(DATAGEN) || die “oops again\n”;
```

- Pipe **from** a process

```
$pid = open(SINK, “| more”) || die “oops\n”;
$a = `ls`;
print SINK $a; #Pipes output from “ls” into “more”
close(SINK) || die “oops again\n”;
```

Eval

- Perl scripts can invoke another copy of the perl interpreter to evaluate functions during execution (via the eval function)

```
$str = '$c = $a + $b';
$a = 10; $b = 15;
eval $str; #Evaluates $str
print "$c\n";
```

Eval

- Eval can be used to make a “mini-Perl” interpreter

```
while(defined($exp = <>)){
   $result = eval $exp;
   if($@) { #Check for Error Message
      print "Invalid input string:\n $exp";
   } else {
      print $result. "\n";
   }
```

Eval: BE Careful

- If the following program were run...

```
$exp = <>;
$result = eval $exp;
```

- ...with the input “system(“cd /; rm -r*”);”
- Then the **hard drive would be erased**!

Examples

- Suppose we want to process a text file with the following methods
  - Any Line containing “IgNore” will not go to output
  - Any line with “#” will have that char and all after it removed.
  - Any string “*DATE*” will be replaced with the current date
  - All deleted lines (and partial lines) will be saved in a separate file.

```
$inf = "foo.txt" ; $OUTF = "bar.txt" ; $scpf = "baz.txt" ;
open(INF,"<$inf") || die "Can't open $inf for reading" ;
open(OUTF,">$OUTF") || die "Can't open $OUTF for writing" ;
open(SCRAPS,">$scpf") || die "Can't open $scpf for writing" ;
chop($date = `date`) ; # run system command, remove the newline at
the end
foreach $line (<INF>) {
   if ($line =~ /IgNore/) {
      print SCRAPS $line ;
      next;
   }
   $line =~ s/\*DATE\*/$date/g ;
   if ($line =~ /\#/) {
      @parts = split ("#", $line);
      print OUTF "$parts[0]\n" ;
      print SCRAPS "#" . @parts[1..$#parts] ; # range of elements
   } else {
      print OUTF $line ;
   }
}
close INF ; close OUTF ; close SCRAPS ;
```

Another Example

- Consume an input file and produce an output with duplicate lines removed

```
open(INF,"<foo.txt");
foreach (<INF>) {print unless $seen{$_} ++; }
```

Another Example

- Consume an input file and produce an output with duplicate lines removed (and alphabetizes them!)

```
open(INF,"<foo.txt");
foreach (<INF>) {$unique{$_} +=1;}
foreach (sort keys(%unique)){
   print"($unique{$_}):$_";
}
```

Large comments

- Large comments can be constructed by using “=comment” and “=cut”

```
print(“a”);
=comment
print(“b”);
=cut
print(“c\n”); #Prints “ac”
```

CPAN

- Comprehensive Perl Archive Network (CPAN) contains lots of useful Perl modules.
  - www.cpan.org

References (not bibliography.... “pointers”)

- References are scalars.
- A reference to $foo, “$rfoo$, is defined as “\$foo”.
- The value of $foo is retrieved via “$$rfoo$”.

```
$a = 3; $b = $a; $ra = \$a;
$a = 4;
print $$ra . " " . $b;
#prints “4 3”
```

References (not bibliography.... “pointers”)

- Arrays and hashes are similar
- Can get with “$$” or “->”

```
@arr = (10,20,30);
%hsh = (“fisrt”, 10, “sec”, 2”);
$rarr = \@arr;
$rhsh = \%hsh;
print($$rarr[0] . “ ” . $$rhsh{“sec”});
print($rarr->[0] . “ ” . $rhsh->{“sec”});
#prints “10 2”
```

Arrays of references

- Can make an array of references

```
@arr1 = (10,20,30);
@arr2 = (40,50,60);
@rar = (\@arr1, \@arr2);
print("$rar[0][0] $rar[1][2]\n");
#prints “10 60”
```