1. Cast-a-Box

   The `castabox` software required for this problem simulates transient three-dimensional heat conduction with phase change and complex boundary conditions in a right regular hexahedron using finite differences on a uniform grid. You will use `castabox` to modify a casting design such that the last place to freeze is not the inside, but the top surface, preventing the formation of a large shrinkage cavity in the "casting".

   Note that by ignoring fluid flow and convective heat transport, and not actually modeling the change in geometry due to shrinkage, this program enormously simplifies actual casting processes and is not likely to be terribly accurate. But it does illustrate the principle in a simple, fast parallel C program which is easy to read and modify if you are interested in doing so.

   (a) Run `castabox` with its default geometry and boundary conditions, and capture (and submit) a couple of temperature plots and their associated times, particularly one when the top surface is just fully frozen. (You may find the program `xv` useful for grabbing window snapshots.) Document the temperatures represented by each contour surface.

   (b) If the top surface freezes with liquid trapped beneath it (as you should find under the default conditions), solidification shrinkage will lead to the formation of a *shrinkage cavity*. (Ice, silicon, and certain other materials have the opposite problem: expansion during solidification of trapped liquid can fracture the casting.)

   Propose a design change which will produce a fully-solid box casting of the same geometry and material (*i.e.* same properties). Show with a `castabox` simulation that your design change is likely to work, by again capturing a couple of temperature plots, particularly when the top surface is just fully frozen.