HELMHOLTZ ZENTRUM
DRESDEN ROSSENDORF

FORTRAN Legacy Code Refactoring

I have many questions and came to you for answers

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DRESDEN concept

Who am I?

HZDR / Institute of Resource Ecology / Reactor Safety Department

- Computational simulations of nuclear reactors
- Set of simulation tools – own and external
- In-house development: reactor dynamics code **DYN3D**
  - Few dozens of external users (research and industry)
  - Closed source code
  - Export controlled

What is my Framework?

Reactor dynamics code DYN3D

- Fortran
- In continuous development since 198X
  - ~ 1000 files
  - ~ 300000 lines of code
  - Two authors of the code kernel (retired)
  - Multiple contributions by PhD-students, guest scientists, externals, etc.
- SVN version control
- Build and test system (cmake)

What is my Challenge?

- Code readability
  - Implicit variables, cryptic variable names
  - GOTO for logical blocks
  - (no) code indentation
  - Minimal comments
  - Code duplication
- Code structure
  - (no) encapsulation of important functionality
  - Needed for code coupling
- Parallelization
- Post-processing
  - Need for convenient visualization and extraction
- Pre-processing
  - GUI

```
110           XHE   => BDA(35)
111     C
112     C      TDIM(2)=1000.
113           TD(2) = 1000.
114          4 TW =TSF
115           ITW=0
116     C     URO
117     C    11 TWN=TSF+(FB+FH)*QL*HTC6/FLMH(TW)
118          11 TWN=TSF+(FB+FH)*QL*HTC6/FLMH(TW,ITYPF)
119           ! FLMH - Wärmeleitfähigkeit Hüllrohr
120     C     URO end
121           IF (ABS(TWN-TW)/TW.LT.EPS7.OR.ITW.GT.10) GOTO 10
122           TW =TWN
123           ITW=ITW+1
124           GOTO 11
125          10 TW =TWN
126           TSA=TW +HTC5/HTC6*(TW-TSF)*FB/(FB+FH)
127           DO 2 IR=1,NR
128          2 TF(IR)=TW
129     C     FUEL TEMP. DISTRIBUTION ITERATION
130     C     ALSP-GAS GAP HEAT TRANSFER COEFFICIENT
131     C     CON -FUEL CONDUCTIVITY VALUES
132           IT  =0
133           ALFN=ALSP
134           ! zwischen alpha und Brennstofftemperatur wird iteriert
135          1 ALSP=EPS9*ALFN+(1.-EPS9)*ALSP
136           TSI=TSA+FB     *QL*HTC4/ALSP
137           TN(NR)=TSI+FB  *QL*HTC3/CON(NR)
138           DEV=ABS(TN(NR)-TF(NR))
139           TB =TN(NR)
140           IF (NR.LE.1) GOTO 13
141           DO 12 IR=2,NR
```

What is my Challenge?

My ideas

- Code readability
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- AI (ChatGPT, Copilot, …?)
  - should work with Fortran
  - should keep code proprietary
  - “Prettier”
- AI?
- ?
- HDF5?
  - some practical help is appreciated
- HTML + JS +CSS?
  - Get some student to do it?