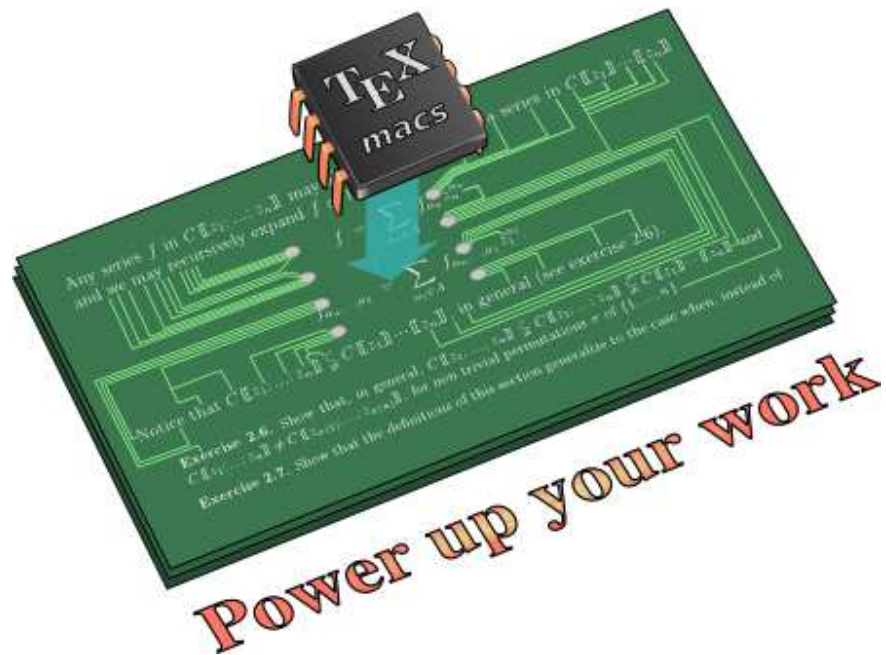# GNU TEXMACS

Joris van der Hoeven

CNRS

Assistant professor at École polytechnique

- 4 open positions

- contact JORIS VAN DER HOEVEN for applications to join MAX team

- `https://portail.polytechnique.edu/informatique/en/employment-opport/teaching-positions`

Assistant professor at École polytechnique

- 4 open positions

- contact JORIS VAN DER HOEVEN for applications to join MAX team

- `https://portail.polytechnique.edu/informatique/en/employment-opport/teaching-positions`

Post-doc at École polytechnique

- 2 open positions: computer algebra & error correcting codes

- official announcement: soon

- contact GRÉGOIRE LECERF for more information

- Writing a paper with mathematical formulas

- Search and replace

- Version control

- Compatibility with LaTeX and Html

- Graphics and animations

- Preparing a presentation

- Shell interfaces with CAS systems

- Other types of interfaces with CAS systems

Unrolling

Unrolling

* Point 1

Unrolling

- Point 1

- Point 2

Unrolling

- Point 1

- Point 2

Ornamented text

Manilla paper   Granite   Wood   Metal

Unrolling

- Point 1

- Point 2

Ornamented text

Manilla paper　Granite　Wood　Metal

Graphical effects

Blurred　Gnawed　Outlined emboss　Wow!

$$1 + x + \tfrac{1}{2}x$$

Pari GP ⇓

Maxima ⇓

Pari GP ⇑

```
Pari] factor (768726872167273526526351726537l)

Pari] (a+b+c)^10

Pari]
```

Maxima ⇓

Pari GP ⇑

```
Pari] factor (7687268721672735265263517265371)
```

$$\%1 \; = \; \begin{pmatrix} 3109 & 1 \\ 31219 & 1 \\ 79201307836816878370501 & 1 \end{pmatrix}$$

```
Pari] (a+b+c)^10
```

```
Pari]
```

Maxima ⇓

Pari GP ⇑

```
Pari] factor (76872687216727352652635172€5371)
```

$$\%1 = \begin{pmatrix} 3109 & 1 \\ 31219 & 1 \\ 7920130783681687837050 1 & 1 \end{pmatrix}$$

```
Pari] (a+b+c)^10
```

$\%2 = a^{10} + (10\,b + 10\,c)\,a^9 + (45\,b^2 + 90\,c\,b + 45\,c^2)\,a^8 + (120\,b^3 + 360\,c\,b^2 + 360\,c^2\,b + 120\,c^3)\,a^7 + (210\,b^4 + 840\,c\,b^3 + 1260\,c^2\,b^2 + 840\,c^3\,b + 210\,c^4)\,a^6 + (252\,b^5 + 1260\,c\,b^4 + 2520\,c^2\,b^3 + 2520\,c^3\,b^2 + 1260\,c^4\,b + 252\,c^5)\,a^5 + (210\,b^6 + 1260\,c\,b^5 + 3150\,c^2\,b^4 + 4200\,c^3\,b^3 + 3150\,c^4\,b^2 + 1260\,c^5\,b + 210\,c^6)\,a^4 + (120\,b^7 + 840\,c\,b^6 + 2520\,c^2\,b^5 + 4200\,c^3\,b^4 + 4200\,c^4\,b^3 + 2520\,c^5\,b^2 + 840\,c^6\,b + 120\,c^7)\,a^3 + (45\,b^8 + 360\,c\,b^7 + 1260\,c^2\,b^6 + 2520\,c^3\,b^5 + 3150\,c^4\,b^4 + 2520\,c^5\,b^3 + 1260\,c^6\,b^2 + 360\,c^7\,b + 45\,c^8)\,a^2 + (10\,b^9 + 90\,c\,b^8 + 360\,c^2\,b^7 + 840\,c^3\,b^6 + 1260\,c^4\,b^5 + 1260\,c^5\,b^4 + 840\,c^6\,b^3 + 360\,c^7\,b^2 + 90\,c^8\,b + 10\,c^9)\,a + (b^{10} + 10\,c\,b^9 + 45\,c^2\,b^8 + 120\,c^3\,b^7 + 210\,c^4\,b^6 + 252\,c^5\,b^5 +$

Pari GP ⇑

```
Pari] factor (768726872167273526526351726537l)
```

$$\%1 \; = \; \begin{pmatrix} 3109 & 1 \\ 31219 & 1 \\ 792013078368168783705ol & 1 \end{pmatrix}$$

```
Pari] (a+b+c)^10
```

$\%2 \; = \; a^{10} + (10\,b + 10\,c)\,a^9 + (45\,b^2 + 90\,c\,b + 45\,c^2)\,a^8 + (120\,b^3 + 360\,c\,b^2 + 360\,c^2\,b + 120\,c^3)\,a^7 + (210\,b^4 + 840\,c\,b^3 + 1260\,c^2\,b^2 + 840\,c^3\,b + 210\,c^4)\,a^6 + (252\,b^5 + 1260\,c\,b^4 + 2520\,c^2\,b^3 + 2520\,c^3\,b^2 + 1260\,c^4\,b + 252\,c^5)\,a^5 + (210\,b^6 + 1260\,c\,b^5 + 3150\,c^2\,b^4 + 4200\,c^3\,b^3 + 3150\,c^4\,b^2 + 1260\,c^5\,b + 210\,c^6)\,a^4 + (120\,b^7 + 840\,c\,b^6 + 2520\,c^2\,b^5 + 4200\,c^3\,b^4 + 4200\,c^4\,b^3 + 2520\,c^5\,b^2 + 840\,c^6\,b + 120\,c^7)\,a^3 + (45\,b^8 + 360\,c\,b^7 + 1260\,c^2\,b^6 + 2520\,c^3\,b^5 + 3150\,c^4\,b^4 + 2520\,c^5\,b^3 + 1260\,c^6\,b^2 + 360\,c^7\,b + 45\,c^8)\,a^2 + (10\,b^9 + 90\,c\,b^8 + 360\,c^2\,b^7 + 840\,c^3\,b^6 + 1260\,c^4\,b^5 + 1260\,c^5\,b^4 + 840\,c^6\,b^3 + 360\,c^7\,b^2 + 90\,c^8\,b + 10\,c^9)\,a + (b^{10} + 10\,c\,b^9 + 45\,c^2\,b^8 + 120\,c^3\,b^7 + 210\,c^4\,b^6 + 252\,c^5\,b^5 +$

Maxima ⇑

(%i1) $\mathrm{diff}(x^x, x, 4)$

(%i2) $\displaystyle\int_{-\infty}^{\infty} e^{-x^2}\, dx$

(%i3) $\displaystyle\int \frac{x+2019}{x^2-7x+3}\, dx$

(%i4)

Pari GP ⇑

```
Pari] factor (7687268721672735265263517265371)
```

$$\%1 \ = \ \begin{pmatrix} 3109 & 1 \\ 31219 & 1 \\ 79201307836816878370501 & 1 \end{pmatrix}$$

```
Pari] (a+b+c)^10
```

$\%2 \ = \ a^{10} + (10\,b + 10\,c)\,a^9 + (45\,b^2 + 90\,c\,b + 45\,c^2)\,a^8 + (120\,b^3 + 360\,c\,b^2 + 360\,c^2\,b + 120\,c^3)\,a^7 + (210\,b^4 + 840\,c\,b^3 + 1260\,c^2\,b^2 + 840\,c^3\,b + 210\,c^4)\,a^6 + (252\,b^5 + 1260\,c\,b^4 + 2520\,c^2\,b^3 + 2520\,c^3\,b^2 + 1260\,c^4\,b + 252\,c^5)\,a^5 + (210\,b^6 + 1260\,c\,b^5 + 3150\,c^2\,b^4 + 4200\,c^3\,b^3 + 3150\,c^4\,b^2 + 1260\,c^5\,b + 210\,c^6)\,a^4 + (120\,b^7 + 840\,c\,b^6 + 2520\,c^2\,b^5 + 4200\,c^3\,b^4 + 4200\,c^4\,b^3 + 2520\,c^5\,b^2 + 840\,c^6\,b + 120\,c^7)\,a^3 + (45\,b^8 + 360\,c\,b^7 + 1260\,c^2\,b^6 + 2520\,c^3\,b^5 + 3150\,c^4\,b^4 + 2520\,c^5\,b^3 + 1260\,c^6\,b^2 + 360\,c^7\,b + 45\,c^8)\,a^2 + (10\,b^9 + 90\,c\,b^8 + 360\,c^2\,b^7 + 840\,c^3\,b^6 + 1260\,c^4\,b^5 + 1260\,c^5\,b^4 + 840\,c^6\,b^3 + 360\,c^7\,b^2 + 90\,c^8\,b + 10\,c^9)\,a + (b^{10} + 10\,c\,b^9 + 45\,c^2\,b^8 + 120\,c^3\,b^7 + 210\,c^4\,b^6 + 252\,c^5\,b^5 +$

Maxima ⇑

(%i1) $\mathrm{diff}(x^x, x, 4)$

(%o1) $x^{x-1}\left(\log(x) + \dfrac{x-1}{x}\right)^2 + x^x(\log(x)+1)^4 +$
$3\,x^{x-1}(\log(x)+1)^2 + 2\,x^{x-1}(\log(x)+1)\left(\log(x) + \dfrac{x-1}{x}\right) + \left(\dfrac{2}{x} - \dfrac{x-1}{x^2}\right)x^{x-1} + 2\,x^{x-2}$

(%i2) $\displaystyle\int_{-\infty}^{\infty} e^{-x^2}\,dx$

(%i3) $\displaystyle\int \dfrac{x+2019}{x^2-7x+3}\,dx$

(%i4)

Pari GP ⇑

```
Pari] factor (7687268721672735265263517265371)
```

$$\%1 \;=\; \begin{pmatrix} 3109 & 1 \\ 31219 & 1 \\ 79201307836816878370501 & 1 \end{pmatrix}$$

```
Pari] (a+b+c)^10
```

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(%i1) $\mathrm{diff}(x^x, x, 4)$

(%o1) $x^{x-1}\left(\log(x) + \dfrac{x-1}{x}\right)^2 + x^x(\log(x)+1)^4 +$
$3\,x^{x-1}(\log(x)+1)^2 + 2\,x^{x-1}(\log(x)+1)\left(\log(x) + \dfrac{x-1}{x}\right) + \left(\dfrac{2}{x} - \dfrac{x-1}{x^2}\right)x^{x-1} + 2\,x^{x-2}$

(%i2) $\displaystyle\int_{-\infty}^{\infty} e^{-x^2}\,dx$

(%o2) $\sqrt{\pi}$

(%i3) $\displaystyle\int \dfrac{x+2019}{x^2-7x+3}\,dx$

(%i4)

Pari GP ⇑

```
Pari] factor (76872687216727352652635172653711)
```

$$\%1 \ = \ \begin{pmatrix} 3109 & 1 \\ 31219 & 1 \\ 792013078368168783700501 & 1 \end{pmatrix}$$

```
Pari] (a+b+c)^10
```

$\%2 \ = \ a^{10} + (10\,b + 10\,c)\,a^9 + (45\,b^2 + 90\,c\,b + 45\,c^2)\,a^8 + (120\,b^3 + 360\,c\,b^2 + 360\,c^2\,b + 120\,c^3)\,a^7 + (210\,b^4 + 840\,c\,b^3 + 1260\,c^2\,b^2 + 840\,c^3\,b + 210\,c^4)\,a^6 + (252\,b^5 + 1260\,c\,b^4 + 2520\,c^2\,b^3 + 2520\,c^3\,b^2 + 1260\,c^4\,b + 252\,c^5)\,a^5 + (210\,b^6 + 1260\,c\,b^5 + 3150\,c^2\,b^4 + 4200\,c^3\,b^3 + 3150\,c^4\,b^2 + 1260\,c^5\,b + 210\,c^6)\,a^4 + (120\,b^7 + 840\,c\,b^6 + 2520\,c^2\,b^5 + 4200\,c^3\,b^4 + 4200\,c^4\,b^3 + 2520\,c^5\,b^2 + 840\,c^6\,b + 120\,c^7)\,a^3 + (45\,b^8 + 360\,c\,b^7 + 1260\,c^2\,b^6 + 2520\,c^3\,b^5 + 3150\,c^4\,b^4 + 2520\,c^5\,b^3 + 1260\,c^6\,b^2 + 360\,c^7\,b + 45\,c^8)\,a^2 + (10\,b^9 + 90\,c\,b^8 + 360\,c^2\,b^7 + 840\,c^3\,b^6 + 1260\,c^4\,b^5 + 1260\,c^5\,b^4 + 840\,c^6\,b^3 + 360\,c^7\,b^2 + 90\,c^8\,b + 10\,c^9)\,a + (b^{10} + 10\,c\,b^9 + 45\,c^2\,b^8 + 120\,c^3\,b^7 + 210\,c^4\,b^6 + 252\,c^5\,b^5 +$

(%i1) $\operatorname{diff}(x^x, x, 4)$

(%o1) $x^{x-1}\left(\log(x) + \dfrac{x-1}{x}\right)^2 + x^x(\log(x)+1)^4 +$
$3\,x^{x-1}(\log(x)+1)^2 + 2\,x^{x-1}(\log(x)+1)\left(\log(x) + \dfrac{x-1}{x}\right) + \left(\dfrac{2}{x} - \dfrac{x-1}{x^2}\right)x^{x-1} + 2\,x^{x-2}$

(%i2) $\displaystyle\int_{-\infty}^{\infty} e^{-x^2}\,dx$

(%o2) $\sqrt{\pi}$

(%i3) $\displaystyle\int \dfrac{x+2019}{x^2-7x+3}\,dx$

$\dfrac{4045\log\left(\dfrac{2x-\sqrt{37}-7}{2x+\sqrt{37}-7}\right)}{} \quad \log(x^2-7x+3)$
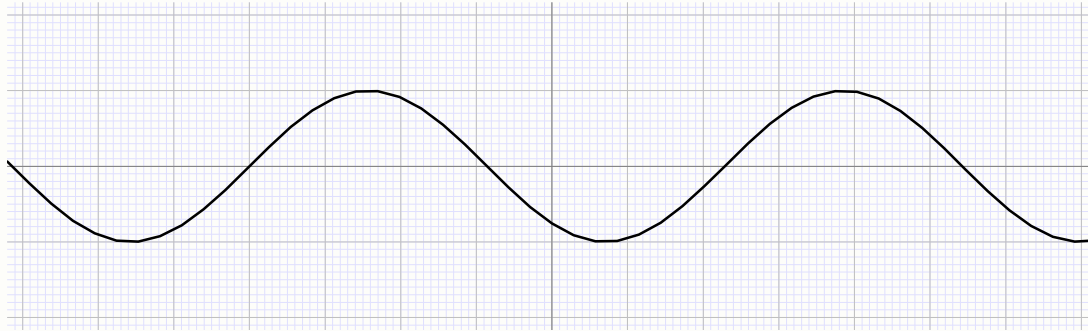
```
Mmx] sin_wave (x,t) ==
        sin (x + 0.5*t);
```

```
Mmx] $wave sin_wave
```

```
Mmx] sin_wave (x,t) ==
      sin (x + 0.5*t);
```

```
Mmx] $wave sin_wave
```

```
Mmx] pulse_wave (x, t) ==
       exp (-(x + 0.25*(10.0 - t))^2);

Mmx] $wave pulse_wave
```

```
Mmx] pulse_wave (x, t) ==
        exp (-(x + 0.25*(10.0 - t))^2);
```

```
Mmx] $wave pulse_wave
```

Other types of CAS interfaces

Exercise 1. Perform the following additions

$$5+10 \ = \ ......$$

$$3+2 \ = \ ......$$

$$13+5 \ = \ ......$$

$$46+16 \ = \ ......$$

Exercise 2. Perform the following multiplications

$$1 \times 6 \ = \ ......$$

$$10 \times 6 \ = \ ......$$

$$7 \times 4 \ = \ ......$$

$$11 \times 9 \ = \ ......$$

Other types of CAS interfaces

Exercise 3. Perform the following additions

$$1 + random(10) + 10 \;=\; \ldots\ldots$$

$$3 + 2 \;=\; \ldots\ldots$$

$$13 + 5 \;=\; \ldots\ldots$$

$$46 + 16 \;=\; \ldots\ldots$$

Exercise 4. Perform the following multiplications

$$1 \times 6 \;=\; \ldots\ldots$$

$$10 \times 6 \;=\; \ldots\ldots$$

$$7 \times 4 \;=\; \ldots\ldots$$

$$11 \times 9 \;=\; \ldots\ldots$$

Other types of CAS interfaces

Exercise 5. Perform the following additions

$$1 + \text{random}(10) + 1 + \text{random}(10) = \ldots\ldots$$

$$3 + 2 = \ldots\ldots$$

$$13 + 5 = \ldots\ldots$$

$$46 + 16 = \ldots\ldots$$

Exercise 6. Perform the following multiplications

$$1 \times 6 = \ldots\ldots$$

$$10 \times 6 = \ldots\ldots$$

$$7 \times 4 = \ldots\ldots$$

$$11 \times 9 = \ldots\ldots$$

Other types of CAS interfaces

Exercise 7. Perform the following additions

$$1 + \text{random}(10) + 1 + \text{random}(10) \ = \ i1 + j1$$

$$3 + 2 \ = \ \ldots\ldots$$

$$13 + 5 \ = \ \ldots\ldots$$

$$46 + 16 \ = \ \ldots\ldots$$

Exercise 8. Perform the following multiplications

$$1 \times 6 \ = \ \ldots\ldots$$

$$10 \times 6 \ = \ \ldots\ldots$$

$$7 \times 4 \ = \ \ldots\ldots$$

$$11 \times 9 \ = \ \ldots\ldots$$

Other types of CAS interfaces

Exercise 9. Perform the following additions

$$1 + \text{random}(10) + 1 + \text{random}(10) \;=\; i1 + j1$$

$$1 + \text{random}(10) + 2 \;=\; \ldots\ldots$$

$$13 + 5 \;=\; \ldots\ldots$$

$$46 + 16 \;=\; \ldots\ldots$$

Exercise 10. Perform the following multiplications

$$1 \times 6 \;=\; \ldots\ldots$$

$$10 \times 6 \;=\; \ldots\ldots$$

$$7 \times 4 \;=\; \ldots\ldots$$

$$11 \times 9 \;=\; \ldots\ldots$$

Other types of CAS interfaces

Exercise 11. Perform the following additions

$$1 + \text{random}(10) + 1 + \text{random}(10) \ = \ i1 + j1$$

$$1 + \text{random}(10) + 1 + \text{random}(10) \ = \ \ldots\ldots$$

$$13 + 5 \ = \ \ldots\ldots$$

$$46 + 16 \ = \ \ldots\ldots$$

Exercise 12. Perform the following multiplications

$$1 \times 6 \ = \ \ldots\ldots$$

$$10 \times 6 \ = \ \ldots\ldots$$

$$7 \times 4 \ = \ \ldots\ldots$$

$$11 \times 9 \ = \ \ldots\ldots$$

Other types of CAS interfaces

Exercise 13. Perform the following additions

$$1 + \text{random}(10) + 1 + \text{random}(10) \;=\; i1 + j1$$

$$1 + \text{random}(10) + 1 + \text{random}(10) \;=\; i2 + j2$$

$$13 + 5 \;=\; \ldots\ldots$$

$$46 + 16 \;=\; \ldots\ldots$$

Exercise 14. Perform the following multiplications

$$1 \times 6 \;=\; \ldots\ldots$$

$$10 \times 6 \;=\; \ldots\ldots$$

$$7 \times 4 \;=\; \ldots\ldots$$

$$11 \times 9 \;=\; \ldots\ldots$$

Other types of CAS interfaces

Exercise 15. Perform the following additions

$$1 + random(10) + 1 + random(10) \; = \; i1 + j1$$
$$1 + random(10) + 1 + random(10) \; = \; i2 + j2$$
$$11 + random(90) + 5 \; = \; ......$$
$$46 + 16 \; = \; ......$$

Exercise 16. Perform the following multiplications

$$1 \times 6 \; = \; ......$$
$$10 \times 6 \; = \; ......$$
$$7 \times 4 \; = \; ......$$
$$11 \times 9 \; = \; ......$$

Other types of CAS interfaces

Exercise 17. Perform the following additions

$$1 + random(10) + 1 + random(10) \; = \; i1 + j1$$

$$1 + random(10) + 1 + random(10) \; = \; i2 + j2$$

$$11 + random(90) + 1 + random(10) \; = \; ......$$

$$46 + 16 \; = \; ......$$

Exercise 18. Perform the following multiplications

$$1 \times 6 \; = \; ......$$

$$10 \times 6 \; = \; ......$$

$$7 \times 4 \; = \; ......$$

$$11 \times 9 \; = \; ......$$

Other types of CAS interfaces

Exercise 19. Perform the following additions

$$1 + \text{random}(10) + 1 + \text{random}(10) \;=\; i1 + j1$$

$$1 + \text{random}(10) + 1 + \text{random}(10) \;=\; i2 + j2$$

$$11 + \text{random}(90) + 1 + \text{random}(10) \;=\; i3 + j3$$

$$46 + 16 \;=\; \ldots\ldots$$

Exercise 20. Perform the following multiplications

$$1 \times 6 \;=\; \ldots\ldots$$

$$10 \times 6 \;=\; \ldots\ldots$$

$$7 \times 4 \;=\; \ldots\ldots$$

$$11 \times 9 \;=\; \ldots\ldots$$

Other types of CAS interfaces

Exercise 21. Perform the following additions

$$1 + \text{random}(10) + 1 + \text{random}(10) \;=\; i1 + j1$$

$$1 + \text{random}(10) + 1 + \text{random}(10) \;=\; i2 + j2$$

$$11 + \text{random}(90) + 1 + \text{random}(10) \;=\; i3 + j3$$

$$11 + \text{random}(90) + 16 \;=\; \ldots\ldots$$

Exercise 22. Perform the following multiplications

$$1 \times 6 \;=\; \ldots\ldots$$

$$10 \times 6 \;=\; \ldots\ldots$$

$$7 \times 4 \;=\; \ldots\ldots$$

$$11 \times 9 \;=\; \ldots\ldots$$

Other types of CAS interfaces

Exercise 23. Perform the following additions

$$1 + \text{random}(10) + 1 + \text{random}(10) \;=\; i1 + j1$$

$$1 + \text{random}(10) + 1 + \text{random}(10) \;=\; i2 + j2$$

$$11 + \text{random}(90) + 1 + \text{random}(10) \;=\; i3 + j3$$

$$11 + \text{random}(90) + 11 + \text{random}(90) \;=\; \ldots\ldots$$

Exercise 24. Perform the following multiplications

$$1 \times 6 \;=\; \ldots\ldots$$

$$10 \times 6 \;=\; \ldots\ldots$$

$$7 \times 4 \;=\; \ldots\ldots$$

$$11 \times 9 \;=\; \ldots\ldots$$

Other types of CAS interfaces

Exercise 25. Perform the following additions

$$1 + random(10) + 1 + random(10) \quad = \quad i1 + j1$$

$$1 + random(10) + 1 + random(10) \quad = \quad i2 + j2$$

$$11 + random(90) + 1 + random(10) \quad = \quad i3 + j3$$

$$11 + random(90) + 11 + random(90) \quad = \quad i4 + j4$$

Exercise 26. Perform the following multiplications

$$1 \times 6 \quad = \quad ......$$

$$10 \times 6 \quad = \quad ......$$

$$7 \times 4 \quad = \quad ......$$

$$11 \times 9 \quad = \quad ......$$

Other types of CAS interfaces

Exercise 27. Perform the following additions

$$1 + \text{random}(10) + 1 + \text{random}(10) \ = \ i1 + j1$$

$$1 + \text{random}(10) + 1 + \text{random}(10) \ = \ i2 + j2$$

$$11 + \text{random}(90) + 1 + \text{random}(10) \ = \ i3 + j3$$

$$11 + \text{random}(90) + 11 + \text{random}(90) \ = \ i4 + j4$$

Exercise 28. Perform the following multiplications

$$1 + \text{random}(10) \times 6 \ = \ \dots\dots$$

$$10 \times 6 \ = \ \dots\dots$$

$$7 \times 4 \ = \ \dots\dots$$

$$11 \times 9 \ = \ \dots\dots$$

Other types of CAS interfaces

Exercise 29. Perform the following additions

$$1 + \text{random}(10) + 1 + \text{random}(10) \;=\; i1 + j1$$

$$1 + \text{random}(10) + 1 + \text{random}(10) \;=\; i2 + j2$$

$$11 + \text{random}(90) + 1 + \text{random}(10) \;=\; i3 + j3$$

$$11 + \text{random}(90) + 11 + \text{random}(90) \;=\; i4 + j4$$

Exercise 30. Perform the following multiplications

$$1 + \text{random}(10) \times 1 + \text{random}(10) \;=\; \ldots\ldots$$

$$10 \times 6 \;=\; \ldots\ldots$$

$$7 \times 4 \;=\; \ldots\ldots$$

$$11 \times 9 \;=\; \ldots\ldots$$

Other types of CAS interfaces

Exercise 31. Perform the following additions

$$1 + random(10) + 1 + random(10) \;=\; i1 + j1$$
$$1 + random(10) + 1 + random(10) \;=\; i2 + j2$$
$$11 + random(90) + 1 + random(10) \;=\; i3 + j3$$
$$11 + random(90) + 11 + random(90) \;=\; i4 + j4$$

Exercise 32. Perform the following multiplications

$$1 + random(10) \times 1 + random(10) \;=\; i11 \; j11$$
$$10 \times 6 \;=\; ......$$
$$7 \times 4 \;=\; ......$$
$$11 \times 9 \;=\; ......$$

Other types of CAS interfaces

Exercise 33. Perform the following additions

$$1 + random(10) + 1 + random(10) \quad = \quad i1 + j1$$
$$1 + random(10) + 1 + random(10) \quad = \quad i2 + j2$$
$$11 + random(90) + 1 + random(10) \quad = \quad i3 + j3$$
$$11 + random(90) + 11 + random(90) \quad = \quad i4 + j4$$

Exercise 34. Perform the following multiplications

$$1 + random(10) \times 1 + random(10) \quad = \quad i11 \; j11$$
$$1 + random(10) \times 6 \quad = \quad ......$$
$$7 \times 4 \quad = \quad ......$$
$$11 \times 9 \quad = \quad ......$$

Other types of CAS interfaces

Exercise 35. Perform the following additions

$$1 + random(10) + 1 + random(10) \ = \ i1 + j1$$

$$1 + random(10) + 1 + random(10) \ = \ i2 + j2$$

$$11 + random(90) + 1 + random(10) \ = \ i3 + j3$$

$$11 + random(90) + 11 + random(90) \ = \ i4 + j4$$

Exercise 36. Perform the following multiplications

$$1 + random(10) \times 1 + random(10) \ = \ i11 \ j11$$

$$1 + random(10) \times 1 + random(10) \ = \ ......$$

$$7 \times 4 \ = \ ......$$

$$11 \times 9 \ = \ ......$$

Other types of CAS interfaces

Exercise 37. Perform the following additions

$$1 + \text{random}(10) + 1 + \text{random}(10) \quad = \quad i1 + j1$$

$$1 + \text{random}(10) + 1 + \text{random}(10) \quad = \quad i2 + j2$$

$$11 + \text{random}(90) + 1 + \text{random}(10) \quad = \quad i3 + j3$$

$$11 + \text{random}(90) + 11 + \text{random}(90) \quad = \quad i4 + j4$$

Exercise 38. Perform the following multiplications

$$1 + \text{random}(10) \times 1 + \text{random}(10) \quad = \quad i11 \; j11$$

$$1 + \text{random}(10) \times 1 + \text{random}(10) \quad = \quad i12 \; j12$$

$$7 \times 4 \quad = \quad \ldots\ldots$$

$$11 \times 9 \quad = \quad \ldots\ldots$$

Other types of CAS interfaces

Exercise 39. Perform the following additions

$$1 + \text{random}(10) + 1 + \text{random}(10) \quad = \quad i1 + j1$$

$$1 + \text{random}(10) + 1 + \text{random}(10) \quad = \quad i2 + j2$$

$$11 + \text{random}(90) + 1 + \text{random}(10) \quad = \quad i3 + j3$$

$$11 + \text{random}(90) + 11 + \text{random}(90) \quad = \quad i4 + j4$$

Exercise 40. Perform the following multiplications

$$1 + \text{random}(10) \times 1 + \text{random}(10) \quad = \quad i11 \; j11$$

$$1 + \text{random}(10) \times 1 + \text{random}(10) \quad = \quad i12 \; j12$$

$$1 + \text{random}(10) \times 4 \quad = \quad ......$$

$$11 \times 9 \quad = \quad ......$$

Other types of CAS interfaces

Exercise 41. Perform the following additions

$$1 + random(10) + 1 + random(10) \;=\; i1 + j1$$
$$1 + random(10) + 1 + random(10) \;=\; i2 + j2$$
$$11 + random(90) + 1 + random(10) \;=\; i3 + j3$$
$$11 + random(90) + 11 + random(90) \;=\; i4 + j4$$

Exercise 42. Perform the following multiplications

$$1 + random(10) \times 1 + random(10) \;=\; i11 \; j11$$
$$1 + random(10) \times 1 + random(10) \;=\; i12 \; j12$$
$$1 + random(10) \times 1 + random(10) \;=\; ......$$
$$11 \times 9 \;=\; ......$$

Other types of CAS interfaces

Exercise 43. Perform the following additions

$$1 + \text{random}(10) + 1 + \text{random}(10) \ = \ i1 + j1$$
$$1 + \text{random}(10) + 1 + \text{random}(10) \ = \ i2 + j2$$
$$11 + \text{random}(90) + 1 + \text{random}(10) \ = \ i3 + j3$$
$$11 + \text{random}(90) + 11 + \text{random}(90) \ = \ i4 + j4$$

Exercise 44. Perform the following multiplications

$$1 + \text{random}(10) \times 1 + \text{random}(10) \ = \ i11 \ j11$$
$$1 + \text{random}(10) \times 1 + \text{random}(10) \ = \ i12 \ j12$$
$$1 + \text{random}(10) \times 1 + \text{random}(10) \ = \ i13 \ j13$$
$$11 \times 9 \ = \ ......$$

Other types of CAS interfaces

Exercise 45. Perform the following additions

$$1 + \text{random}(10) + 1 + \text{random}(10) \ = \ i1 + j1$$
$$1 + \text{random}(10) + 1 + \text{random}(10) \ = \ i2 + j2$$
$$11 + \text{random}(90) + 1 + \text{random}(10) \ = \ i3 + j3$$
$$11 + \text{random}(90) + 11 + \text{random}(90) \ = \ i4 + j4$$

Exercise 46. Perform the following multiplications

$$1 + \text{random}(10) \times 1 + \text{random}(10) \ = \ i11 \ j11$$
$$1 + \text{random}(10) \times 1 + \text{random}(10) \ = \ i12 \ j12$$
$$1 + \text{random}(10) \times 1 + \text{random}(10) \ = \ i13 \ j13$$
$$11 + \text{random}(10) \times 9 \ = \ \ldots\ldots$$

Other types of CAS interfaces

Exercise 47. Perform the following additions

$$1 + random(10) + 1 + random(10) \;=\; i1 + j1$$
$$1 + random(10) + 1 + random(10) \;=\; i2 + j2$$
$$11 + random(90) + 1 + random(10) \;=\; i3 + j3$$
$$11 + random(90) + 11 + random(90) \;=\; i4 + j4$$

Exercise 48. Perform the following multiplications

$$1 + random(10) \times 1 + random(10) \;=\; i11 \; j11$$
$$1 + random(10) \times 1 + random(10) \;=\; i12 \; j12$$
$$1 + random(10) \times 1 + random(10) \;=\; i13 \; j13$$
$$11 + random(10) \times 1 + random(10) \;=\; ......$$

Other types of CAS interfaces

Exercise 49. Perform the following additions

$$1 + random(10) + 1 + random(10) = i1 + j1$$
$$1 + random(10) + 1 + random(10) = i2 + j2$$
$$11 + random(90) + 1 + random(10) = i3 + j3$$
$$11 + random(90) + 11 + random(90) = i4 + j4$$

Exercise 50. Perform the following multiplications

$$1 + random(10) \times 1 + random(10) = i11 \; j11$$
$$1 + random(10) \times 1 + random(10) = i12 \; j12$$
$$1 + random(10) \times 1 + random(10) = i13 \; j13$$
$$11 + random(10) \times 1 + random(10) = i14 \; j14$$

Example 1

Let $g(x) = \sin(x)$. Then

$$
\begin{aligned}
g(x) &= g \\
g'(x) &= \mathrm{diff}(g, x) \\
g''(x) &= \mathrm{diff}(\mathrm{dg}, x) \\
g'''(x) &= \mathrm{diff}(\mathrm{ddg}, x) \\
g''''(x) &= \mathrm{diff}(\mathrm{dddg}, x)
\end{aligned}
$$

Can you give other examples of functions $g(x)$ with $g''''(x) = g(x)$?

Example 2

Let $g(x) = \sin(x)$. Then

$$\begin{aligned} g(x) &= \sin(x) \\ g'(x) &= \mathrm{diff}(g, x) \\ g''(x) &= \mathrm{diff}(dg, x) \\ g'''(x) &= \mathrm{diff}(ddg, x) \\ g''''(x) &= \mathrm{diff}(dddg, x) \end{aligned}$$

Can you give other examples of functions $g(x)$ with $g''''(x) = g(x)$?

Example 3

Let $g(x) = \sin(x)$. Then

$$
\begin{aligned}
g(x) &= \sin(x) \\
g'(x) &= \cos(x) \\
g''(x) &= \text{diff}(dg, x) \\
g'''(x) &= \text{diff}(ddg, x) \\
g''''(x) &= \text{diff}(dddg, x)
\end{aligned}
$$

Can you give other examples of functions $g(x)$ with $g''''(x) = g(x)$?

Example 4

Let $g(x) = \sin(x)$. Then

$$
\begin{aligned}
g(x) &= \sin(x) \\
g'(x) &= \cos(x) \\
g''(x) &= -\sin(x) \\
g'''(x) &= \text{diff}(ddg, x) \\
g''''(x) &= \text{diff}(dddg, x)
\end{aligned}
$$

Can you give other examples of functions $g(x)$ with $g''''(x) = g(x)$?

Example 5

Let $g(x) = \sin(x)$. Then

$$
\begin{aligned}
g(x) &= \sin(x) \\
g'(x) &= \cos(x) \\
g''(x) &= -\sin(x) \\
g'''(x) &= -\cos(x) \\
g''''(x) &= \text{diff}(\text{dddg}, x)
\end{aligned}
$$

Can you give other examples of functions $g(x)$ with $g''''(x) = g(x)$?

Example 6

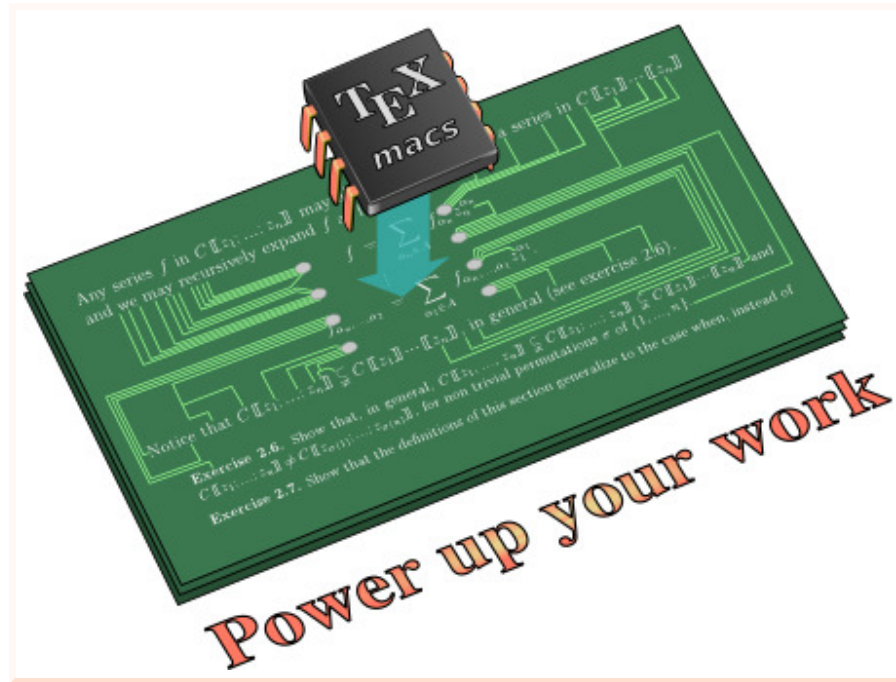Let $g(x) = \sin(x)$. Then

$$
\begin{aligned}
g(x) &= \sin(x) \\
g'(x) &= \cos(x) \\
g''(x) &= -\sin(x) \\
g'''(x) &= -\cos(x) \\
g''''(x) &= \sin(x)
\end{aligned}
$$

Can you give other examples of functions $g(x)$ with $g''''(x) = g(x)$?

Thank you !

`http://www.`T_EX`macs.org`