Barcelona Supercomputing Center
Centro Nacional de Supercomputación

EXCELENCIA SEVERO OCHOA

Programming Distributed Computing Platforms with COMPSs

Workflows & Distributed Computing Group

26-27/01/2021

Barcelona

Supercomputers Hands-on

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Supercomputers Hands-on

- Execution in MareNostrum 4
- Tracing Analysis Overview

Execution in MareNostrum 4

- How to connect to MareNostrum?
  - > **ssh -X** **nct01XXX@mn1.bsc.es**
  - Password: **gc9hha.XXX**

(Where XXX is 148 – 187 or 248-252)

- Update .bashrc
  - Edit: **.bashrc**
  - Add: "**module load COMPSs/2.8**" at the end
  - Execute: **source .bashrc**

- Where is the source code?
  - **cd**
  - **cp –r /gpfs/home/nct00/nct00012/source .**

- Available editors
  - vi
  - emacs

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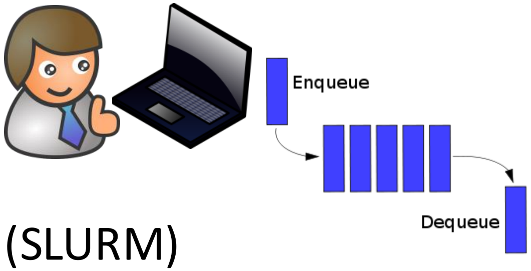
WordCount@ Sequential

- Remember the dataset path
- How to launch with python sequentially?
  - > cd source/src
  - > python wordcount.py /gpfs/home/nct00/nct00012/dataset/dataset_4f_4mb
  - Results:

```
user@login:~> python wordcount.py /path/to/dataset/
Elapsed Time (s): 0.959941864014
Words: 2551735
```



- Submit jobs to MareNostrum 4:
  - All jobs should be submitted to the queuing system (SLURM)
  - We will use a launcher script which calls to **enqueue_compss**
  - Useful commands:
    - squeue – This command shows the status of the job.
    - scancel jobId – This command kills a job with id ‘jobId’.

Execution in MareNostrum 4 - HandsOn

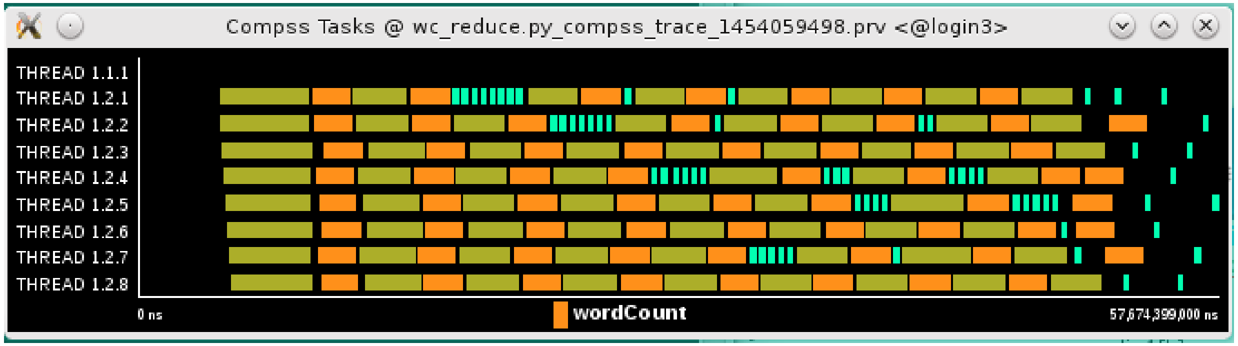
- launch_with_pycompss.sh

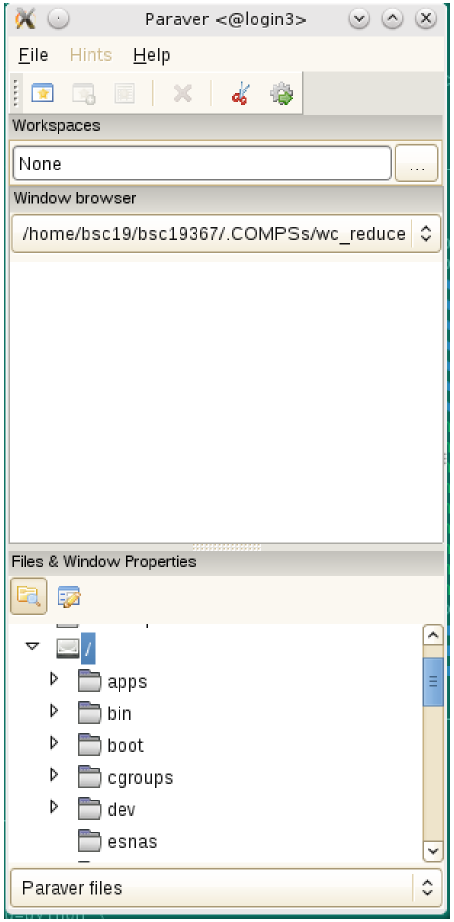
```
#/bin/bash

enqueue_compss \
  --qos=training \
  --num_nodes=2 \
  --exec_time=10 \
  --reservation=COMPSs_Tutorial_2021 \
  --lang=python \
  --tracing=true \
  --graph=true \
  /home/nct01/nct01XXX/source/src/wordcount.py  /gpfs/home/nct00/nct00012/dataset/dataset_288f_16mb
```

- Parameters:
  - num_nodes: amount of nodes where to execute (1 master + 1 worker).
  - Dataset path: **/gpfs/home/nct00/nct00012/dataset/dataset_64f_16mb**
- How to execute with PyCOMPSs?
  - chmod 755 launch_with_pycompss.sh
  - ./launch_with_pycompss.sh

Wordcount @ Performance Analysis

- Paraver is the BSC tool for trace visualization
  - Trace events are encoding in Paraver (.prv) format by Extrae
  - Paraver is a powerful tool for trace visualization.
  - An experimented user could obtain many different views of the trace events.
- For more information about Paraver visit:
  - https://tools.bsc.es/paraver





Workspaces: None

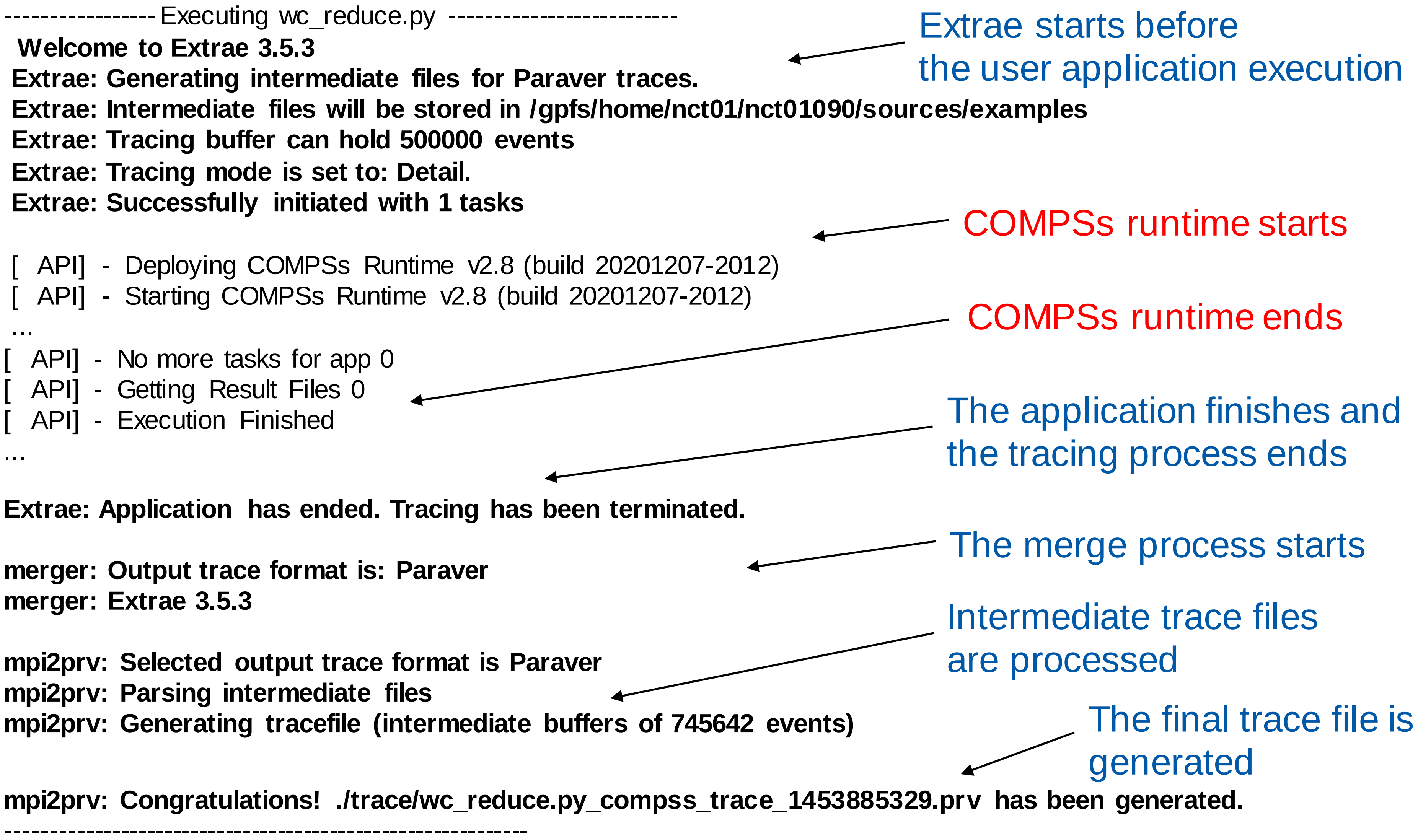
Window browser: /home/bsc19/bsc19367/.COMPSs/wc_reduce

Paraver files

Wordcount @ Performance Analysis

- COMPSs can generate post-execution traces of the distributed execution of the application
  - Useful for performance analysis and diagnosis
- How it works?
  - Task execution and file transfers are application events
  - An XML file is created at workers to keep track of these events
  - At the end of the execution all the XML files are merged to get the final trace file
  - COMPSs uses Extrae tool to dynamically instrument the application
    - In a worker:
      - Extrae keeps track of the events in an intermediate file
    - In the master:
      - Extrae merges the intermediate files to get the final trace file

Wordcount @ Performance Analysis



```
----------------- Executing wc_reduce.py --------------------------
 Welcome to Extrae 3.5.3
Extrae: Generating intermediate files for Paraver traces.
Extrae: Intermediate files will be stored in /gpfs/home/nct01/nct01090/sources/examples
Extrae: Tracing buffer can hold 500000 events
Extrae: Tracing mode is set to: Detail.
Extrae: Successfully initiated with 1 tasks

[   API] - Deploying COMPSs Runtime v2.8 (build 20201207-2012)
[   API] - Starting COMPSs Runtime v2.8 (build 20201207-2012)
...
[   API] - No more tasks for app 0
[   API] - Getting Result Files 0
[   API] - Execution Finished
...

Extrae: Application has ended. Tracing has been terminated.

merger: Output trace format is: Paraver
merger: Extrae 3.5.3

mpi2prv: Selected output trace format is Paraver
mpi2prv: Parsing intermediate files
mpi2prv: Generating tracefile (intermediate buffers of 745642 events)

mpi2prv: Congratulations! ./trace/wc_reduce.py_compss_trace_1453885329.prv has been generated.
----------------------------------------------------------
```

Extrae starts before the user application execution

COMPSs runtime starts

COMPSs runtime ends

The application finishes and the tracing process ends

The merge process starts

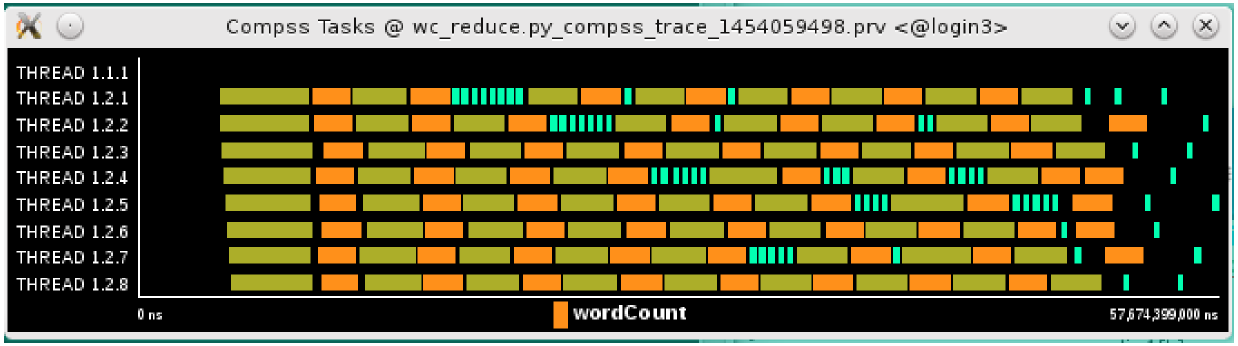
Intermediate trace files are processed

The final trace file is generated

WordCount @ Performance Analysis

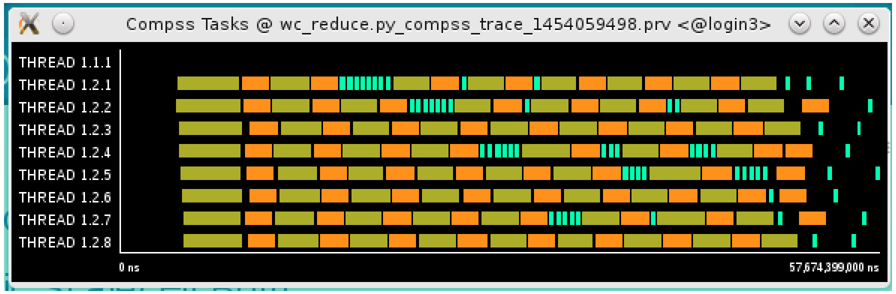
- Open Paraver
  - $> module load paraver
  - $> cd $HOME/.COMPSs/wordcount.py_01
  - $> wxparaver trace/*.prv
- COMPSs provides some configuration files to automatically obtain the view of the trace
  - File/Load Configuration...

(/gpfs/apps/MN4/COMPSs/2.8/Dependencies/paraver/cfgs/compss_tasks.cfg



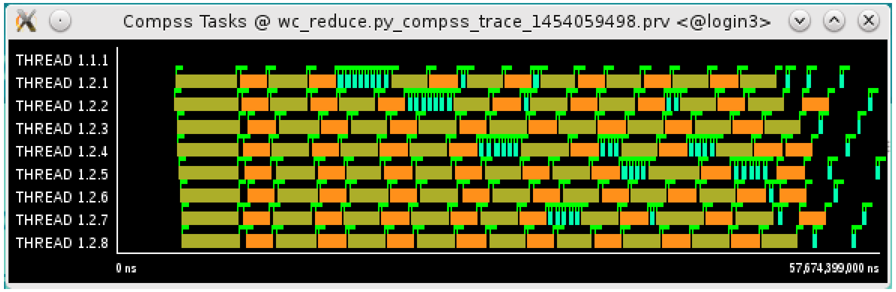
Wordcount @ Performance Analysis

- Fit window
    - Right click on the trace window
    - Fit Semantic Scale/ Fit Both



Compss Tasks @ wc_reduce.py_compss_trace_1454059498.prv <@login3>

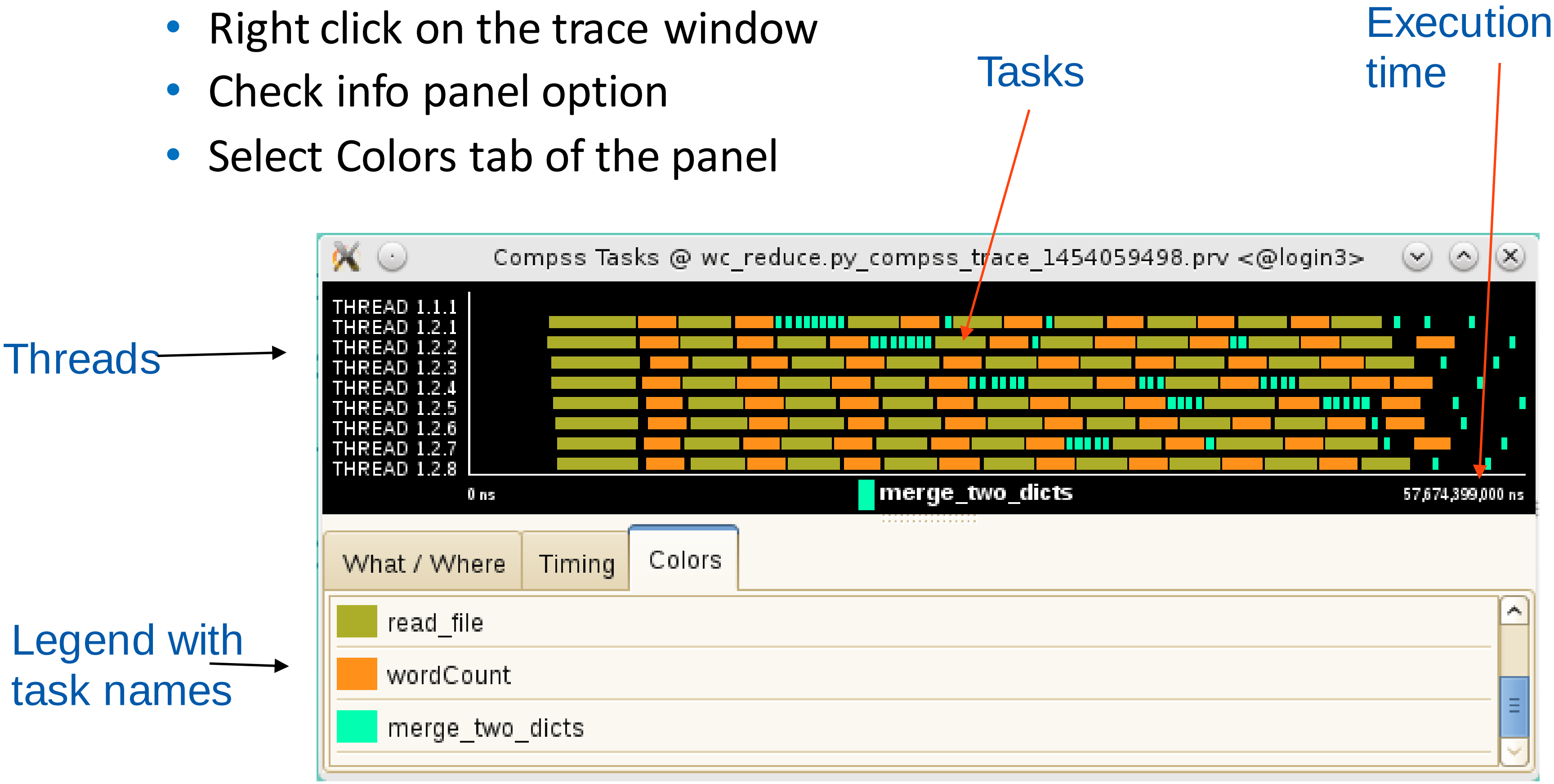
- View Event flags
    - Right click on the trace window
    - View / Event Flags



Compss Tasks @ wc_reduce.py_compss_trace_1454059498.prv <@login3>

Wordcount @ Performance Analysis

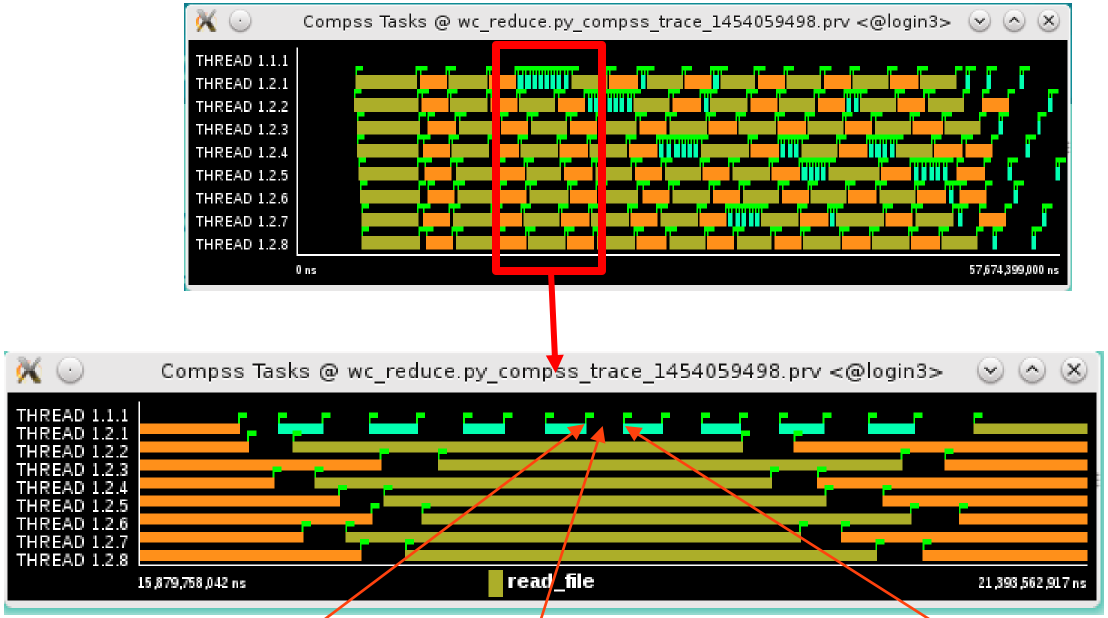
- Show info Panel
  - Right click on the trace window
  - Check info panel option
  - Select Colors tab of the panel



🟩 read_file
🟧 wordCount
🟩 merge_two_dicts

Wordcount @ Performance Analysis

- Zoom to see details
  - Select a region in the trace window to see in detail
  - And repeat the process until the needed zoom level
  - The undo zoom option is in the right click panel



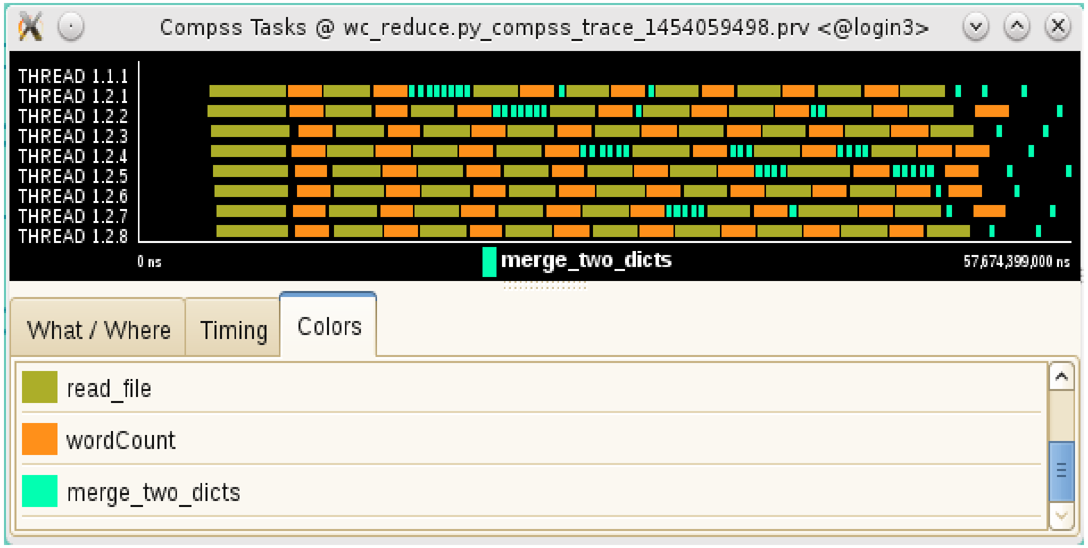
Previous task ends

Processor is idle

New task starts

Wordcount @ Performance Analysis

- Summarizing:
  - Lines in the trace:
    - THREAD 1.1.X are the master threads
    - THREAD 1.X.Y are the worker threads
- Meaning of the colours:
  - Black: idle
  - Other colors: task running
    - see the color legend
- Flags (events):
  - Start / end of task



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THANK YOU!

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