```c
/* ========================================================================
 *
 * CS 566 - Assignment 03
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 *
 * Header file for shared declarations.
 *
 * ======================================================================== */

#define VDIM 0
#define HDIM 1

struct problem {
        MPI_Comm mesh;
        int rank;
        int n;
        int k;
        int blksz;
        int blkcells;
        int p;
        int sqp;
        int coords[2];
        MPI_Comm hcomm, vcomm;
        struct matrix X;        // only root uses this
        int *Xblocks;
        struct matrix Xpow;     // only root uses this
        struct matrix Xb;       // original block:
        struct matrix A;        // cannon matrix 1
        struct matrix B;        // cannon matrix 2
        struct matrix C;        // cannon product
        int *temp;                      // scratch space for shift
        MPI_Comm rowring;
        int rowblksz;
};

/* LU things */

#define MPI_number_type MPI_DOUBLE
#define number_type double

struct fmatrix {
        int n;
        number_type *data;
};
void alloc_fmatrix(struct fmatrix *m, int n);

struct pivot {
        int row;
        number_type value;
};

void best_pivot( void *invec, void *inoutvec, int *len, MPI_Datatype *datatype);
int setup_pivot_struct(MPI_Datatype *pivot_type, MPI_Op *best_pivot_op);
void LU_decomp(struct problem *info, struct fmatrix *X, int *reorder, MPI_Datatype pivot_type, MPI_Op
best_pivot_op);
int count_swaps(int *reorder_all, int n);
number_type lu1d_determinant(struct problem *info);
number_type lu2d_determinant(struct problem *info);
```