Feasibility Intervals for Homogeneous Multicores, Asynchronous Periodic Tasks, and FJP schedulers

CISTER Research Unit, ISEP/IPP, Porto, Portugal
PARTS - Université Libre de Bruxelles, Bruxelles, Belgique

Vincent Nélis
Patrick Meumeu Yomsi
Joël Goossens
What do we have?

- **Initial offset is known**
- **Strictly Periodic**
- **Deadlines no larger than periods!**
- **Global, fully preemptive, and job-level static prio.**
- **Deterministic!!!**
What do we want?

We want Guarantees!!!

Sure...everyone does
But how
A first solution

Mathematical tests

- Relatively easy to implement
- Doesn’t take too long to get the result
- Support many task and platform models
- Not very accurate…
- Only sufficient: Yes means yes, no means “I don’t know”
Schedulability tests
A second option

Feasibility intervals

- Provide exact analysis
  - Yes means yes
  - No means no

- Take more time to implement

- May take a very long time to get the results
In this presentation, there is one and only one concept that you have to understand (please focus):

This concept is the system state!
Let us define a “System state”
Properties that we know – 1/4

If the system is schedulable then...

There is a loop!
Properties that we know – 2/4

...and we know the length of that loop!
Properties that we know – 2/4

One hyper-period!
Properties that we know – 3/4

If there is a loop:

then the system is schedulable!
A straightforward solution...

All jobs execute for its WCET

Let's press play and monitor the system state at each unit!

I hope there is no bug...

Let see…
You “just” have to wait...
But what are you waiting for?
But what are you waiting for?
How long can be that path?

Maximum length = Max nb of states
Properties that we know – 4/4

If the system is schedulable…

HP = 10
Properties that we know – 4/4

If the system is schedulable…”
If the system is schedulable...
Properties that we know – 4/4

If the system is schedulable...

\( (1, 2, 2) \geq (1, 2, 1) \)
How long can be that path?
A worst-case scenario

First state: (a, b, c)

HP

(a-1, b, c)

HP

HP

HP

0, 0, 0

“minimum”
A worst-case scenario

First state: $a, b, c$

Result: $0, 0, 0$

$HP \times (a + b + c)$
A worst-case scenario

HP x (wcet + wcet + wcet)

“maximum”

“minimum”

0, 0, 0
How long can be that path?

Maximum length = HP \times \sum (WCET)

Max: \text{Max nb of states}
How much time it will take to know if it's schedulable?

According to their research, it should take around 3.2 millions of years

Seriously, people are actually paid for that?
Improved results

- We came up with 3 optimization techniques to considerably reduce the length of the interval.

- Simulation results have showed that the length of the interval highly depends on the task parameters.
1st observation
2nd observation

Feasible systems

System utilization

nb feas. system
Questions