CODE: FD1D FAMILY

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1. FD1D.M

[Need a description as in Section 'compressible"]

2. FD1D_HEAT.M

[Need a description as in Section "compressible"]

3. COMPRESSIBLE_SINGLE_PHASE.M

This code solves slightly compressible Darcy fluid flow problem in subsurface.

3.1. Problem.

$$\frac{\partial \phi \rho}{\partial t} - \nabla \cdot (\frac{K}{\mu} \rho (\nabla p - G \rho D) = f(x) \tag{1a}$$

with appropriate boundary and initial boundary conditions. Here K, μ, D, G, ϕ are data supplied by the user or hardcoded in the code.

The problem is solved assuming the fluid is slightly compressible

$$\rho(p) = \rho_{ref} exp(c(p - p_{ref})) \tag{1b}$$

3.2. Discretization. The numerical method for (1) is cell-centered finite difference method (CCFD), with the particular discretization details following [**?**].

3.3. Solver. The code uses MATLAB 'for linear solver.

Nonlinearities are solved with a Newton solver; the code provides a template for clearly coded handling of adaptive time stepping depending on the success of Newton iteration, use of absolute and relative tolerance, and so on.

3.4. Code preamble and parameters. **[I think variable switch and explicit implicit are not used. Should be removed from code and description]**

```
function compressible_single_phase (nx,dfac,dt0,t1,t2,...
      bdary1,bdary2,val1,val2,...
      upwind,...
      variable_switch,...
      implicit_explicit,...
      pmin,pmax, ...
      ifpause)
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
%% 1D FD cell-centered solution to compressible flow equation PRESSURE UNKNOWN
%% <nx,dfac,dt0,t1.t2>: physical domain
%% dfac=0:depth=0,dfac=1: depth=x;
%% bdary? == 0: Dirichlet (nonhomogeneous) values (use val1, val2)
%% bdary? == 1: Neumann flux condiion
%% upwind = 0: use artithmetic aeveraging
%% upwind = -1: use harmonic
%% upwind = 1: use upwinding
%% explicit and implicit time stepping, variables 's' and 'p'
%% pmin pmax smin smax - parameters for plotting
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
```

3.5. **Hard-coded parameters.**

3.6. **Examples.** **Ex. 1: Vertical flow example, no flow at the bottom**

```
>> compressible_single_phase(10,1,0.1,0,1,0,1,2000,0,0,0,0,0,5e4,1)
```

[Need a picture in file/animation for website]

Ex. 2: Horizontal case, Dirichlet conditions

```
>> compressible_single_phase(10,0,0.1,0,1,0,0,0,1000,0,0,0,0,1e3,1)
```

[need a picture in file/animation for website]

[need a bibtex file with proper references]