Medical Education Original Article

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Preference signaling in orthopaedic surgery: applicant perspectives and opinions

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Abstract

Context: Orthopaedic surgery has become increasingly competitive over the years, with the COVID-19 pandemic creating additional challenges for applicants and programs. To promote an equitable match experience, the American Orthopaedic Association (AOA) introduced a formal preference signaling (PS) system into the 2022–2023 application cycle. PS allows applicants to indicate their heightened interest in specific programs, which improves the likelihood of receiving an interview and ultimately matching at their desired residency program.

Objectives: The objective of this anonymous survey is to assess applicants' opinions and perspectives toward PS in orthopaedic surgery prior to the 2022–2023 match results. Additionally, we sought to evaluate the signaling strategies being utilized by applicants.

Methods: An anonymous 22-question survey was distributed to applicants of an orthopaedic surgery residency program (34.2 % response rate). Responses were collected after the application submission deadline but before the match lists and results were available. This survey included questions germane to demographics, signal utilization, signaling reasons and strategies, and opinions toward PS. Descriptive statistics were calculated utilizing R (version 4.2.1) and RStudio.

Results: Most respondents (96.1 %) participated in PS, and 96.7 % utilized all 30 signals. Signaling encouraged 24.2 % of applicants to apply to fewer programs. In accordance with guidelines, 83.2 % of respondents signaled each away rotation program; however, only 53 % signaled their home program. Applicants commonly signaled 1–10 "reach" and "safety" programs each. *Proximity to Family* and *Perceived Operative Experience* were the most important reasons for signaling, whereas *Program Prestige* was the least. A program's social presence and virtual interview option did not influence many applicants' decisions for signaling. Most applicants believe that the COVID-19 pandemic and pass/fail licensure examinations influenced PS adoption. Sixty-seven of 149 respondents (45 %) claimed that applicants and programs benefit equally from PS, while 41 % believe programs benefit more. Nearly half (40.94 %) knew *very little* or *nothing* about PS.

Conclusions: During the inaugural introduction of PS in orthopaedic surgery, nearly every applicant utilized all 30 signals, prioritizing factors like family proximity and perceived operative experience over program prestige. This shift reflects the importance of geographic location and presumed training quality. Despite unfamiliarity toward PS, personalized signaling strategies were implemented, accompanied by a slight decrease in application volumes. The 30 allotted signals in orthopaedic surgery may serve as an informal application cap due to the necessity of signaling a program for an interview invite. However, improved educational efforts are needed to enhance the understanding and maximize the benefits of PS for both applicants and programs.

Keywords: medical education; medical students; program signal; residency application; residency interviews; the match

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Successfully matching into orthopaedic surgery is a progressively difficult task [1–3]. The match rate in orthopaedic surgery was between 75 and 79 % from 2008 to 2018, dropping to 60 % in the 2021–2022 cycle [1, 4].

Medical students have been applying to an increasing number of programs over the years to improve their chances of matching into orthopaedics [1–3]. In 2022, orthopaedic surgery applicants submitted an average of 86 applications, which is substantially higher than the mean of 46.5 applications per applicant in 2008 [1, 5]. Due to the overwhelming volume of applications, orthopaedic surgery residency programs are relying more heavily on prospectively determined metric screening techniques rather than holistic review [1, 2, 6]. The COVID-19 pandemic further complicated the application and match process as restrictions were placed on away rotations and programs conducted virtual interviews for the first time [7, 8]. As a result, expressing and identifying genuine interest has become obscured for both applicants and residency programs [8, 9].

The American Orthopaedic Association's (AOA) Council of Orthopaedic Residency Directors (CORD) introduced a formal preference signaling (PS) system into the 2022–2023 application cycle in response to the growing complexity of applying and matching into orthopaedic surgery [10]. According to the AOA CORD, this was done to enable "applicants a reliable and equitable approach to demonstrate a sincere interest in specific residency programs." [10] Applicants were allowed to send a maximum of 30 signals to programs in a voluntary, supplemental portion of the Electronic Residency Application Service (ERAS) to indicate their heightened interest [10]. In collaboration with the American Association of Medical Colleges (AAMC), Otolaryngology (Ear, Nose, and Throat [ENT]) was the first specialty to implement PS, allotting five signals per applicant in 2020–2021 [11, 12]. Subsequent evidence demonstrated that most ENT program directors (PDs) and applicants strongly favored the ongoing use of PS [13, 14]. Additionally, ENT applicants received interview offers at a significantly higher rate from signaled programs compared to nonsignaled programs, regardless of applicant strength [15, 16].

Prior to the use of PS in the orthopaedic surgery residency application process, Mun et al. [9] collected insight from orthopaedic PDs to assist applicants' signaling strategies. According to their findings, 87.5 % of PDs stated that PS will be beneficial and 65 % claimed that receiving a signal will improve an applicant's interview chance [9]. Subsequent studies have supported these claims, showing that applicants are significantly more likely to receive interview invites from signaled programs [17, 18]. Surveyed applicants recently reported a mean of nine invitations from signaled programs, compared to a mean of two from nonsignaled programs [17]. Furthermore, 90 % of responding programs indicated that their interviewee pool consisted of at least 75 % signaling applicants [18]. As evidence on PS in orthopaedic surgery continues to emerge, there remains an apparent lack of data from applicants' perspectives. Additionally, the signaling strategies in orthopedic surgery are largely unknown, and they likely differ from other specialties due to the relatively large number of allotted signals. Therefore, the primary goal of this study is to assess applicants' perspectives and opinions on PS at a time in which match results were unknown. Additionally, we sought to evaluate the signaling strategies utilized by applicants during the inaugural use of PS in orthopaedic surgery.

Methods

We adapted our methods from previous investigations related to applicants' opinions on social media presence and residency applications [19]. A list of candidates applying to the corresponding author's orthopaedic surgery residency program for the 2022–2023 application cycle was gathered after obtaining Institutional Review Board (IRB) approval (OSU-CHS IRB #2022071). All participants submitted applications through the ERAS. Each student that provided an email address to ERAS received an email message containing a 22-question survey (Appendix A) along with study and consent details. As clearly stated in the recruitment email, this survey was completely anonymous, voluntary, and did not in any way influence their standing within our institution or their chances to match. Each question included a "Prefer not to answer" option per the IRB requirements. The survey was distributed on November 7th, 2022, and remained open until December 25th, 2022. We sent the survey to orthopaedic applicants intentionally at this time to collect sincere and unvarnished opinions regarding the PS process. There were no incentives, awards, or honorariums offered for participation in this study.

Our survey was created in a systematic manner by first reviewing the literature for trending thoughts regarding PS. Then, orthopaedic faculty, residents, and research methodologists were consulted to ensure proper survey relevance and structure. This survey included questions germane to demographics, signal usage (i.e., reasons, strategies), and opinions related to PS. All but one of the survey questions were single-answer multiple-choice formats. Demographic data included age range, home region, institutional region, gender identity, and race/ethnicity. Inquiries about gender identity and race/ethnicity were conducted in adherence to the Federal Committee on

Statistical Methodology, Office of Management and Budget (OMB) Standards, and Institute of Medicine (IOM) recommendations/guidelines [20–24]. A regional map created by the US Government National Parks Service was utilized to standardize region-specific data for home and institutional location [25]. First, participation status and signal quantities were assessed. In separate questions, we asked the most, second most, and least important factors for signaling programs. We also asked about program social presence, remote interviews, and application quantity in relation to PS. Applicants were then inquired about signal distribution strategies to programs considered as "reach" and "safety" programs, home program, and audition/subinternship programs. Applicant opinions were collected regarding beneficiary status (applicants vs. programs), the COVID-19 pandemic, transition to pass/fail licensure examinations, and knowledge status related to PS. Survey questions and answer choices can be found in Appendix A, along with condensed questions and responses included in the results tables.

Descriptive statistics (i.e., frequencies, percentages) were utilized to describe the survey responses. Statistical analysis was performed utilizing R (version 4.2.1) and RStudio. Respondents were included in the final data analysis if they indicated participation in signaling during the 2022–2023 application cycle and completed the survey.

Table 1: Demographic data (n=149), n (%).

Age groups, years	
25–30	139 (93.3)
31–35	8 (5.37)
36–40	2 (1.34)
40+	0
Gender identity[a]	
Male	129 (83.2)
Female	25 (16.8)
Self-identified race/ethnicity	
White	105 (70.5)
Black or African American	5 (3.36)
Hispanic or Latino	9 (6.04)
Asian	8 (5.37)
Native Hawaiian or other Pacific Islander	0
American Indian or Alaska Native	5 (3.36)
Two or more	2 (1.34)
Other	2 (1.34)
Prefer not to answer	13 (8.73)

[a]The following answer choices for gender identity were not selected by any respondents: non-binary, transgender, gender-fluid, none of the above, prefer not to answer.

Results

Among the 453 applicants contacted, 155 (34.2 %) responded. Six of the 155 initial respondents did not utilize PS and thus were excluded from the data analysis. The remaining 149 (of 155; 96.1 %) applicants that participated in PS and completed the survey were included in the final analysis.

Demographic information

Most respondents (139 of 149; 93.3 %) were 25–30 years of age when they completed the survey (Table 1). For gender identity, 129 (83.2 %) identified as male, 26 (16.8 %) identified as female, and zero respondents selected nonbinary, transgender, or gender-fluid. Among the 149 applicants, 105 (70.5 %) identified as *White*, 9 (6.04 %) identified as *Hispanic or Latino*, 8 (5.37 %) identified as *Asian*, 5 (3.36 %) identified as *Black or African American*, and 5 (3.36 %) identified as *American Indian or Alaska Native*. Germane to home geographic region (Figure 1), 35 (23.5 %) respondents were from the Intermountain region, 35 (23.5 %) from the Southeast, 32 (21.5 %) from the Midwest, 28 (18.8 %) from the Northeast, and 15 (10.1 %) from the Pacific. Regarding medical school region (Figure 1), the most common responses were Southeast (51; 34.2 %), Midwest (37; 24.8 %), and Intermountain region (26; 17.5 %).

Use of signals and applicant strategies

A total of 144 (96.7 %) participants sent all 30 signals (Table 2). The most important reasons for signaling were *Proximity to Family* (44; 29.5 %), *Perceived Operative Experience* (40; 26.9 %), *Other Geographical Reason* (32; 21.5 %), and *Mentor Recommendations* (27; 18.1 %). In a separate question, *Perceived Operative Experience* (33; 22.2 %) and *Other Geographical Reason* (32; 21.5 %) were most frequently selected as the second most important reasons for signaling a program. The least important reason for signaling was *Prestige of the Program* (61; 40.9 %). Most respondents (124 of 149; 83.22 %) signaled a program they considered a "reach," with 115 (77.2 %) signaling 1–10 "reach" programs. Respondents most commonly signaled 1–10 "safety" programs (61; 40.9 %), whereas 40 (26.2 %) applicants did not signal any "safety" programs. A total of 124 (83.22 %) applicants signaled all audition/subinternship programs. Fifty (33.6 %)

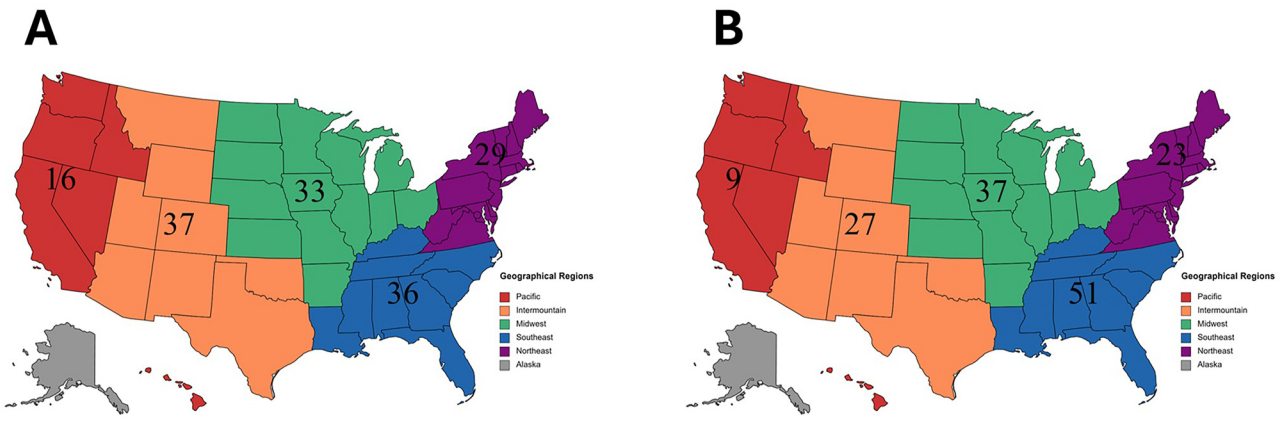

Figure 1: Frequency of home (A) and medical school (B) geographic region by applicant.

applicants signaled their home program because of heightened interest, and 28 (18.8 %) felt obligated. Twenty-two (14.8 %) did not signal their home program because they considered their audition/subinternship rotation as a signal. When asked about the number of applications in relation to PS, 36 (24.2 %) respondents submitted fewer applications, but 101 (67.8 %) claimed that PS did not impact their application quantity. A total of 130 (87.3 %) applicants indicated that remote interview options did not affect their signaling decisions. In addition, 105 (70.5 %) applicants stated that a program's social presence (i.e., social media, open houses, etc.) did not influence their decision to signal.

Table 2: Applicant signaling strategies (n=149).

Survey question	Responses	n (%)
How many programs did you signal?	30	144 (96.6)
	21–29	3 (2.01)
	11–20	0
	1–10	0
	Prefer not to answer	2 (1.34)
What was the most important factor when signaling programs?	Proximity to family	42 (28.2)
	Perceived operative experience	40 (26.2)
	Other geographical reason	32 (21.5)
	Mentor recommendations	27 (18.1)
	Prestige of the program	4 (2.69)
	Proximity to attended medical school	3 (2.01)
	Prefer not to answer	1 (0.67)
What was the second most important factor when signaling programs?	Perceived operative experience	33 (22.2)
	Other geographical reason	32 (21.5)
	Mentor recommendations	29 (19.5)
	Proximity to family	25 (16.8)
	Prestige of the program	20 (13.4)
	Proximity to attended medical school	8 (5.37)
	Prefer not to answer	2 (1.34)
What was the least important factor when signaling programs?	Prestige of the program	61 (40.9)
	Proximity to attended medical school	45 (30.2)
	Perceived operative experience	12 (8.05)
	Other geographical reason	12 (8.05)
	Mentor recommendations	8 (5.37)
	Proximity to family	7 (4.70)
	Prefer not to answer	4 (2.69)
Did you signal programs that you considered a "reach"? If yes, how many?	No	17 (11.4)
	1–10	115 (77.2)
	11–20	10 (6.7)
	>20	5 (3.36)
	Prefer not to answer	2 (1.34)

Table 2: (continued)

Did you send any signals to programs that you considered a "safety"? If yes, how many?	No	40 (26.2)
	1–10	61 (40.9)
	11–20	24 (16.1)
	>20	19 (12.8)
	Prefer not to answer	5 (3.36)
Did you send signals to programs where you had an "audition" or "subinternship"?	Yes, all	124 (83.2)
	Yes, but not all	18 (12.1)
	No, saved signals for other programs	3 (2.01)
	No, uninterested	1 (0.67)
	Prefer not to answer	3 (2.01)
Did you send a signal to your home program (if applicable)?	Yes, due to genuine interest	50 (33.6)
	Yes, obligated	28 (18.8)
	No, saved signals for other programs	22 (14.8)
	No, uninterested	4 (2.69)
	Prefer not to answer	45 (30.2)
How did the signaling process impact the number of applications you submitted?	No effect	101 (67.8)
	Applied to less programs	36 (24.2)
	Applied to more programs	10 (6.71)
	Only applied to signaled programs	2 (1.34)
Did remote interviews influence your signaling decisions?	No	130 (87.3)
	Yes	18 (12.1)
	Prefer not to answer	1 (0.67)
Did a program's social presence increase your likelihood to signal them?	No	105 (70.5)
	Yes	44 (29.5)

This table includes condensed questions and responses; see Supplementary Attachment 1 for complete questions and answer choices.

Applicant opinions related to preference signaling

Sixty-seven (45.0 %) respondents think that PS is equally advantageous for applicants and programs, whereas 61 (40.9 %) think it is more advantageous for programs (Table 3). Ninety-five (63.8 %) applicants felt that the COVID-19 pandemic influenced the widespread adoption of PS, and 108 (72.5 %) agreed the transition to pass/fail licensure examinations influenced specialties to adopt PS. Eighty-five (57.1 %) respondents reported to know *some things*, *a good amount*, and *a lot* about PS. However, 61 (40.9 %) applicants claimed to know *very little* or *nothing*. *AAMC Resources* was the most frequent response (63; 42.3 %) for acquiring PS information, followed by *Mentors* (29; 19.5 %), *Fellow Applicants* (28; 18.8 %), and *Social Media* (18; 12.1 %).

Discussion

Orthopaedic surgery introduced PS into the 2022–2023 residency application cycle for applicants to express heightened interest in programs of their choosing [10]. Due to the novelty of PS and its measurable influence on residency selection [9, 14, 16], we distributed a 22-question anonymous survey to assess applicant opinions and perspectives. Nearly all respondents (96.1 %) participated in PS, with 96.7 % utilizing all 30 signals. Proximity to family and perceived operative experience were considered the most important reasons for signal allocation among the responding applicants. Previous studies have identified geographic location as a major influential factor for signaling among urology applicants [26]. As the first study to include family proximity as a geographic subset, our findings provide further insight about how applicants consider it an important component for residency selection. In contrast to previous evidence [7, 8, 14, 16, 26], program prestige was of lesser importance to respondents. Although a complicated topic, the authors' hypothesis is that the competitiveness of orthopaedic surgery has encouraged applicants to find a program that is a good fit to increase their likelihood of matching, rather than seeking out prestigious programs.

Without the opportunity to indicate their heightened interest to programs, applicants have relied upon high application volumes to increase their odds for interviewing and matching. In 2021, applicants submitted an average of 67 applications, increasing to 86 during the 2022 cycle [1]. It was thought that PS would disincentivize the mass application approach, yet evidence in other specialties utilize PS saw initial increases in application volumes [16, 18, 27]. The use of signaling strategies based on individualized priorities and strengths may further combat application congestion in

Table 3: Applicant opinions related to preference signaling (n=149).

Survey question	Responses	n (%)
Is signaling more advantageous to residency programs or applicants?	Equal	67 (45.0)
	Programs	61 (40.9)
	Not valuable	11 (7.38)
	Applicants	10 (6.71)
Did the COVID-19 pandemic influence more specialties to adopt preference signaling?	Yes	95 (63.8)
	No	51 (34.2)
	Prefer not to answer	3 (2.01)
Did the transition to pass/fail licensure examinations influence more specialties to adopt preference signaling?	Yes	108 (72.5)
	No	39 (26.2)
	Prefer not to answer	2 (1.34)
How much did you know about preference signaling prior to completing your ERAS application?	Nothing	21 (14.1)
	Very little	40 (26.9)
	Some	42 (28.2)
	A good amount	35 (23.5)
	A lot	11 (7.38)
How did you learn about preference signaling?	AAMC resources	63 (42.3)
	Mentors	29 (19.5)
	Fellow applicants	28 (18.8)
	Social media	18 (12.1)
	Other[a]	10 (6.71)
	Prefer not to answer	1 (0.67)

[a]Other includes the following responses: medical school administration and faculty, blogs/articles, combination of the choices, all the above.

orthopaedics and increase the likelihood of receiving an interview for applicants. Specifically, Feroe et al. [27] suggests that applicants distribute signals among "reach," "possible," and "likely" programs. Our study revealed that most applicants signaled 1–10 programs they considered a "reach" and 1–10 "safety" programs, highlighting the early use of individualized strategies among orthopaedic applicants. Recent ERAS data from the 2022–2023 application cycle demonstrates slight reductions in application volumes, with results from our study indicating similar findings [5].

Nearly a quarter (24 %) of respondents submitted fewer applications due to the newly introduced PS option in the 2022–2023 cycle. According to ERAS data, orthopaedic applicants submitted an average of 86 applications before PS (2021–2022) and an average of 76.8 during the inaugural application cycle offering PS (2022–2023) [5]. Taken together, these findings are encouraging, indicating that PS could help alleviate the overapplication phenomenon in orthopaedics. However, submitting nearly 77 applications with 30 signals in orthopaedic surgery appears to be an unfruitful endeavor. The probability of matching in orthopaedics eventually plateaus, suggesting that submitting additional applications beyond a certain threshold does not increase the likelihood of matching [1]. Furthermore, a recent survey reported that 86 % of programs considered signaling an important factor when selecting their interviewee pool. This same study found that signaling applicants were 26 times more likely to receive an interview invitation than those who did not [18]. Given this information, the discrepancy between average application volume per applicant and the allotted signals in orthopaedics indicates unfamiliarity or intentional disregard toward the necessity to signal a program for an interview invite.

Approximately 41 % of respondents stated that they knew nothing to very little about PS before completing their ERAS application. The most common sources of information were AAMC resources, mentors, and fellow applicants. Surprisingly, just 12 % of applicants obtained information about PS through social media. When the AOA posted announcements about signal participation on social media in the Spring of 2022 [28, 29], they did not post their guidelines on how to utilize them on social media [10]. Nonetheless, the AOA CORD instructed applicants to signal programs based on interest regardless of rotation history or home program affiliation, whereas urology applicants were previously encouraged not to signal their home programs or away rotations, as interest was implied [10, 15]. In accordance, most applicants (83.2 %) in the current study signaled all away rotation programs. However, 22 (14.8 %) respondents indicated that they did not signal their home program to save this signal for another program. Considering the evidence, the absence of a signal is detrimental to an applicants' interview probability and likely perceived as a complete lack of interest to orthopaedic programs [9, 17, 18, 30].

While it appears that PS has been generally well received, applicants in our study seem conflicted about the beneficiary status of signaling. Consistent with the intentions of PS, 45 % of respondents believe applicants and programs benefit

equally. However, 41 % claimed that programs benefit more. For the time being, much of the dispute is likely associated with the novelty, unfamiliarity, timing, and ambiguous guidance on PS in orthopaedics. The lack of uniform instructions on PS in orthopaedics has been highlighted in the present study by the unfamiliarity and uncertainty toward PS among applicants and discussed throughout the recent literature [17, 18]. The authors hypothesize that a more consensual agreement will develop over time as the mutual benefits and effects are revealed. During this novel period, stronger educational efforts, ongoing research, and proper distribution of evidence and information related to PS in orthopaedic surgery are warranted to improve the clarity and understanding among applicants. The potential immediate benefits therein include improved signaling strategies, a better understanding of PS and its benefits, a more reliable effect measurement of signaling on applicant success, and potential reductions in application volumes.

Strengths and limitations

The current study was conducted in concordance with similar studies related to PS and other aspects of the residency application process. This was among the first assessments of applicant perspectives and opinions toward PS in orthopaedic surgery. Responses were collected after the application submission deadline but before rank list availability. This intentional timing was aimed to provide unique perspectives from applicants and to minimize potential response bias stemming from match outcomes, which are unknown during data collection. Even though the authors believe this unique feature to be a strength of this study, the findings should be interpreted within such context. The response rate demonstrated here (34.22 %) is relatively low compared to survey-based studies throughout literature. However, the response rate here is much higher than recently published similar studies (34.22 vs. 12.4 % and 7.6 %) that surveyed orthopaedic surgery applicants [17, 31]. The findings here are based on a sample of applicants that applied to our orthopaedic surgery residency program and may not be representative of all applicants. Finally, due to the cross-sectional and subjective nature of this study, further investigations are warranted to determine the longitudinal effects of PS in orthopaedic surgery.

Conclusions

Nearly every responding applicant participated and utilized all 30 signals during the first residency application cycle offering PS (2022–2023). Proximity to family and perceived operative experience were favored rather than program prestige when delegating signals, highlighting the importance of geographic location and presumed quality of training for applicants. Individualized signaling strategies were employed by respondents, accompanied by a slight reduction in application volumes. Application volumes may continue to decrease as the 30 allotted signals in orthopaedic surgery may serve as an informal application cap due to the necessity of signaling a program to receive an interview invite. However, the average number of applications submitted per applicant more than doubles the number of allotted signals, indicating unfamiliarity and/or uncertainty toward PS among orthopaedic applicants. Ultimately, the introduction of PS presents a transformative opportunity in the orthopaedic surgery residency application processes, yet it requires concerted efforts to enhance its understanding and maximize its potential benefits for both applicants and programs.

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