General information about the used benchmark

The used benchmark for this training is NPB3.3-MZ-MPI:
www.vi-hps.org/upload/material/general/NPB3.3-MZ-MPI.tar.gz

For the compilation, first modify or specify the compiler and compilation flags in config/make.def. Use the following line to compile the application:

```
make benchmark CLASS=class NPROCS=number_of_procs [VERSION=VEC]
```

The compile line to use in this training is:

```
make bt-mz CLASS=W NPROCS=4
```

Exercise 1: Detecting the focus of analysis (FOA)

a) Create or copy a configuration file `extrae.xml` in your working directory. Update the path Define all needed environment variables for your EXTRAE installation.

b) Generate a trace for your application by executing the binary with defined EXTRAE-configurations and with the desired number of processes and/or threads.

c) Use the *Paraver* GUI to open the generated trace and investigate the results. Identify with help of the MPI call time line the structure of the application and regions, which are worth further analysis (FOA).

Exercise 2: Load Balance

a) Load the MPI call profile and identify the Load Balance of computation time outside of MPI among processes in the FOA.

$$\text{LB} = \text{Avg comp time} \,/\, \text{Max comp time}$$

b) Look at the Useful Duration and Useful Instructions Histograms and analyze the computation time and instructions load balance among the processes in the FOA.

c) Identify from the MPI call profile the average number of instructions per cycle (IPC) for each process in the FOA and note the load balance of IPC among processes.

Exercise 3: Efficiency

a) Simulate the program execution on an ideal network by applying the `Dimemas` tool on your trace. Use the Dimemas configuration file `IdealNetwork.4.1ppn.cfg`.

b) Calculate Serialization (SE) and Transfer Efficiency (TE), consequently, the communication efficiency (ComE) and the combined parallel efficiency (PE) of the application in the FOA.

$$\text{SE} = \text{Max comp time} \,/\, \text{ideal time}$$
$$\text{TE} = \text{ideal time} \,/\, \text{total time}$$
$$\text{ComE} = \text{SE} * \text{TE}$$
$$\text{PE} = \text{LB} * \text{ComE}$$

Exercise 4: Computing Performance

a) Run the cluster analysis of your trace by executing the `BurstClustering` tool with configuration file `cluster_explained.xml`. Look at the created diagram. What can you see there?

b) Load the new clustered trace in Paraver and look at the related Cluster ID time line. Identify the main computing regions.

c) Detect the relationship among IPC, number of executed instructions and L3 cache miss ratio for each cluster.

Exercise 5: Communication

a) Identify, which MPI operations need most execution time. Look at the zoomed MPI call time line to better understand the communication behavior of the processes.

b) Identify, how often the processes communicate with each other.