Review of the first 14 lectures

The exam is open book, open notes and open computer. To prepare for the exam you must organize your course materials to be ready for fast consultation. The worksheets of the lectures will still be available on the web for browsing; however, there is no guarantee the network or the computers at the math department will function properly. A diligent student has a backup on a zip disk and/or on paper.

Typically, on an open book exam, you use the course materials for consultation (e.g., to seek confirmation for your methods), not for study. If you have no clue how to start on a problem, you will run out of time if you start scanning all course materials looking for some hint.

The questions below 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.

1. Explain, give definition or difference between, illustrate...

This type of questions tests your understanding of Maple and symbolic computation in general.

1. What is the difference between the commands `subs` and `algsubs`. Illustrate giving two examples, one where `subs` has to be used instead of `algsubs` and another one where `algsubs` has to be used instead of `subs`.
2. Explain the difference between left quotes and right quotes and give two good examples of their usage.
3. Give three different examples of occasions where we wish to prevent evaluation.
4. Give two good uses of the alias command.
5. What is a protected variable? Give an example.
6. Explain the difference and similarity between the commands evala and evalc.
7. What is an environment variable? Give an example of an environment variable.
8. Explain why Maple does not automatically normalize? Give an example to illustrate your arguments.
9. What is the best way to evaluate a dense polynomial? How many arithmetical operations are needed to evaluate a dense polynomial of degree d.
10. Give an example when evalhf is useful.

2. Give Maple command(s) to...

The list of questions below tests your operational understanding of Maple.

1. Compute $\sqrt{e}$ with 17 significant decimal places.
2. Give the Maple commands to display the implementation of the command assign as a Maple procedure.
3. Consider the polynomial $p = 2x^3 + 4x + 3$.
   (a) Show that p is irreducible over $\mathbb{Z}_5 = \{0, 1, 2, 3, 4\}$.
   (b) Declare α as a formal root of p and compute $(\alpha + 1)^7$ over $\mathbb{Z}_5(\alpha)$.
   (c) With α, we can write p as $p = (x - \alpha)q$. Find the coefficients of q in $\mathbb{Z}_5(\alpha)$.

4. Consider the sequence `restart; a := b; b := c; c := 5;`
   (a) Draw the dependencies between the variables.
   (b) Give the Maple commands to verify the dependencies between the variables.
   (c) Suppose we started the sequence with `restart; c := 5;`
   What are the commands introducing the same dependencies between the variables `a`, `b`, and `c`, as established by the first sequence above?

5. Consider $p = x^{16} - 3x^4 + 9$ and
   (a) Give the Maple command(s) to compute the number of operations it takes to evaluate p.
   (b) Convert p into Horner form and let Maple compute the number of operations it takes to evaluate the Horner form.
   (c) What is the best way to evaluate p? How can you let Maple show this way of evaluating p?

6. Explain the difference between symbolic and numerical factorization of a univariate polynomial into a product of linear factors.
   Illustrate this difference on the polynomial $x^3 + 2x - 1$.
   Give the Maple commands you used to get the factorizations.

7. Give the Maple commands to transform
   $$(x + (z^2+1))(y - (z^2+1)) \quad \text{into} \quad xy - x(z^2+1) + (z^2+1)y - (z^2+1)^2.$$

8. Give the Maple command (just ONE command!) to build the expression
   ```
   c[0]*x[0,0]*x[1,0]*x[2,0] + c[1]*x[0,1]*x[1,1]*x[2,1] + ...
   ... + c[17]*x[0,17]*x[1,17]*x[2,17]
   ```
   where the `...` is the shorthand for all intermediate terms in $\sum_{j=0}^{17} c_j \prod_{i=0}^{2} x_{i,j}$.
   Typing the expression as literally as above is not an acceptable answer.

3. Draw directed acyclic graph of internal representation

Since polynomials and rational expressions are so important in symbolic computation, their internal representation is worthwhile studying.

1. Consider the expression $y - 1/x$.
   (a) Draw the directed acyclic graph of the internal representation of the expression.
   (b) Explain why `subs(-1 = Pi, y - 1/x)` turns out $y + x^{\pi}\pi$.

2. Consider the expression $-1/\sin(1/x)$.
   (a) Draw the directed acyclic graph of the internal representation of the expression.
   (b) Explain why `subs(-1 = e, -1/sin(1/x))` turns out $\sin\left(x^e\right)^e e$.

Please note the policy on skipping exams: If an exam is missed, then greater weight will be placed on the final exam, especially on the material covered on the missing exam. *What this means is* that if you decide not to take one midterm exam, your final exam will be weighted for one hundred points more. *What it does NOT mean is* that you can drop the score of a midterm exam. If you take the midterm, then your score counts. So, please be prepared when you show up for the exam.