CS 404: Problem Set 2 Answer Key

Directions for Submission

E-mail your answers to me at `ajp9@cornell.edu`. The subject of your message should be "CS404 PS2," and the body of the message should contain your answers. Some mailers can format messages using HTML or RTF. Please turn this feature off and send your message using plain text. If for some reason you cannot send your message as text, you may attach your answers as a text file.

Essential Knowledge–Please give a brief answer (1-2 sentences) for each

1. Ocean currents are driven by very small differences in the height of the sea surface. Thus, one way to compute the velocity of a current is to measure the sea-surface height at two locations and take the difference. One ocean circulation model does exactly this: at each time step, it computes the change in sea-surface height due to a variety of processes and then computes the velocity field by taking the height difference between adjacent points. Values for mean sea-surface height (chiefly, the depth of the seafloor) vary from 100m on the continental shelf >4,000m in the deep sea, while the height difference between adjacent points is usually less than 0.1cm (0.001m). Based on your knowledge of floating point arithmetic, would the currents predicted by this model be more accurate in deep or shallow water. Please explain.

   The Answer According to Renfeng Cao: "The Currents predicted by this model is more accurate in shallow water. For example, suppose we use single precision in the model. The eps for single precision is 1e-7. In the case of deep water 4000+0.001=4000.001, we use all of the 7 digits, the single precision is barely represent. While in the case of shallow water, 100+0.001=100.001. We only need 6 digits. There is one more digits for details. In the case of double precision, eps=1e-16. Both of them can be represent accurate enough although the shallow water still better than deep water."

2. Why is it easier to link a C program which calls FORTRAN routines using a FORTRAN compiler? If you wanted to do the linking with the

C compiler, what would you need to do?

FORTRAN compilers hide the fact that they link to a library containing the FORTRAN intrinsic functions. By linking with FORTRAN, we save ourselves the trouble for hunting around the system for the library with the FORTRAN intrinsics.

3. Computer memory is one dimensional. How would the 2D array:

1	2	3	4
10	20	30	40
100	200	300	400

be stored in the memory of a C (or C++ or Java) program. How would Matlab or FORTRAN store the array?

C: [1, 2, 3, 4, 10, 20, 30, 40, 100, 200, 300, 400]
FORTRAN: [1, 10, 100, 2, 20, 200, 3, 30, 300, 4, 40, 400]

Calling C from FORTRAN (and maybe even some MATLAB...)

4. Get the call to SaveToMat to work without calling MATLAB. Describe in detail the changes you made to main.f and savemat.c. If you are working on a system other than ACCEL, please describe the system and any differences between it and ACCEL. For example, "I built Fpca on my Mac using an Absoft FORTRAN compiler and GNU C compiler. To get the call to work, I had to compile the FORTRAN code with the -f and -N15 flags."

   To run in ACCEL, the only changes required are in savemat.c. First, change the name of the routine and its prototype to all lowercase with a trailing underscore: e.g. savetomat_(...). Then, change len so that it is called by reference rather than by value. To do this, add a "*" to all occurrences of len.