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#include <math.h>
#include <stdio.h>
#include <stdlib.h>
#include <string.h>


int main() {

    FILE *filename1,*filename2,*filename3;
    char file1[150],file2[150],file3[150];
    int N_time = 1001;
    int N_space = 1001;
    int i = 0, j = 0;

    float x0 = -10.0, x1 = 10.0;
    double *r, *u;

    double dx = (x1 - x0) / (N_space - 1.);     // Step in x.
    double dt = 0.1 * dx * dx;                  // Time step.
    double t= 0.0;

    u = new double[N_space];
    r = new double[N_space]; //values of u from previous time step

    // Initial condition.
    for (i = 0; i < N_space; i++) {
        u[i] = exp(-pow((x0 + i * dx), 2));
    }

    // Finite difference method
    for (j = 1; j < N_time; j++) {

    for(i=0; i < N_space; i++){
        if (i == 0 || i == N_space - 1) r[i] = 0; //Boundary Conditions
            else    r[i] = u[i];//store the previous u information
        }

    // Solve for other u's
    for(i=1; i<N_space-1; i++){
        u[i]=r[i] + dt/(dx*dx) * (r[i+1]-2*r[i]+r[i-1]);
    }

    t+=dt;

    // Print out the information at a specified timestep
        if (j == 100) {
        strcpy (file1, "/home/quantum-monkey/workspace/CPAcodes/ps9/data/
            p1data1.dat");
            filename1 = fopen (file1, "w");
            for (i = 0; i < N_space; i++) {
                fprintf(filename1,"%d\t%d\t%f\t%f\n", j, i, x0 + i * dx, u[i])
                    ;
            }
    fclose (filename1);
        }

    if (j == 700) {
        strcpy (file2, "/home/quantum-monkey/workspace/CPAcodes/ps9/data/
            p1data2.dat");
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            filename2 = fopen (file2, "w");
            for (i = 0; i < N_space; i++) {
                fprintf(filename2,"%d\t%d\t%f\t%f\n", j, i, x0 + i * dx, u[i])
                    ;
            }
    fclose (filename2);
        }

    if (j == 900) {
        strcpy (file3, "/home/quantum-monkey/workspace/CPAcodes/ps9/data/
            p1data3.dat");
            filename3 = fopen (file3, "w");
            for (i = 0; i < N_space; i++) {
                fprintf(filename3,"%d\t%d\t%f\t%f\n", j, i, x0 + i * dx, u[i])
                    ;
            }
    fclose (filename3);
        }
    }

    free(u);
    free(r);

    return 0;
}
```