These scripts are part of the lecture materials for my courses on reactor physics at Technical University of Munich. 2011 – 2016. The software comes as is, only for educational purposes and no warranties. © Dr.Sdl

2-Group diffusion theory is one of the oldest methods to determine the neutron flux inside a nuclear reactor. With appropriate macroscopic cross sections it is still the foundation of modern reactor simulators. See for example here: <https://www.nrc.gov/docs/ML1214/ML12142A086.pdf> or <https://canteach.candu.org/Content%20Library/20041805.pdf> or <http://www.math.kent.edu/~varga/pub/paper_4.pdf> .

The equation is obtained under the assumptions that scattering is isotropic in the laboratory coordinate system and the region of interest is considered piecewise homogeneous, so that the diffusion coefficients are invariant under spatial transforms like translation and others. It is well known, that such a derivation of diffusion theory rests on certain assumptions, i.e. the flux being sufficiently smooth especially by virtue of neutron absorption or production, which is reasonable since the mean free path is typically larger than the dimensions of the fuel cell and moderator space geometry. Further, the continuous energy distribution of neutrons is reduced by the use of two energy groups (from: Fernandes J.C.L., Oliveira F., Bodmann B.E.J., Vilhena M.T.B. (2015) The Multi-Group Neutron Diffusion Equation in General Geometries Using the Parseval Identity. In: Constanda C., Kirsch A. (eds) Integral Methods in Science and Engineering. Birkhäuser, Cham).