

# CS542200 Parallel Programming

## Homework 4: Observe the behavior of UCX yourself

Due: Sun. Jan 7 23:59, 2024

### 1 GOAL

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Develop observability code within the UCX framework to gain a comprehensive understanding of its architecture and enhance our knowledge in modern parallel computing frameworks, with the following objectives:

1. **Comprehend the UCX Framework:** Delve into the UCX framework to understand the roles and interconnections of its subcomponents, thereby gaining a deeper insight into its overall functionality.
2. **Examine TLS Impact:** Investigate how Transport Layer Security (TLS) is influenced by the interactions and dependencies between UCP, UCS, and UCT within the UCX framework.
3. **Learn Program Structure:** Acquire knowledge about the program structure of modern parallel computing frameworks, focusing on how they are designed, implemented, and optimized for performance.

### 2 REQUIREMENTS

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- In this assignment, you are required to modify and recompile the UCX system (the underlying communication protocol for MPI) to add the following two features:
    - Display the UCX transport protocols currently configured in the system.
      - ◆ You are required to insert code at `// TODO: PP-HW4` (`src/ucs/config/parser.c`) to ensure your program is compatible with the UCX framework.
    - Output the UCX transport protocols actively utilized by the program.

### 3 RUN YOUR PROGRESS

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1. Recompile UCX and install it in the `$HOME/hw4` directory, ensuring that a `lib` folder is present that contains the required dynamic link files. (`libucp.so.0`, `libuct.so.0`, `libucm.so.0`, `libucs.so.0`).

Note that every time you modify the UCX code, you need to re-execute the last line of commands to recompile.

```
git clone -b pp-hw4 https://github.com/NTHU-LSALAB/UCX-lsalab
cd UCX-lsalab
mkdir build && cd build
../configure --prefix=$HOME/hw4/ --with-go=no
srunk -n 1 -c 12 make -j12 install
```

2. We provide a custom command `mpiucx`, designed to replace `mpirun`, which will utilize your self-compiled UCX as the underlying communication framework for running MPI parallel programs. You could find the test cases in `UCX-lsalab/test/`

```
module load openmpi/4.1.5
mpiucx -x UCX_LOG_LEVEL=info -np 2 ./mpi_hello.out
```

3. Alter the internal code of UCX to enable printing of:
  - The UCX\_TLS information is currently specified by the system.
  - The final TLS transport method was selected by UCX.
4. You may need to trace the files within `src/ucp`, `src/uct`, and `src/ucs` directories and modify at least the following two files to complete the homework.
  - `ucp/core/ucp_worker.c`
    - Invoke `ucp_config_print` to print UCX\_TLS.
    - Print Line 2 by identifying a key variable.
  - `ucs/config/parser.c`
    - Implement the `ucs_config_parser_print_opts` function to be invoked by `ucp_config_print` here.

## 4 RESULT

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For each transport, the output comprises 2 lines.

- Line 1: The information from UCX\_TLS needs to be exactly the same.
- Line 2: The information should include only the key strings of transport protocols selected by UCX. The example must contain strings  
`cfg#0 tag(sysv/memory cma/memory)`

### Sample input & output

- For the Apollo31 configuration, the default transport protocol is set to utilize `ud_verbs`.

```
[willian@apollo31 mpi]$ mpiucx -np 1 ./mpi_hello.out
UCX_TLS=ud_verbs
0x56544467c8f0 self cfg#0 tag(ud_verbs/ibp3s0:1)
Hello world from processor apollo31, rank 0 out of 1 processors
```

- We have enabled UCX to leverage all available transport protocols by setting up UCX\_TLS.

```
[willian@apollo31 mpi]$ mpiucx -n 2 -x UCX_TLS=all ./send_recv.out
UCX_TLS=all
0x5580604e1a90 self cfg#0 tag(self/memory cma/memory)
UCX_TLS=all
0x559a90bb7a00 self cfg#0 tag(self/memory cma/memory)
UCX_TLS=all
0x5580604e1a90 intra-node cfg#1 tag(sysv/memory cma/memory)
UCX_TLS=all
0x559a90bb7a00 intra-node cfg#1 tag(sysv/memory cma/memory)
Process 0 sent message 'Hello from rank 0' to process 1
Process 1 received message 'Hello from rank 0' from process 0
```

## 5 REPORT

Here is the report template <https://hackmd.io/IRFyciGGQYS4yxwaInteVw?both>

Please copy the markdown into your markdown editor and submit the PDF after converting it at <https://md2pdf.netlify.app/>.

## 6 GRADING

### 1. [30%] Correctness

- The pass rate of test data for hw4-judge.

### 2. [20%] Demo

- A demo session will be held remotely. You'll be asked questions about the homework.

### 3. [50%] Report

- Grading is based on your evaluation, discussion and writing. If you want to get more points, design or conduct more experiments to analyze your implementation.

## 7 SUBMISSION

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Upload the files below to eeclass. (**DO NOT COMPRESS THEM**)

- hw4.diff
  - You can obtain this file by
    - `git add -A && git commit -m "Observed the behavior of UCX."`
    - `git diff --color remotes/origin/pp-hw4 > hw4.diff`
- hw4\_{student\_ID}.pdf
- **KEEP \$HOME/hw4/ CORRECTLY**

## 8 HINTS

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- Type hw4-judge on **apollo** to run the test cases.
- Scoreboard:
  - <https://apollo.cs.nthu.edu.tw/pp23/scoreboard/hw4/>
- You can use `-x UCX_LOG_LEVEL=info` in `mpirun` to obtain debug information during UCX runtime, which will help you understand the progress of UCX and gain insights into the transport protocol.
- Refer to slide **p37** of the presentation to determine which component is accountable for the `UCX_TLS` configuration in the system.
- Consult slides **p41** to **p42** of the presentation for insights into UCP's architecture, which will aid in navigating your code to pinpoint the transport protocols actually in use.
- Contact TA via [pp@lsalab.cs.nthu.edu.tw](mailto:pp@lsalab.cs.nthu.edu.tw) or eeclass if you find any problems with the homework specification, judge scripts, example source code or the test cases.
- You are allowed to discuss and exchange ideas with others, but you are required to write the code on your own. You'll get **0 points** if we found you cheating.