

The ra and la tutorial

ra ra ra ra ra ra ra and **la la la la la la la** are words in the MCtools package which respectively will take a sequence of expressions and strings and return respectively an asciimath string (surrounded by backquotes) suitable for displaying typeset math in mathclass homework or a latex string surrounded by dollar signs suitable for exporting to a tex file from Maple (so far just the classic interface.)

Both of these words call on the word **rascim**, a word in the MCtools package which will take an expression and convert it to asciimath or latex depending on whether the **Latex=** option is set to no or yes.

Here is the help message for **rascim**

```
> rascim(Help=yes);

rascim(expr) converts an expression into an asciimath

expression suitable for mathclass homework. Use ra(expr sequence) to
convert a sequence of expressions and strings into an asciimath
expression surrounded by backquotes '.

It also can return a latex expression. Use la(expr sequence) to
convert a sequence of expressions and strings into a latex expression
surrounded by dollar signs $.

options:

Latex=no   change to yes to get latex

Surds=yes  This does surds for powers of roots rather than fractional
exponents

           change this to no if you want the usual crappy fractional
powers.
```

The help by necessity rather terse and not at all complete. This page is intended as a more complete primer of the current conversion capabilities of **la** and **ra**

1 la examples

If you want latex output to be processed as latex (using the word **latexit** from MCtools), you need to type **underscoreLATEX** at the beginning of a text line as shown below. To turn off latex processing, you need to type **underscoreXETAL** at the end. See below where we stop and compare with the pdf file of this page.

You can typeset integrals and integral equations with **la**. Use **big** as shown to make the integral larger.

```
> mcprint(la(Int(x^2,x=0..1)));mcprint(la(big,Int(sin(theta),theta=0..P
i)=int(sin(theta),theta=0..Pi)));
```

$$\int_0^1 x^2 dx$$

$$\int_0^\pi \sin(\theta) d\theta = 2$$

We can do indefinite integrals

```
> mcprint(la(big,Int(x^2,x),"\\ \\
",big,Int(sin(theta),theta)));
```

$$\int x^2 dx \quad \int \sin(\theta) d\theta$$

We can do ordinary derivatives and partial derivatives, small or big

```
> mcprint(la(Diff(sin(x*y),x)));mcprint(la(Pdiff(sin(x*y),x)));
```

$$\frac{d}{dx} \sin(xy)$$

$\frac{\partial}{\partial x} \sin(xy)$
`> mcprint(la(big,Diff(sin(x*y),x)));mcprint(la(big,Pdiff(sin(x*y),x)));`
 $\frac{d}{dx} \sin(xy)$
 $\frac{\partial}{\partial x} \sin(xy)$

We can do products and sums, big and small. If you want text in la, you must use tex(" ") as shown.

```
> mcprint(la(tex("The product of the first $n$ integers is
"),big,Product(i,i=1..n)), " = ",n!," = ",GAMMA(n+1));
mcprint(la(tex("The sum of the first $n$ squares is
"),big,Sum(i^2,i=1..n)), "=",sum(i^2,i=1..n));
```

The product of the first n integers is $\prod_{i=1}^n i = n! = \text{GAMMA}(n+1)$

The sum of the first n squares is $\sum_{i=1}^n i^2 = \frac{1}{3}n + 1^3 + \frac{-1}{2}n + 1^2 + \frac{1}{6}n + \frac{1}{6}$

We can do inequalities, although if you want greater than inequalities, you have to build them as shown, without running them through the maple parser.

```
> mcprint(la(x<y)),mcprint(la(x>y)),mcprint(la(x," \\\geq ",y));
```

$x \leq y$

$y \leq x$

$x \geq y$

We can do piecewise defined functions

```
> mprint(la(g(x)=piecewise(x<0,x-2,x <3,x^2,x<4))));
```

$$g(x) = \begin{cases} x-2 & \text{if } x < 0 \\ x^2 & \text{if } x < 3 \\ x < 4 & \text{otherwise.} \end{cases}$$

If you want to have more complicated descriptions of the domain of the rules, use Pcwise

```
> mcprint(la(f(x)=Pcwise(x<=0,x^2-3,"0 \\\leq x \\\leq
6",sin(3*x+2),tan(x))));
```

$$f(x) = \begin{cases} x^2-3 & \text{if } x \leq 0 \\ \sin(3x+2) & \text{if } 0 \leq x \leq 6 \\ \tan(x) & \text{otherwise.} \end{cases}$$

We can do Systems of equations or inequalities, using Syseqn.

```
> mcprint(la(Syseqn([x^2+x>= y+3,e^x=ln(x^2+3*x)]))));
```

$$\begin{cases} y+3 & \leq x^2+x \\ e^x & = \ln(x^2+3x) \end{cases}$$

You can bypass the maple parser and get greater than or equal to inequalities by using geq, as below. Also you can add an argument to Syseqn: "l" left justifies the sides of the relation. "r" will right justify. "lr" will left justify the left side and right justify the right side. "cc" centers each side, etc.

```
> mcprint(la(Syseqn([x^2+x>= y+3,e^x=ln(x^2+3*x)]))));
```

$$\begin{cases} y+3 & \leq x^2+x \\ e^x & = \ln(x^2+3x) \end{cases}$$

Any latex relation can be put in the middle: for example neq gives $\neq$

```
> mcprint(la(Syseqn([neq(3*x^3-x^2+a,3),geq(e^x,ln(x^2+3*x)]))));
```

$$\begin{cases} 3x^3-x^2+a & \neq 3 \\ e^x & \geq \ln(x^2+3x) \end{cases}$$

We can do the binomial symbol

```
> mcprint(la(Binomial(n,r)));
```

$$\begin{pmatrix} n \\ r \end{pmatrix}$$

We can do matrices Mat has round brackets, Det has vertical brackets, Tab has no brackets. Each will accept a list of lists, a Matrix or an array. The column justification of each is modified by adding a second argument: "l" left justifies all columns, "c" is the default, "r" right justifies all columns, and otherwise a string "llrc.." of the right length will justify each column as you like.

```
> T:=Matrix([[5,4,x^2+s*sin(theta)],[a,b]]);
```

$$T := \begin{bmatrix} 5 & 4 & x^2 + s \sin(\theta) \\ a & b & 0 \end{bmatrix}$$

```
> mcprint(la(Mat([[2,3],[a,b]]),"\\ \\
",Det([[5,exp(x^2+3)],[a,b]]),"l"),"\\ \\ ",Tab([[2,3],[a,b]]));
mcprint(la(Mat(T),"\\ \\
",Det(matrix([[5,ln(x^2+3)],[a,b]]),"r"),"\\ \\
",Tab([[2,3],[a,b]])));
```

$$\begin{pmatrix} 2 & 3 \\ a & b \end{pmatrix} \left| \begin{array}{cc} 5 & \exp(x^2 + 3) \\ a & b \end{array} \right| \begin{array}{cc} 2 & 3 \\ a & b \end{array}$$

$$\begin{pmatrix} 5 & 4 & x^2 + s \sin(\theta) \\ a & b & 0 \end{pmatrix} \left| \begin{array}{cc} 5 & \ln(x^2 + 3) \\ a & b \end{array} \right| \begin{array}{cc} 2 & 3 \\ a & b \end{array}$$

You can put text in a matrix with tex(" ") (in the asciimath version ra it is text(" "))

```
> mcprint(la(Mat([[tex("now is the time"),3],[a,tex("for all good men
to come to the aid of their
queen.")]]))));mcprint(la(Tab([[2,3],[a,b]])));;
```

$$\begin{pmatrix} \text{now is the time} & 3 \\ a & \text{for all good men to come to the aid of their queen.} \end{pmatrix}$$

$$\begin{array}{cc} 2 & 3 \\ a & b \end{array}$$

Here is a column vector.

```
> mcprint(la(ColVec([tex("now is the time"),3,a,tex("for all good men
to come to the aid of their queen.")]]))));
```

$$\begin{pmatrix} \text{now is the time} \\ 3 \\ a \\ \text{for all good men to come to the aid of their queen.} \end{pmatrix}$$

Here is a randomly generated Matrix. You have to watch that doesn't get split at an endline.

```
> mcprint(la(Tab(LinearAlgebra[RandomMatrix](6,7),"r")));;
```

$$\begin{array}{cccccc} 77 & 25 & -16 & -38 & 57 & -32 & 99 \\ 9 & 94 & -9 & -18 & 27 & -74 & 29 \\ 31 & 12 & -50 & 87 & -93 & -4 & 44 \\ -50 & -2 & -22 & 33 & -76 & 27 & 92 \\ -80 & 50 & 45 & -98 & -72 & 8 & -31 \\ 43 & 10 & -81 & -77 & -2 & 69 & 67 \end{array}$$

Here is a row vector

```
> mcprint(la(RowVec([tex("now is the time"),3,a,tex("for all good men
to come to the aid of their queen.")]]))));
```

(now is the time, 3, a, for all good men to come to the aid of their queen.)

Use Pnt to typeset ordered tuples

```
> mcprint(la(X=Pnt(3,4,2,a,x[6]),"\\ \\ P =
",Pnt(63,-2,theta,phi,omega)));mcprint(la(Pnt(Vector([3,4,5,6]))));
```

$X = (3, 4, 2, a, x_6)$ $P = (63, -2, \theta, \phi, \omega)$

$(3, 4, 5, 6)$

We can do Matrices with subscripts.

```
> mcprint(la(ColVec([3,4,5,6])));
```

$$\begin{pmatrix} 3 \\ 4 \\ 5 \\ 6 \end{pmatrix}$$

```
> M:=matrix(4,5);
```

$$M := \text{array}(1..4, 1..5, [])$$

```
> mcprint(la(Mat(M)));
```

$$\begin{pmatrix} M_{1,1} & M_{1,2} & M_{1,3} & M_{1,4} & M_{1,5} \\ M_{2,1} & M_{2,2} & M_{2,3} & M_{2,4} & M_{2,5} \\ M_{3,1} & M_{3,2} & M_{3,3} & M_{3,4} & M_{3,5} \\ M_{4,1} & M_{4,2} & M_{4,3} & M_{4,4} & M_{4,5} \end{pmatrix}$$

2 ra examples

Here are the asciimath strings of commands like the ones above for latex. They look fine if used in the tagit line of a mathclass problem.

You can typeset integrals and integral equations with ra.

```
> mcprint(ra(Int(x^2,x=0..1)));mcprint(ra(Int(sin(theta),theta=0..Pi)=i
nt(sin(theta),theta=0..Pi)));
```

```
‘ int_(0)^(1)x^(2)\ d x ‘
```

```
‘ int_(0)^(Pi)text(sin)(\theta)\ d theta = 2 ‘
```

We can do indefinite integrals

```
> mcprint(ra(Int(x^2,x),"\\ \\ ",Int(sin(theta),theta)));
```

```
‘ int x^(2)\ d x \ \ int text(sin)(\theta)\ d theta ‘
```

We can do ordinary derivatives and partial derivatives,

```
> mcprint(ra(Diff(sin(x^2*y),x)));mcprint(ra(Pdiff(sin(x*y),x)));
```

```
‘ d/(d x)\ text(sin)(x^(2)\ y) ‘
```

```
‘ del/(del x)\ text(sin)(x\ y) ‘
```

We can do products and sums. Use text(" ") to put text in ra.

```
> mcprint(ra(text("The product of the first n integers is
"),Product(i,i=1..n)," = ",n!," = ",GAMMA(n+1)));
mcprint(ra(text("The sum of the first n squares is
"),Sum(i^2,i=1..n),"=",sum(i^2,i=1..n)));
```

```
‘ text{The product of the first n integers is } Pi_(1)^(n)i = n! =
\Gamma ( n+1 ) ‘
```

```
‘ text{The sum of the first n squares is } sum_(1)^(n)i^(2)=(1)/(3)\
(n + 1)^(3) + (-1)/(2)\ (n + 1)^(2) + (1)/(6)\ n + (1)/(6) ‘
```

We can do inequalities, although if you want greater than inequalities, you have to build them as shown, without running them through the maple parser.

```
> mcprint(ra(x<=y)),mcprint(ra(x>=y)),mcprint(ra(x," >= ",y));
```

```
‘ x <= y ‘
```

```
‘ y <= x ‘
```

```
‘ x >= y ‘
```

We can do piecewise defined functions

```
> mcprint(ra(g(x)=piecewise(x<0,x-2,x<3,x^2,x<4))));

'g ( x ) = {(x - 2, text{ if }x < 0),(x^(2), text{ if }x < 3),(x
< 4, text{ otherwise.}):}'
```

If you want to have more complicated descriptions of the domain of the rules, use Pcwise

```
> mcprint(ra(f(x)=Pcwise(x<=0,x^2-3,"0 <= x <=
6",sin(3*x+2),tan(x))));

'f ( x ) = {(x^(2) - 3, text{ if }x <= 0),(text(sin)(3\ x + 2),
text{ if }0 <= x <= 6),(\tan(x), text{ otherwise.}):}'
```

We can do Systems of equations or inequalities, using Syseqn.

```
> mcprint(ra(Syseqn([x^2+x>= y+3,e^x=ln(x^2+3*x)]))));

'{(y + 3 <= x^(2) + x),(e^(x) = text(ln)(x^(2) + 3\ x)):}'
```

You can bypass the maple parser and get greater than or equal to inequalities by using geq, as below. Also you can add an argument to Syseqn: "l" left justifies the sides of the relation. "r" will right justify. "lr" will left justify the left side and right justify the right side. "cc" centers each side, etc.

```
> mcprint(ra(Syseqn([x^2+x>= y+3,e^x=ln(x^2+3*x)]))));

'{(y + 3 <= x^(2) + x),(e^(x) = text(ln)(x^(2) + 3\ x)):}'
```

Any latex relation can be put in the middle: for example neq gives $\neq$

```
> mcprint(ra(Syseqn([neq(3*x^3-x^2+a,3),geq(e^x,ln(x^2+3*x)]))));

'({\it neq} ( 3 {x}^3-{x}^2+a,3 )),( {\it geq} ( {e}^x,\ln
( {x}^2+3 x ) ) ):}'
```

We can do the binomial symbol

```
> mcprint(ra(Binomial(n,r)));

'((n),(r))'
```

We can do matrices Mat has round brackets, Det has vertical brackets, Tab has no brackets. Each will accept a list of lists, a Matrix, a matrix or an array.

```
> mcprint(ra(A=Mat([[2,3],[a,b]]),"\\ \\
",B=Det(Matrix([[5,exp(x^2+3)],[a,b]])),"\\ \\
",Tab(array([[2,3],[a,b]]))));

'A = ((2 , 3),(a , b))\ \ B = |(5 , text(exp)(x^(2) + 3)),(a , b)|\ \
{(2 , 3),(a , b):}'
```

You can put text in a matrix with text(" ")

```
> mcprint(ra(Mat([text("now is the time"),3],[a,text("for all good men
to come to the aid of their
queen.")])));mcprint(ra(Tab([2,3],[a,b])));

'(( text{now is the time} , 3),(a , text{for all good men to come to
the aid of their queen.}))'

'{(2 , 3),(a , b):}'
```

Here is a column vector.

```
> mcprint(ra(ColVec([text("now is the time"),3,a,text("for all good men
to come to the aid of their queen.")])));

'(( text{now is the time}),(3),(a),( text{for all good men to come to
the aid of their queen.}))'
```

Here is a randomly generated Matrix. You have to watch that $\backslash$ doesn't get split at an endline.

```
> mcprint(ra(Tab(LinearAlgebra[RandomMatrix](6,7))));

'{(90 , 41 , 52 , -59 , 22 , -95 , 24),(80 , 91 , -13 , 12 , 14 , -20
, 65),(19 , 29 , 82 , -62 , 16 , -25 , 86),(88 , 70 , 72 , -33 , 9 ,
51 , 20),(-82 , -32 , 42 , -68 , 99 , 76 , -61),(-70 , -1 , 18 , -67 ,
60 , -44 , -48):}'
```

Here is a row vector

```
> mcprint(ra(RowVec([text("now is the time"),3,a,text("for all good men
to come to the aid of their queen.")])))

‘( text{now is the time},3,a, text{for all good men to come to the aid
of their queen.})’
```

Use Pnt to typeset ordered tuples. It accepts sequences, lists or Vectors

```
> mcprint(ra(X=Pnt(3,4,2,a,x[6]),"\ \ \ P =
",Pnt([63,-2,theta,phi,omega]),"\ \ \
",Pnt(Vector([3,4,5,6]))));

‘X = (3,4,2,a,x_(6))\ \ P = (63,-2,\theta,\phi,\omega)\ \ (3,4,5,6)’
```

We can do Matrices with subscripts.

```
> mcprint(ra(A=ColVec([3,4,5,6])));

‘A = ((3),(4),(5),(6))’

> M:=matrix(4,5):
> mcprint(ra(M=Mat(M)));

‘M = ((M_(1,1) , M_(1,2) , M_(1,3) , M_(1,4) , M_(1,5)),(M_(2,1) ,
M_(2,2) , M_(2,3) , M_(2,4) , M_(2,5)),(M_(3,1) , M_(3,2) , M_(3,3) ,
M_(3,4) , M_(3,5)),(M_(4,1) , M_(4,2) , M_(4,3) , M_(4,4) , M_(4,5)))’
```

3 Using ra in the tagit line of a mathclass problem

You can use ra in the tagit line of a problem for mathclass. Here are some examples.

If you want a single problem, you can use tagit by itself

```
> tagit("Solve the system of equations for
x:",brak(),[ra(Syseqn(3*x-y=7,-4*x+y=9),text(" Answer:  "),x," =
"))],_AC(-16));
```

QM_[.05;-16]

AH_[0]

Solve the system of equations for x:

brk

‘{(3\ x - y = 7),(-4\ x + y = 9):} text{ Answer: }x = ‘

AC_[15]

SKIP_

If you want versions of a problem, use a problem generator.

```
> prob:=proc()
local a,b;
getparams([args],[[a,[2,3,4]],[b,perm,[1,2,3]]]);
> tagit("Compute the following:",brak(),
["a" ,ra((Diff(x^a-b[1]*x + b[2],x))),
",_AF(diff(x^a-b[1]*x+b[2],x))],brak(),
> ["b" ,ra(Int(x^a-b[1]*x + b[2],x)),
",_AI(int(x^a-b[1]*x+b[2],x))],brak(),
["c" ,ra(Int(x^a-b[1]*x + b[2],x=1..5)),
",_AF(int(x^a-b[1]*x+b[2],x=1..5))] end:
> prob(1);
```

current inputs are (1,2,[1, 2, 3])

QM_[.05;2*x-1;1/3*x^3-1/2*x^2+2*x;112/3]

AH_[0]

Compute the following:

brk

a) 'd/(d x)\ (x^(2) - x + 2)'

AF_[15;x;6;.1;1]

AH_[0]

brk

b) ' int x^(2) - x + 2\ d x'

AI_[15;x;6;.1;1]

AH_[0]

brk

c) ' int_(1)^(5)x^(2) - x + 2\ d x'

AF_[15;x;6;.1;1]

SKIP_

4 converting mathclass problems to latex problems

You can convert a mathclass problem to a hard copy latex version. Basically it involves changing tagit to ltagit, ra to la, and possibly making some other minor changes. Instead of typing underscoreLATEX above and underscoreXETAL below the problem, you must put LATEX_:=yes and LATEX_:=no in the input above and below the ltagit line.

The output is designed to be extracted from the latex export of this file using **latexit latexit latexit latexit latexit** or **makexam makexam makexam makexam makexam makexam makexam**. Also, we replace the AC format with AX and supply an answer box (use **ansbox ansbox ansbox ansbox ansbox ansbox ansbox** from latextools)

```
> LATEX_:=yes:
ltagit(["Solve the system of equations for
x:"],brak(),[la(Syseqn([3*x-y=7,-4*x+y=9]),tex(" Answer:  "),x," =
>  "),ansbox(Height=.5,Width=.9,Fill="",Placement="c")],_AX(la(x=-16)));
LATEX_:=no:
```

Solve the system of equations for x:

$$\begin{cases} 3x - y = 7 \\ -4x + y = 9 \end{cases} \quad \text{Answer: } x =$$



◇ $x = -16$

If you want versions of a problem, use a problem generator. Note the changes from the mathclass generator. We insert a global line, change tagit to ltagit, and ra to la. We also changed all the answer formats (AF and AI) to AX formats and added an answer box for them to put their answers in.

```
> prob:=proc()
global LATEX_:
local a,b,f,x,abox;
```

```

> getparams([args],[[a,[2,3,4]],[b,perm,[2,3,4]]]);
abox:=ansbox(Height=.7,Width=1.5,Fill="",Placement="c"):
LATEX_:=yes:
> ltagit("Compute the following:",brak(),
["a"  ",la(f(x)=x^a-b[1]*x + b[2],"\\ \\  ",big,Diff(f(x),x)," =
"),abox],
> _AX(la(Diff(f(x),x)=diff(x^a-b[1]*x+b[2],x))),brak(),
["b"  ",la(big,Int(x^a-b[1]*x + b[2],x),"
="),abox],_AX(la(big,Int(f(x),x)=int(x^a-b[1]*x+b[2],x))),brak(),
> ["c"  ",la(big,Int(x^a-b[1]*x + b[2],x=1..5),"
="),abox],_AX(la(big,Int(f(x),x=1..5)=int(x^a-b[1]*x+b[2],x=1..5))));
LATEX_:=no:
> NULL:
end:
> prob(1);

current inputs are (1,2,[3, 4, 2])

```

Compute the following:

a) $f(x) = x^2 - 3x + 4 \quad \frac{d}{dx} f(x) =$

b) $\int x^2 - 3x + 4 dx =$

c) $\int_1^5 x^2 - 3x + 4 dx =$

- ◇ $\frac{d}{dx} f(x) = 2x - 3$
- ◇ $\int f(x) dx = \frac{1}{3}x^3 + \frac{-3}{2}x^2 + 4x$
- ◇ $\int_1^5 f(x) dx = \frac{64}{3}$

5 creating a joint problem

We can make mathclass and latex problem jointly. Then one can post the homework (or exam) and also make a hardcopy version done in latex using makexam. I illustrate with a simple example.

```

> prob:=proc()
global LATEX_:
local a,b;

```



```

> getparams([args],[[a,[2,3,4]],[b,[5,7,9]]]);
tagit(["Compute the sum of the arithmetic series
",ra(Sum(a+b*i,i=3..25)," = ")],_AC(sum(a+b*i,i=3..25))):
> LATEX_:=yes:
ltagit(["Compute the sum of the arithmetic series
",la(big,Sum(a+b*i,i=3..25)," =
> ")],_ansbox(Height=.7,Width=1,Fill="",Placement="c")],_AX(sum(a+b*i,i=3.
.25))):
LATEX_:=no:
> NULL:
end:
> prob(1);

```

current inputs are (1,4,5)

QM_[.05;1702]

AH_[0]

Compute the sum of the arithmetic series ' $\sum_{i=3}^{25} 4 + 5i =$ '

AC_[15]

SKIP_

Compute the sum of the arithmetic series $\sum_{i=3}^{25} 4 + 5i =$



◇ 1702

The following command will create a latex hardcopy of this worksheet. First export it to latex.

```

> latexit("laratest","c://carl/whs/MCtools1_30_09");

```

index words duplicated

laratestwhs.tex created

laratestwhs.dvi created.

fixed eps files (removed their borders and recolored if Color=yes is set)

laratestwhs.ps created sucessfully.

finished

Now we will extract some of the latex problems in this file and make an exam. Since there are only three latex problems in it we will get them all.

```

> makexam(Help=yes); #will get you the help sheet.

```

```

> makexam("laratest","c:/carl/whs/Mctools1_30_09",
Version=[[1],[1,2,3],[1,2,3]],
Cover=cat("\\textbf{\\Large Math Test}\\hfill Jan 31, 2009
> \\hfill
\\textbf{Name:}\\rule[-.01in]{1in}{.01in}\\\\ " ),

```

```
> Spacing=[1,1,1],  
ExtraPreamble=cat("\\raggedright\\n\\topmargin=-1in\\n\\ ");
```

The latest eps files are already recolored.

laratestv1_la.tex created: 3 problems

index words duplicated

laratestv1_lawhs.tex created

laratestv1_lawhs.dvi created.

fixed eps files (removed their borders and recolored if Color=yes is set)

laratestv1_lawhs.ps created successfully.

finished