CAS simplification comparison between Maple and Mathematica

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1 introduction

1.1 links to older version using Maple 11 and Mathematica 5.2

A detailed but older version that used Maple 11 and Mathematica 5.2 is here which contains images to each expression used.

1.2 updated results using Maple 14 and Mathematica 8.04

This version only shows the final result using an updated version of Mathematica and Maple, but does not show each expression generated. When I have more time I hope to also show those in this updated version.

For this version I used Mathematica 8.04 and Maple 14, both on windows 7. The PC is `intel i7 930 @ 2.8 Ghz` with 8 GB memory

This is the result of doing a simplification measure on an expression using Maple and Mathematica using an expression posted on `sci.math.symbolic` by Dr Carlos.

The expression given in the original post can be found at `http://sci4um.com/about26200.html`

```
xnum = ((6-4*Sqrt[2])*Log[3-2*Sqrt[2]]+(3-2*Sqrt[2])*Log[17-12*Sqrt[2]]+32-24*Sqrt[2]);
xden = (48*Sqrt[2]-72)*(Log[Sqrt[2]+1]+Sqrt[2])/3;

x    = xnum/xden;
```

The answer is $x = 1$.

Where x is the following expression

```
In[247]:= xnum = ((6 - 4 * Sqrt[2]) * Log[3 - 2 * Sqrt[2]] + (3 - 2 * Sqrt[2]) *
          Log[17 - 12 * Sqrt[2]] + 32 - 24 * Sqrt[2]);
          xden = (48 * Sqrt[2] - 72) * (Log[Sqrt[2] + 1] + Sqrt[2]) / 3;
          x = xnum / xden
```

Out[249]=
$$\frac{3\left(32 - 24\sqrt{2} + \left(3 - 2\sqrt{2}\right)\text{Log}\left[17 - 12\sqrt{2}\right] + \left(6 - 4\sqrt{2}\right)\text{Log}\left[3 - 2\sqrt{2}\right]\right)}{\left(-72 + 48\sqrt{2}\right)\left(\sqrt{2} + \text{Log}\left[1 + \sqrt{2}\right]\right)}$$

Figure 1: x expression

and in expanded form

Out[49]=
$$\frac{96}{\left(-72+48\sqrt{2}\right)\left(\sqrt{2}+\text{Log}\left[1+\sqrt{2}\right]\right)} - \frac{72\sqrt{2}}{\left(-72+48\sqrt{2}\right)\left(\sqrt{2}+\text{Log}\left[1+\sqrt{2}\right]\right)} + \frac{9\,\text{Log}\left[17-12\sqrt{2}\right]}{\left(-72+48\sqrt{2}\right)\left(\sqrt{2}+\text{Log}\left[1+\sqrt{2}\right]\right)} - \frac{6\sqrt{2}\,\text{Log}\left[17-12\sqrt{2}\right]}{\left(-72+48\sqrt{2}\right)\left(\sqrt{2}+\text{Log}\left[1+\sqrt{2}\right]\right)} + \frac{18\,\text{Log}\left[3-2\sqrt{2}\right]}{\left(-72+48\sqrt{2}\right)\left(\sqrt{2}+\text{Log}\left[1+\sqrt{2}\right]\right)} - \frac{12\sqrt{2}\,\text{Log}\left[3-2\sqrt{2}\right]}{\left(-72+48\sqrt{2}\right)\left(\sqrt{2}+\text{Log}\left[1+\sqrt{2}\right]\right)}$$

Figure 2: x expression expanded

Using x as shown above , the function `Expand[]` in Mathematica and `expand()` in Maple are then applied to $x, x^2, x^4, x^8, x^{16}, x^{32}$, then the result is fully simplified again, and the leaf count (measure of simplifcation) is compared to the original expression to obtain a measure of the system simplification.

Mathematica has both `Simplify[expr]` and `FullSimplify[expr]` and Maple has `simplify(expr,size)` and `simplify(expr)`. Here, I used only the `simplify(expr,size)` since `LeafCount` was used.

The tables below show the result of using both functions in each system.

The tables show the size of the expression before and after simplification, the percentage in size reduction and the cpu time used.

2 results

2.1 Mathematica

Source code used is

```
xnum = ((6-4*Sqrt[2])*Log[3-2*Sqrt[2]]+(3-2*Sqrt[2])*Log[17-12*Sqrt[2]]+32-24*Sqrt[2]);
xden = (48*Sqrt[2]-72)*(Log[Sqrt[2]+1]+Sqrt[2])/3;
x    = xnum/xden;
xtab = Expand[{x,x^2,x^4,x^8,x^16}];
n    = Length[xtab];
stab = Table[0,{n},{4}];

For[i=1,i<= n,i++,
 {
  stab[[i,1]] = LeafCount[xtab[[i]]];
  s = Timing[Simplify[ xtab[[i]] ]];  (*use FullSimplify or Simplify *)
  stab[[i,2]] = LeafCount[ s[[2]] ];
  stab[[i,3]] = s[[1]];
  stab[[i,4]] = Round[100.0*stab[[i,2]]/stab[[i,1]]];
  }
];

Grid[Join[{{"leaf count before","leaf count after","cpu","% reduction"}},stab],
     Frame->All
    ]
```

2.1.1 using Simplify[]

When running the above code, using `Simplify[]`, this is the result

leaf count before	leaf count after	cpu	% reduction
230	50	0.093	22
507	96	0.156	19
1394	362	0.265	26
4500	1052	0.702	23
16040	3533	2.231	22

Figure 3: Output from Simplify

2.1.2 using FullSimplify[]

When running the above code, using `FullSimplify[]`, this is the result

leaf count before	leaf count after	cpu	% reduction
230	32	0.296	14
507	90	0.78	18
1394	232	888.894	17
4500	1043	65.302	23
16040	3525	393.637	22

Figure 4: Output from FullSimplify

2.2 Maple

2.2.1 using LeafCount()

In maple, using `with(MmaTranslator[Mma])` to access the function `LeafCount()`.

Source code

```
restart;
with(MmaTranslator[Mma]):
xnum := ((6-4*sqrt(2))*ln(3-2*sqrt(2))+(3-2*sqrt(2))*ln(17-12*sqrt(2))+32-24*sqrt(2)):
xden := (48*sqrt(2)-72)*(ln(sqrt(2)+1)+sqrt(2))/3:
x    := xnum/xden:

n:=5:
stab := Matrix(5,4,0):  #Matrix where to keep track of stats
xtab : =expand({x,x^2,x^4,x^8,x^16}):

for i from 1 to n do

    stab[i,1]:= LeafCount(xtab[i]):

    startingTime := time():
    s            := simplify(xtab[i],size):
    stab[i,3]    := time()-startingTime:

    stab[i,2]    := LeafCount(s):
    stab[i,4]    := ceil(100.*stab[i,2]/stab[i,1]):
od:
stab;
```

Columns have the same meaning as above.

180	62	0.	35
399	114	0.	29
1104	272	0.	25
3582	804	0.	23
12810	2732	0.	22

Figure 5: Output from Maple

2.2.2 using length()

Source code used is

```
restart;

xnum := ((6-4*sqrt(2))*ln(3-2*sqrt(2))+(3-2*sqrt(2))*ln(17-12*sqrt(2))+32-24*sqrt(2)):
xden := (48*sqrt(2)-72)*(ln(sqrt(2)+1)+sqrt(2))/3:
x    := xnum/xden:

n    := 5:
stab := Matrix(5,4,0):  #Matrix where to keep track of stats
xtab := expand({x,x^2,x^4,x^8,x^16}):

for i from 1 to n do

    stab[i,1]:=length(xtab[i]):

    startingTime := time():
    s            := simplify(xtab[i],size):
    stab[i,3]    := time() - startingTime:

    stab[i,2]    := length(s):
    stab[i,4]    := ceil(100.*stab[i,2]/stab[i,1]):
od:

stab;
```

Columns have the same meaning as above.

$$\begin{bmatrix} 555 & 198 & 0. & 36 \\ 1245 & 372 & 0.015 & 30 \\ 3509 & 956 & 0.016 & 28 \\ 11905 & 3316 & 0.031 & 28 \\ 47654 & 14960 & 0.094 & 32 \end{bmatrix}$$

Figure 6: Output from Maple simplify size

3 side-by-side

This shows Mathematica Simplify result against Maple `simplify(expr,size)` both using `LeafCount`.

Maple 14

$$\begin{bmatrix} 180 & 62 & 0.35 \\ 399 & 114 & 0.29 \\ 1104 & 272 & 0.25 \\ 3582 & 804 & 0.23 \\ 12810 & 2732 & 0.22 \end{bmatrix}$$

Mathematica 8.04

leaf count before	leaf count after	cpu	% reduction
230	50	0.093	22
507	96	0.156	19
1394	362	0.265	26
4500	1052	0.702	23
16040	3533	2.231	22

And this shows Mathematica FullSimplify result against Maple simplify(expr,size) both using LeafCount.

Maple 14

$$\begin{bmatrix} 180 & 62 & 0.35 \\ 399 & 114 & 0.29 \\ 1104 & 272 & 0.25 \\ 3582 & 804 & 0.23 \\ 12810 & 2732 & 0.22 \end{bmatrix}$$

Mathematica 8.04

leaf count before	leaf count after	cpu	% reduction
230	32	0.296	14
507	90	0.78	18
1394	232	888.894	17
4500	1043	65.302	23
16040	3525	393.637	22