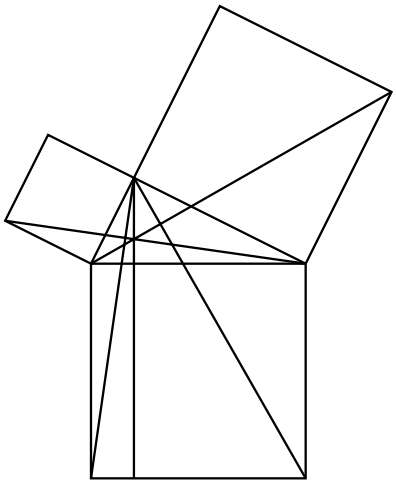
Mathematics 308 — Geometry

Second homework — solutions

Sample solutions will be posted as text files on the 'Net.

Exercise 1. *Draw in PostScript the following picture, taken from Euclid's Elements. In class I will explain how I want you to use colours.*



Use variables a, b here are to be variables, so to change the picture for different a and b you only have to change a couple of lines.

Here, the important mathematical point is to calculate the right-angled corner of the triangle. Put the origin at the lower left corner of the triangle. Using similar triangles, this is (x, y) where

$$x/a = a/c, \quad x = a^2/c, \qquad y/a = b/c, \quad y = ab/c\ .$$

It helps also to have a routine to draw squares, perhaps even triangles.

Exercise 2. *Draw in PostScript a picture of the French flag (red, white, & blue vertical stripes), with grey lines separating the different colours. Size about $4'' \times 5''$, centred on a page.*

This is simple enough tht I can skip it. The proportions aren't correct for the real French flag, and the true order of colours is blue, white, red from left to right.

Exercise 3. *Draw a picture of a regular heptagon (seven sides) centred on a page, radius $1''$. Of a regular 17-gon!*

The magic trick is to start with **`/theta 0 def`** and then to repeat

```
/theta theta 360 7 div add def
theta cos theta sin lineto
```

over 7 times (with 17 instead of 7 for the other).

Exercise 4. *Write a PostScript procedure with two arguments r and θ that replaces them by the corresponding x and y.*

```
/polar-to-rect {
2 dict begin
/theta exch def
/r exch def
r theta cos mul
```

```
r theta sin mul
end
} def
```

Exercise 5. *Write a PostScript procedure with a single argument x that replaces it by* $\operatorname{acos}(x)$.

For this the trick is that $\cos^{-1} x$ is equal to the polar angle of $(x, \sqrt{1-x^2})$.

```
/acos {
1 dict begin
/x exch def
1 x x mul sub sqrt x atan
end
} def
```