Olympiad Training for Individual Study: Syllabus

OTIS Year VII (2021-2022)

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OTIS Syllabus

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§1 Overview

OTIS is a guided self-study program for math olympiads. It is not primarily meant as a tutoring program due to the large number of students.

§1.1 What does OTIS consist of?

- Centrally, a sequence of units consisting of a couple worked examples, plus a problem set of approximately 10-20 olympiad problems (of which you solve some subset) focused on one particular topic. Participants are given units “buffet-style”; you get access to as many units as you can complete. See Section 4 for details.

- An OTIS Discord server for discussion with staff and peers; see Section 5.

- Regular one-on-one communication (via email, Facebook, Discord, etc.) for questions, advice, etc. See Section A.1 for a long speech on this.

- A set of ten full-length mock olympiads (4.5 hours and 3 problems, USAMO/IMO style) and eight brief short-answer quizzes (for computation practice). Half of the mock olympiads are graded with some minimal feedback. See Section 6 for details about practice exams.

- Possibly online one-on-one meetings, as described in Section 1.3 and Section 7.

§1.2 Prerequisites

- International students from anywhere are welcome. OTIS is taught in English and an Internet connection is required.

- OTIS assumes that you are able to read and write proofs.

- You should be prepared to work quite hard. OTIS is serious business™, and its rigor is comparable to that of MOP. A crude estimate for the total time commitment might be roughly 8-16 hours per week, though this varies substantially between different people and between units.

- Since OTIS is focused on olympiads, it is recommended that you are reasonably confident in qualifying for your country’s national olympiad\(^1\).

- It is a good investment\(^2\) to learn $\LaTeX$ well in the summer before OTIS begins; it will pay back in spades later.

- Admissions is done based on perceived preparedness for OTIS. This process is not a merit-based competition. In other words, the goal is to admit anyone who is ready for OTIS, rather than to select the top $N$ applicants.

- Students from minorities and underrepresented groups are especially encouraged to apply. (I promise I don’t bite.) Financial aid is possible (see Section 1.5) and admissions is need-blind.

\(^1\)This is to avoid an awkward situation in which e.g. someone fails to qualify for USA(J)MO after spending a whole year preparing for it!

\(^2\)This suggestion is actually from one of my past participants.
§1.3 Possible meeting formats for OTIS

There are three possible tracks:

Biweekly with Evan (rare)  Lectures are held every two weeks and are 0.7 hours (42 minutes) each. See Section 7 for details about what happens in a meeting.

You can do at most two full years in the Biweekly format.3

Meeting with other instructor  You can have an instructor other than me for lectures. These instructors are usually OTIS alumni who have won USAMO or attended IMO. The advantage of this is that you can have longer or more frequent meetings by agreement. Scheduling and payment for meetings would be done entirely with the instructor.

Correspondence (most common)  The Correspondence format has no lectures at all. You submit problem sets as you complete them, and communication is done asynchronously. Thus you pick your own pace, and you can move through as many or as few units as you have time for. (Obviously, requires a lot of self-motivation.)

§1.4 Payment information

- The rate is $80(H + 3) each semester in US dollars, where $H$ is the number of hours of lecture.4 By definition, $H = 0$ for Correspondence. The rate could be different for other instructors.

- Note that a year has two semesters (fall and spring). If you want, you can participate in just one of the two.

For enrolled students, the portal has a “Parent Information” handout with details on payment methods and so on (the boring stuff).

§1.5 Financial aid: OTIS is need-blind and meets full demonstrated need

If you or your family has financial circumstances which make the payment prohibitive, please describe the situation in your application, and name the amount that you would be able or willing to pay (even zero).

Requesting financial aid will not affect admissions in any way. My hope is that no students are prevented from joining OTIS purely for monetary reasons.

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3This is both for fairness, as well as limitations on my materials. Also, note that practice exams repeat every two years, so in a third year the practice exams would become redundant.

4The +3 term is for grading, answering questions, administration, preparing materials, etc.
§2 Dates

§2.1 Calendar

We follow the MIT academic calendar. Each academic year is divided into two semesters:

Orientation weeks August 15 to August 31.

Fall semester September 1 to December 14.

Winter break December 15 to January 10. No lectures are held during this time.

However, the rest of the program still runs, though I may be slower.

Spring semester January 11 to April 15.

In Biweekly, lectures last about twelve weeks per semester (barring unexpected conflicts, snow days, apocalypse, etc.). Since one can work through materials outside these dates (e.g. during the long winter break), progressing through six to eight units per semester is a good baseline.

§2.2 Application timeline

• The regular deadline is August 1. If at all possible, make this deadline.

• The late application window is August 15 to December 15. These are processed on a rolling basis. Only the Correspondence format is available for late applications.

Applications accepted during this window are billed for both semesters, so there is no incentive to apply late. Apply by the regular deadline if at all possible.

• No applications are processed during winter break (December 15 to January 10).

• The extremely late application window is January 11 to February 28. These applications are also processed on a rolling basis, and again, only the Correspondence format is available for late applications.

Applications accepted during this window are billed for only the spring semester. Despite the lower cost, I do not recommend this option at all; this should be a last resort for people who find out about OTIS extremely late. The spring semester tends to feel shorter than the fall, since orientation and winter break are absent. In any case, OTIS is meant to be a full-year program.

• No applications are accepted after February 28. By this point, there is not enough time left in the program to make much meaningful progress.

§2.3 Drop policy

Anyone can drop OTIS at any point. There is no penalty for doing so.

If you drop the program within the first three weeks of the semester, then you do not have to pay anything for that semester. After three weeks, you are billed by default for the whole semester, but if you have some special situation or it is still pretty early, you should talk to me anyways.

For Biweekly students: the value of $H$ in Section 1.4 refers only to meetings that actually take place. You may reschedule or cancel meetings at any point without penalty, though obviously I appreciate advance notice for my sanity. You can also switch to Correspondence at any time, without penalty.
§3 What to expect from OTIS units

A unit refers to a handout on a particular topic. A topic can have multiple units of varying difficulties or versions.

§3.1 Catalog of OTIS units

The page http://web.evanchen.cc/static/otis-samples/synopsis.html contains a catalog of possible units (which is always changing, so may be slightly out of date).

The choice of which units to cover each year is entirely up to you. Usually, it’s a bit of an overwhelming task to try and pick from such a long list; when you join, there will be a long guide giving you hints on what units to select, and I sometimes provide recommendations as well. You can (and should) also request changes at any time, see Section A.2. Starting with Year V the website has an automated system for submitting requests.

§3.2 Some units come with reading

Several units come with clearly marked “reading”. If so, you probably want to do the reading before starting the unit. Usually it will be some selections from some publicly available notes.

§3.3 Most units contain lecture notes formatted as walkthroughs

The lecture notes for every unit includes some “walkthroughs”: example problems together with a sequence of parts intended to take you step by step through the problems. Here is an example of what that might look like.

Problem (IMO 2003/6). Let \( p \) be a prime number. Prove that there exists a prime number \( q \) such that for every integer \( n \), the number \( n^p - p \) is not divisible by \( q \).

Walkthrough. (a) Show that if \( q \not\equiv 1 \pmod{p} \) then this fails. So we will restrict our attention to \( q = pk + 1 \).

(b) Prove that it’s sufficient to have \( p^k \not\equiv 1 \pmod{q} \), for the \( k \) in (a).

... and so on.

The philosophy of walkthroughs is to emulate a lecture in text format (indeed the walkthroughs are based teaching the problems live). Full solutions to all the walkthroughs are provided in an appendix.

During meetings, I will probably pick one or two of the walkthroughs to work through with you. You can (and should) read through remaining walkthroughs on your own time.

§3.4 Materials are hosted on OTIS-WEB

Once you are enrolled in OTIS, you will be sent a link to register on the dedicated OTIS-WEB server. The website is the central hub for all academic materials. It is mostly self-explanatory

§3.5 Materials are internal use only

All materials are internal use only.
§4 Instructions for working on and submitting problem sets

§4.1 Write-ups and submission

Each problem set has many problems, but you’re not expected to solve all of them: each problem has a weight\(^5\) (like \([5♣]\)) attached to it, and you are aiming to solve a certain target score or more.

Instructions for submitting:

- Upload a single PDF\(^6\) to OTIS-WEB. You should upload it under “file uploads” page for that unit.

- **You only need to submit outlines of solutions**, since full write-ups can be quite time-consuming. Of course, full solutions are welcome too if you have the time and patience.

- Please include the name/source of the problem when known (e.g. “IMO Shortlist 2016 G2”); this makes it much easier for me to grade. You don’t have to reproduce the entire statement (unless you want to).

- Every unit will also have a “mini-survey” at the end worth \([1♣]\). I am always looking for feedback on how long the problem sets are taking, which problems are useful or not, and if you know any problems that you think could be good additions. Completing the mini-survey is appreciated and encouraged, even if you don’t need the \([1♣]\).

To elaborate, an “outline” is just a few sentences such that someone reading the outline could basically solve the problem from there. Here is an example of what I mean:

**Problem** (HMMT 2016 Guts #17): Compute the sum of all integers \(1 \leq a \leq 10\) with the following property: there exist integers \(p\) and \(q\) such that \(p, q, p^2 + a\) and \(q^2 + a\) are all distinct prime numbers.

**Solution outline**: Odd \(a\) fail for parity reasons; \(a \equiv 2 \pmod{3}\) fail for mod 3 reasons. This leaves \(a \in \{4, 6, 10\}\), for which we can take \((p, q) = (3, 5), (5, 11), (3, 7),\) respectively. Thus \(4 + 6 + 10 = 20\).

§4.2 Problem set submissions are not graded, but checked off

Regular problem set submissions are NOT graded.\(^7\). Sorry, there are just too many. Usually, I scroll through the solutions to sanity-check them and point any obvious issues I can see (wrong final answer, common pitfalls, etc.). But I will probably not notice typos or more subtle errors.

For Biweekly and Correspondence students, I usually check off submissions and unlock the next unit within about 2-3 days.

If you have an instructor other than Evan, you should notify them (say, by email) to check your submission; they are the ones responsible.

\(^5\)The weight of the problem is actually meant to reflect how much you learn from solving the problem. This is well-correlated with difficulty just because you will take longer on harder problems, but it’s not exactly the same.

\(^6\)As I mentioned in the beginning, I suggest typesetting your problem sets in \LaTeX\. The output is pretty, you learn how to use \LaTeX\ (useful later), and you now have digital copies of all your work. After all, given how much time you’re spending, don’t you want to have something to keep?

\(^7\)This is part of why I only ask for outlines of solutions.
§4.3 Getting un-stuck on problems (I promise you will get stuck sometimes)

You will probably not be able to solve all the problems, and will need some help on the toughest ones. Being able to ask for this help is an important part of the program.

There are a few ways to ask for help:

- Contacting Evan directly (see Section A.1)
- Using the Discord server (see Section 5)
- Checking the ARCH system (see Section 8.2).

When asking humans for hints, you should describe the progress you’ve made so far, or approaches that you’ve tried and didn’t work, and so on.

§4.4 The lack of due dates, and the unlock system

- Since OTIS is self-paced, there are no submission-deadlines. The program is run buffet-style where completing existing units unlocks new ones.
- Therefore, at any time you will have a choice of a few units to work on, and you can complete as much or as little as you have time for.
- You may work on units in any order. The order given on the website is just a recommendation, but you do not have to follow it.
- When you finish a unit, if you don’t specify what unit you want, Evan will probably just unlock the next one on the list. This is an arbitrary decision, so if you want a specific unit, say so!
- You can also submit requests to unlock units as you wish (see Appendix A.2).

§5 The OTIS Discord server

OTIS has a permanent Discord server containing current OTIS participants as well as alumni, staff, instructors, etc.

Registering on the OTIS Discord is strongly encouraged. You’re free to check it as frequently or infrequently as you choose, but the social space is an important part of the program.

On the OTIS Discord, you should feel welcome to, e.g.

- ask for hints on OTIS problems (many alumni worked through the same problems, so you often get a quick response),
- ask math questions,
- discuss problems that you find interesting,
- find friends to play games,
- listen to music,
- search past messages for hints on a problem you worked on (surprisingly effective! e.g., if you want help on 2013 A4, just search “2013 A4”),
- ... and so on.
§5.1 Open office hours on Discord every so often (free)

About once every couple weeks or so, I will hold open office hours on Discord, in which any participants (even those in Correspondence) are welcome to drop by and ask questions, chat, etc.

These are completely optional, but free — there is no change for attending.

The office hours are held at irregular (but pre-announced) times to accommodate differing schedules and time zones.

§6 Mock olympiads and quizzes

§6.1 Downloading the exams

- The exams themselves will be shared on OTIS-WEB.
- The solutions are actually available immediately, so you can read them right after taking the test, without waiting for grading.
- The mock olympiads and the short quizzes will be submitted via GradeScope. (You’ll be set up for the GradeScope website after acceptance.)

§6.2 Table of exam dates for OTIS

There will be 10 tests (mock olympiads) in the school year, which come in pairs. The short quizzes are short-answer practice, each with 5 much quicker short-answer problems. The dates for the practice exams are specified in Table 1.

(There is no test due November 15 because of USEMO, see Appendix D.)

<table>
<thead>
<tr>
<th>Test Name</th>
<th>Released</th>
<th>Due</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tests 1 and 2</td>
<td>Sep 1</td>
<td>Oct 15</td>
</tr>
<tr>
<td>Quiz A</td>
<td>Oct 1</td>
<td>Nov 15</td>
</tr>
<tr>
<td>Tests 3 and 4</td>
<td>Nov 1</td>
<td>Dec 15</td>
</tr>
<tr>
<td>Quizzes B and C</td>
<td>Nov 1</td>
<td>Dec 15</td>
</tr>
<tr>
<td>Tests 5 and 6</td>
<td>Dec 1</td>
<td>Jan 15</td>
</tr>
<tr>
<td>Quizzes D, E, F</td>
<td>Dec 1</td>
<td>Jan 15</td>
</tr>
<tr>
<td>Tests 7 and 8</td>
<td>Jan 1</td>
<td>Feb 15</td>
</tr>
<tr>
<td>Quizzes G and H</td>
<td>Jan 1</td>
<td>Feb 15</td>
</tr>
<tr>
<td>Tests 9 and 10</td>
<td>Feb 1</td>
<td>Mar 15</td>
</tr>
</tbody>
</table>

Table 1: Schedule for OTIS practice exams

§6.3 Handout on test-taking strategy, to be read before Test 1

Once you are registered for OTIS, you will find on the portal a handout about meta-strategies for test taking on olympiads (with respect to write-ups, problem ordering, etc). I strongly recommend reading through this before taking your first mock olympiads, since this will give you a chance to practice these strategies on many practice tests.
§6.4 Instructions for tests (mock olympiads)

- Only the odd-numbered tests (i.e. tests 1, 3, 5, 7, 9) are graded, starting from Year VII and onwards. The even-numbered tests (i.e. tests 2, 4, 6, 8, 10) can be taken for practice but should not be submitted for grading.

- Each test is three problems, 7 points per problem.

- There are three levels: JMO, USAMO, and TST. You should pick one of them to take.

- The time limit is 4.5 hours.

- Like a real olympiad, submit complete solutions on the given answer sheets. You can download the answer sheets from OTIS-WEB.

- You are encouraged to do the problems on the olympiad that you didn’t take, but please do not submit those solutions on GradeScope; leave them blank.\(^8\)

- When submitting mock olympiads, be careful to submit the right papers to the right problems. There are five distinct questions among the tests, of which you will only submit three.

- Even if you do not think you solved any problems, submit whatever progress you made. This helps me with record-keeping so I can adjust tests in the future. In any case, if you are following my advice you should have tried every problem for some time, so it is better to avoid leaving anything blank.

§6.5 Instructions for quizzes (short answer)

These are intended to give you bit of short-answer practice during the school year, to help prepare you for AIME, HMMT, PUMaC, MP4G, et cetera. (Indeed, you can expect most of the problems to come from there.)

- Each quiz is 45 minutes long, and features 5 short answer problems. Think of it like \(\frac{1}{3}\) of an AIME, except probably harder and faster.

- Use the answer sheet provided on OTIS-WEB. You will only submit short answers for grading. (Thus your score will be one of \(\{0, 1, \ldots, 5\}\).)

§6.6 Additional places to look for practice exams

If 10 practice tests isn’t enough for you, a couple more options:

- On the OTIS-WEB portal, there will be a link to a set of 30 or so mock IMO days, using problems from old IMO shortlists that you can practice on.

- If you want other countries with good national olympiads and TST’s that don’t use IMO shortlist, I recommend (not exauhstively):
  - national olympiads from Brazil, Canada, Korea, Romania, Russia;
  - team selection tests from China and Iran.

- Appendix D has a ton more “real” tests to offer.

\(^8\)It seems that the GradeScope now lets you omit submissions for problems; this was not true before.
§7 Meetings

This section describes meetings for those in the Biweekly formats with Evan. If you have a different instructor, you can expect something similar to what’s below, but the exact details might be slightly different.

Correspondence students may skip this section altogether; it doesn’t apply.

§7.1 Logistics and scheduling

- We use Zoom\textsuperscript{9} for meetings. The course webpage will contain a link that opens the Zoom classroom. You will need to install the Zoom client beforehand.

- Meetings with Evan are always 0.7 hours and one-on-one, every two weeks. The exact time of day is usually coordinated close to the start of each semester.\textsuperscript{10}

- Meetings with other instructors should be coordinated by agreement.

§7.2 What happens in a meeting?

Examples of things we can do in a meeting on the $n$th unit (all flexible):

- Present solutions to problems from the previous $(n - 1)$st unit.

- Work together through the examples/walkthroughs for the $n$th unit.

- Work together through any practice problems from the $n$th unit (for example, things you’ve tried and are stuck on).

- Questions about reading or lecture notes (or anything else).

§7.3 Transcripts of meetings

Typically, I will have a LATEX document (in real time\textsuperscript{11}) which serves as a sort of “black board” for the class. So problem statements, partial progress, etc. will all appear there, live, during the meeting.

To the right is an example of part of a transcript from last year (which is also posted in full on my website for download).\textsuperscript{12}

The advantage of this setup is that we get a full transcript of the class that you can review on your own time; not too much of a need to try and take your own notes, or deal with video transcripts and the like. I usually upload these immediately after your class (if not, I probably made a mistake, so please send me a reminder).

You can review the transcripts at any time later; the transcripts will be under the link “File Uploads” for each unit.

\textsuperscript{9}I used Zoom before it was cool ha ha.

\textsuperscript{10}Fair warning: There are a lot of you, so I re-schedule classes often. I apologize in advance.

\textsuperscript{11}This means a lot of me typing furiously and getting angry at LATEX compilation errors. I always forget the fragile option when using Asymptote in Beamer.

\textsuperscript{12}Yes, I really type LATEX that fast.
§ 8 Miscellaneous

§ 8.1 Major surveys

Throughout the year, I send three large OTIS surveys by email.

- The first (longest) survey is sent around the third unit or so.
- The second survey will be sent around the end of the fall semester.
- The third (shortest) survey will be sent at the end of the year.

You need not worry about these until you see them, but when you do, I really appreciate your feedback. Of course if you have comments at other times of the year, I am more than happy to take those as well.

§ 8.2 Automated Repository of Canned Hints (ARCH)

- The OTIS-WEB also contains a repository of hints for practice problems, known as the ARCH system. This is a recent addition and a work-in-progress, but I am slowly adding hints to it to problems that are frequently asked about.
- You may find it useful to check ARCH to see if problems you are stuck on might already be in the database.
- In addition, if you wish to contribute hints to the ARCH system (any OTIS student can add in hints), your help would be much appreciated.

§ 8.3 Problem suggestions can be submitted through OTIS-WEB

- If you have suggestions for problems from past contests to add to OTIS units, you can submit them through OTIS-WEB.
- Approved suggestions get added to the unit immediately, with credit to you (unless you choose to submit anonymously).
- You will need to write up a solution to the suggested problem.
- By proposing a problem and solution, you agree to let Evan use, edit, or adapt it for OTIS or other math-olympiad-related purposes. On the other hand, you retain copyright/ownership of your writing, so you can also use it for whatever you want elsewhere.
- For problems from famous contests, you may want to double check whether I already have the problem in my database and am using it in a different unit before taking the time to write it up.

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13 The nice thing about having a start-of-year survey (rather than an end-of-year survey like the rest of the world) is that your feedback will actually be used right away this year, rather than just helping future instances of OTIS.

14 In particular, if you run into a problem you think would fit well on one of my units, please send it to me! (Or if you run into a nice problem in general.) Many of the problems you see in OTIS were forwarded to me by participants and friends.

15 I used to try to solve them all myself, but haven’t been able to keep up with the number of suggestions anymore.
§8.4 T-shirt ordering around March each year

- Assuming sufficient demand, participants can order OTIS T-shirts around March of each year.
- Typically, there is a small nominal cost to the T-shirt to cover shipping, but I pay for most of the actual cost for production.

§8.5 Twitch stream

- I run a public Twitch stream on twitch.tv/vEnhance.
- The stream is generally Fridays at 8pm ET.
- During this time I will solve math problems I haven’t seen before, together with discussion and suggestions from my viewers. So, if you want to see what the process of solving a math olympiad problem looks like for me, tune in!
- You can find more details about the stream at: https://web.evanchen.cc/videos.html.
§9 Your to-do checklist

Here is a checklist of what’s expected of you, to help keep track of the many parts.

• After acceptance:
  □ Register for an account on OTIS-WEB and GradeScope
  □ Agree on a schedule for the school year
  □ Read the handout on test-taking strategy (before first practice olympiad)

• Before each unit:
  □ Do any reading specified in the notes for that unit

• During each unit:
  □ Meet with me/instructor at scheduled times
  □ Work through the walkthroughs
  □ Solve the problem set for that unit
  □ Keep me updated on your progress on the problems (see Section A.1)
  □ Submit outlines of solutions to OTIS-WEB (under “file uploads”)
  □ Optionally, drop by office hours

• Before the deadlines in Table 1, submit:
  □ Practice olympiads (usually two per month)
  □ Quizzes (in selected months)

• Throughout the year:
  □ Respond to surveys
  □ Send me good problems
§A Some advice and words of encouragement

§A.1 Talk to me, I don’t bite

I want to really stress the importance of keeping in contact with me, and in particular the importance of asking for pointers when stuck. The problem sets are meant to help you learn through practice, rather than for me to measure anything (skill, time spent, or whatever). A problem will usually teach you a lot more in the first one or two hours than in the six hours after that. So it’s much better to ask for feedback on your approaches once you’ve hit a barrier, rather than being stuck for hours on problem 5 and then not reading problems 6-10.

On any unit, a rough estimate is that you will need help on at least 1/3 of the problems, in the sense that you’re unlikely to solve the problem no matter how much time you spend. (The actual constant varies a lot by person and unit.) That means that in expectation you should be writing to me 3+ times per unit. This is a lot! Put more concisely, the problem sets should feel interactive. This only works if you reach out to me.

Some pointers on asking questions:

- **Do it.** Really. I want to hear from you.
- You can contact me through Facebook messenger, email or Discord, whichever one is easier for you. One advantage of asking on the OTIS Discord is that other students (who often have done the same problem) may be able to help you before I can.
- **Timing:** I try to respond to OTIS messages as soon as I see them, since I consider this to be one of the most important parts of my job. However I tend to sleep early (sometimes as early as 10PM ET), so if you message me late at night I will probably not get it until next morning. In general, response times of 1-2 days are normal. If I don’t respond to something within 2 days, please remind me.
- It’s more convenient for me if you refer to problems by source e.g. “USAMO 2010/6” (instead of “problem 10”, say). I have a lot of the contest years memorized by now.
- Describing what you’ve tried so far (even things that didn’t work) is helpful, so I can give more refined suggestions.
- Don’t be afraid to ask for further directions if the first answer I give isn’t sufficient! That +3 term in the semester payment is there for a reason. Make use of it!

§A.2 Flexibility of units

I want to stress that the curriculum is malleable. You can and should request changes or additions to your chosen units, at any time, for any reason. Starting with Year V the website has an automated system for submitting requests.

There are many, many, valid reasons to do so. If I really think that something is a bad idea, then I will warn you in advance, but in general this is supposed to be a one-on-one learning experience and so I want to really give you a lot of ownership.

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16Here’s another long digression: people often call this “asking for hints”, but I don’t like this phrasing and try to avoid it when possible. The reason is that hints are seen as things that you only take if you can’t do something yourself. This is only true during the “big game” when you’re being scored. Training is not like that: long delays in feedback actually make learning slower.

17If you find you’re consistently able to solve nearly all the problems, consider asking me to make your curriculum more difficult.
Here is a list of examples of good reasons (not exhaustive) that you should request changes to curriculum:

(a) I made a mistake and accidentally gave you a unit that you’ve already done, or didn’t give you a unit that you specifically requested.

(b) Your preferences have changed since last June, and now you want to work on less geometry and more combinatorics.

(c) A little bird told you that the Anti-Problems unit is hilarious.

(d) You cleared that Euclidean Algorithm unit in three days, and want another unit to work on for the other eleven days. This applies even if you are weekly or biweekly.

(e) More generally, if you work through units faster than one every two weeks, you should add some more. As an extreme example, Grant Yu holds the program record with 51 units completed in one year.

(f) That Z-level Analysis or Extreme Graph unit just isn’t clicking. You want to downgrade the difficulty, or skip it altogether.

(g) You find a D-level of a unit too easy and want to do the Z-level one instead.

(h) You saw Evan nuke a problem with homography, and are now curious.

(i) You’ve realize you’ve seen most of the problems on the Linear Algebra unit already so you’d rather work on something else.

In short: this is an all-you-can-eat buffet with 100% satisfaction guarantee™. The “one unit per two weeks” is meant as a baseline and shouldn’t be taken too seriously.

§A.3 Hints on scanning files

If you have a iPhone/Android/whatever, there are quite a few apps that will let you take pictures with your phone, and then automatically apply the correct linear transformation to get a scan of the page. For many of you this will be more convenient.

The one I use is called “Tiny Scanner” on iPhone (free if you put up with a few annoyances). Others have used “Cam Scanner” as well.

§A.4 OTIS documents are on Dropbox

Almost all OTIS content (e.g. handouts) is actually hosted on Dropbox, so whenever I make changes to documents on my computer, they are updated online in real-time. Thus problems and documents change (or disappear) frequently for this reason. If you don’t like this behavior, save local copies of the documents as you get them, and check for updates time to time.

Also plan accordingly if you plan on being in China, since without a VPN you cannot access Dropbox content.

18Seriously, happens all the time.
19There are some units that have multiple versions so that you can do them more than once, though.
20I’ll probably notice this, too, so you may not even have to say anything.
21If you do this, I might have a hard time finding units for you the next year.
§B Mission statement (not meant to be read)

I want to have an official mission statement here, but it’s more for completeness and my own reference. You do not need to read it unless you really really want to.

OTIS is built with four goals. These are the metrics which I use to measure my “success” each year, and guide all my design decisions. For each goal, I give a brief description and my plans to achieve it.

- **Systematic hard work.** Most importantly, I want students to learn work ethic. The focus is squarely placed on problem sets, with lectures minimal or nonexistent. You will do a large number of problems: there is no way around this. The program’s structure is set in a fairly explicit way, with individual units and concrete deliverables. Thus students work in a systematic and organized fashion. I like to think that the careful planning and design of OTIS (and even the sheer amount of material) helps set a good example as well.

- **Learning how to learn.** OTIS is my attempted answer to “how should people learn?”, in the context of math olympiads. Yes, you have to spend a lot of time, but there’s more to it than that. How do you know you really understand something? What should you be thinking about after you’ve done each problem? How do you prioritize approaches? Why are philosophy and intuition so important? And so on. During OTIS, these ideas are addressed indirectly through examples and explicitly through discussion. I don’t claim my answers are the best or only ones. But I hope it’s one helpful viewpoint. My intention is that seeing olympiad math from the OTIS perspective gives insight into these nuances.

- **Enjoyable and worthwhile experience.** In the short-term, I want OTIS to be fun. In the long-term, I want students to be able say, “hey, I really enjoyed OTIS and learned a lot from it, and I’m glad that I joined”, even if they didn’t do as well on USAMO as they hoped. I think this kind of maturity and appreciation is important later on in life (for example in trying new things without excessive fear of failure). This is where the human face of OTIS comes in. Part of it is in design: point-based problem sets, picking fun problems, keeping a human voice in writing. The other part is just being available. During the school year, I see a lot of students who are left to float around and fend for themselves. My hope is that I can be a good mentor for students: being there to answer questions, giving guidance and encouragement, just being enthusiastic, etc. It’s hard to learn math in a vacuum; I hope to fix that.

- **Olympiad math itself:** after completing OTIS, students should have learned a lot of olympiad math. The mechanism for this should be self-explanatory!

Optimizing all four metrics simultaneously is hard enough. And so, to take a page from Ravi Vakil: **there are no other goals.**

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22To quote Palmer Mebane: “It’s always discouraging to see people say that they’re planning to do every problem in PSS or every IMO SL, because it sounds like they’re more intent on being able to say they’ve done that than actually doing the problems as thoroughly as they should.”

23I follow Unix philosophy: “write programs that do one thing and do it well”.

18
§C Math conventions

Here are some conventions and notation that OTIS will use. (For example, they may appear on OTIS practice exams with no further clarification.)

- We let $\mathbb{N} = \mathbb{Z}_{>0} = \{1, 2, \ldots\}$ denotes the set of positive integers (i.e. 0 is not a natural number). We use $\mathbb{Z}_{\geq 0}$ for nonnegative integers.

- The functions $\lfloor \cdot \rfloor$ and $\lceil \cdot \rceil$ are the floor and ceiling functions.

- The graph-theory terms “graph”, “vertex”, “edge”, “degree”, “directed graph”, “tournament” will be used freely. Graphs are simple graphs unless otherwise specified.

- The function $\log$ actually denotes the natural logarithm (not the base-10 logarithm).

- We say 0 divides itself, but not any other integer.

- Some problems may refer to chess pieces (e.g. bishops on a chessboard), and a few problems may refer to entire chess games (really!). We take https://en.wikipedia.org/wiki/Rules_of_chess as the agreed-upon rules for the games of chess for such problems.

- Empty sums are equal to 0 and empty products are equal to 1.

§D Recommended additional contests

The following contests, free and open to everyone, are recommended if you want to get some further experience and feedback on your proofs. I believe all these contests are free and open to all USA students.

- **USA Math Talent Search**, https://usamts.org
  Free competition with some feedback on proofs for USA students.

- **KoMaL points contest**, https://komal.hu/verseny/feladatok.e.shtml
  A Hungarian journal which gives you a few weeks to solve some problems, but there is some span of difficulty. The problems with sign “A” are often genuinely difficult.

  This is my contest! It’s as close to a mock USAMO as you can get, but it aims to be a lot friendlier and more transparent, by providing individual feedback on student solutions and posting full rubrics to all the problems.

- **Christmas Math Competition**, http://cmc.ericshen.net/
  This is an annual mock competition series which emulates an entire year of AMC, AIME, and USA(J)MO, and is open to everyone (and doesn’t have qualification bars).

- **Sharygin Geometry Olympiad**, http://geometry.ru/olimp.php
  Take-home contest with some usually quite nice geometry problems. (There is actually a finals round in Moscow if you do well on the correspondence round, and are willing to buy a plane ticket to Russia.)

There are actually a surprisingly large supply of mock JMO/USAMO style contests on Art of Problem Solving as well, https://aops.com/community/c594864. The quality of these contests varies, but the well-organized ones are actually on par with the real USAMO.