

## Review of the first two parts of the course

In the first two parts of the course we learned about Maple's advanced number system and about its favorite objects: polynomials and rational expressions.

Observe that the final exam does not happen in a computer lab, but in a regular room. Without computer, the exam will not require the availability of Maple and MATLAB, but will be a bit more conceptual than otherwise. The exam is still open book and open notes. Calculators or laptop computers are not allowed.

1. Illustrate with an example how you can link one variable (say  $a$ ) to another variable (say  $b$ ): if the value of  $b$  changes, then also the value of  $a$  changes.
2. Concerning the evaluation of a polynomial in one variable
  - (a) What is the best way to evaluate a *dense* polynomial?  
(*dense* = all monomials have a nonzero coefficient)
  - (b) What is the best way to evaluate a *sparse* polynomial?  
(*sparse* = only few monomials have a nonzero coefficient)

In both cases, illustrate your answer with examples.

Compare the methods you propose with the straightforward method to evaluate a polynomial.

3. How can you see in Maple whether a function is part of the kernel, or written in the language of Maple.
4. What is the difference between `evalf` and `evalhf`? When do we use `evalf` and when `evalhf`? When does the difference really start to matter? Illustrate with examples.
5. Why is the command `evaln` needed? Illustrate with a good use.
6. Why can Maple not simplify  $\sqrt{x^2}$  directly to  $x$ ? Illustrate with an example.
7. What is the difference between an attribute and a property in Maple?  
Give an illustration of a good use of an attribute. Give an illustration of a good use of a property.
8. Give three different good uses of the right quotes.  
What is the use of left quotes?
9. Give two examples of good uses of the alias command.
10. When do we use `writeto` and when do we use `writedata`? Give an illustration of appropriate uses of these commands.
11. Give an example of a polynomial in two variables where the pure lexicographic order differs from the total degree order.
12. Give a finite field (i.e., a prime  $p$  which defines  $\mathbb{Z}_p$ ) so that the polynomial  $x^2 + 3$  factors over this field.
13. Explain the difference between `factor` and `Factor`.  
Why is there a need for two versions of a factorization command?
14. Explain the difference between the exact, symbolic, and numerical factorization of a polynomial in one variable into a product of linear factors.  
For each type of factorization, give the typical Maple commands.  
Give two examples of polynomials and their factorizations to illustrate
  - (a) a case when the three types of factorizations are the same;
  - (b) a case when the three types of factorizations are different.

15. Consider the polynomial  $p$ ,  $p := xy - 7x + y$ ;

(a) Consider the output of `dismantle(p)`:

```
SUM(7)
  PROD(5)
    NAME(4): x
    INTPOS(2): 1
    NAME(4): y
    INTPOS(2): 1
  INTPOS(2): 1
  NAME(4): x
  INTNEG(2): -7
  NAME(4): y
  INTPOS(2): 1
```

Draw the directed acyclic graph to show the internal representation of the polynomial  $p$ .

(b) Explain why  $q := \text{subs}(1 = -1, p)$ ; defines  $q$  as  $-\frac{1}{xy} - 7x - y$ .

16. Explain why Maple does not normalize rational expressions automatically.

Give a good illustration of your answer.

17. Why are normal forms so important to symbolic computation? Illustrate with an example.

18. Concerning polynomials in one variable, what is the difference between the canonical form and a normal form?

19. Explain the symbolic and numerical way to test whether two expressions are the same.

20. What is the difference between `algsb`s and `sb`s? Give an example where `algsb`s is needed (instead of `sb`s) and another example where `sb`s is needed (and where `algsb`s makes no sense).

The questions above are just samples of the type of questions you may expect. Also review the homework assignments and quizzes. The experience gained in the project may also help you.

**FINAL EXAM is in Taft Hall 0219 on Tuesday 6 May 2003 from 1:00 till 3:00PM.**

In case of a scheduling conflict with another final exam, please let me know as soon as possible so we can schedule a makeup.

Observe the university rules concerning incompletes. An incomplete can only be granted if all of the following conditions are satisfied:

1. The student is in good standing and needs only a final exam to complete the course. In particular, this means that no midterms are skipped, attendance to the discussion sessions was documented by quiz scores, and all projects received a satisfactory grade.
2. Some event (for which adequate documentation can be provided) prevented the student from doing a makeup final exam.

Note that these rules are from the university, and that the administration needs to approve incompletes.