Project-1

- **Write a computer program to solve the heat conduction equation on a single block of steel**
  - k = 18.8 W/m K, ρ = 8000 kg/m^3, c_p = 500 J/(kg K)
  - Solve the transient heat conduction equation using the general, explicit control volume scheme on a non-uniform computational grid.
- **Use a computational grid:**
  - That is IMAX x JMAX in dimensions
    - Where IMAX=JMAX=101 AND IMAX=JMAX=501 (2 cases)
  - That has the following non-uniform distribution:

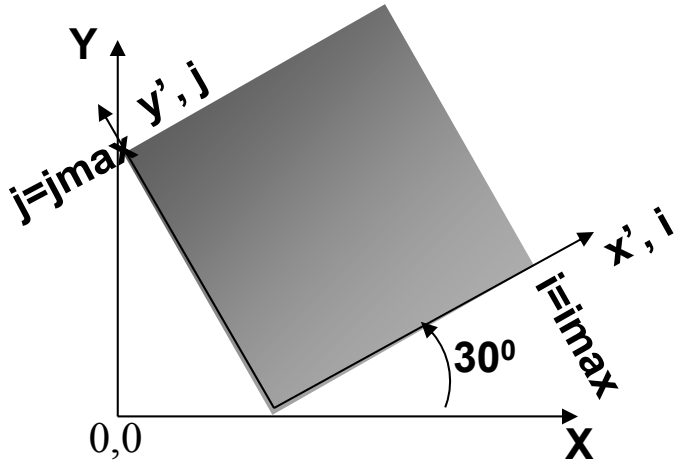
rot= 30.*3.141592654/180.

xp = cos[0.5*π(imax-i)/(imax-1)]

yp = cos[0.5*π(jmax-j)/(jmax-1)]

x(i,j) = xp*cos(rot)+(1.-yp)*sin(rot)

y(i,j) = yp*cos(rot)+xp*sin(rot)



Project-1

- **Find the temperature distribution on a 1m x 1m block with Dirichlet boundary conditions:**
  - T=5.[sin(πxp)+1.] at j=jmax
  - T=abs(cos(πxp))+1. at j=0
  - T=3.yp+2. at i=0 and i=imax

Note that xp and yp are used in these equations!

- **Iterate until the maximum residual magnitude drops below TOLER=1.0 x 10^{-5}**
  - Hint: The number of iterations will depend on the equation and the algorithm (~10,000 for 101 grid dimension)
- **Initialize the temperature field to a uniform value of 3.5**
- **Write out your converged solution to a (PLOT3D or equivalent) file that can be used for plotting or restart capability**
  - an example plot3d routine is on smartsite. Additional information can be found on the internet.

Project-1

- **Run your code on a cluster node via the job launching scripts described in lecture-1**
  - Compiling of code can only be performed on hpc1

Project-1

- **Due Thursday October 15th (PAY CLOSE ATTENTION TO WHAT IS ASKED FOR!):**
  - Statement of problem, equations, and algorithm(s) used
  - Listing of Fortran or C code (You may program this and all projects in C if you prefer)
  - Output of run. Print out the iteration number, the magnitude of the maximum residual, and the indicies where the maximum residual was located
  - The CPU time from start of iteration to convergence. Let's use the clock routine from MPI for all projects by doing the following:

```
Include "mpif.h"
double start, finish, time

start = MPI_Wtime()
        .
        .
        .
finish = MPI_Wtime()
 time = finish – start
```

    Time all parts of your code from start to finish so that we can see total performance as well as just the iteration loop so that we can see solver performance. Give both times.
  - Plot of computational grid
  - Plot of converged temperature fields