Computer Algebra with Maple – exercises

Version February 5, 2024

- Finish all the exercises. If you can't complete them in-class, finish them out-of-class.
- Do everything within a Maple `document` file (which has extension `.mw`).
- Store all exercises in your logbook. The Maple document file can be used for this.
- Make regular backups on at least *two* different locations (e.g., OneDrive and email). Note: using a USB stick is not advisable because they can suffer from data corruption. This can happen when you don't do 'eject', but also for other reasons.

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Some of the exercises are based on or from the book *Maple by Example* by Martha L. Abell and James B. Braselton (third edition).

1 Exercises session 1

Note: include all exercises, also the *tutorials*, in your logbook. Do this for this and the subsequent sessions.

1.1 Tutorials

1. Open the *Getting Started* (re-open Maple if it is not present any more), then complete the *Tutorial: Talking to Maple* tutorial (first one) and complete this, using a separate blank Maple document. Store that document, once finished, on your OneDrive. So you need to reproduce the right column (indicated by 'Results') in a separate Maple document.
2. Open the *Getting Started* (re-open Maple if it is not present any more), then complete the *Tutorial: Putting Ideas Together* tutorial (second one) and complete this, using a separate blank Maple document.

2 Exercises session 2

2.1 Tutorials

1. Open the *Getting Started* (re-pen MAPLE if it is not present any more), then complete the *Tutorial: Commands and Packages* tutorial (third one) and complete this, using a separate blank MAPLE document.

2. Open the *Getting Started* (re-open MAPLE if it is not present any more), then complete the *Tutorial: Plotting* tutorial (fourth one) and complete this, using a separate blank MAPLE document.

2.2 Calculator

Do everything within a MAPLE `document` file (which has extension `.mw`). This can be used for your logbook.

1. (a) Calculate 13×12.
   (b) Calculate $\cos(\pi/2)$. Verify that this is what you would expect.

2. Calculate $n!$ for
   (a) $n = 3$
   (b) $n = 100$
   (c) $n = 200$

3. Calculate and/or simplify
   (a) $(1+i)(1-i)$
   (b) $|2+4i|$
   (c) i^i
   (d) $\sqrt{i}$

2.3 Calculus

1. Determine the following single or higher order derivatives

   (a) $f'(x)$ with $f(x) = 8\cos(3x)$

   (b) $f''(x)$ with $f(x) = c\sin(\exp(x^3))$

   (c) $\dfrac{\mathrm{d}^3 f(x)}{\mathrm{d}x^3}$ with $f(x) = \cos(x^n) + x^4$

   (d) $\dfrac{\partial^2 f(x,y)}{\partial x \partial y}$ with $f(x,y) = \cos(xy)$

2. Determine the following integrals

(a)
$$\int x^2 \sin(x) \mathrm{d}x$$

(b)
$$\int_0^x t^2 \sin(t) \mathrm{d}t$$

(c)
$$\int_{-\infty}^{\pi} \exp(y) \sin(y) \mathrm{d}y$$

(d)
$$\int_0^{\pi} \int_1^3 x^2 \sin(y) \mathrm{d}x \mathrm{d}y$$

3. Which of the following integrals can be solved by MAPLE analytically (i.e., it will return a function) and which other ones numerically? Give the answers if it can be solved either way.

(a)
$$\int \exp(\cos(x)) \mathrm{d}x$$

(b)
$$\int \exp(a \cos(bx)) \mathrm{d}x$$

(c)
$$\int_0^1 \exp(\cos(x)) \mathrm{d}x$$

(d)
$$\int_0^{2\pi} \exp(\cos(x)) \mathrm{d}x$$

(e)
$$\int_0^{2\pi} \exp(a \cos(x)) \mathrm{d}x$$

(f)
$$\int_0^{2\pi} \exp(a \cos(bx)) \mathrm{d}x$$

4. Determine the following sums with MAPLE

(a)
$$\sum_{k=1}^{10} a$$

(b)
$$\sum_{k=1}^{10} k^2$$

(c)
$$\sum_{k} k^3$$

(d)
$$\sum_{n} n^{-2}$$

(e)
$$\sum_{n=1}^{\infty} n^{-2}$$

(f)
$$\sum_{n=0}^{\infty} x^n$$

(g)
$$\sum_{n=1}^{\infty} \frac{1}{n!} x^n$$

5. Determine the following limits with MAPLE

(a)
$$\lim_{x \to 0} \frac{\sin(8x)}{2x}$$

(b)
$$\lim_{x \to \infty} x \exp(-x)$$

(c)
$$\lim_{x \to \infty} \frac{x - 8x^4}{7x^4 + 5x^3 + 2000x^2 - 6}$$

(d)
$$\lim_{x \to \infty} \frac{\sqrt{16x^4 + 8} + 3x}{2x^2 + 6x + 1}$$

(e)

$$\lim_{x\to 0} \frac{\cos(ax) - 1}{bx^2}$$

(f)

$$\lim_{x\to 0} \frac{\exp(x) - 1}{|x|}$$

(g)

$$\lim_{x\to 0^+} \frac{\pi x}{|x|}$$

(h)

$$\lim_{x\to 0^-} \frac{x}{c|x|}$$

Verify the limits graphically by plotting the expression around the limit value (substitute numerical values for variables if needed).