Introduction to Mathematica

September 12, 1995.

Starting/Stopping:

To start, click on Mathematica program group and then click on the Mathematica icon. Use the Quit/Exit option under the "File" menu to quit.

In the Unix version, add "/p/math" to your path and then type "math" to get the dumb-terminal interface and "mathematica" to get the notebook interface. In CS, this is only available on icarus. Type "Quit"to get out of the terminal version.

To evaluate a command in the notebook version, type Shift-Return.

In terminal version a command is evaluated as soon as its complete (and u hit return).

Basics:

Mathematica also has a command interpreter model similar to MAXIMA. Mathematical expressions have the usual syntax, with the noted exception that whitespace may be used to indicate multiplication.

Function names all start with a capital letter. Long function names with multiple words are preferred. First letter of each word is capitalized in this case.

```
In[1]:= 1 + 2

Out[1]= 3

In[2]:= 2 * 3

Out[2]= 6

In[3]:= 2 (x + y)

Out[3]= 2 (x + y)
```

```
In[4]:= 2 (x + y) 3

Out[4]= 6 (x + y)

In[5]:= Sin[x]

Out[5]= Sin[x]
```

Differentiation & Integration:

```
In[6]:= D[Sin[x],x]

Out[6]= Cos[x]

In[7]:= D[Sin[x y], x, y]

Out[7]= Cos[x y] - x y Sin[x y]

In[8]:= D[Sin[x], t, NonConstants -> {x}]

Out[8]= Cos[x] D[x, t, NonConstants -> {x}]

In[9]:= Dt[f[x,y]]

                   (0,1)                    (1,0)
Out[9]= Dt[y] f         [x, y] + Dt[x] f         [x, y]

In[10]:= Integrate[Cos[x], x]

Out[10]= Sin[x]

In[11]:= D[%,x]

Out[11]= Cos[x]

In[12]:= Integrate[%,x];
```

```
In[13]:= Integrate[ Exp[-a x^2] / x^5, x]

            1      a
           ---- - ----
              4      2     2                    2
           4 x    4 x      a  ExpIntegralEi[-(a x )]
Out[13]= -(-----------) + ------------------------
                  2                   4
               a x
              E

In[14]:= D[%, x]

             -5    a                        1      a
           -x   + ----                 2 a (---- - ----) x
                     3        2               4      2
                  2 x        a               4 x    4 x
Out[14]= -(-----------) + --------- + -------------------
                  2             2                2
               a x           a x              a x
              E            2 E     x         E

In[15]:= Simplify[%]

            1
Out[15]= --------
             2
          a x   5
         E     x

In[16]:= Integrate[ x^3 Log[x^2], {x, 0, t}]

Integrate::gener: Unable to check convergence.

          4              2
         t  (-1 + 2 Log[t ])
Out[16]= -------------------
```

```
                   8

In[17]:= % /. t -> 1

           1
Out[17]= -(-)
           8

In[18]:= N[%]

Out[18]= -0.125

In[19]:= NIntegrate[x^3 Log [x^2], {x,0,1}]

Out[19]= -0.125
```

Functions:

```
In[20]:= 30!

Out[20]= 265252859812191058636308480000000

In[21]:= fac[n_] := Product[i, {i, 1,n}]

In[22]:= fac[30]

Out[22]= 265252859812191058636308480000000

In[23]:= fac[n_] := If [n <= 1, 1, n * fac[n-1]]

In[24]:= fac[30]

Out[24]= 265252859812191058636308480000000

In[25]:= Clear[fac]
```

```
In[51]:= Clear[fac]

In[52]:= fac[n_] := Module[
           {res, i},
           For[res = 1; i = 1, i <= n, i = i + 1, res = res * i];
           res]

In[53]:= fac[30]

Out[53]= 265252859812191058636308480000000

In[54]:= Clear[fac]

In[55]:= fac[n_Integer] := Product[i, {i, 1, n}]

In[56]:= fac[30]

Out[56]= 265252859812191058636308480000000

In[57]:= fac[2.3]

Out[57]= fac[2.3]
```

Internals:

```
In[1]:= x + x^2 - Sin[x] == a

              2
Out[1]= x + x  - Sin[x] == a

In[2]:= FullForm[%]

Out[2]//FullForm= Equal[Plus[x, Power[x, 2], Times[-1, Sin[x]]], a]

In[3]:= x + x^2 - Sin[x] == a // FullForm
```

```
Out[3]//FullForm= Equal[Plus[x, Power[x, 2], Times[-1, Sin[x]]], a]

In[4]:= x + x^2 - Sin[x] == a // TreeForm

Out[4]//TreeForm= Equal[|                                      , a]
                        Plus[x, |            , |                ]
                                Power[x, 2]  Times[-1, |     ]
                                                       Sin[x]

In[5]:= x + x^2 - Sin[x] == a // Head

Out[5]= Equal

In[6]:= e =  x + x^2 - Sin[x] == a

             2
Out[6]= x + x  - Sin[x] == a

In[7]:= Part[e,1]

             2
Out[7]= x + x  - Sin[x]

In[8]:= Part[e,0]

Out[8]= Equal

In[9]:= Part[e,2]

Out[9]= a
```

Getting Help:

```
In[1]:= ?Sin
Sin[z] gives the sine of z.
```

```
In[1]:= ?If
If[condition, t, f] gives t if condition evaluates to True, and f if it
   evaluates to False. If[condition, t, f, u] gives u if condition evaluates
   to neither True nor False.

In[1]:= ?While
While[test, body] evaluates test, then body, repetitively, until test first
   fails to give True.

In[1]:= ?Which
Which[test1, value1, test2, value2, ...] evaluates each of the testi in turn,
   returning the value of the valuei corresponding to the first one that
   yields True.
```