Computer math at Elof Lindälvs gymnasium, Kungsbacka

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1995 we (i.e. I) created a local course, *Computers and mathematics*, at Elof Lindälvs gymnasium, Kungsbacka, for second year students studying at the Science program. This 32 hours course has taken place every spring semester since 1995. The course is optional. The maximum number is of participants is 16 which is equal to the number of computers in a computer lab. Some times students have asked for a follow up course during their third year and we have succeeded in organising such a course.

The theme of the *Computers and mathematics* course is problem solving with *DERIVE*, Cabri Geometry and Excel.

Time table

A rough timetable for the *Computers and mathematics* course looks like this.

Introduction to *DERIVE*: 4 lessons

Problem solving with *DERIVE*: 6 lessons

Introduction to Cabri: 4 lessons

Problem solving with Cabri: 4 lessons

Introduction to Excel: 6 lessons

Problem solving with Excel: 6 lessons

Assessment

I can follow the students work in the lab. The students also have two do written reports and give their files to me.

In Sweden we have 4 different marks, IG, G, VG MVG in increasing order. Students who are working hard but not necessarily very hard get VG. Students who solve almost all problems with very little help from me get MVG.
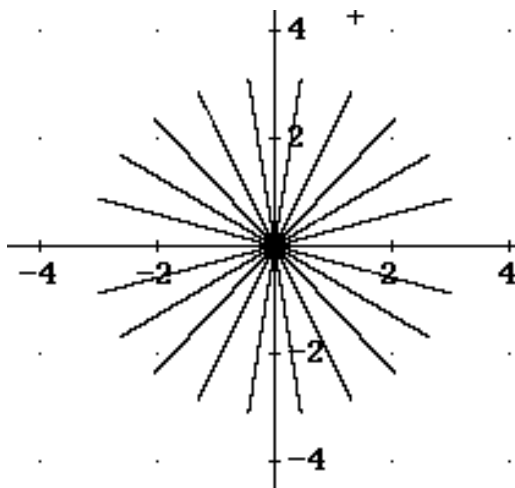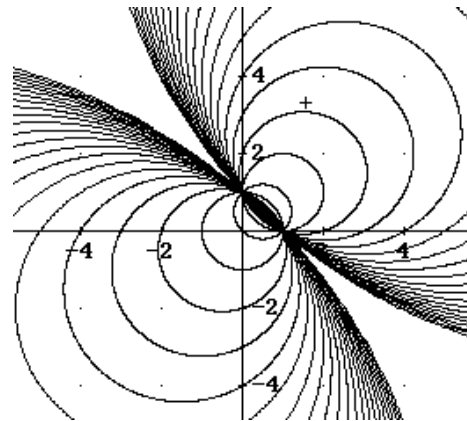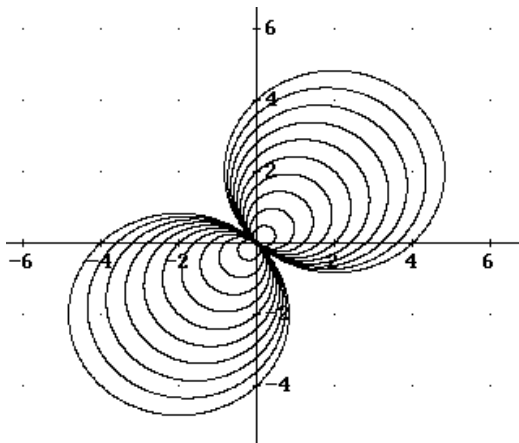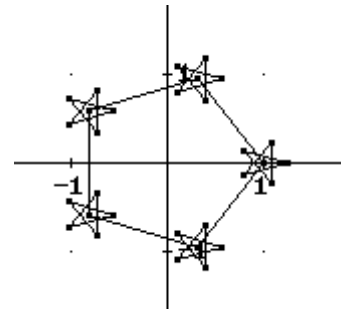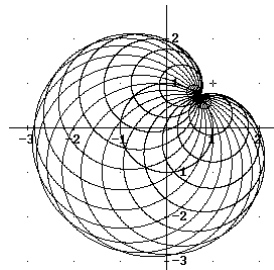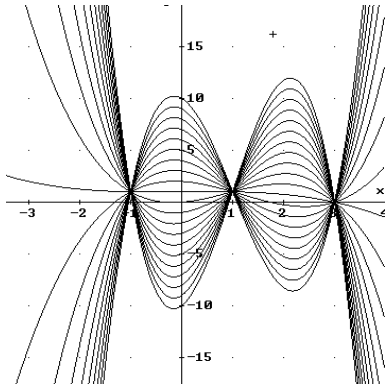
Very few students get G and almost no one IG.

(This course competes with floral decoration-, hunting- and cooking courses etc.)

Example of problems

1.

Create the below figures with *DERIVE*.

2. (*xm*, *ym*) is the centre of the circumscribed circle of the triangle with the vertices (*a*, *b*), (*c*, *d*) and (*e*, *f*).

a) Write *xm* and *ym* as functions of *a*, *b*, *c*, *d e* and *f*.

b) Use the expressions in a) to create an Excel sheet by which you can plot any triangle together with its circumscribed circle.

3. (*xm*, *ym*) is the centre of the inscribed circle of the triangle with side lengths *l*1, *l*2 and *l*3.

a) Write *xm* and *ym* as functions of *l*1, *l*2 and *l*3 with *DERIVE*.

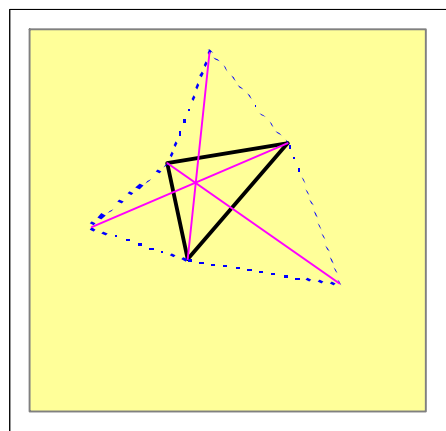b) Create an Excel sheet by which you can plot any triangle together with its inscribed circle.

4. Use *DERIVE* and/or Excel to construct a circle tangent to three given circles.

5. Use *DERIVE* or Excel and Cyclone (a very nice implicit 3D plotter) to construct a sphere tangent to three given spheres. (This is a problem for spring 00. I hope that it will be possible to solve.)

6. Use *DERIVE* and/or Excel to construct a circle tangent to three given lines.
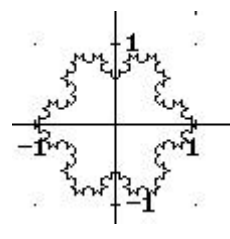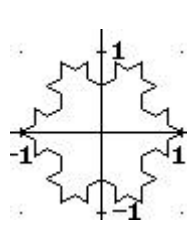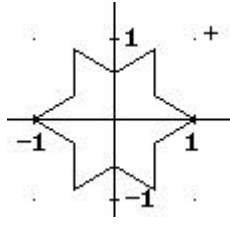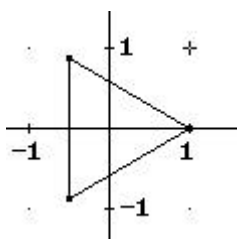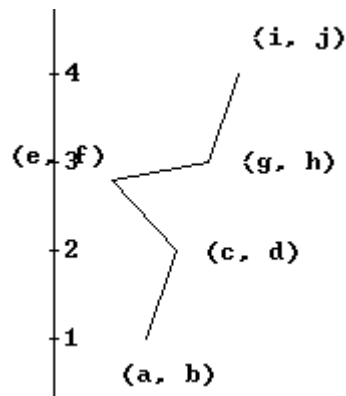
7. Use *DERIVE* and Excel and/or Cabri to construct the

Fermat point of a given triangle.

8. Helge von Koch´s snowflake curve (*DERIVE* and Cabri)

a) (a, b) and (i, j) are given points. Construct the points (c, d), (e, f) and (g, h).

9. Use *DERIVE* to prove Heron´s Theorem, $T = \sqrt{p(p-a)(p-b)(p-c)}$. T is the area of a triangle having the sides a, b and c. $p = \dfrac{a+b+c}{2}$.
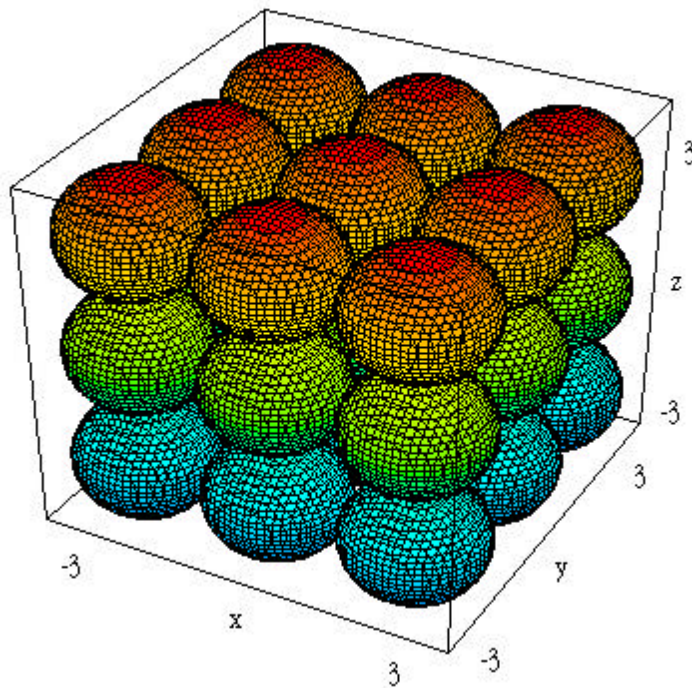
10. Use Cabri to construct the altitudes, medians and perpendicular bisectors of a triangle. Use *DERIVE* to prove that what you see is correct. (The Euler line.)

Future plans

Before my retirement I would like to make mathematics at the science program at my school a subject with laboratory work in the same sense that physics, chemistry and biology are. I would like to have extra time for half class laboratory work in a computer lab, a double lesson every second week.

Next spring I will include MathWare Cyclone in the computer maths course. You can do some nice things with *DERIVE* and Cyclone together. Here is an example that visualises the deep connection between algebra and geometry.

How to plot 27 spheres with Cyclone (and DERIVE)

You can regard the above 27 spheres as one surface with the equation

$$\prod_{c=-1}^{1} \prod_{b=-1}^{1} \prod_{a=-1}^{1} ((x - 2*a)^2 + (y - 2*b)^2 + (z - 2*c)^2 - 1) = 0$$

If you simplify this expression in DERIVE, you can easily export the result to Cyclone and hence receive the above picture.