

## Physics 350 Lab 9 Sample Solutions

For **Part 1**, all you have to do to modify the **tutorial.pro** program to run through 100 years instead of 10 is

- change the generated array to have 100 elements by changing  
years = 2000+indgen(10) to years = 2000+indgen(100)
- Change the array for holding weekdays to have 100 elements:  
wdays = intarr(10) to wdays = intarr(100)

For **Part 2**, we present the IDL output of a session answering all the questions:

**IDL Version 7.0, Mac OS X (darwin i386 m32). (c) 2007, ITT Visual Information Solutions**

**Installation number: 218484-1.**

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```
IDL> ; Problem 2 part a)
IDL> X=5/2
IDL> Y=5./2
IDL> print,x,y
      2      2.50000
IDL> ; X is an integer found with integer division, Y is a real number
```

```
IDL> ; Problem 2, part b)
IDL> ; X will be the number 2.0, and Y will again be 2.5
IDL> X=float(5/2) & Y=float(5)/2 & print,x,y
      2.00000      2.50000
```

```
IDL> ;Problem 2, Part c)
IDL> C = 3e10 ; cm/sec
IDL> print,c^2
      9.00000e+20
IDL> print,c^3
      2.70000e+31
IDL> print,c^4
      Inf
% Program caused arithmetic error: Floating overflow
IDL> ; So the exponent we want is between 3 and 4. Try 3.5...
IDL> print,c^3.5
      4.67654e+36
IDL> ; ok, now try 3.75, halfway between 3.5 and 4
IDL> print,c^3.75
      Inf
% Program caused arithmetic error: Floating overflow
IDL> ; ok, now try the value halfway between 3.5 and 3.75, which is
IDL> ; 3.625
IDL> print,c^((3.5+3.75)/2)
      9.54036e+37
IDL> ; ok, keep increasing the exponent...
IDL> print, c^3.7
      Inf
% Program caused arithmetic error: Floating overflow
IDL> ; now start lowering until we don't get Inf for the result
```

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```
IDL> print, c^3.69
      Inf
% Program caused arithmetic error: Floating overflow
IDL> print, c^3.68
      Inf
% Program caused arithmetic error: Floating overflow
IDL> print, c^3.67
      2.82511e+38
IDL> ; Now, just for fun, move up from 3.67 to nail exactly where we lose
IDL> print, c^3.675
      3.18728e+38
IDL> print, c^3.676
      3.26512e+38
IDL> print, c^3.677
      3.34484e+38
IDL> print, c^3.678
      Inf
% Program caused arithmetic error: Floating overflow
IDL> ; So the answer seems to be 3.678
IDL> ; In double precision,
IDL> Cdbl = 3d10 ; cm/sec, and notice I wrote 3d10 instead of 3e10
IDL> print,Cdbl^3.678
      3.4265076e+38
IDL> ; No problem, try something bigger:
IDL> print,Cdbl^10
      5.9049000e+104
IDL> print,Cdbl^20
      3.4867844e+209
IDL> print,Cdbl^30
      Infinity
% Program caused arithmetic error: Floating overflow
IDL> ; The problem occurs somewhere between 20 and 30, try 25
IDL> print,Cdbl^25
      8.4728861e+261
IDL> print,Cdbl^27.5
      1.3207922e+288
IDL> print,Cdbl^28.75
      1.6490585e+301
IDL> print,Cdbl^28.8
      5.5091442e+301
IDL> print,Cdbl^28.85
      1.8405694e+302
IDL> print,Cdbl^28.9
      6.1489401e+302
IDL> print,Cdbl^28.95
      2.0543211e+303
IDL> print,Cdbl^29
      6.8630377e+303
IDL> print,Cdbl^29.5
      Infinity
% Program caused arithmetic error: Floating overflow
IDL> print,Cdbl^29.4
      1.0650277e+308
IDL> ; so here the largest power is 29.4, much larger than for single precision
```

## Physics 350 Lab 9 Sample Solutions

```
IDL> ; Problem 3, part a
IDL> x = indgen(100)
IDL> print, 'Number of elements is ', n_elements(x)
Number of elements is      100
IDL> print, 'Minimum value of x is ', min(x)
Minimum value of x is      0
IDL> print, 'Maximum value of x is ', max(x)
Maximum value of x is      99
IDL> print, 'Sum of all elements of x is ', total(x)
Sum of all elements of x is 4950.00
```

```
IDL> ; Problem 3, part b
IDL> print, x
   0   1   2   3   4   5   6   7   8   9
10  11  12  13  14  15  16  17  18  19  20
21
32  22  23  24  25  26  27  28  29  30  31
43  33  34  35  36  37  38  39  40  41  42
54  44  45  46  47  48  49  50  51  52  53
65  55  56  57  58  59  60  61  62  63  64
76  66  67  68  69  70  71  72  73  74  75
87  77  78  79  80  81  82  83  84  85  86
98  88  89  90  91  92  93  94  95  96  97
99
IDL> ; From the output it looks like x is a row vector.
```

```
IDL> ; Problem 3, part c
IDL> Q = 2*x
IDL> find = where( q le 40, count)
IDL> ;
IDL> ; printing Q[FIND] should print only those values of Q less than or equal to 40.
IDL> print, Q[find]
   0   2   4   6   8  10  12  14  16  18
20  22  24  26  28  30  32  34  36  38  40
```

```
IDL> ; Problem 3, part d
IDL> ;
IDL> ; z = x*0.0 is a vector with 100 floating point elements all of which are zero
IDL> help, x*0.0
<Expression>      FLOAT      = Array[100]
IDL> ; z = 0 is the single number 0, as a short integer
IDL> z = 0 & help, z
Z                  INT        =          0
```

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```
IDL> ; Problem 3, part e
IDL> ; We want the elements numbered from 5 to 15
IDL> ;
IDL> for j=5, 15 do print, x[j]
    5
    6
    7
    8
    9
   10
   11
   12
   13
   14
   15
IDL> ; now without a for loop
IDL> print, x[5:15]
    5      6      7      8      9      10      11      12      13      14
15
IDL> k = 5
IDL> print, x[10-k:10+k]
    5      6      7      8      9      10      11      12      13      14
15
IDL> ; both methods, numbering 5:15 and (k-5):(k+5) give the same result

IDL> ; Problem 3, part f
IDL> y = x[5:15]
IDL> print, y
    5      6      7      8      9      10      11      12      13      14
15
IDL> q = y^4
IDL> print, q
    625    1296    2401    4096    6561    10000    14641    20736    28561    -27120
-14911
IDL> ; WOW! That seems crazy..surely 15 to the 4th power is positive
IDL> print, float(y)^4
    625.000    1296.00    2401.00    4096.00    6561.00    10000.0
14641.0    20736.0    28561.0    38416.0    50625.0
IDL> ; Now it works. The problem was that 14 to the 4th and 15 to the 4th are
IDL> ; bigger than the biggest integer that can be represented with 2 bytes.
```

## Physics 350 Lab 9 Sample Solutions

```
IDL> ; Problem 4
IDL> ; part 1
IDL> x = indgen(101) ; note you need 101 in there to get all integers from 0 to 100
IDL> z = sin(x)/x
Program caused arithmetic error: Floating illegal operand
IDL> ; This error is actually OK, it is being caused because for x=0 you have a
IDL> ; division by zero problem. I can check by seeing if z did get defined...
IDL> help, z
Z                FLOAT      = Array[101]
IDL> ; z is floating point because the result of the sin function is a floating
IDL> ; point number.
IDL> ;
IDL> ; part 2
IDL> ;
IDL> plot, x, z
IDL> ; now find points where the absolute value of z is less than 0.05
IDL> SmallZ = where( abs(z) lt 0.05)
Program caused arithmetic error: Floating illegal operand
IDL> ; Again the error is actually OK since it is being caused by an ill-defined
IDL> ; x=0 term.
IDL> oplot, x[SmallZ], z[SmallZ], psym=5
IDL> ; to get a hard copy first change the device to postscript
IDL> set_plot, 'ps'
IDL> device, FILE='lab8.ps'
IDL> ; this sets the name of the postscript file...if you skip this it will be
IDL> ; called idl.ps
IDL> plot, x, z
IDL> oplot, x[SmallZ], z[SmallZ], psym=5
IDL> device, /close
IDL> ; once this command is issued no more output goes to the file lab8.ps
IDL> set_plot, 'x' ; this sets the display back to the screen
```