Errata for E.G.M.O.

https://web.evanchen.cc/geombook.html

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This document contains an exhaustive list of all mistakes that I am aware of in my textbook *Euclidean Geometry in Mathematical Olympiads*. Most are annoying but benign, but a few are substantial — these are **emphasized in bold sans serif red, in a slightly larger font**. You can send any more mistakes you find to the author at the email on `evanchen.cc`.

I currently do not have any plans to create a second edition.

p. xi append a comma after "lectures at MOP".

p. xiii change "explain how it comes from" to "explain where it comes from".

p. xiv second bullet, the phrase "intersection the medians" is missing "of".

p. 3 in example 1.1, assume $WXYZ$ is convex as in the figure.

p. 4 **the proof of Theorem 1.3 assumes O is inside $\triangle ABC$.** One should do (annoyingly) the other cases by a similar argument as well.

p. 7 beneath Figure 1.3A, change "orthocenter of H" to "orthocenter of ABC".

p. 9 in Problem 1.16, change $\triangle BFD$ and $\triangle CDE$ to $\triangle DBF$ and $\triangle DEC$.

p. 10 change (LBC) to (IBC) in the paragraph starting "Because $LB = LI = LC$".

p. 12 **Theorem 1.22, the four points could also be collinear.** That is, $\measuredangle AXB = \measuredangle AYB$ if and only if A, B, X, Y lie on a circle *or* a line.

p. 12 Proposition 1.24, the isosceles triangle condition holds only when A, B, C are not collinear.

p. 16 in problem 1.33, change "$\angle KC = 90^\circ$" to "$\angle KCB = 90^\circ$".

p. 17 last paragraph, change "inscribed arcs" to "inscribed angles".

p. 18 in problem 1.37, delete the word "again" in the definition of Q.

p. 18 in problem 1.38, it would be better to say "prove I_1I_2CB is cyclic" for clarity since this is the order in which the vertices actually appear. Also, quadrilateral $ABCD$ should be required to be convex.

p. 18 in problem 1.39, I is the incenter of $\triangle ABC$.

p. 19 in problem 1.45, change "ray BI" to "the $\angle B$-bisector".

p. 20 in problem 1.47, change "Let ABC be triangle" to "Let ABC be a triangle".

p. 20 in lemma 1.48, the converse should be proven to since it is quoted on page 59.

p. 24 in problem 2.2, change $\measuredangle BCA = \measuredangle YZX$ to $\measuredangle ABC = \measuredangle XYZ$.

p. 28 change "immediately corollary" to "immediate corollary".

p. 29 in Theorem 2.9, excise "of Intersecting Circles" from the theorem name.

p. 29 in proof of Theorem 2.9, change both > 0's to < 0's.

p. 30 bottom of page, "coaxal" should be "coaxial".

p. 31 in Lemma 2.13, the circles can also be tangent to one another at X (i.e. the intersection is counted with multiplicity).

p. 32 near start of S2.6, "alluded the excenter" is missing "to".

p. 33 in Lemma 2.20, swap the definitions of X and D. (The problem is technically correct as stated, but it should be consistent with Figure 2.6A.)

p. 34 in the discussion for Example 2.21, the definition of O_1 and O_2 is accidentally omitted (but is obvious from the figure).

p. 34 in discussion to Example 2.21, in "we already know that that lines PQ, RS, and XY concur at a point X", the extraneous "that" and "X" should both be deleted.

p. 34 end of third paragraph in discussion to Example 2.21, change "ω_1 an ω_3" to "ω_1 and ω_3" and change O_1O_3 to $\overline{O_2O_3}$.

p. 35 in the second set of aligned equations, change O_2X^2 to OO_2^2.

p. 35 very bottom of page, change "circumradii" to "radii".

p. 37 Example 2.23, the source is Russia 2011, not 2010.

p. 39 Example 2.24, I is the incenter.

p. 40 Problem 2.29, change "six points" to "the six points".

p. 40 Problem 2.30, the lines may also be pairwise parallel.

p. 46 change $\frac{1}{1}\frac{1}{1}\frac{1}{1} = 1$ to $1 \cdot 1 \cdot 1 = 1$. (not technically wrong but quite misleading as written.)

p. 47 before figure 3.3B, change $AA_1 = p$ to $AA_1 = |p|$; ditto for B_1 and C_1.

p. 48 Theorem 3.8, the lines may also be pairwise parallel.

p. 49 when defining homothety, $h(P)$ must also lie on line PO.

p. 49 third to last line, lengths are multiplied by $|k|$.

p. 51 before Lemma, in "this circles is called the nine-point circle", change "circles" to "circle".

p. 51 Lemma 3.13, change $2 : 1$ to $1 : 2$.

p. 54 third paragraph, change "pick let" to "let".

p. 55 immediately after display, $\measuredangle BH_AO$ should be $\measuredangle OH_AB$.

p. 56 in the Ceva application, change $\frac{BF}{FA}$ to $\frac{AF}{FB}$.

p. 57 in Problem 3.25 require $ABCD$ to be convex.

p. 59 after Problem 4.2, change $AHPK'$ to $AHK'P$.

p. 61 before Problem 4.8, the definition of D is omitted (but obvious from Figure 4.2B).

p. 65 Problem 4.25, change $\frac{BM}{MC}$ to $\frac{CM}{MB}$.

p. 67 in Lemma 4.33, change the second ω to Ω.

p. 68 just before Problem 4.38, change "show" to "shown".

p. 71 Problem 4.53 is missing a trailing period.

p. 76 **Theorem 5.1 is missing a factor of $\frac{1}{2}$.**

p. 76 The shoelace formula is **antisymmetric**, not symmetric.

p. 89 at the start of the final paragraph in solution to Example 5.14 change "if and only θ" to "if and only if θ".

p. 89 to finish example 5.14, one should also verify that $\angle A = 60^\circ$ and $\angle A = 90^\circ$ actually work. As written, this is a proof that only 60° and 90° *could* work, and does not mention the converse direction.

p. 92 **In Problem 5.23, when defining point G, line HE should intersect Γ_1, not Γ_2.** Also, "interest" should be "intersect" in the first line.

p. 97 Figure 6.2A, should be $iz = -4 + 3i$.

p. 98 after the display, *is* should not be in math mode.

p. 100 in the first sentence of the paragraph before Theorem 6.7, delete the extra repeated "that".

p. 101 in the proof of Example 6.10, Lemma 6.3 should be Lemma 6.5. Also, $\frac{xa}{bc}$ should be $\frac{bc}{xa}$ (two changes).

p. 101 in the proof of Lemma 6.12, every logical $\implies$ should really be a bidirectional $\iff$ for the proof to be executed correctly.

p. 103 second to last paragraph, replace "indeed cyclic" with "indeed concyclic".

p. 104 in the proof of 6.16, replace "similar" with "directly similar".

p. 105 in Problem 6.20 change "Theorem 6.16" to "Theorem 6.15".

p. 107 **The proof of the theorem has several issues, and is probably best to just ignore.** The figure 6.6B is similarly broken. (The result is still true.)

p. 109 Third paragraph, $A = x^2$, $B = y^2$, $C = z^2$ should just be $a = x^2$, $b = y^2$, $c = z^2$ though this doesn't really matter.

p. 111 the last expression should actually be negated.

p. 112 in the second displayed line, change $y^2 + x^2z/y$ to $-y^2 + x^2z/y$. In the fourth, change the second y^2/z^2 to z^2/y^2. In the ninth, change the second y^2/z^2 to z^2/y^2. In the penultimate display (starting from b_1), change the period to a comma.

p. 113 in the definition of M_2, change DH_A to AH_A.

p. 113 First line after the end of Solution to Example 6.26, change AB to BC.

p. 114 Solution to Example 6.27, the a in the numerator of a' should be $\bar{a}$. Follow through with the rest of the solution.

p. 114 Solution to Example 6.27, near the end, negate all terms of $\sum(a\bar{b} - a\bar{c} + c\bar{a} - b\bar{a})$

p. 115 In Lemma 6.30, "chord AB" should technically be "line AB".

p. 117 in Problem 6.38 (which starts on the previous page), the similarity $\triangle DPO \sim \triangle PEQ$ should be a direct similarity.

p. 120 change PAB to PXY.

p. 121 change "his idea" to "this idea".

p. 121 "delimited with colons" should be "delimited with commas".

p. 125 at the end of the proof of Theorem 7.13, change "occurs only when" to "occurs precisely when", since the statement is if-and-only-if.

p. 126 before Theorem 7.14, the quote

> As a result, however: It is important that $x + y + z = 1$ when doing calculations with displacement vectors.

is confusing as written, since in a displacement vector the coordinates sum to zero. It would be better to say something like "Coordinates of points should be normalized to sum 1, so that displacement vectors always have coordinates with sum 0".

p. 126 in Theorem 7.14 and proof, $|PQ|^2$ should technically be just PQ^2.

p. 128 after the first display, although it's obvious what's meant, it would be better to write $\vec{O} = \vec{0}$ instead of $\vec{O} = 0$ for consistency with the rest of the text.

p. 130 in the proof of Example 7.20, change $(bs : b : 2b) = (bs : b : c)$ to $(bt : b : 2b) = (bt : b : c)$. Omit $s = t/b$ which is never used.

p. 132 in the proof of Example 7.20, change $C = (0, 0, 1)$ to $D = (0, 0, 1)$ and $F = (0 : b : b - a)$ to $F = (0 : b : a - b)$.

p. 132 in the last display change $\angle FAD$ to $\angle KAD$.

p. 133 Proposition 7.21, last display, change S_a to S_A.

p. 134 in the display before Theorem 7.25, change $\overrightarrow{HO}$ to $\overrightarrow{OH}$.

p. 134 after proving Lemma 7.24, although it's obvious what's meant, it would be better to write $\vec{O} = \vec{0}$ instead of $\vec{O} = 0$ for consistency with the rest of the text.

p. 134 in Theorem 7.25, change $\overrightarrow{AO}$, $\overrightarrow{BO}$, $\overrightarrow{CO}$ to $\overrightarrow{OA}$, $\overrightarrow{OB}$, $\overrightarrow{OC}$. (Technically, the original theorem is still true, but this way the notation is consistent with preceding paragraph.)

p. 135 in Example 7.26, change both $\overrightarrow{PA}$'s to $\overrightarrow{AP}$'s, and $\overrightarrow{AO}$ to $\overrightarrow{OA}$. Also, although it's obvious what's meant, it would be better to write $\vec{O} = \vec{0}$ instead of $\vec{O} = 0$ for consistency with the rest of the text.

p. 136 very top, $c = AE$ should be $c = AC$.

p. 137 in the definition of bolded term "homogeneous coordinates", replace (x, y, z) with $(x : y : z)$ for clarity.

p. 137 in Example 7.28, change "$\overline{BC}$" to "segment BC".

pp. 137–138 the solution to 7.28 only addresses one direction though the other follows similar.

p. 138 eighth line from top, change $AD : AC$ to $AD : CD$.

p. 139 start of page, delete "determinants and".

p. 139 in the sentence "The second is that a homothety with ratio 2…", delete "that".

p. 139 Solution 7.29, change the first display to $0 = c^2(t-1)+(a^2-b^2) \implies t = \frac{c^2+b^2-a^2}{c^2}$.

p. 139 just before Example 7.30, the "closing problem from Chapter 3" (referencing TSTST 2011/4) should actually be "penultimate problem from Chapter 3". The last problem from Chapter 3 is instead USAMO 2015/2.

p. 140 in the first display, S_{AC} should be S_{CA} for consistency.

p. 140 in the second display, $x + y$ should be $x - y$.

p. 141 $H = (S_{BC}, S_{CA}, S_{AB})$ should have colons and not commas.

p. 141 change "$P = (x' : y' : z') = (x' : y' : -S_{AB})$" to "$P = (x : y : z) = (x' : y' : -S_{AB})$", "$0 = x' - y' + \left(\frac{S_{AC}-S_{BC}}{S_{AB}}\right) z'$" to "$0 = x - y + \left(\frac{S_{AC}-S_{BC}}{S_{AB}}\right) z$", and "$a^2y'z' + b^2z'x' + c^2x'y' = 0$" to "$a^2yz + b^2zx + c^2xy = 0$".

p. 142 very top, in $a^2 = S_{AB} + S_{AC}$, change LHS to a^2S_A. Also, the rest of the solution is wrong, since a factor of two is dropped in the first display.

p. 144 second line of 7.42, change "tangency points" to "tangency point".

p. 145 in Problem 7.44, C_1 should be different from A or B.

p. 145 in Problem 7.44, hints 12 and 66 should be deleted (see correction to 7.26 solution).

p. 145 Problem 7.50 should clarify that $E \neq B$ and $F \neq C$.

p. 146 **Problem 7.52, change $\angle PCB$ to $\angle PBC$.**

p. 149 second paragraph of 8.1, change "three ordinary points" to "three noncollinear ordinary points".

p. 149 third paragraph of 8.1, change R to r.

p. 150 in Lemma 8.1, replace "tangents from A^*" with "tangency points from A^*".

p. 151 at start of 8.2, in "simplest example is a just a line", delete the extra "a".

p. 151 immediately before figure, add a period after 8.2A.

p. 151 the proof of Proposition 8.5 only shows that ℓ^* is a subset of the circle γ, and some bijection-like comment is technically needed to finish.

p. 152 right before theorem 8.7, change "the following lemma" to "the following theorem".

p. 153 in Theorem 8.7(c), "another circle" does not imply distinctness. (To be precise, circles invert to themselves if and only if they are orthogonal.)

p. 153 Lemma 8.11 is misnamed, and should be "inverting the circumcircle" or "inverting *around* the incircle".

p. 154 in Example 8.12 require $ABCD$ to be convex.

p. 154 in Step 6, change "$WXYZ$ is concyclic" to "W, X, Y, Z are concyclic".

p. 155 first bullet, delete the extra comma.

p. 156 change "they are **orthogonal**" to "ω_1 is **orthogonal** to ω_2", and insert "We therefore say that they are orthogonal if one is orthogonal to the other." after the last sentence of the first paragraph.

p. 158 Γ^*_{AB} and Γ^*_{AC} are rays, not lines (in both figure and text). Also, ω_0 is a semicircle rather than a circle.

p. 159 second line of Example 8.15, change "tangent to ω at T" to "tangent to Ω at K". Also, in the second paragraph of the proof, change the last Γ to Ω.

p. 159 in Lemma 8.16, change "fixes B and C" to "swaps B and C".

p. 162 item 5 of list, change G_1 to G_1^*. Also G^* in the first paragraph of the solution.

p. 162 in the first sentence of the solution, change "the intersection" to "the second intersection".

p. 163 step 3, change BS^* to BC^*.

p. 163 switch C^* and D^* in the diagram 8.7D.

p. 164 change $\measuredangle BX^*G^*$ in the display to $\measuredangle BXG^*$.

p. 164 switch R^* and S^* in the diagram 8.7E.

p. 164 in the second sentence of the reduced problem, insert "respectively".

p. 164 in Solution to Example 8.22, insert "respectively" in the definitions of C^*, D^*; P^*, Q^*, respectively.

p. 164 insert "is" between "it isosceles".

p. 166 Problem 8.26 is BAMO 2008/4, not BAMO 2008/6.

p. 167 Problem 8.34 requires A, B, C, D to be distinct.

p. 167 Problem 8.36, "circumcircle" is misspelled.

p. 171 "if one of the angles" would be clearer as "if any of the angles", when defining the sign of $(a, b; x, y)$.

p. 171 Theorem 9.2, change "$\overline{AB}$ and $\overline{XY}$" to "segments AB and XY".

p. 171 there's some abuse of notation in that $P(A, B; X, Y)$ was technically only defined for $ABXY$ collinear, but the intention is that $P(A, B; X, Y)$ refers to the cross ratio obtained from the four lines concurrent at P.

p. 172 in the paragraph before Figure 9.2C, "(and vice versa)" is redundant, it is in the previous sentence already.

p. 173 in Problem 9.3, the points should also be collinear.

p. 173 in Problem 9.4, add $k \neq 0$.

p. 173 7th line of Section 9.3, in "we present four configurations", change "four" to "five".

p. 174 display in proof of Lemma 9.9, take perspectivity at Y, not X. After the display, also change every X to a Y in the following paragraph.

pp. 174–175 in names of Lemmas 9.11-9.12, change "Induces" to "Induce".

p. 175 "directed form *of* Ceva's theorem".

p. 176 in Problem 9.14, delete "and Lemma 9.18" (and "proofs" to "proof").

p. 177 in Lemma 9.18, change "implies" to "imply".

p. 178 in the proof of Theorem 9.19, change $\angle CAY = \angle YBC$ to $\angle ACY = \angle YCB$.

p. 179 top of page, first sentence, ℓ is allowed to pass through O.

p. 179 in proof of Proposition 9.24, La Hire is used implicitly at the end to get Q lies on the polar of P iff P lies on the polar of Q.

p. 181 in Lemma 9.27, change "pole" to "polar" (two instances).

p. 184 **in Theorem 9.33, uniqueness is not true for (b) or (c). The last sentence is also wrong as written. The correct sentence is: if the *circumcircle* of a cyclic quadrilateral is sent to a circle, then so is the cross ratio of the cyclic quadrilateral.**

p. 184 in Example 9.34, swap the definitions of P, Q.

p. 184 in solution to Example 9.34, replace the definition of P' with $P' = \overline{A'B'} \cap \overline{C'D'}$.

p. 185 in proof of Theorem 9.35, "Because we must have the cross ratio … is preserved" is grammatically broken, and should be changed to "Because the cross ratio … must be preserved" or similar.

p. 185 in proof of Theorem 9.35, change (P', Q', P'_∞, M') to $(P', Q'; P'_\infty, M')$ and (X', Y', P'_∞, M') to $(X', Y'; P'_\infty, M')$.

p. 187 in solution to 9.38, I_A is the A-excenter (of course).

p. 189 in Solution 1, T should be $\overline{AA} \cap \overline{CR}$.

p. 190 immediately before problems, P is the point at infinity along $\overline{AC}$ instead.

p. 191 the source "Singapore TST" of Problem 9.43 is a bit dubious. It seems to have come from `https://aops.com/community/p3491333`, which suggests the year is 2008, but is not present in `https://aops.com/community/c3691_2008_singapore_team_selection_test`. Go figure.

p. 191 in Problem 9.47, last line of problem statement, change "circumference" to "circumcircle".

p. 191 in Problem 9.48, the definition of E and F are swapped from the original source, though this has no bearing on the problem.

p. 192 Problem 9.54, should be the interiors of the sides, i.e. $C \neq D$ and $A \neq E$.

p. 193 Problem 9.58, delete the last "again" in definitions of P, Q.

p. 196 it may be clearer if the remark $AB \neq CD$ was at the start of the page rather than the bottom of the page (unless one allows the spiral similarity centered at a point at infinity, which amounts to a translation).

p. 196 right after Figure 10.1B, "similar" would be better as "directly similar".

p. 198 in proof of 10.3, change "BC to DA" to "BC to AD".

pp. 198–∞ replace "Gauss line" with "Newton-Gauss line" everywhere — that's the standard term, apparently.

p. 200 in third sentence of proof, add "of" after "radical center".

p. 201 Lemma 10.9, change "though" to "through".

p. 201 the complete quadrilateral $ABCD$ is cyclic if A, B, C, D lie on a circle.

p. 202 Proposition 10.14, delete extra "the" before M.

p. 202 part (a), the latter four circles should be (PAB), (PCD), (QAD), (QBC).

p. 202 part (b), change "AB to CD" to "AB to DC" and change "BC to DA" to "BC to AD".

p. 203 there's a superfluous period after the displayed $(S, T; A, B)$.

p. 205 solution to Example 10.16 should define O as the center of ω, once it is proved that KLK^*L^* is cyclic.

p. 206 problem 10.23, change "IMO 2005/2" to "IMO 2005/5", and "lie of the sides" to "lie on the sides".

p. 209 problem 11.5, for clarity, expand "USAMTS" as "USA Mathematical Talent Search", and require $ABCD$ to be convex.

p. 209 problem 11.6, change "circumcenter" to "circumcircle".

p. 210 problem 11.8, assume $AB \neq AC$.

p. 210 problem 11.10, change "PA, PB, PC" to "AP, BP, CP". Also, require P to not be the orthocenter.

p. 216 in phrase "third column from the first column", change "first" to "second".

p. 217 to be extremely pedantic, what's defined is a vector in $\mathbb{R}^n$. In abstract algebra the definition of a vector is more general and there is not necessarily a norm or direction.

p. 218 in definition of vector addition, change to $\langle x_1 + x_2, y_1 + y_2 \rangle$.

p. 218 the misspelled "ofter" should be "often"

p. 219 replace "two vectors v and w" with "two vectors $\vec{v}$ and $\vec{w}$".

p. 219 **the dot product is not associative**; that property does not even make sense for this operation, since is an operation from $\mathbb{R}^n \times \mathbb{R}^n \to \mathbb{R}$.

p. 221 hint 8, replace "How you can" with "How can you".

p. 221 hint 12 is wrong (see page 268 correction below).

p. 222 hint 40, "It equivalent" is missing "is".

p. 222 hint 60, the inequality should be strict.

p. 221 hint 66 is wrong (see page 268 correction below).

p. 223 hint 77, replace "$\measuredangle CMN = \measuredangle BMN$" with "$\measuredangle CNM = \measuredangle BNM$".

p. 223 hint 83, replace "not disjoint" with "not disjoint nor neither one is contained inside the other".

p. 223 hint 87, the inequality should be strict.

p. 223 hint 93, replace "at least" with "more than".

p. 223 hint 96 is wrong (see page 274 correction below).

p. 224 hint 113, replace "B_1B_1" with "B_1B_2".

p. 224 hint 133, you only get four pairs if you ignore the condition T lies on arc AQB.

p. 225 hint 164 should be: let $X = \overline{EF} \cap \overline{BC}$ and $Y = \overline{AD} \cap \overline{EF}$, show $(X, Y; E, F) = -1$.

p. 226 hint 183, replace "$ABCD$" with "$ABXY$".

p. 226 hint 185, replace "$\angle WXY = 40^\circ$" with "$\angle XZY = 40^\circ$".

p. 226 hint 193, replace "major arc BC" with "arc $\widehat{BAC}$".

p. 226 hint 197 is wrong (see correction to Solution 6.45 below).

p. 226 hint 217, replace $\measuredangle BAC$ with $\measuredangle CAB$ and $\measuredangle BDC$ with $\measuredangle CDB$.

p. 226 hint 218, change CD to XY.

p. 227 hint 231, replace P, C, D with P, A, B; replace $ABCD$ with $AXBY$.

p. 227 hint 232, L should be the midpoint of BC.

p. 227 hint 252, replace O with O^*.

p. 227 hint 255, replace A with C.

p. 228 hint 257, change "as do C and F" to "as do B and D".

p. 228 hint 267, change QS to HK.

p. 228 hint 274, the definition of point M is missing. Point M is the midpoint of AB.

p. 229 hint 296, in hint 296, "$H_A = a + b + d$" change H_A to h_A for consistency.

p. 229 hint 303, change first two instances of de to bc.

p. 229 hint 304, the comma in $K = (2S_B, 2S_A : -c^2)$ should be a colon, of course.

p. 229 hint 316, change "the circle is" to "the circle is centered at".

p. 229 hint 321, delete "applies".

p. 230 hint 340, replace P with $\overline{A_1A_2} \cap \overline{C_1C_2}$.

p. 230 hint 355, change AC to AB.

p. 230 hint 362, X should instead be the second intersection of QI with the circumcircle.

p. 230 hint 364, the angle should be BPC not PBC.

p. 231 hint 373, replace "$90^\circ - A$" with "$90^\circ - B$".

p. 231 hint 380, replace "$\sin 30^\circ$" with "$i \sin 30^\circ$".

p. 231 hint 383, "trigonometric" is misspelled.

p. 231 hint 389, change L^* to A^*.

p. 231 hint 393, delete "$M = (0 : 1 : 1)$" and change the later "L" to "M".

p. 232 hint 422, the definition of point T is missing. Point T is the contact point of the A-mixtilinear incircle.

p. 232 hint 425, change "reflection" to "reflections".

p. 233 hint 445, the fraction should be $\frac{(a+b+c)bc}{b^2+bc+c^2}$.

p. 233 hint 449, change A to C.

p. 234 hint 499, change $FARM$ to $FACE$.[1]

p. 234 hint 500, the inequality should be strict.

p. 234 hint 506, the angles should be directed.

p. 235 hint 544, change "equivalent" to "equivalent to".

p. 235 hint 554, change the similarity to $\triangle AOD \sim \triangle CO_1D$.

p. 235 **hint 556 is broken**. I have no memory of what I meant to write.

[1] I know this sounds idiotic out of context…

p. 236 hint 571, replace k with AB.

p. 236 hint 589, change ... to $\cdots$.

p. 236 hint 594, "midpoint" should be "median".

p. 237 hint 616, change the second "ω" to "circle with diameter $\overline{PQ}$"

p. 237 hint 633, change H to M.

p. 238 hint 649 is wrong (see correction to Solution 6.45 below).

p. 238 hint 653 is missing a period.

p. 238 hint 666, change $\frac{XB}{XA}$ to $\frac{XA}{XB}$.

p. 242 in Solution 1.46, should be $\triangle O'AB \cong \triangle ODC$.

p. 243 **in Solution 1.50, one also needs to check A, P, W are collinear. Thus, add the remark $\measuredangle NPA = \measuredangle NMA = \measuredangle NMC = \measuredangle NBC = \measuredangle NBW = \measuredangle NPW$.** (Radical axis also works.)

p. 246 in Solution 2.38, change "circumcircle of ω" to "ω".

p. 246 in Solution 3.17, change X_1Y_1 to $X'Y'$ at the bottom (twice).

p. 249 Solution 3.29, add a remark that (AMN) is tangent to (ABC).

p. 250 in Solution 4.50, second-to-last sentence, change "circumcircle" to "circumcenter".

p. 251 in Solution 4.52, last display, change $\measuredangle BED + \measuredangle BDE$ to $\measuredangle BED + \measuredangle DBE$.

p. 252 in Solution 5.21, change $-BI \cdot CI \cdot \sqrt{2}$ to $+BI \cdot CI \cdot \sqrt{2}$. Thus, in last display change $\sqrt{2}$ to $-\sqrt{2}$.

p. 256 in Solution 6.30, the case $P = B$ should be addressed separately to avoid division-by-zero issues.

p. 258 in Solution 6.36, the comma should be deleted in "By, Lemma 6.11".

p. 259 in Solution 6.36, change $ab - 1$ to $ab + 1$ and follow through.

p. 262 there is a minus sign missing on fifth display. Carrying through, we actually get $x = h - \frac{bc(a+b+c)}{b^2+bc+c^2}$ instead, id est we want $x/h = 1 - \frac{bc}{b^2+bc+c^2}$ to be real.

p. 264 the footnote calculation appears broken. The correct expression is

$$\mathcal{N} - \overline{p}\mathcal{D} = -s_4\overline{p}^3 + p^2\overline{p} + s_3\overline{p}^2 - s_2\overline{p} + s_1 - 2p.$$

p. 265 in Solution 6.45, the first quantity under consideration should be $\frac{a-b}{c-b} \cdot \frac{c-d}{e-d} \cdot \frac{e-f}{a-f}$.

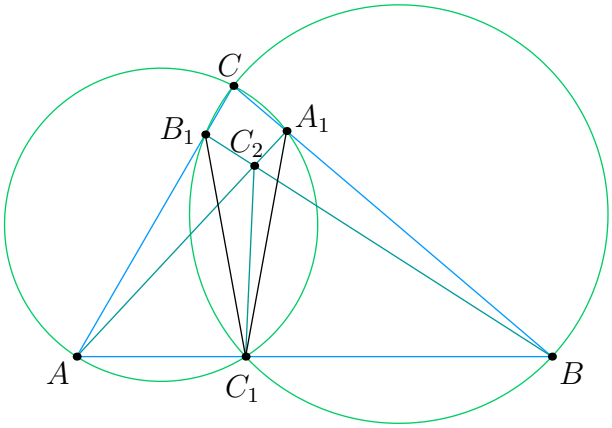
p. 265 in Solution 6.45, the solution proves $|(a-b)(c-e)(d-f)| = |(d-e)(f-b)(a-c)|$. It should instead prove $|(b-c)(a-e)(f-d)| = |(c-a)(e-f)(d-b)|$, which is the same up to permutation of point labels.

p. 267 in Solution 7.38 (which starts on the previous page), in the last paragraph, one does need to verify that the coefficient of k is nonzero in order to conclude that there is exactly one solution in k.

p. 268 at the end of Solution 7.42, the end of the display should be $-2S_A + 2bc$.

p. 268 **Solution 7.44 is completely messed up, including the diagram: it is solving a different problem.** Here is a corrected solution.

In the usual barycentric notation, we claim that the common point is $K = \left(a^2 - b^2 + c^2 : b^2 - a^2 + c^2 : -c^2\right)$. Let $C_1 = (u : v : 0)$, with $u + v = 1$.



By power of a point, we observe that $BA_1 = \frac{uc^2}{a}$. Therefore, we obtain that

$$A_1 = \left(0 : a - \frac{uc^2}{a} : \frac{uc^2}{a}\right) = \left(0 : a^2 - uc^2 : uc^2\right).$$

Similarly, $B_1 = \left(b^2 - vc^2 : 0 : vc^2\right)$. Therefore,

$$C_2 = \left(u(b^2 - vc^2) : v(a^2 - uc^2) : uvc^2\right).$$

Now we show that C_1, C_2, and K are collinear. Expand

$$\begin{aligned}
\begin{vmatrix} u(b^2 - vc^2) & v(a^2 - uc^2) & uvc^2 \\ u & v & 0 \\ a^2 - b^2 + c^2 & b^2 - a^2 + c^2 & -c^2 \end{vmatrix} &= uvc^2 \begin{vmatrix} b^2 - vc^2 & a^2 - uc^2 & uv \\ 1 & 1 & 0 \\ \frac{a^2 - b^2 + c^2}{u} & \frac{b^2 - a^2 + c^2}{v} & -1 \end{vmatrix} \\
&= uvc^2 \Big[(a^2 - uc^2) - (b^2 - vc^2) \\
&\qquad + u(b^2 - a^2 + c^2) - v(a^2 - b^2 + c^2) \Big] \\
&= uvc^2 (b^2 - a^2)(u + v - 1) = 0.
\end{aligned}$$

p. 269 in Solution 7.47, delete "Let ω_i be the circle with center O_i and radius r_i".

p. 270 in Solution 7.49, second display, delete "det".

p. 270 in solution 7.52, T should be $au^{-1} + bv^{-1} + cw^{-1}$.

p. 271 in solution 7.52, the line $PC^2 = \dots$ is missing a plus sign after $-a^2(vw)^{-1}$.

p. 271 in solution 7.52, second-to-last display, the expressions actually equal $-\gamma$, not γ.

p. 273 Solution 8.31, change "an reflection" to "a reflection".

pp. 273–274 Solution 8.31, swap A and C everywhere, including the figure. In addition, Ψ should swap A and B (not fix them).

p. 274 in Solution 8.31, change "isogonal with respect to $\angle BAC$" to "isogonal with respect to $\triangle BAC$".

p. 274 Solution 8.36, change "nine-point circle" to "the nine-point circle" in third sentence.

p. 274 **Solution 8.37 is wrong, it assumes AB passes through the center of ω_2.**

p. 276 in Solution 9.46, the concurrence of lines IP and EF with the two tangents t the incircle needs justification as well (in order to apply Lemma 9.40). It follows from $DEFX$ being harmonic, where X is the second intersection of line AD with the incircle.

p. 276 in Solution 9.47, change $(A, X; B, C)$ to $(A, X; C, B)$.

p. 277 in Solution 9.50, change $\overline{CG} \cap \overline{BE}$ to $\overline{CG'} \cap \overline{BE}$.

p. 281 in Solution 10.26, the last line, change $\measuredangle HMN$ to $\measuredangle HNM$.

p. 282 in Solution 10.29, change $(P, E; X, Y)$ to $(F, E; X, Y)$ in last paragraph.

p. 282 in Solution 10.30, change "This solves ... $\measuredangle A_2C_2B_2$" to "This solves the problem, because the analogous calculation gives $\measuredangle BC_3A_3 = \measuredangle B_2AC$, which implies $\measuredangle A_3C_3B_3 = \measuredangle A_3C_3A + \measuredangle AC_3B_3 = \measuredangle A_3C_3B + \measuredangle AC_3B_3 = \measuredangle CAB_2 + \measuredangle A_2BC = \measuredangle CC_2B_2 + \measuredangle A_2C_2C = \measuredangle A_2C_2B_2$. Similarly, we have $\measuredangle B_3A_3C_3 = \measuredangle B_2A_2C_2$ and $\measuredangle C_3B_3A_3 = \measuredangle C_2B_2A_3$. Hence $A_3C_3B_3 \sim A_2C_2B_2$ and we are done".

p. 286 in Solution 11.6, change "power" to "radius".

p. 288 in Solution 11.9, final sentence of second paragraph, the tangency is to (DCM), and not (BCM).

p. 288 in Solution 11.9, last display, change $\frac{KL}{PL}$ to $\frac{PL}{KL}$.

p. 289 in Solution 11.11, change "the angle bisector" to "an angle bisector" and "the line through O perpendicular to BC" to "the perpendicular bisector of BC".

p. 292 in Solution 11.15, change "$\angle MOA$" to $\angle MO'A$".

p. 293 in Solution 11.15, change "the OPH'" to "$\triangle OPH'$".

p. 293 in Solution 11.16, what is none other than the BC is not ω_A^* but ω_A^+.

p. 294 delete the dotted circle in solution 11.16, it shouldn't be there.

p. 295 in Solution 11.17, delete "(where A_0 is the tangency point of the incircle on BC)".

p. 296 first line, I meant to write $\triangle AQL$ and not (ABL) although these are the same conclusion.

p. 296 in Solution 11.18, very very end, change $2t$ to $(b^2 + c^2)t$.

p. 297 in Solution 11.18, the first display should read $-a^2v + b^2w + c^2v = (b^2 + c^2)t + (abc)^2 - (ab)^2S_B - a^2t = S_A((ab)^2 + 2t)$. The next display should be $X' = \left(a^2vw : S_A(c^2S_C + t)((ab)^2 + 2t) : S_A(b^2S_B + t)((ac)^2 + 2t)\right)$. Similarly for Y' and Z'.

p. 297 in Solution 11.19, start of last paragraph, change DBC_1 to DB_1C_1.

p. 298 in Solution 11.20, start of solution, define P as the tangency point of ℓ.

pp. 298–299 in Solution 11.20, change ℓ_A, ℓ_B, ℓ_C to ℓ_a, ℓ_b, ℓ_c, respectively.

p. 300 in Solution 11.21, the definition of points T and H' are missing. Point T is the contact point of the A-mixtilinear incircle. Point H' is the reflection of H across M^*. Change $I^*L^*A^*$ to IL^*A^*.

p. 303 in the description of CGMO, "Girls" should be "Girls' ".

p. 303 in the description of IMO, change "problem" to "problems".

p. 303 in the description of ELMO, change "Exceeding" to "Exceedingly".

p. 305 the link to reference [3] is broken. Fortunately, it's on this website! The publication date should be amended to 2012 though.

p. 305 the link to reference [7] is broken. `http://e.math.hr/afine/planegeo.pdf` or `https://archive.org/details/planegeo` has the file.

p. 305 reference [10], change "Geogebral" to "GeoGebra".