From Idea to Project: Experiences towards an ERC Advanced Grant

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My background

• 1992: MSc in Computer Science, KU Leuven
• 1999: PhD in Computer Science, KU Leuven
• Since 2015: Full Professor in the Department of Computer Science, KU Leuven

• Main field of expertise: Natural Language Processing
• Research fits ERC PE6: Computer Science and Informatics
2017 ERC Advanced Grant CALCULUS

Commonsense and Anticipation enriched Learning of Continuous representations sUpporting Language UnderStanding

H2020-ERC-2017-ADG 788506
What was the motivation to apply for an ERC Advanced Grant?

1. To do fundamental research on a topic I dreamed of for a long time
2. To have more time to focus on high risk research
3. To have time to write a book
4. To obtain recognition and impact of ideas
5. Not to have to spend time to constantly apply for research grants
What counts in the application?

- CV and track record
- Project
My CV

• Interdisciplinary profile
• Strong track record in attracting funding (e.g., coordinator of FET Open)
• My research team (at the time of application): 1 postdoc and 9 PhD researchers
• My h-index at time of application: 37 (but growing)

Convince your panel that you are at the forefront of your research field (in Europe)
Convince your panel of your key strengths and accomplishments: this might be different for everyone
Track record: some suggestions

Research and innovative thinking: explain the innovations realized in past projects

Independency and leadership: stress own realizations and management capabilities

Leadership in the training of young scientists: what important positions have your PhDs now?

International visibility: e.g., keynotes, tutorials, citations, chair roles in conferences
Track record: some suggestions

Publications in top-tier venues

International collaborations with top-researchers and institutes

Entrepreneurship and collaboration with international companies

Teaching and scientific services: shows expertise and recognition in the field
The project

• The most important thing

• Key idea of the proposal must:
  • Be creative and innovative
  • Be high risk / high gain
  • Be relevant
  • Have a potential of high impact

• You must be the ideal person for the job
Key idea of the CALCULUS project

Current neuroscience studies show that humans perform language understanding tasks instantly by relying on their capability to imagine situations. The goal of CALCULUS is to study new paradigms for machines that learn to understand language, for fast parsing of language and efficient use of memory, and for inference in imagined and real physical spaces that are inspired by human intelligence.
What makes the project high risk/high gain?

• CALCULUS: **paradigm shift:**
  • Since the early days of AI (from 1956 onwards): language understanding = translation to discrete symbolic representations and reasoning with these => poor representation of reality

• CALCULUS:
  • Translation of language to continuous representations that integrate (visual) context
  • Reasoning in 3D/4D imagined or real-world spaces, or reasoning with the continuous representations that generate these spaces
What makes the project high risk/high gain?

At the time of submission of the proposal in 2017:

• Insights into the real bottlenecks of language understanding from a previous FET-open project
  
  Shows real good understanding of the problems

• A few publications of our lab in highly ranked conferences that support the novel paradigm

  Shows that objectives are achievable
CALCULUS = novel machine learning paradigms inspired by results of neuroscience research with impact on:

- Natural language processing
- Natural language processing and robotics
- Information retrieval
- Human-computer interaction
- Human-robot natural language dialogue
- Indexing, storage and retrieval of continuous representations of content
- Brain-computer interfaces
Takeaway

• Pose innovative, high-impact research hypotheses and objectives
• Propose a novel solution to a long-standing problem

And provide preliminary evidence (obtained by you or other researchers) to support these: contributes to feasibility

• Show that now is the right time to investigate the proposed solution
• Convince the panel that you are the ideal person for the job:
  • Expertise
• Clarify the impact also beyond your field
How was the writing done?

1. First quick draft with ideas (submission in 2015)
2. Refinement with many technical details and literature studies including the current neuroscience studies (submission in 2016)
3. Final version: only few content changes were made, but technical details were better framed, explained and motivated; our own preliminary results added (submission in 2017)
Methodology section: novel approaches with good motivation and source of inspiration
How was the writing done?

<table>
<thead>
<tr>
<th>Problems of current NLU</th>
<th>Proposed solutions</th>
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<tbody>
<tr>
<td>Current continuous representations of content do not model semantic and discourse relations unless trained on data manually annotated</td>
<td>Feasibility evidenced by preliminary experiments by the PI and her team</td>
</tr>
<tr>
<td>Current continuous representations do not model commonsense and world knowledge unless trained on resources built manually</td>
<td>CALCULUS</td>
</tr>
<tr>
<td>Current semantic and discourse parsing is slow, does not cope well with data not seen in supervised training, and does not translate language to relational metric spaces in case of dealing with spatial and temporal language</td>
<td>Continuous representations capture relational structure as found in language and images</td>
</tr>
<tr>
<td></td>
<td>Continuous representations capture commonsense and world knowledge</td>
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<td>The solution space during parsing is constrained by the anticipatory representations</td>
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<td>Enriched representations generated better user data can be seen when training the parsers</td>
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<td></td>
<td>Translation of language to matrix spaces with linear coordinates of subjects and times</td>
</tr>
</tbody>
</table>

Figure 1. Gaps in current natural language understanding and solutions proposed by CALCULUS.
How was the writing done?

• Make sure that the proposal is written with both the expert and not-so-expert in mind
  • Part B1 is reviewed by panel, Part B2 by external (expert) reviewers

• Make your proposal visually attractive, e.g., nice layout and add some pictures

• Have the proposal read by colleague researchers
Conclusion

• If you have a track record of excellent science
• If you have an innovative idea (that preferably has some interdisciplinary flavor)
• If you can somehow demonstrate that this idea will work

=> Dream, think, dare, write an excellent proposal and do not give up
Thank you and success!