Past and Future of CP

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One of my slides from CP96 panel discussion on future of CP

<table>
<thead>
<tr>
<th>AI/CS Culture</th>
<th>Math/engineering culture</th>
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<tbody>
<tr>
<td>Constraint satisfaction</td>
<td>OR Optimization</td>
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<tr>
<td>Constraint programming</td>
<td>Math programming</td>
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- But the time is right for synthesis.
- This seems to be widely recognized now.
- It will happen quickly.
- It may be helpful to become consciously aware of differences between the two approaches ...
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Prediction

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Did it happen?

- First CPAIOR workshop was in 1999.
  - Became a conference with proceedings in 2004.
- Hybrid methods often used in CP.
  - Growing literature.
- There are CP sessions in OR, math programming meetings.
  - But OR has been slow to recognize CP.

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Future of OR/CP integration?

- Depends partly on what the commercial solvers do.
  - Eclipse – unknown in OR world
  - OPL Studio – only a first step.
  - BARON – already combines OR/CP for global optimization

- New CP systems routinely include hybridization.
  - People will use something that works.

- OR solvers are slow to incorporate hybridization.
  - Highly engineered solvers allow the community to postpone looking at other approaches.
  - OR modeling style does not easily accommodate CP.
Related Issue

- Why so little CP in North America?
  - Lags behind Europe, East Asia.
- Some factors:
  - Historical inertia.
    - CP started in Europe, where few North Americans are trained.
  - OR is well established, particularly in USA.
    - CP often seen as competition. There is no obvious opening for it.
Future of CP in North America?

- Assuming CP continues to prosper, it may catch on with the next generation…
  - …which will have less vested interest in current OR methods.
- Best point of entry may be through integrated CP/OR methods.
Next big research thrust: Modeling

- Perhaps there can be no science of modeling, because science is modeling.
- But we can develop modeling tools and understand them.
- This is essential for widespread use of CP.
- A strength of CP (relative to OR) is its larger repertoire of modeling constructs, plus its familiarity with formal languages.
- Models serve two purposes:
  1. Understanding: they reduce the problem to intelligible form.
  2. Solution: they permit automatic deduction of consequences.
- We have focused on number 2.
- We need better modeling tools and packages for number 1, along with methods for converting models to soluble form.
- Part of number 1 is developing tools to explain the solution of a model.
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We have this:

and are beginning to see this:

- Part of number 1 is developing tools to explain the solution of a model.
What next?

- CP has become an established field.
  - Now we have an association (ACP).
- Sociology of organizations will play a role…
Two types of successful fields:

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- **Academic fields.**
  - For example, computer science, molecular biology.
  - Dedicated to answering a core question.
  - Practice is important…
    - … but application papers may appear at the back of the conference proceedings volume.
Case study: Operations research.

- Originally conceived as an engineering field, but it wants to be an academic field.
  - Partly because it includes mathematical programming and other areas of mathematics.

- Yet it is unclear what the core question is.
  - So OR has no natural home in the academy.
    - Sometimes engineering, sometimes business school, sometimes mathematical sciences.
    - Often a 2\textsuperscript{nd} class citizen.
Past reports of OR’s death have been greatly exaggerated…

…but there is something behind these reports.

- Relatively few PhDs, academic jobs in OR.
- No longer taught in business school (a few exceptions).

High-grade commercial software keeps OR practice alive.

- The tools are very useful, after all.
The problem with OR

- It wants to be an academic field, but it is defined by its techniques rather than a core question.
  - This could happen to CP.
How about CP?

- CP should decide what it wants to be.
  - An engineering field?
    - I don’t think so.
  - An academic field with applications?
    - Yes, but it seems to be defined by its techniques, not by a core question.
- A mature field can remain exciting when it pursues a mystery.
  - CP must do this.