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Building a Sustainable Competitive Programming Ecosystem in Argentina: From Olympiad Training to ICPC Institutionalization

Mariano CROSETTI[1], Agustín Santiago GUTIÉRREZ[2], Micaela BASSANI[3], Mariano MALUF[4]

[1]ICPC World Finalist & LATAM Champion. ICPC coach. Research Engineer. Applied AI in Aleph (YC S21). Ex-Founder. ex-Google. Member of AAPC's Committee.

[2]Main Judge at OIA. IOI Silver Medalist. IOI Scientific Committee (Chair, 2025). President of AAPC. MS in Computer Science, University of Buenos Aires. ICPC World Finalist & LATAM Champion. ICPC coach.

[3]Sponsor Director of AAPC. National University of Rosario, Argentina.

[4]Director of OIA. ECyT, National University of San Martín. IOI Team Leader (2013-2025).

e-mail: marianocrosetti@frro.utn.edu.ar, asgutierrez@dc.uba.ar, micaelabassani.1@gmail.com, mariano.maluf@unsam.edu.ar

Abstract. This paper traces the development of Argentina's competitive programming scene, from high school training through the Argentine Olympiad in Informatics (OIA–IOI) to the establishment of university-level ICPC activities with the founding of the Argentine Association of Competitive Programming. The Argentine experience underscores the importance of educational continuity and community organization in creating sustainable competitive programming ecosystems.

Keywords: ICPC, IOI, OIA, AAPC, Argentina, competitive programming, educational continuity, institutional sustainability, alumni engagement.

1. Introduction: Competitive Programming as an Educational Continuum

Competitive programming offers a structured setting for students to develop algorithmic reasoning, teamwork, and persistence through problem-solving under pressure. Research on computing education increasingly recognizes it as both a cognitive and social learning experience: students strengthen analytical reasoning while acquiring collaboration and communication skills within small teams that mirror real-world software environments (Černý & Mannová, 2011). In this sense, competitive programming functions as a pedagogical bridge between academic theory and practical computational thinking (Yuen *et al.*, 2023).

In many countries, two distinct competitive programming traditions exist: Olympiad-level training aimed at the International Olympiad in Informatics (IOI), which targets secondary-school students competing individually, and university-level team contests focused on the International Collegiate Programming Contest (ICPC). These traditions generally operate as separate ecosystems with different organizations, formats, and communities. However, they share a common foundation in algorithmic problem-solving, and students who participate in one often go on to compete in the other. The extent to which a country's competitive programming ecosystem supports this transition, and the degree of interaction between the two communities, can have important implications for talent development and long-term sustainability.

Argentina offers a valuable example in this area. The country has run an active secondary-school Olympiad, the Argentine Olympiad in Informatics (OIA), since 1990, and has participated in ICPC since the early 2000s. These two communities have evolved separately: OIA is a government-managed program hosted at a national university, while the ICPC ecosystem began in 1999 and grew naturally through university workshops and volunteer efforts. This growth led to the founding of the Argentine Association of Competitive Programming (AAPC) as an independent nonprofit organization in 2023. The two operate as separate entities with different governance, funding, and activities.

However, tangible connections between them have existed for years and are becoming more apparent. Several individuals serve as coaches or organizers in both communities simultaneously. A number of Argentina's top ICPC performers, including World Finalists, began their competitive programming careers as OIA participants in secondary school. More recently, events like ICPC Training Camp Argentina indicate an emerging, albeit still early, cross-pollination between the two ecosystems involving secondary students. At the institutional level, initial discussions have begun regarding potential integration of initiatives, such as adapting ICPC-style training models for IOI preparation, although no formal coordination structure is currently in place.

This paper traces the parallel development of these two communities and the organic connections that link them. It starts by exploring the foundational role of OIA in introducing secondary school students to algorithmic thinking and international competitions. It then explains how students trained through Olympiad programs carried their skills and motivation into universities, sparking the growth of competitive programming workshops nationwide. Within this ecosystem, the formation of the Argentine Association of Competitive Programming (hereinafter, AAPC) is analyzed as a response to the organizational challenges posed by a volunteer-based model. The paper also discusses Training Camp Argentina (TCA) as a national training platform. It highlights the emerging yet still informal convergence between the OIA and ICPC communities, the tangible impacts of this ecosystem, and the sustainable practices that ensure its future. Finally, the paper offers lessons that could be useful for other national competitive programming ecosystems aiming to strengthen educational continuity across different stages.

2. Early Foundations: The Argentine Olympiad in Informatics (OIA)

The Argentine Olympiad in Informatics (OIA, from the Spanish Olimpíada Informática Argentina) has been the primary gateway to competitive programming for high school students in Argentina for nearly thirty years. OIA is a government-supported academic Olympiad; it functions as part of the National Program of Olympiads managed by Argentina's Ministry of Education, which assigns each scientific discipline's Olympiad to a designated national university. In the case of informatics, OIA has been hosted at General San Martín National University (UNSAM) since 1996, when the Olympiad was restarted after a short hiatus following Argentina's early IOI participation in 1990–1994 (Gutiérrez, 2020).

OIA's organizational structure reflects the federal nature of the Argentine educational system. The country is divided into 25 to 30 jurisdictions, covering provinces, Buenos Aires City, and regions within large provinces, each with a coordinator appointed by OIA. The selection process involves three rounds. The Jurisdictional Contest serves as an open, nationwide first round in which any high school student can participate. Since 2019, this round has been conducted as a single, unified contest across the country using the CMS contest management system (Maggiolo & Mascellani, 2012), a major improvement over the previously decentralized selection methods. The National Contest brings together the top performers from all over the country for an onsite competition, and the Selection Contest, designed to mirror the IOI format with two five-hour competition days, determines the four-member team that will represent Argentina at the International Olympiad in Informatics (Gutiérrez, 2020).

Participation data showcase OIA's reach and growth. From 2013 to 2019, the number of students submitting solutions in the Jurisdictional Contest ranged from around 200 to over 460, while the National Contest consistently attracted between 60 and 100 students each year (Gutiérrez, 2020). On the international level, Argentina has participated in over 30 IOI competitions, earning 3 Gold Medals, 9 Silver Medals, 26 Bronze Medals, and 2 Honorable Mentions, demonstrating a strong tradition of competitive excellence at the secondary-school level.

Beyond the competitions themselves, OIA built an ecosystem of educational resources that lowered the barrier to entry for students nationwide. An online judge (OIAJ), based on the social platform, hosts past competition problems through a Spanish-language interface, offering year-round practice opportunities. A curated wiki provides reference materials on algorithms and data structures tailored for secondary-school competitors. Official booklets documenting solutions to all competition problems have been published annually since 2017. Additionally, talks and lectures by former competitors during National Contest events, many of which are recorded and published online, have become an important channel for knowledge transfer between generations of participants (Gutiérrez, 2020).

The educational and cultural foundations built by OIA are important. For many Argentine students, the Olympiad is their first experience with algorithmic problem solving, formal reasoning, and competitive settings. It introduces a teaching method focused on individual effort, increasing difficulty, and repeated improvement of mind habits that can be directly

applied to university-level competitive programming. Likewise, OIA formed a national community of students, teachers, and coordinators united by a shared interest in computational thinking, creating the social infrastructure that would support future developments.

3. Transition to University-Level Competitive Programming

The first Argentine team to gain international recognition came from the University of Buenos Aires (UBA), which earned two Bronze Medals at the ICPC World Finals in Honolulu (2002) and Beverly Hills (2003). The most recent Bronze Medal was secured by the team "InChaVoLa" (UBA) at the ICPC World Finals in Egypt (2023). For more than two decades, UBA remained the only Argentine institution to consistently reach the ICPC World Finals, establishing an early tradition of excellence. However, the arrival of IOI olympiad-trained students at universities across the country gradually shifted this landscape from a single-institution phenomenon to a broader national movement.

At several universities, ICPC coaches started organizing weekly competitive programming workshops. These sessions, usually three hours long and held in university labs, are free and open to students from all STEM fields and experience levels. During these workshops, students receive curated study materials, work on original programming problems, and practice strategies for effective teamwork. Coaches guide participants in problem-solving, time management, and team coordination, combining learning with collaborative exercises that mimic the competitive environment. This hands-on approach strengthens technical skills while encouraging collaboration, creativity, and resilience—key qualities for success in ICPC and beyond.

The expansion of these workshops beyond the University of Buenos Aires was gradual but important. Universities in La Plata (National University of La Plata, UNLP), Córdoba (National University of Córdoba, UNC), Bahía Blanca (National University of the South, UNS), Rosario (National University of Rosario, UNR), and Santa Fe (National Technological University, UTN–Santa Fe), among others, developed their own competitive programming programs. Additionally, over the past few years, ICPC coaches organized online workshops for high school students. This geographic diversification, with participating institutions now spanning more than ten Argentine provinces at the national competition, turned competitive programming into a truly national effort.

A key part of this expansion was the involvement of former contestants who became coaches and organizers, many of whom also took part in IOI. This pattern of leadership continuity fosters an organic system for knowledge transfer across educational levels and institutions. The Argentine model reflects a pedagogical approach aligned with research highlighting the fusion of competition and collaboration (Černý & Mannová, 2011).

4. From Community to Institution: Creation of AAPC

As participation in ICPC-related activities expanded across Argentine universities, the limitations of a purely volunteer-based structure became increasingly evident. The growth

in the number of teams, institutions, and national-level initiatives introduced new demands for coordination, funding, and long-term planning. In this context, the ecosystem required not only committed individuals but also stable organizational mechanisms.

The Argentine Association of Competitive Programming (AAPC), formed in late 2023, is a response to these structural challenges. It was established as an independent nonprofit organization by community members, marking a shift from an informal network to a more organized and official ecosystem.

Its role can be understood through three main functions. First, AAPC provides legal and administrative capacity, enabling the ecosystem to secure funding, formalize sponsorship agreements, and manage resources transparently. This is a necessary condition for scaling activities such as training camps, national contests, and international participation. Second, it centralizes coordination and governance, allowing for the consolidation of previously dispersed initiatives. National competitions, training events, and community activities can now be organized under a shared framework, reducing fragmentation and improving efficiency. This transition from decentralized volunteer efforts to structured coordination has been identified as a critical step in the maturation of competitive programming ecosystems (Blum, 2023). Third, AAPC supports long-term sustainability by reducing dependence on individual organizers. Through a structured governance model and a growing membership base composed largely of former contestants, the association transforms individual commitment into institutional continuity.

Importantly, this process of institutionalization arose from within the community itself. Instead of replacing grassroots dynamics, AAPC formalizes and supports them. In this way, the Argentine case shows how community-driven ecosystems can develop into stable institutions without losing legitimacy or engagement.

5. Training Infrastructure: Training Camp Argentina and National Activities

The consolidation of the ecosystem is closely tied to the development of a nationwide, structured training infrastructure. This infrastructure comprises two main components: recurring local training venues and large-scale national events.

At the local level, universities regularly host workshops and training groups that offer ongoing preparation in algorithms and problem-solving, as mentioned earlier. These spaces make sure learning continues over time and that new participants can gradually join the community.

At the national level, Training Camp Argentina (TCA) and the Argentine Programming Tournament (TAP) form a coordinated annual cycle of preparation and competition. TCA, in particular, has grown into one of the largest training events in Latin America. Recent editions have hosted over 250 participants on-site, an increase from around 80 in its early years (circa 2010), bringing together students from more than 40 universities across 10 Latin American countries. Additionally, the camp's online dissemination has broadened its reach, with official content exceeding 4,000 views on its YouTube platform.

The interaction between these two levels, local continuity and national concentration, is crucial to the ecosystem's function. Local training promotes long-term growth, while national events unify practices, strengthen community bonds, and expose participants to top-level competition.

6. Articulation Between OIA and ICPC

Although OIA and ICPC operate within different institutional frameworks, their interaction is a crucial part of the Argentine ecosystem. The most direct link is the pipeline of participants. Many students who are introduced to competitive programming through OIA continue their development at the university level within ICPC training environments. This reduces the gap usually seen between secondary and higher education. Additionally, there is considerable overlap in community members. Former contestants often participate in both arenas as trainers, judges, or organizers, helping spread knowledge and practices across levels. This interaction also fosters cultural continuity. Shared norms, such as merit-based advancement, disciplined practice, and collaborative learning, persist at both stages, easing transitions and strengthening community identity. The relationship is not one-way. A strong university-level ecosystem increases the value placed on early participation, while alumni involvement boosts secondary-level training.

Taken together, these dynamics imply that OIA and ICPC should be seen not as separate systems but as interconnected parts of a larger ecosystem connected through continuity across educational stages.

7. Growth and Competitive Outcomes

The growth of the Argentine ecosystem can be evaluated through both organizational expansion and competitive achievements.

At the organizational level, competitive programming has shifted from being a highly concentrated activity to a geographically dispersed network. While in the early 2000s, sustained international participation was mainly linked to a single institution (notably UBA), today ICPC teams and training groups are active across universities in more than ten Argentine provinces. Institutions such as UBA, UNLP, UNC, UNR, and UNS, among others, regularly compete in regional contests, indicating a broader, more decentralized foundation of activity.

This expansion is also evident in national-level participation. In 2024, ICPC-qualifying competitions in Argentina, including the Argentine Programming Tournament (TAP), attracted more than 1,200 contestants. Meanwhile, key national programs have shown strong consistency: Training Camp Argentina has been held annually since 2010, and TAP since 2011, maintaining over a decade of continuous activity with increasing participation levels.

At the competitive level, Argentina has consistently dominated the region. From 1999 to 2025, Argentine teams secured the Latin American Championship 15 times (2000, 2002,

2003, 2004, 2007, 2008, 2009, 2011, 2015, 2016, 2019, 2020, 2021, 2023, 2024), accounting for 55.6% of all editions during that period. In other words, Argentina won the majority of Latin American championships in this timeframe.

Argentine universities have also consistently represented at the ICPC World Finals, demonstrating the system's ability to remain competitive internationally. Within this broader ecosystem, the Argentine Olympiad in Informatics (OIA) serves as a key platform for identifying and developing early talent. Operating under a federal structure with nationwide reach, including all 23 provinces and the City of Buenos Aires, OIA provides widespread access to competitive secondary school programming. In recent years, participation in its initial (school-level) stages has increased significantly, with about a 40% growth over the past three years. Beyond rankings or medals, OIA functions as a developmental platform that supports long-term careers in computer science. Many of its former participants continue into university-level competitive programming and related fields, with many later working for leading technology companies. In this way, OIA not only promotes early engagement but also helps sustain the talent pipeline that feeds the ICPC ecosystem.

Beyond quantitative indicators, qualitative outcomes are also important. These include strengthening mentorship networks, fostering greater collaboration between institutions, and increasing recognition of competitive programming as a valuable educational practice within universities.

Together, these elements indicate a system that has reached both scale and performance, backed by ongoing activity, territorial growth, and continuity across educational stages.

8. Conclusions

The Argentine case highlights several factors that support the development of sustainable competitive programming ecosystems. First, maintaining continuity across educational stages reduces attrition and enhances long-term participation. The connection between OIA and ICPC is crucial in this regard. Second, alumni involvement serves to transfer knowledge and sustain organizations, ensuring that experience is retained rather than lost. Third, institutionalization allows for growth and stability without necessarily harming community dynamics, especially when it originates from within the ecosystem. Fourth, the Argentine experience challenges the idea that inclusivity and excellence cannot go hand in hand. In fact, broader access seems to strengthen competitive performance by expanding the talent pool.

These elements are interconnected; their interaction creates systemic effects. The Argentine ecosystem demonstrates how educational, organizational, and community aspects can come together into a unified structure.

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Mariano Crosetti is a Research Engineer in Applied AI at Aleph (YC S21). He was a two-time ICPC World Finalist (2015, 2016), winning the Latin America Regional Championship in his last appearance. Since then, he has dedicated significant effort to promoting competitive programming in Argentina: as an ICPC coach at UNR, he has helped teams qualify for seven World Finals from 2017 to 2025; as a problem setter, he contributed problems to the 2019 ICPC Latin America Regional and the 2018–2019 Argentine National Tournament; as an instructor at national and international training camps (Argentina 2018, Colombia 2019, Argentina 2023, Peru 2024); and he led the organization of Training Camp Argentina 2024, which became the largest edition and one of the most recognized events in Latin America for its technical level.

Agustín Santiago Gutiérrez Holds an MS in Computer Science from FCEN-UBA (Buenos Aires University). He is the President of the Argentine Association of Competitive Programming. He has competed twice in the IOI, earning a Silver Medal, and has been a finalist twice at the World and Latin American levels in ICPC, with eight appearances as a world finalist coaching team. Since 2011, he has been actively involved in organizing and managing the Argentine Olympiad in Informatics (OIA) contests. Since 2015, he has served as an official National Jury member and IOI team trainer at OIA, as well as Deputy Leader of Argentina at IOI. He organized the Iberoamerican Olympiad in Informatics (CIIC) in 2019 and 2020, a regional contest covering Latin America, Spain, and Portugal. He has served as an ISC member at IOI (2022-2025). He has been an organizer and lecturer at most editions of the Argentine ICPC Training Camp and many other camps across Latin America. He was a teaching fellow at

FCEN-UBA from 2013 to 2018, teaching Algorithms and Data Structures. Since 2025, he has been an invited professor at Universidad de San Andrés, teaching Algorithm Design. Additionally, he is a private instructor in Competitive Programming.

Micaela Bassani is the Sponsorship Director at the Argentine Competitive Programming Association (AAPC). She studied Political Science at the National University of Rosario and now leads fundraising and strategic partnerships with tech companies, securing support for training programs and the international participation of Argentine teams at ICPC contests. She is involved in organizing competitions and training initiatives, including Training Camp Argentina 2024-2026 and the Argentine Programming Tournament (TAP) at UNR (2024–2025). Her work focuses on creating sustainable structures for competitive programming ecosystems.

Mariano Maluf holds a Bachelor's degree in Public Administration from UNSAM and a Degree in Systems Analysis from ORT. He is the Director of the Argentine Olympiad in Informatics (OIA) and has been collaborating with the OIA since 1996. He has been involved in organizing jurisdictional, national, and selective competitions from 2013 to the present. He served as the Argentina Team Leader at the IOI from 2013 to 2025. Currently, he works at the School of Science and Technology at the National University of San Martín.