Application Summary

Competition Details

Competition Title:	2021 Teaching Excellence Award for Online Teaching
Category:	Institutional Awards - CTL
Award Cycle:	2021
Submission Deadline:	02/28/2021 11:59 PM

Application Information

Submitted By:	Roshan Vengazhiyil
Appplication ID:	5933
Application Title:	Pascal Van Hentenryck
Date Submitted:	02/28/2021 2:04 PM

Personal Details

Applicant First Name:	Pascal
Applicant Last Name:	Van Hentenryck
Email Address:	pascal.vanhentenryck@isye.gatech.edu
Phone Number:	(404) 894-2300

Primary School or Department

H. Milton Stewart School of Industrial and Systems Engineering

Primary Appointment Title:	A. Russell Chandler III Chair and Professor

Application Details

Proposal Title

Pascal Van Hentenryck

Professor Pascal Van Hentenryck

Teaching Excellence Award for Online Teaching

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Total package 20 pages

Georgia Tech | H. Milton Stewart School of Industrial and Systems Engineering

February 28, 2021

To: CTL award committee

Re: Nomination for Pascal Van Hentenryck for the Teaching Excellence Award for Online Teaching

Dear Members of the Award Committee:

I am enthusiastically nominating Professor Pascal Van Hentenryck (Pascal) for the Teaching Excellence Award for online Teaching.

As Associate Chair for Undergraduate Studies, I ask students about their instructors anytime I find a chance. In Fall 2020, two professors stood out, especially Pascal. Several students immediately named Pascal: they said that the quality of his classes was almost as effective as if they were in person! In fact, some said it was the best classes ever taken in Georgia Tech, on-line or in person. I knew he put a lot into his on-line class ISYE 4134/ISYE 8813 Constraint Programming. I contacted Pascal. He showed me some recorded videos and recitation sessions. Wow! They are better than my imaginations. It is difficult to describe in words. You have to see the videos and CIOS comments to appreciate the quality and how far he went to provide the best on-line educational experience for his students.

Please find sample recorded lectures and a recitation session at   The site is password protected due to copyright. After you view a few minutes of his lectures you can appreciate why his CIOSs are so good. They are after his recitation session video. His numerical scores are 4.98 and 4.95 for 4134 and 8813, respectively. Furthermore, you can see all the CIOS comments. I included a few sample quotes is at the end of this letter. No wonder Prof. Sokol, the Director of Online MS Analytics program, provided such strong support in his letter. Prof. Sokol himself has been the winner of the Ector and Beard awards and the ANAK award among many other teaching awards.

Pascal also teaches at the Seth Bonder Camps on STEM course on computational and data science to underserved high school students. The video introduction for the two on-line summer camps is at https://sethbondercamp.isye.gatech.edu/. The quality is also impressive.

In addition, Pascal offers a MOOC class on Coursera on Discrete Optimization. The trailer for the class and a sample lecture are at the end of his 4134/8813 class sample website. His Coursera ratings is 4.9/5. You can also see many great comments at the Coursera website https://www.coursera.org/learn/discrete-optimization#reviews.

These accomplishments are rooted in his love of teaching, love of his students and teaching philosophy.

In late Spring 2020, Georgia Tech announced that Fall classes will be mostly remote, especially for large classes (94 in his case). Pascal started preparations right away for his undergraduate and early graduate class in Constraint Programming (ISyE 4134/8813), leveraging his experience in his MOOC course Discrete Optimization on Coursera and the Seth Bonder Camp in Computational and Data Science for Middle and High-School Students. He built a home recording studio with hardware and software systems of near-professional quality. This included green screen, professional lighting, microphone, and camera, and editing software that can be used to produce quality videos. Pascal also

organized his class along three components: high-quality videos lectures, interactive sessions and motivating assignments.

Pascal first artfully designed lectures and assignments around a Star Wars theme. The lecture contents are carefully fitted into different episodes of Star Wars (including music and costumes), and each problem-solving assignment/project connects the course material with a Star Wars adventure. You can see from students comments in CIOS how impactful this design was. The students loved his Star War themed lectures that kept their attention, curiosity, and motivation over the course of the semester for a material that is quite technical.

The second element of his class is the recitations during scheduled lecture times. The result of the real time delivery is also professional quality. Pascal again uses technology to make his recitations highly interactive, engaging, and motivating, as he often designs and implements solutions to problems during class. The sample recitation should also give you some insights of how these recitations help student understanding. You will find many testimonies about the recitations in the CIOS comments section and the supporting letters from the students.

The third element is his Star Wars themed assignments. Included in this package are two sample assignments. You can see how he worked hard to link the problem solving in Star Wars to different applications in Constraint Programming. You can also find in CIOS students comments how effective the theme inspired the students to take the challenges and to learn.

Pascal is also demanding the best from his students. The assignments are increasingly complex and challenging as his students progressing through the semester. By the end of the semester, students can actually solve large-scale realistic problems. The assignments toward the end of semester have become very challenging and complicated. Many students struggle. He strategically used the breakout room in BlueJeans to inspire and help students in smaller groups. Many students used the word "contagious" for his enthusiasm, energy and love. In such environment, the students do not mind the hard work. In addition, Pascal created a script for each assignment that can automatically check on correctness, computing efficiency and the quality of the results. He then went through each submission to find out where the students do well and where do not. He used these observations to improve his teaching and help the students. This is a very large undertaking for 94 students. As a renowned scholar around the world, he is very busy. However, he puts the students learning first. I have noticed that more and more senior design teams apply the tools in ISyE 4314 Constraint Programming to solve real world complex problems. Some of them are very complicated but achieve outstanding results. All to Pascal's credits.

Pascal also promotes diversity, inclusion and fairness in (online) education. Since 2017, each summer, Pascal offers the Seth Bonder Camp to underserved middle-school or high-school students. In the weeklong program, Pascal teaches computational and data science to students with no or little exposure to computer science and/or data science in their schools, through combinations of lectures and projects. Each year, there are approximately 40 campers. For the 2020 Summer camp, Pascal had to move the camp online because of COVID. He had to offer two sessions of the camp with 20 participants to give students personalized attention (through breakout rooms). The introductory video mentioned earlier at the beginning should give you a sense about how he makes challenging concepts fun and interesting for the high schoolers. Because of the online camp success, Booker T. Washington High School (a historically black high school in Atlanta) is now partnering with Pascal for a longitudinal training in computational and data science for their students. In Summer 2021, he will run two Seth Bonder Camps

with Booker T. Washington High School, and build a course specifically dedicated to their STEM teachers.

Pascal also developed a MOOC class on Discrete Optimization offered at Coursera. It had registered 48,527 total learners (2/15/2021) and 32,607 active learners. His course rating is 4.9/5.0, which is rate for Coursera courses. More importantly, 29% started a new career after completing the course, and 19% got a tangible career benefit from this course! What an impact to the society on a rather specific topic course. The quality of the course and delivery are again top notch, and you can read the comments on the Coursera website.

Pascal is always willing to help his colleagues and community. He wrote an ACM SIGSE paper (the most prestigious conference for computer science) to distill his experience in teaching creative problem solving to the entire community. He shared a lot of tips and advises in ISyE's Instructor's Townhall meetings, and in his other interactions with colleagues based on his experience in on-line teaching. This includes the contents design, lighting, audio, interactions, etc. Pascal will make his videos available to other instructors if they are assigned to teach this class. He is also exploring to convert ISyE 4134 Constraint Programming into a MOOC class. Hopefully, the MOOC impact will be as significant as his Discrete Optimization class on Coursera.

I have received multiple support letters from the students. I only included one due to 20-page limitation. The others are similar. In fact, his complete CIOS comments shows much broader support. I include some sample CIOS students comments here to give you some idea. Some from graduate students in 8813. You can refer to the original CIOS for the complete set, available in the first video link.

I have never enjoyed any course material more than I've enjoyed the lectures for this course. Pascals video were genuinely the highlight of my week

I loved his video lectures. They were super helpful and I learned a lot. I loved that everything was related to Star Wars as well.

The problems and homework were really helpful in increasing my understanding of the course

Interactive sessions were very helpful, especially in the virtual environment

The professor went way beyond any other I have ever had. He made a theme in the class and made each assignments story very interesting

I genuinely had a great time! Assignments were challenging and made me work hard, meanwhile the lectures were very good at explaining the needed material

Also all of the projects were a ton of fun

Every single assignment was a super fun time and extremely rewarding. I learned so much from the lectures and assignments

Short and to-the-point lecture videos in well organized modules helps in mental organization and in learning the material first-pass (something few professors have spend the time to think through)

The best parts of the class were the real world examples and homework problems.

The lectures and assignments, all very engaging with the Star Wars theme.

The whole course was done amazingly well. Each aspect of the course contributed in a very impactful way to my learning experience.

I've been at Tech for 4.5 years, and I honestly think Pascal is the best professor I've ever had.

His enthusiasm for the course material was contagious, and his genuine interest in his students learning greatly impacted and created our success.

The ability to understand and listen to students is the greatest ability

Best professor at GT. An honor to be taught by him. Focuses on our knowledge not just grades and gives us flexibility to grow and become good jedis

(ISYE 8813) Thanks for Pascal provide such funny and full of knowledge class that I learn a lots from the optimization. This class return me more than I expected. I think most because the Star Wars setting and interactive session allows me to study actively. And the professors lecture present topics and logic behind them very well. So I can quickly catch and understand given information.

(ISYE 8813) Everything about the course was incredible. The lecture videos were high quality and engaging. The interactive sessions were a must have. Getting to interact with the professor after having watched the lecture videos and read through the assignments really helped and he generally gave great pointers and advice. The breakout rooms were must haves as well as often the questions I wanted to ask would not have been appropriate to ask to the class (I would be sharing potential partial solutions to assignments). Finally, I thought the assignments were incredible benchmarks for whether or not we fully grasped and could synthesize many concepts from the course.

(ISYE 8813) Video lectures and class discussions were exceptional. Pascal is exceptionally engaging. His passion for the topic is contagious to the class.

(ISYE 8813) Pascal is exceptional in his ability to inspire passion for the subject. Its very challenging over BlueJeans, yet Pascal was still among the best professors I have been exposed to.

In summary, Pascal had designed and rendered an outstanding on-line course in which students loved to learn. His teaching philosophy, his passion, his artful design and superb delivery form an on-line teaching system that inspired all his students to learn and to achieve.

Pascal's on-line teaching also impacts a broader community through his teachings to his colleagues, offer inspiring STEM education to underserved high school students. He teaches his TAs for the STEM course on how to build successful classes. His outstanding MOOC impact many throughout the world.

I enthusiastically nominate Dr. Pascal Van Hentenryck for the Teaching Excellence Award for Online Teaching.

If you have further questions, please contact me at cz3@gatech.edu

Sincerely,
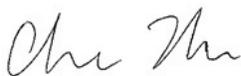
Chen Zhou

Assoc. Professor and Assoc. Chair, ISyE, Undergrad Studies

Georgia Tech | Master of Science in Analytics

Joel Sokol
Director, Master of Science in Analytics
Professor, H. Milton Stewart School of Industrial and Systems Engineering

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(404) 894-6484

Dear CTL Awards Committee,

I am very happy to be writing in support of ISyE's nomination of our colleague Pascal Van Hentenryck for the Teaching Excellence in Online Teaching Award. As the Director of a large (5000+ student, 20+ course) online Master's program at Georgia Tech, as well as someone who has taught online courses for 12 consecutive semesters (and counting), I can say that Pascal's innovative approach, his ability to connect with online students both synchronously and asynchronously, and his absolute success in teaching both the material and an appreciation for it are outstanding.

I am most familiar with Pascal's teaching in his Constraint Programming course, ISYE 4134/8813. This is a difficult course to teach, because he has to reach a mix of undergraduate and graduate students, and teach them complex and esoteric material that they (especially some of the undergraduates) might not really be interested in, and his syllabus contains a strict grading scale. However, my students who took his course have uniformly reported loving Pascal's course and learning a lot, and Pascal's CIOS evaluations – both graduate and undergraduate – are not just high, they are off the charts. I have only very rarely seen evaluations this high for on-campus courses (I get to see all of the evaluations for MS Analytics courses, across three Colleges), and I have never seen them be this high – including in my own – in an online course, where the top evaluations tend to be lower than on campus. (For perspective, I've won the Ector and Beard awards, the ANAK award, and a bunch of other teaching awards at GT and from professional societies, and I've never gotten ratings in online courses as high as Pascal's.)

How does Pascal do it? I wondered too, so I investigated. First, he has a unique home studio (with real studio equipment); he gave us a virtual tour of it when GT first went remote after Spring Break 2020. But the way he uses the studio is what really makes the difference. In his instructional videos, he enhances the technical and mathematical information with images, videos, music, and even (on at least one occasion) costumes! It's thematic, with connections from video to video, and the combination seems to really help students remember the material – they say they get excited for each time he releases new material throughout the semester.

In addition to making these connections with students asynchronously, Pascal also uses synchronous sessions – for example, he holds recitations to work with students in real time. The students really seem to appreciate those sessions; they really help the students learn, and it shows that he cares a lot about their success and about connecting with them even during COVID.

Overall, I think Pascal Van Hentenryck's ability to teach, excite, and connect with his students online is outstanding, and I believe he would be a great recipient of the Teaching Excellence in Online Teaching Award.

Sincerely,

Joel Sokol

Georgia Institute of Technology
Atlanta, Georgia 30332 U.S.A.

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PROFESSIONAL PREPARATION:

1987: PhD in Computer Science, University of Namur (Belgium).
1985: Joint ScB/MSc in Computer Science, University of Namur (Belgium).

APPOINTMENTS:

2019-	: Associate Chair for Innovation and Entrepreneuship, ISyE, Georgia Tech.
2018-	: A. Russell Chandler III Chair and Professor, ISyE, Georgia Institute of Technology.
2015–2018	: Seth Bonder Collegiate Professor, University of Michigan, Ann Arbor.
	– Professor, Industrial and Operations Engineering
	– Professor, Electrical Engineering and Computer Science (EECS/CSE)
	– Core Faculty, Michigan Institute of Data Science
2012–2015	: Optimization Research Group Leader, NICTA, Australia. On secondment from
	– Strategic Chair in Data-Intensive Computing, Australia National University
	– Professor of Computing and Information Systems, University of Melbourne
1990–2012	: Professor, Department of Computer Science, Brown University.
	– Professor, 2000–2012
	– Associate Professor, 1995–1999
	– Assistant Professor, 1990–1995
1999–2000	: Professor, Department of Computer Science and Engineering, UCL
1985–1989	: Research Scientist at the European Computer-Industry Research Center, Munich.

BRIEF BIO:

Pascal Van Hentenryck is the A. Russell Chandler III Chair and Professor in the H. Milton Steward School of Industrial and Systems Engineering at Georgia Tech and the associate chair for innovation and entrepreneurship. Prior to this appointment, he was a professor of Computer Science at Brown University for about 20 years, he led the optimization research group (about 70 people) at National ICT Australia (NICTA) (until its merger with CSIRO), and was the Seth Bonder Collegiate Professor of Engineering at the University of Michigan.

    Van Hentenryck is a Fellow of AAAI (the Association for the Advancement of Artificial Intelligence) and INFORMS (the Institute for Operations Research and Management Science). He has been awarded two honorary doctoral degrees from the University of Louvain and the university of Nantes, the IFORS Distinguished Lecturer Award, the Philip J. Bray Award for teaching excellence in the physical sciences at Brown University, the ACP Award for Research Excellence in Constraint Programming, the ICS INFORMS Prize for Research Excellence at the Intersection of Computer Science and Operations Research, the Student Recognition of Excellence in Teaching: Class of 1934 Award at Georgia Tech, an NSF National Young Investigator Award and a Ulam Fellowship from Los Alamos National Laboratories. He received a Test of Time Award (20 years) from the Association of Logic Programming and numerous best paper awards, including at IJCAI and AAAI.

    Van Hentenryck's research focuses in Artificial Intelligence, Data Science, and Operations Research. His current focus is to develop methodologies, algorithms, and systems for addressing challenging problems in mobility, energy systems, resilience, and privacy. In the past, his research

focused on optimization and the design and implementation of innovative optimization systems, including the CHIP programming system (a Cosytec product), the foundation of all modern constraint programming systems and the optimization programming language OPL (now an IBM Product).

TEACHING ACTIVITIES:

1. **K-12 Education and Beyond:** Development and teaching (2017–) of the week-long Seth Bonder Camp in Computational and Data Science for Middle and High-School Students. Latest delivery in the Summer of 2020, consisting of two online sessions (due to COVID-19) in collaboration with Booker Washington High School, a minority high school in Atlanta whose students have no opportunity for computer science education at their high schools.

2. **Undergraduate Education:** Van Hentenryck has continuously taught freshman and sophomore undergraduate classes at Brown University for more than 20 years including: Introduction to programming, introduction to computer systems, programming languages, computational biology, and discrete optimization. He has taught undergraduate students for more than 30 years.

3. **MOOC on Discrete Optimization:** Van Hentenryck is teaching a MOOC on discrete optimization in Coursera. The average review rating is 4.9/5.0.

RESEARCH ACTIVITIES:

1. Author of 5 books published by the MIT Press;

2. Author of more than 130 journal papers and 200 conference papers;

3. Google Scholar – Citations: 22,226; H-Index: 66.

4. External grant funding in excess of $7,000,000 since 2018.

5. Plenary talks at the premier conferences on artificial intelligence and operations research.

SYNERGETIC ACTIVITIES:

1. **Editorial Responsibilities**: *Program co-Chair* of AAAI-2019 (more than 7,000 submissions) and associate editor of about 8 journals.

2. **Leadership Role:** *Co-Chair* of the INFORMS Strategic Initiative on Artificial Intelligence.

3. **Software and Teaching Artifacts:** Design and implementation of OPL, the first modeling language for constraint programming and hybrid optimization. OPL has been in industrial use for about 20 years and is now an IBM product.

4. **Management Roles**: Leader of the Optimization Research Group at NICTA (about 70 people), reporting directly to the CEO and performing theoretical and applied research in logistics, energy, resilience, and social networks (2012-2015).

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Teaching Statement

Pascal Van Hentenryck

February 24, 2021

Teaching is one of the most rewarding experiences in academia. I cherish the classroom experience, I enjoy spending time with students and my teams of teaching assistants, and I am always delighted when undergraduates visit my office when they return to campus. I have taught freshman or sophomore classes every year of my 20 year tenure at Brown University, and I have taught undergraduate classes every year (but 2) in the last 30 years. I have prepared and delivered a massively online course in discrete optimization, which has an average rating of 4.9/5.0. I am running the Seth Bonder summer camp in computational and data science, teaching computational thinking and data science to middle- and high-school students who have no exposure to computer science and/or data science. Over the course of my career, I have taught classes in computer systems, discrete optimization, computational biology, constraint programming, infrastructure optimization, and programming languages to name a few.

Teaching Philosophy   My teaching philosophy relies on three key principles:
- Conveying the essence of the material during lectures and/or videos;
- Reinforcing the concepts through weeekly projects that bridge theory and practice;
- Spending significant time with the students in Q/A and help sessions.

The focus of the lectures is on giving students the intuition behind the theoretical concepts and how they can be used. Moreover, each of my courses is organized around a central theme, and each individual lecture/video "tells a story" on its own. For instance, at Georgia Tech, I teach an undergraduate class on "Constraint Programming" to expose students to one of the fundamental paradigms for solving complex optimization problems (e.g., scheduling and routing, evacuation planning, relief distribution). Its theme is to show how complex optimization problems can be solved by carefully modeling the combinatorial structure of the application at hand. Each week introduces a new modeling concept and highlights its benefits by showcasing its use in practice. Students are also assigned weekly modeling projects to translate the theory into practice. The projects are simplified versions of real case studies, and students implement them in a modeling language, mimicking the solving process that happens in real life. The projects not only reinforce the theoretical concepts; they also require significant creativity so that students can develop their own intuition about why some models are better than others.

Massively Open Online Classes   I also teach a massively online course (MOOC) in discrete optimization that started in 2012 and was revised in 2016. The course has accumulated about 50,000 learners. Its theme is to demonstrate the complementary and synergies between a variety of algorithmic techniques designed to tackle these discrete optimization applications. It is organized around a sequence of substantial projects and case studies in resource allocation, logistics, and scheduling in order to help students develop their own intuition about the strengths and limitations of each paradigm. MOOCs raise fundamental challenges in the presentation and delivery of the material and in evaluating students. My teaching style is based on a highly interactive classroom experience, which is not possible in MOOCs. As a result, it became critical to simplify and motivate the material much more carefully, anticipate questions even more, and alternate between intuition

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and formalization on a systematic basis. I tried to stay engaging in the material delivery and organized mailbags (inspired by how NFL sport writers keep their blogs interesting) to review issues arising in the MOOC. I also motivated the students by using leaderboards and various statistics that are dynamically updated during the running of the MOOC. My experience in the MOOC is summarized in my ACM SIGCSE paper. The MOOC itself has been consistently ranked as one of the best in Coursera. This experience in developing this MOOC was invaluable in moving my constraint programming class online.

Online Classes during COVID-19 My constraint programming class was moved online last Fall. I built a small studio at home with proper lighting and sound, and acquire some video-editing software. I produced about 90 videos for replacing the lectures, each of which covering a single topic in less than 15 minutes. Class time was replaced by interactive sessions that I organized in three parts: (1) a review of the material where I would ask questions to judge the students' level of understanding; (2) a Q/A session where students asked questions on the material and projects; and (3) breakout rooms where the students could talk to me and the teaching assistants to debug their models, and ask modeling questions, and clarifications about the material. Additional sessions were added when requested when projects were due, especially at the end of the semester when the projects were significantly harder. I revised the material significantly, with videos going into a lot more depth for the reasons mentioned earlier. I added many projects to make sure that students would remain engaged with the course; and I split larger ones in smaller pieces to ensure that the students would actively participate every week. I was awarded the 2020 Student Recognition of Excellence in Teaching: Class of 1934 Award, Georgia Tech for my large undergraduate class on constraint programming. Students liked the videos, and their technical depth: they could view the material multiple times as they build their understanding, something that is not so easy in in-person lectures in fact. That was a key take-away from the reviews, and it confirmed my experience in developing the MOOC. *My goal from this point on is to create high-quality videos for completement all classes I am teaching, including a number of advanced classes in computational optimization and machine learning.*

The Seth Bonder Camp for High-School Students Every summer, I teach the Seth Bonder summer camp in computational and data science for middle- and high-school students with no exposure to computer science and/or data science in their schools. The first part of the week-long camp teaches them computational skills using the Snap! visual programming language and a simple robot. The second part of the camp teaches them computational thinking in the context of applications in social sciences, biology, medical diagnosis, and optimization. Students implement a sentiment analysis for the tweets during hurricane Harvey, align DNA sequences, solves sudokus, and implement a machine learning algorithms. It is an incredible experience to see these students grasping the material within a week through my morning lectures and afternoon laboratories. It confirmed my belief that computational thinking can be taught much earlier in K-12 education through exciting applications. Last year, I had to move the camp online as well and taught two online sessions. One was coordinated with Booker T. Washington High School (BTWHS), a historically black school in Atlanta. *Based on this experience, my goal in the next few years is (1) to establish a longitudinal educational program for these high schools, and (2) to enpower STEM teachers to teach this material themselves.* The first step will take place in April and June 2021, with online introductory and intermediary camps at BTWHS and an online STEM teacher course.

Innovative Teaching Artifacts

Pascal Van Hentenryck

February 22, 2021

1 ISyE 4134/8813

I taught ISyE 4134/8813 online in the Fall of 2020. These classes are for junior/senior undergraduates and master students, and teach Constraint Programming, a methodology for solving hard combinatorial optimization problems (e.g., scheduling and routing, timetabling, ...).

This contains a number of videos: the trailer, the class organization, a sample of lectures, a long introduction to the class, the syllabus, and the student reviews. The site of password protected).

I was awarded the Student Recognition of Excellence in Teaching: Class of 1934 Award, Georgia Tech., 2020 for them. The evaluations are attached. Here are a sample of the comments:

- "I have never enjoyed any course material more than Ive enjoyed the lectures for this course. Pascals video were genuinely the highlight of my week."
- "Lecture quality was the highest I've seen in any online lecture at GT. I think the theme made the class really entertaining. Pascal's enthusiasm about the subject really showed in the videos. This made me excited to learn and do well. I also like how the lecture videos were broken into chunks based on topic. This made it so easy to go back and find a video based on a topic."
- "The professor went way beyond any other I have ever had. He made a theme in the class and made each assignments story very interesting and I genuinely had a great time! Assignments were challenging and made me work hard, meanwhile the lectures were very good at explaining the needed material."
- "So much. First, Pascal is such a quirky and fun guy. You can tell he puts a lot of effort into teaching and making the material interesting for the students. What other class is so well themed? Lectures were very clear and informative. Assignments were challenging and very practical. I think I learned a lot."
- "Ive been at Tech for 4.5 years, and I honestly think Pascal is the best professor Ive ever had."
- "Pascal is the most engaging professor Ive ever had! Hes obviously very knowledgeable about the course material, but he never makes students feel dumb. GT is so lucky to have him!"
- "Pascal is objectively the best professor I have had the privilege of being taught by here at Tech. He is an absolute genius who has done (and is actively doing) so many amazing things and yet finds time to teach and inspire the next generation. I think I would have missed out had I not taken this class and I can only dream that I am as passionate about my work as Pascal is. Not to mention, he is extremely humble despite clearly being an absolute academic juggernaut."
- "Best professor at GT. An honor to be taught by him. Focuses on our knowledge not just grades and gives us flexibility to grow and become good jedis!"
- "The nicest and best professor at Georgia Tech."

2 Coursera Graduate Class on Discrete Optimization

This is a graduate class on discrete optimization taught online through Coursera. The course has a grade of 4.9/5.0 based on 536 ratings. The class has 48,527 total learners (2/15/2021) and 32,607 active learners. Here are a sample of the comments:

- "Exceptional coverage of optimization fundamentals. Learning of practical applied methods. Real university level course, no water down "data science". Absolutely love it! Thank you professor Pascal." (May 30, 2019)
- "This is, without a doubt, one of the most interesting courses I have ever taken. You will be challenged to create your own ideas and you will get to know what NP hard means in practice." (June 3, 2020)
- "One of the best courses I've ever taken, including all my main studies in three different universities. Don't expect to breeze through this course with some easy multiple choice questionnaires - the professor is not kidding in the beginning when he says the course is hard." (March 26, 2020)
- "The instructor for this course, Professor Hentenryck, is wonderful. His excitement and passion are palpable in his lectures and his team has clearly put in a ton of effort into creating all the graphics, images, etc. to make the illustrations as lucid as possible. Make no mistake - despite the simplicity of the problems you learn (in terms of how you can state them), this can be a very tough course." (April 26, 2020)
- "This course is absoutely excellent. It has really time consuming and challenging programming assignments, but I learned more than I have in a long while. I could not recommend this course more highly, and I have completed 20+ MOOCs. This is one of the best ones by far" (Jan 24, 2017)
- "I am sure this is the best course out there to help students/Professionals to understand the complexity of the optimization problems specially designed and explained by Professor Pascal Van Hentenryck in his own hilarious style ." (July 2, 2019)
- "Truly challenging course. Had enrolled out of curiosity. Before starting had only basic knowledge on combinatorial optimization. The course content is good and the course theme is basically exploratory. Really a dense course if determined to study in depth.The instructor is brilliant and his teaching style keeps you motivated all the time." (March 31, 2019)
- "Amazing course! The Lecturer is not only a leader in the field, but also an excellent educator. The concepts are explained clearly. Historical remarks and anecdotes bring the material to life. I also really enjoyed the assignments. They were challenging and quite time-consuming, but very helpful toward the learning experience." (August 26, 2020).
- "The best course on Coursera. Unlike the do-it-by-rote Deep Learning classes, there is much creativity and freedom in tackling all assignments. The assignments are stimulating, challenging, and approximate real life problem solving very well." (August 26, 2019)
- "This course is the best available resource to understand the fundamentals behind all the discrete optimization techniques. One can gain so much clarity on the subject by listening to the terrific tutor." (Apr 19, 2020)
- "i wish there was 6 start rating so i can give this prof his due, he made a very complicated subject look very simple and easy to understand thanks a million", (Sep 4, 2018)

3 Seth Bonder High-School Summer Camp in Computational and Data Science

Every summer, I teach the Seth Bonder Summer Camp in Computational and Data Science (one or two sessions) to high school students who do not have exposure to computer science and/or data science in their middle or high schools. In 2020, I had to move the camp online due to COVID-19 and taught two online sessions. One of the sessions was coordinated with Booker T. Washington high school, a historically black high school in Atlanta. See this blog entry for all our initiatives in this respect which include

- A dedicated longitudinal education program that will support multiple summer camps with increasingly advanced material;
- A self-paced teacher version of the camp to help BTWHS teachers offer the material themselves in their schools, either as a regular or as a flipped class.

Letter of Support for Professor Pascal:

Pascal is easily the best professor I have had at Tech so far. The ISYE 4134 class material was very interesting, and Pascal's phenomenal teaching style made it even better. Pascal really took advantage of the online-learning environment and did not see it as a hinderance to his teaching. He skillfully taught the class with brief, pre-lecture informative Star-Wars themed videos followed by Star-Wars themed interactive live lectures. Professor Pascal made the class easy to follow and engage with, which is quite difficult to do with online classes. He encouraged his students to engage in lecture, continually challenged us to improve our thinking, and would always support going to his office hours to better personally help us. He personally cared about getting to know each student though we were just "little blue boxes" on the screen, and would occasionally make sure that us students were doing mentally and personally well during lecture. Professor Pascal made his class one that I actually looked forward to virtually attending every week and that in itself is a great accomplishment, considering how difficult it is to make students motivated to log into an hour-long online lecture. Even the homework assignments were engaging! He made class examples and homework problems culturally relevant (Star Wars theme, marriage, COVID relief, chess, etc.) to help show how important his class was for real life, which honestly not many professors manage to do well. In addition to teaching the course material well, Pascal willingly offered great life advice and information on random student questions inquiring about his career, industry relevance, and his opinions on certain subject matters. Every student in the class knew we were blessed with a gem of a professor and was aware of how rare it was to meet such a remarkable person. We all really appreciated his bright insight, humor, and personable character and ended the semester wishing he could teach every one of our other classes.

Sincerely,
Neel Edupuganti
Georgia Institute of Technology, 2022
B.S. Industrial Engineering

COVID19

Fall 2020

Problem Description

COVID19 is ragging in the galaxy. Hospitals are getting organized and are careful to isolate COVID19 patients from others. General Leia is in charge of allocating residents to patients. She has organized the hospital in zones to separate patients. Each patient is allocated to a zone and has a load that describes how sick she/he is. General Leia wants to assign residents to patients so that the following constraints are satisfied:

1. Each resident is assigned to at least *minPatients* and at most *maxPatients*;

2. Each resident cannot have a load that exceeds *maxLoad*, where the load of a resident is the sum of the loads of her patients;

3. Each resident only works in one zone.

General Leia also wants to make sure that the load of the residents is as balanced as possible. To achieve this, she wants to minimize the standard deviation of the resident loads. OPL has a standard deviation function *standardDeviation(x)* that computes the standard deviation of the elements of array *x*.

Help General Leia solve this problem!

The Republic

Due date: See Canvas for accurate information

Problem Statement

Han Solo has been appointed by Obi-Wan to design a resilient communication system for the Republic. He needs to assign a number of control centers to different locations under a variety of constraints, so that they can communicate efficiently. Han Solo has received the following data.

1. C: the set of control centers;

2. L: the set of locations;

3. f: a frequency matrix that describes how much the control centers communicate with each other. In other words, $f_{i,j}$ describes the communication frequency between control centers i and j;

4. h: a hop matrix over the locations that describes the distance in hops between two locations. In other words, $h_{i,j}$ describes the hop distance between locations n and m;

5. *Separed*: a collection of control center sets $S_1, ..., S_k$. Each set S_i specifies that its control centers cannot be located at the same location.

6. *Together*: a collection of control center sets $S_1, ..., S_k$. Each set S_i specifies that its control centers must be located at the same location.

The goal is to assign the control centers to locations so that the separation and togetherness constraints are satisfied. In addition, the objective is to minimize the cost of communication between the control centers. The communication cost between two control centers i and j is the product of the frequency $f_{i,j}$ by the number of hops between the locations of control centers i and j.

Screen captures from his lectures

This is a screen capture from his first class. He uses the Star Wars scenery and even a mask to set the students mind to the proper setting suitable for the contents. He mimics the voice of the Yoda.

Class Organization

This is an early scenery in the introduction lecture. He acted as Han Solo.

Introductory Lecture

This is an animation in which he pushes the red curve to the right to show that constraint programming can reduce the computer running time ("pushing the exponential").

Introductory Lecture
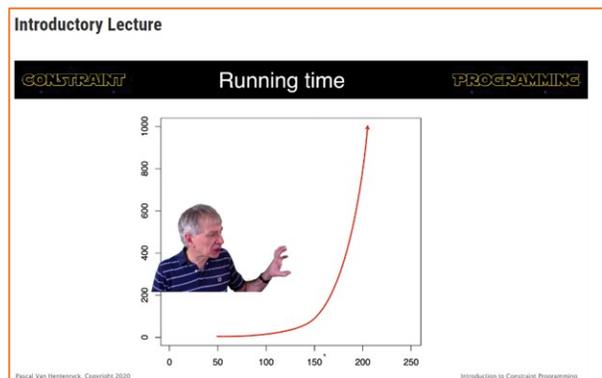
This is a scenery from his MOOC class on Coursera on Discrete Optimization, where he dressed up as Indiana Jones.

Coursera MOOC on Discrete Optimization

Syllabus: ISyE 4134/8813 Constraint Programming
The Star Wars Edition

ISYE 4134 A, Remote Learning

Class Times (Interactive Sessions) MW 5:00−6:15 p.m.

Instructor: Professor Pascal Van Hentenryck (aka Yoda)

Groseclose 314; Phone: 404−385−5538; Email: pvh@isye.gatech.edu

The Teaching Assistants

- The amazing Rey, aka Savannah Quinn
- The cool Han Solo, aka Diego Fernandez Padron
- The wise Luke Skywalker, aka Connor Riley

Catalog Description

This course (ISyE-CP) is an introduction to constraint programming (the "force"), from its modeling language to its computational methodology and its applications to scheduling, routing, and resource allocation.

Course Description

The course is intended primarily for senior undergraduates, Master students, and incoming PhD students. The course is an introduction to the "force" with an emphasis on modeling and solving optimization problems. It is not primarily a course about the implementation of constraint programming systems, although the class will cover the working of constraint programming solvers since this is critical to model problems correctly.

Prerequisites: ISyE 3133 with concurrency, CS 2316

If you have taken algorithms, it is also helpful.

Videos, Texts, and other resources

Professional videos of the lectures as well as PDFs of the lecture slides will be made available on the course website. They will cover all the material needed for learning the course outcomes. The OPL Studio system will be available for your assignments. It contains a sophisticated online documentation that should help design the projects. But the videos should be sufficient to learn OPL, including three especially devoted to the topic.

Attendance

This is an online class, organized as a flipped class. The material is presented in high-quality videos and complemented with interactive online sessions.

The online material is organized in modules. The material is released on Tuesday at 12:00am for the Wednesday class and at Thursday at 12:00am for the next Monday class. Students are expected to have reviewed the videos before the interactive sessions.

The interactive sessions (during class times but online) review the material, include Q/A sessions, go over the assignments and projects, and include one-on-one sessions with Yoda, Rey, Hans Solo, and Luke. They are a great learning experience and we expect you to attend them. Experience has shown that significant learning happens in these sessions. There will be also opportunities to virtual face-to-face interaction with the professor.

Course Outcomes

By the end of this course the students should

- Understand the modeling methodology and computational paradigms underlying constraint programming. Understand how to use constraint programming to model and solve problems in a variety of engineering and scientific fields.

- Understand the fundamental properties of good constraint programming models and how they differ from other methodologies.

- Be able to determine when/how to use constraint programming for practical applications.in areas such as scheduling, routing, and resource allocation.

- Achieve fluency in the modeling language OPL for constraint programming and its derivatives in Python.

- Recognize when additional features (e.g., new constraints and dedicated search procedures) are necessary to solve a problem and understand what this involves.

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Grading

The grades will be based on 16 project assignments. The percentages for each assignment is listed in the table below. There is no exams. The last project for graduate students is a major term project but a regular project for undergraduate students. The weights are shown in the table below. Some of the assignments are routine, others are significantly more challenging. It is strongly recommended to start the assignments early. They have been adapted to online learning and to make sure that the learning process is gradual based on the instructor's experience in teaching online, in academia, industry, and to K-12 students. All assignments are due at 11:59pm on the due date. In case of disagreements in dates and points between the missive and the Canvas modules, the canvas module is the truth, the only truth, and the whole truth.

Project	Due	% Undergrad	% Grad
The Galaxy	Aug 24	5	5
Han Solo	Aug 26	5	5
Luke Skywalker	Aug 31	5	5
Storm Troopers	Sep 2	5	5
Jedi School	Sep 7	10	10
The Republic	Sep 9	10	10
COVID-19	Sep 16	15	15
Yoda	Sep 23	20	20
The Empire Strikes Back	Oct 5	15	15
The Return of the Jedi	Oct 12	15	15
Takodana	Oct 21	10	10
R2D2	Oct 26	15	15
The Empire Strikes Back II	Nov 4	15	15
Jakku	Nov 11	20	20
The Millenium Falcon	Nov 18	5	5
The Rise of Skywalker	Nov 30		30
Princess Leia	Nov 30	30	
Total		200	200

Assignments

Assignments are graded on a 10 scale. Some of the assignments are extremely challenging even for experts in the field. This is the nature of optimization problems. One of the goals of the course is to help you understand this reality. As a result, the grades will be assigned to your individual project write up based on the following scale:

- Submitting junk or infeasible solutions: 0/10;
- Submitting solutions of low quality: 3/10;
- Submitting solutions of good quality: 7/10;

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- Submitting solutions of great quality: 10/10;

Regrading

If the grader or I have made a mistake in grading an assignment, we will be happy to correct it. All requests for regrading must be submitted with 7 days from the test date.

Extensions, Late Assignments

Late projects will be accepted with a 20% penalty per day late. Students will have one late day, which they can use on any project that will excuse them from this penalty for 24 hours. Projects handed in more than three days late will not be graded. However, students must hand in a working version of all projects in order to pass the class. A working version of a project produces a solution to the project. A Dean's excuse or a note from health services is required for any kind of exception to be made to the rules above. Once you have one of these, you should talk with the professor, who is the only person who can give extensions.

Letter grade

The overall grades are the summation of grades from assignments. The final letter grades will be assigned based on

$$A \geq 180, B \geq 160, C \geq 140, D \geq 100.$$

Collaboration Policy

In order to help the course staff evaluate each student in ISYE-CP as fairly and individually as possible, we have written a collaboration policy by which we expect all students to abide. Please read this policy carefully, as it may differ from collaboration policies in classes you have taken previously.

ISYE-CP has a lenient collaboration policy to encourage teaching and learning with your peers. At the same time, your work must, in the end, represent your own understanding of the material. In that spirit, our overall policy is that you can talk about almost anything and work out solutions together, but that no notes may be taken away from collaboration sessions and your final write-up must be your own work (so-called "whiteboard collaboration").

Permissions

You must ensure that your course documents have permissions which do not permit other students to view them. Ask an IT consultant for help with permissions if necessary.

Projects

You may work out solutions to projects together. However, you must understand everything you type up and hand in. To that end, we ask that you compose your solutions on your own and that you not take away any notes from any joint discussions. When you are physically writing up your

solutions, you should not be discussing the problems; your ability to reconstruct what you have developed with your classmates is evidence that you understand it.

You should not be looking at anyone else's write-up, nor should you permit anyone to look at your write-up. Note that once you have started writing up your solution, you are permitted to continue to discuss projects, provided that your solution (and any old notes) are not used (i.e., you should be working off a clean sheet of paper or a clean whiteboard). An obvious consequence of this policy is that you cannot debug the code of anyone else.

Finally, you cannot search the web or any other physical or online medium to help you design your solution.

Excused Absences from Assignments

We only accept notifications from Dean's office https://gatech-advocate.symplicity.com/care_report/index.php/pid167160 or Institute Approved Absences https://registrar.gatech.edu/info/institute-approved-absence-form-for-students.

Please inform the instructor of your approved absences timely. If the notification from Dean's office is for instructor's discretion and your absence prevents you from completing assignments or tests, please discuss the accommodations with the instructor as soon as possible. Since it is difficult to create a different but fair test, and solutions to assignments may have already been published, the accommodation might not be a makeup test or assignment.

Course Outline

1. Basic Concepts
   1.1. Getting started
   1.2. Basic concepts I
   1.3. Basic concepts II
   1.4. OPL Primer
2. Elements of Constraint Programming
   2.1. Reified constraints
   2.2. Optimization
   2.3. Expressions
3. Theoretical Foundation
   3.1. Computational Model
4. Global Constraints
5. The element constraint
   5.1. The table constraint
   5.2. Combinatorial Constraints
   5.3. The pack constraint
   5.4. The circuit constraint
   5.5. The lex constraints