



PPCES 2021 – MPI Course

HPC.NRW Competence Network



THE COMPETENCE NETWORK FOR HIGH PERFORMANCE COMPUTING IN NRW.

Wrap-up and Outlook

HPC.NRW Competence Network

MPI in Small Bites

- MPI Concepts
 - Blocking vs. Nonblocking procedures
 - Asynchronous vs. Synchronous operations
 - Communication paradigms: point-to-point, collective, one-sided
- Point-to-point communication
 - Data exchange between **two** processes
 - Use standard send (MPI_Send) by default and synchronous send (MPI_Ssend) where needed
 - Standard send provides the best of buffered vs. synchronous protocols
 - Correctness of your application should never rely on a specific behavior (buffered vs. synchronous)
 - Nonblocking communication ...
 - ... can help to avoid deadlocks in data exchanges (communication-communication overlap)
 - ... may (or **may not**) progress communication on the side (communication-computation overlap)

- MPI Datatypes
 - Describe memory access patterns (type map)
 - Are local to a process
 - Type signatures (sequence of elementary types) need to match for a communication
- Blocking Collective Communication
 - Implement common parallel data distribution patterns
 - All ranks in the communicator must participate
 - Standard behavior (across platforms/implementation)
 - However, **no** performance portability

– Communicator Basics

- Communicators provide isolation of communication contexts
- Addressing based on ranks
 - Ranks of a process may differ in distinct communicators/groups
- Ranks in communicator are a characteristics of the underlying process group
- Communicators and groups can be derived from each other

– Hybrid Programming

- MPI is largely thread-agnostic (provides selection of different thread levels)
- High thread level may impact overall performance
- Be aware of potential data races when combining MPI with threading

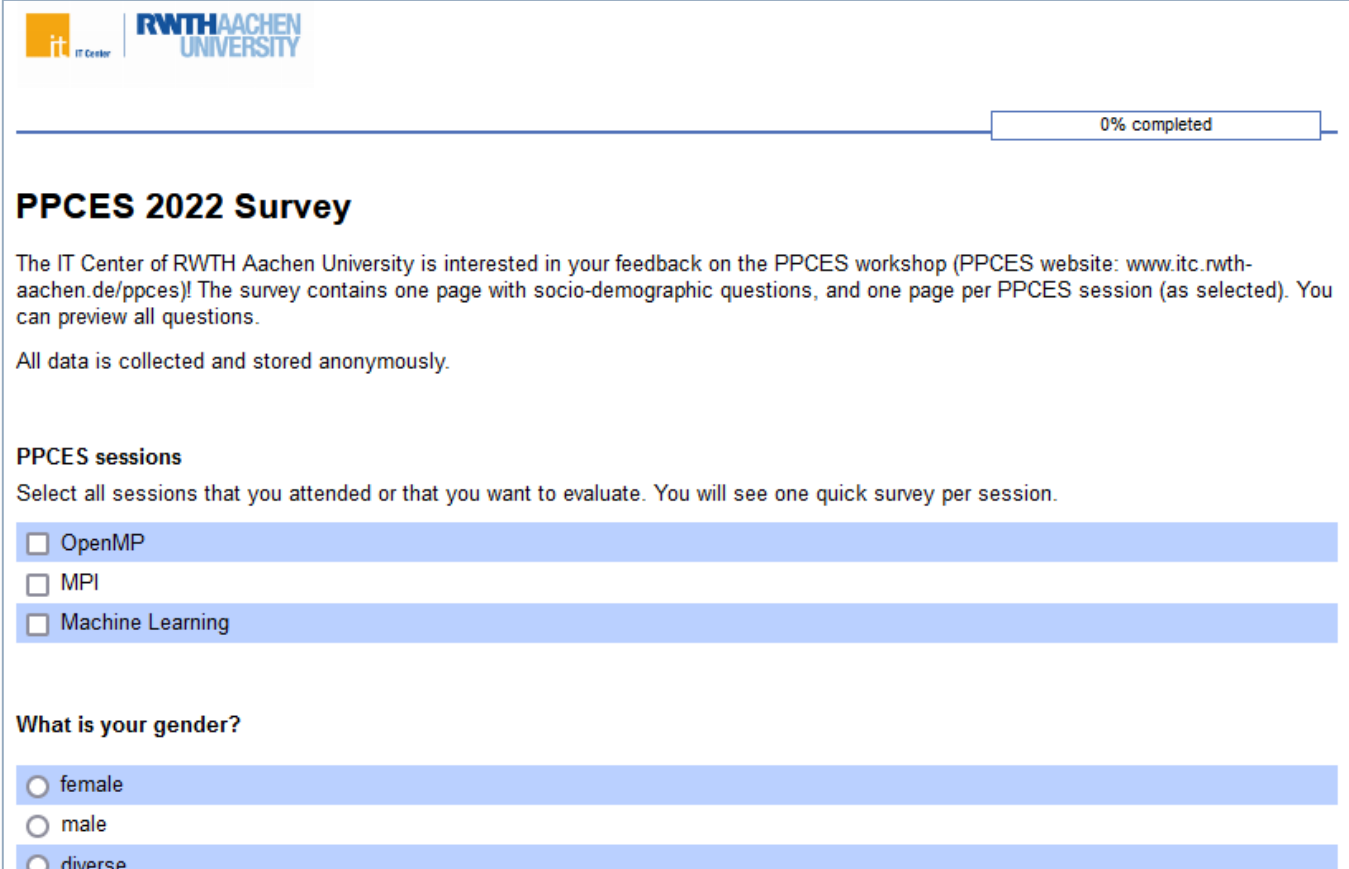
- Advanced MPI Topics
 - Persistent communication (a specialization of nonblocking communication)
 - Nonblocking collective communication
 - Virtual process topologies (Cartesian and general Graph topologies)
 - Neighborhood Collectives (based on virtual process topologies)
 - Dynamic process management & the MPMD model
 - One-sided communication
 - File I/O
 - The Session Model vs. the World Model (introduced with MPI 4.0)
 - Partitioned Point-to-point communication (introduced with MPI 4.0)

Feedback wanted! → Help us make the workshop better!



PPCES Evaluation Form
(valid until April 8th, 2022)

<https://www.soscisurvey.de/ppces2022/>



The screenshot shows the beginning of a survey titled "PPCES 2022 Survey". At the top left, there are logos for "it Center" and "RWTH AACHEN UNIVERSITY". A progress bar on the right indicates "0% completed". The text of the survey reads: "The IT Center of RWTH Aachen University is interested in your feedback on the PPCES workshop (PPCES website: www.itc.rwth-aachen.de/ppces)! The survey contains one page with socio-demographic questions, and one page per PPCES session (as selected). You can preview all questions. All data is collected and stored anonymously." Below this, there is a section titled "PPCES sessions" with the instruction "Select all sessions that you attended or that you want to evaluate. You will see one quick survey per session." There are three checkboxes: "OpenMP", "MPI", and "Machine Learning". The "Machine Learning" option is highlighted in blue. Below this is a question "What is your gender?" with three radio button options: "female", "male", and "diverse". The "female" option is highlighted in blue.