The Spanish Parallel Programming Contest and its use as an educational resource

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Outline

1. The contest
2. Resources
3. Teaching
4. Perspectives
The First Spanish Parallel Programming Contest

- Participation in groups of three students + one teacher-coach
- In situ and online participation
- In the *Jornadas de Paralelismo* in September 2011, La Laguna, Tenerife.
- MPI+OpenMP programming in a cluster of 4 nodes, each node 8 cores
- Five problems, for which a sequential solution is provided and the score is calculated based on speed-ups
- Automatic, real time scoring using Mooshak
Mooshak

- A tool for organization contests. We use it in programming and algorithm courses at the University of Murcia.
- Adapted to work in the cluster and to calculate scoring based on speed-ups.
- Access to mooshak through the contest’s page (cpp.fpcmur.es)
- The participants send their solution to mooshak, which compiles and links it with a scheme (used for I/O, validation and scoring), sends the compiled program to the cluster, collects the result and execution time, validates the output and calculates scores.
Problems

A  Multiplication of matrices with rectangular holes.
B  Live game with variable neighbourhood.
C  Obtain values in given positions after sorting.
D  Multiply four dense square matrices.
E  Knapsack problem with affinities.

Well-known problems, sequential solution provided, solved with well-known algorithmic schemes, but it is necessary to adapt them to the system to obtain high speed-ups;
⇒ the effort is centred on parallelization.
Solutions

- In a file a function with the sequential solution which is substituted by a parallel solution:
  ```
  void mh(int t,double *a,double *b,double *c,int nodo,int np)
  ```

- And a header indicating the resources to use:
  ```
  /*
   CPP_NUM_CORES = 1
   CPP_PROCESSES_PER_NODE 1
   CPP_PROBLEM=mh
   */
  ```
Participation

- **First edition:** 4 in situ + 4 online

- From the second edition: prepared in English and online participation of non-Spanish teams.
For each problem: scoring (execution time, speed-up, submissions)
When in a problem a speed-up higher than 15 is obtained, the scores of all the teams for this problem are linearly scaled to values between 0 and 15
Website: cpp.fpcmur.es

Contest.

Subcluster: used for some practicals at the university of Murcia.

Modifications to Mooshak: it has been adapted and the modifications can be used in other courses.

Problems: are available on the website.

Programs: solutions in the records table.

Explanations: explanation of the improvements for new records.

CUDA stuff: for the second edition.
### Records table

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
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<tr>
<td>sequential</td>
<td>3</td>
<td>1</td>
<td>1.2</td>
<td>4</td>
<td>2</td>
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<tr>
<td>message-passing</td>
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<td>1.5</td>
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<td>3.5</td>
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<td>4</td>
<td>7</td>
<td>6</td>
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<tr>
<td>maximum speed-up</td>
<td>54</td>
<td>9</td>
<td>7.2</td>
<td>98</td>
<td>42</td>
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</table>

**Table:** Estimated maximum speed-ups achievable, and the maximum with sequential, message-passing and shared-memory optimization.
## Possibilities

### Finished and on-going experiences

<table>
<thead>
<tr>
<th>resource</th>
<th>Contest</th>
<th>Early Adopters</th>
<th>Paral.</th>
<th>Prog.</th>
<th>Master</th>
<th>Extra-cur.</th>
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<tr>
<td>Contest</td>
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<td>Modif. Mooshak</td>
<td>X</td>
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<tr>
<td>Explanations</td>
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<tr>
<td>Website</td>
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<td>X</td>
<td></td>
<td>x</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CUDA stuff</td>
<td></td>
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### Planned and possible activities

<table>
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<th>resource</th>
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<th>Autonomous</th>
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</tr>
</tbody>
</table>
Used in:

- Early Adopters project, University of Murcia: approx. 100 students.
- Parallel programming courses: 2 universities, approx. 20 students.
- Master courses: 2 universities, approx. 10 students.
- Extracurricular courses Univ. Murcia+Supercomputing Centre: 10 participants.

and at present in other Spanish universities in Parallel programming courses in the Degree and the Master.
Second edition

- At the University Miguel Hernández of Elche, Alicante, September 19-21, 2012.
- MPI+OpenMP and CUDA competitions.
- MPI+OpenMP in situ and online, CUDA only in situ.
- The online competition open to non Spanish teams.
- Inscription on the website of the contest. Deadline: June 30 (in situ), September 14 (online).

Teaching

- For next year use of the resources in the same courses at the Universities of La Laguna and Murcia.
- Projected use of the problems in Parallel programming courses at other Spanish universities.
- Possible use of the stuff generated for the CUDA competition in other courses at the University of Murcia.
- Plan to use the resources in a virtual extracurricular course.
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Participation during EduPar

The First Contest is temporally open (cpp.fpcmur.es). It is possible to ask for an account today by accessing the contest and creating an account in the group EduPar, with name, the e-mail address. With this account you can try to establish new records.

And if you have some question about the contest or how to participate, I am at the conference until Saturday, or you can contact me at domingo@um.es.

And the same... if you want to sponsor the contest.