Feedback on Lab 2 ("Heat Equation"). EAS 471, 2007

1. A wide difference was evident in students' ability to 'lay out' the problem in their introduction in a compact, flowing, clear way. This is a crucial skill to develop. In many ways the Introduction of a scientific work in one of the most crucial and difficult parts to write. It generates reviewer/reader initial reaction, and can determine his/her attitude to the rest of the paper. There is no unique 'right' way to write your introduction. All you can do is self-critique — edit and edit until you feel: I have got this down in the way I think it is most logical to put it.

2. Please organize your technical figures in the style of the scientific journals, a style which is standardized. Beneath each figure give the figure number, followed by a detailed caption that (in many instances) might give the figure a stand-alone interpretation (e.g. see Fig.1, whose caption some journals might consider *too* detailed). Of course in the text of your report you must specifically refer the reader to the figure/chart/table, then follow up with interpretation.

3. Don't leave your reader in a wasteland of pages of un-captioned figures, where s/he might fall prey to the crocodile of confusion.

4. As a writer you always want to give the reader ways to confirm that s/he is understanding the material. An easy one here would have been to ask the reader to look at the difference $\phi^{num}(0,t^*) - \phi^{num}(1,t^*)$ for large t^*. Does this tend to 1/2, as the analytical solution indicates it should? And does the numerical solution settle down (at large enough t^*) to give you a quadratic profile of temperature that simply gets warmer and warmer in linear proportion to t^* without changing shape? — this is what the analytic solution suggests it should do. Most people calculated ϕ^{num} correctly — but few bothered to make these fairly obvious interpretations of outcome.

5. A concept it is good to be aware of is the idea of "parallel construction" in logic and

writing. Roughly, the idea is that one should be as self-consistent as possible in ways of saying things. Here is an example, pertinent to our assignment, that fails to optimize consistency of presentation/formatting:

- boundary condition at $\xi = 0$: $\phi(0, t^*) \leftarrow \phi(\Delta\xi, t^*) + \Delta\xi$
- The last point is calculating by forcing it equal to the second last grid point value

Inconsistent use of capitalization. Inconsistent mixing of formula for one b/cond and sentence for the other. Ambiguous meaning for 'last point' whereas 'b/c at $\xi = 0$' is precise.

6. Some peoples' flowcharts comprise mostly words, mingled haphazardly with arrows and double arrows that, if not examined, give the impression of indicating program flow — but turn out to be a recipe for the 'hung program' (a good flowchart does not 'hang'... one must infallibly progress to 'end').

   There is no recipe for designing a flowchart, but bear in mind a flowchart is a recipe. It is a sequence of instructions, viz. the instructions obeyed by the machine. It should accurately reflect the sequence of operations, and its statements should normally be formulae, perhaps using a symbol for assignment in lieu of equality (this is an important distinction). Eg.

   for $2 \leq i \leq N-1 : T(n+1, i) \leftarrow \gamma\, T(n, i-1) + (1-2\gamma)\, T(n, i) + \gamma\, T(n, i+1)$

   Because a flowchart needs to be compact, it should downplay the trivial operations (eg. opening and closing files) and provide detail on those elements of the program that are more intricate. Shorthands of notation are fine, eg.

   $\forall$ interior i: $T^{n+1}(i) \leftarrow [\gamma\, T(i-1) + (1-2\gamma)\, T(i) + \gamma\, T(i+1)]^n$

7. It is essential to uphold a clear distinction (in your mind and in your report) between the problem posed as a differential equation (plus initial and boundary conditions), and the

discretized problem. Some students did not uphold this distinction, eg. one report (if read literally) suggested that the boundary condition $\phi(0, t^*) = \phi(\Delta\xi, t^*)$ was applied to obtain the analytical solution. In reality, the latter used $(\partial\phi/\partial x)_0 = -1)$.

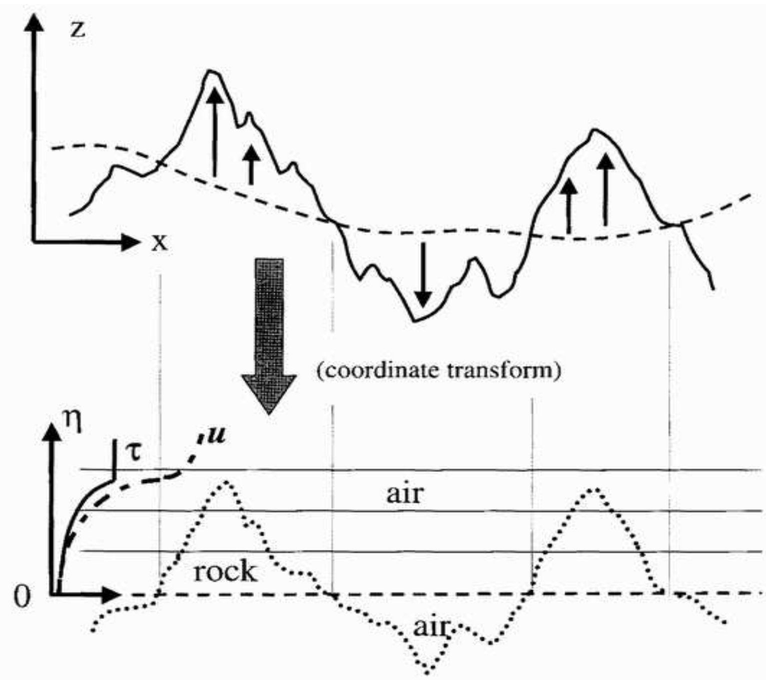

Figure 1: Dashed-line in upper figure represents the smoothed terrain (height $z = \tilde{h}$), which upon coordinate transformation becomes the straight surface $\eta = 0$ in the lower figure; the vertical arrows represent the local (unresolved) terrain deviation $h'(x)$ from the smoothed terrain. The lower sketch represents the configuration of a weather model in a terrain-following coordinate η, recognizing that the terrain 'followed' leaves local topographic deviations unresolved. Schematic at lower left shows the stress divergence $(\partial\tau/\partial z)$ across the layer of unresolved terrain, and resultant splitting of the (spatial-mean) wind profile $(\overline{u})$ into an upper boundary-layer profile (concave upwards) and a lower profile of opposite curvature in the terrain layer, joined at an inflexion point.