



HYLAS

A metrical search engine
for Greek and Latin poetry

<https://miketueller.github.io/article/hylas-at-scs/>



HYLAS a metrical search engine

ΑΩ
ΘΙ A digital humanities project

ASU[®] Institute for
Humanities Research
Arizona State University

ASU[®] School of International
Letters and Cultures
Arizona State University



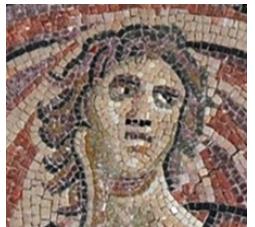
HYLAS a metrical search engine

The team at ASU:

Mike Tueller, team lead; coding & troubleshooting

Liz Grumbach, project consultant

Anup Shamanur Bakkanna, front-end web development



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<http://www.hylas.org/>

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VIRGIL'S *GEORGICS* AND THE ART OF REFERENCE

RICHARD F. THOMAS

Harvard Studies in Classical Philology 90 (1986): 171–198.

p. 179:

A special type of reference within this category is what I would call “technical reference,” by which I mean that the poet deals not so much in reshaping an entire line or number of lines but rather, through the use of a morphological oddity, rhetorical figure, metrical or rhythmical anomaly, or even by numerological criteria, intends to send his reader to a specific model.



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ηδ' ἔγω ἡ τοσάκις Νιόβη λίθος, δσσάκι μήτηρ·
δύσμορος, ἡ μαστῶν (ύγρὸν) ἔπηξα γάλα,
Αἴδεω πολὺς ὅλβος ἐμῆς ὀδῖνος ἀριθμός,
ἡ τέκον, ὡ, μεγάλης λείψανα πυρκαϊῆς.

ῷλεο δὴ πρὸ γάμοιο, Φιλαίνιον, οὐδέ σε μάτηρ
Πυθιὰς ὥραιον ἥγαγεν εἰς θαλάμους
νυμφίον· ἀλλ' ἐλεεινὰ καταδρύψασα παρειὰς
τεσσαρακαΐδεκέτιν τῷδ' ἐκάλυψε τάφῳ.

— ~ ~ — ~ ~ — ~ ~ — ~ ~ — ~ —
— ~ ~ — — — ~ ~ — ~ ~ —
— ~ ~ — ~ ~ — ~ ~ — — — ~ ~ —
— ~ ~ — ~ ~ — — ~ ~ — ~ —

I, here, am Niobe, a stone as many times as a mother.
Unfortunate, I made solid the watery milk of my breasts. The
number of my labor-pangs was a great wealth for Hades: I
bore children for him. Oh! the remains of a great pyre!
—Lollius Bassus (1st C. CE), AP 7.386

You perished before your marriage, Philaeum, and your
mother Pythias did not bring you in season to the chamber of
your bridegroom; but piteously she gouged her cheeks and
veiled you with this tomb at the age of **fourteen**.
—Perses (4th/3rd C. BCE), AP 7.487



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Rules for scansion:

1. If the syllable has a long vowel or diphthong, it's long.
2. If the syllable has a short vowel followed by two or more consonants, it's long, *unless ...*
3. those two consonants are a *mute followed by certain semi-vowels*, in which case it could go either way.
4. Short vowels followed by one consonant or no consonants are short.
5. The last syllable in the line always counts as long.



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1. Read in the line

Homer	Iliad	1	18	ύμιν μὲν θεοὶ δοῖεν Ὄλύμπια δώματ' ἔχοντες	dactylic hexameter
Vergil	Aeneid	1	28	et genus invisum, et rapti Ganymedis honores.	dactylic hexameter



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2. Break into syllables and assign known vowel quantities

vμ iν_μ èv_θ ε oì_δ oî εv_ oλ úμπ i α_δ óμ ατ'_ éχ ovτ ες

L L S S L L S S U U S L U S S S

et_g en us_ inv is um_ et_r apt i_g an ym ed is_h on or es

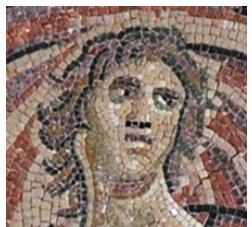
S S S U U S S U L U U U U U L L



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3. Determine the syllables to count

- Synizesis: two syllables with no intervening consonants (except h or a space) combine to make a single long vowel.
- Consonantalization: i/i and u/u, when followed by another vowel with no intervening consonant, may behave as a consonant, and adhere to the preceding syllable, which retains its quantity.
- Elision: in Latin, when a word ends with a vowel or vowel + m, and the next word starts a vowel or h + a vowel, the final syllable of the first word will usually disappear; the vowel of the following syllable retains its quantity.



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3. Determine the syllables to count



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3. Determine the syllables to count

vμ	īv_μ	ɛv_θ	ε	oī_δ	oī	εv_	oλ	ύμπ	ι	α_δ	ώμ	ατ'_	έχ	οντ	ες
L	L	S	S	L	L	S	S	U	U	S	L	U	S	S	S

vμ	īv_μ	ɛv_θ	εoī_δ	oī	εv_	oλ	ύμπ	ι	α_δ	ώμ	ατ'_	έχ	οντ	ες
L	L	S	L	L	S	S	U	U	S	L	U	S	S	S

et_g	en	us_	inv	is	um_et_r	apt	i_g	an	ym	ed	is_h	on	or	es
S	S	S	U	U	S	U	L	U	U	U	U	U	U	L



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4. Determine syllabic length

vμ	īv_μ	ɛv_θ	ε	oī_δ	oī	εv_	oλ	ύμπ	ι	α_δ	ώμ	ατ'_	έχ	οντ	εζ
L	L	S	S	L	L	S	S	U	U	S	L	U	S	S	S
-	-	-	~	-	-	0.9	0.0003	-	10.0	0.5	-	~	~	-	-
vμ	īv_μ	ɛv_θ	εoī_δ		oī	εv_	oλ	ύμπ	ι	α_δ	ώμ	ατ'_	έχ	οντ	εζ
L	L	S		L	L	S	S	U	U	S	L	U	S	S	S
-	-	-	-	-	-	0.9	0.0003	-	10.0	0.5	-	~	~	-	-
et_g	en	us_	inv	is	um_et_r	apt	i_g	an	ym	ed	is_h	on	or	es	
S	S	S	U	U	S	U	L	U	U	U	U	U	U	U	L
-	~	0.2	-	62.5	-	-	-	38.5	24.4	42.8	53.2	54.6	62.1	-	



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5. Metrical pattern-matching

vμ	īv_μ	ɛv_θ	ε	oī_δ	oī	εv_	oλ	ύμπ	ι	α_δ	ώμ	ατ'_	έχ	οντ	εζ
L	L	S	S	L	L	S	S	U	U	S	L	U	S	S	S
-	-	-	~	-	-	0.9	0.0003	-	10.0	0.5	-	~	~	-	-
vμ	īv_μ	ɛv_θ	εoī_δ	oī	εv_	oλ	ύμπ	ι	α_δ	ώμ	ατ'_	έχ	οντ	εζ	
L	L	S	L	L	S	S	U	U	S	L	U	S	S	S	
-	-	-	-	-	0.9	0.0003	-	10.0	0.5	-	~	~	-	-	
et_g	en	us_	inv	is	um_et_r	apt	i_g	an	ym	ed	is_h	on	or	es	
S	S	S	U	U	S	U	L	U	U	U	U	U	U	L	
-	~	0.2	-	62.5	-	-	-	38.5	24.4	42.8	53.2	54.6	62.1	-	



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5. Metrical pattern-matching

vμ	īv_μ	ɛv_θ	εοὶ_δ	οī	εν_	ολ	ύπι	ι	α_δ	ώμ	ατ'_	έχ	οντ	εζ
L	L	S	L	L	S	S	U	U	S	L	U	S	S	S
-	-	-	-	-	0.9	0.0003	-	10.0	0.5	-	~	~	-	-
-	-	-	-	-	-	~	~	~	~	-	~	~	-	-
et_g	en	us_	inv	is	um_et_r	apt	i_g	an	ym	ed	is_h	on	or	es
S	S	S	U	U	S	U	L	U	U	U	U	U	U	L
-	~	0.2	-	62.5	-	-	-	38.5	24.4	42.8	53.2	54.6	62.1	-
-	~	~	-	-	-	-	-	~	~	-	~	~	-	-



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With reference to the metrical phenomenon under discussion here, let me first say that the list of appositives given by H. Fränkel in the first Appendix to his article on the Greek hexameter (*Wege und Formen*, 143) seems to me to be accurate. But it is not complete : I believe it can be demonstrated that there is one further class of words which is prepositive in the hexameter. Fränkel's list of appositives is :

1. the article,
2. prepositions,
3. relative pronouns,
4. conjunctions, co-ordinative or subordinative, and conjunctive particles,
5. anaphoric pronouns,
6. negatives,
7. enclitics.

To this must be added an eighth item : preverbs in tmesis.

A. W. Bulloch, "A Callimachean Refinement to the Greek Hexameter," *Classical Quarterly* 20 (1970), p. 260.



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18. *Caesura and diaeresis.* These terms are used to indicate division between words within a line; word-division within a foot or metron is called *caesura*, word-division at the end of a foot or metron *diaeresis*. (But there is no genuine ‘break’ before the ‘enclitic’ word *est*, or after ‘proclitic’ prepositions such as *ab, in.*)



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6. Word division

vμ	īv_μ	ɛv_θ	εoi_δ	oī	εv_	oλ	ύπι	ι	α_δ	ώμ	ατ'_	έχ	οντ	εζ
L	L	S	L	L	S	S	U	U	S	L	U	S	S	S
-	-	-	-	-	0.9	0.0003	-	10.0	0.5	-	~	~	-	-
-	-	-	-	-	~	~	-	~	~	-	~	~	-	-
et_g	en	us_	inv	is	um_et_r	apt	i_g	an	ym	ed	is_h	on	or	es
S	S	S	U	U	S	U	L	U	U	U	U	U	U	L
-	~	0.2	-	62.5	-	-	-	38.5	24.4	42.8	53.2	54.6	62.1	-
-	~	~	-	-	-	-	-	~	~	-	~	~	-	-



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The dataset

Homer	(<i>Hymns</i>)	Smyrnaeus	Valerius Flaccus
<i>Homeric Hymns</i>	Colluthus	Catullus	Juvenal
Hesiod	Moschus	Lucretius	Lucan
Theognis	Oppian	Horace	Martial
Apollonius	Theocritus	Ovid	Persius
Rhodius	Tryphiodorus	Propertius	Statius
Aratus	<i>Greek Anthology</i>	Tibullus	
Bion	Nonnus	Vergil (including appendix)	
Callimachus	Quintus		



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Back-end outputs

- Lots more statistics in tabular form
- Trace stats back to lines



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Vergil Aeneid 12.948	eripiare mihi? Pallas te hoc uulnere, Pallas	- ~ - - ~ ~ - - - - ~ - -
Vergil Aeneid 12.949	immolat et poenam scelerato ex sanguine sumit.'	- ~ ~ - - - ~ - - - - ~ ~ - -
Vergil Aeneid 12.950	hoc dicens ferrum aduerso sub pectore condit	- - - - - - - - ~ ~ - -
Vergil Aeneid 12.951	feruidus; ast illi soluuntur frigore membra	- ~ ~ - - - - - - - ~ ~ - -
Vergil Aeneid 12.952	uitaque cum gemitu fugit indignata sub umbras.	- ~ ~ - ~ ~ - ~ ~ - - - ~ - - -



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Homer, *Odyssey* 24.531–535

“ἴσχεσθε πτολέμου, Ἰθακήσιοι, ἀργαλέοιο,
ώς κεν ἀναιμωτί γε διακρινθῆτε τάχιστα.”
ώς φάτ’ Ἀθηναίη, τοὺς δὲ χλωρὸν δέος εἶλεν·
τῶν δ’ ἄρα δεισάντων ἐκ χειρῶν ἔπτατο τεύχεα,
πάντα δ’ ἐπὶ χθονὶ πῖπτε, θεᾶς ὅπα φωνησάσης...

Vergil, *Aeneid* 12.948–952

“... eripiare mihi? Pallas te hoc uulnere, Pallas
immolat et poenam scelerato ex sanguine sumit.”
hoc dicens ferrum aduerso sub pectore condit
feruidus; ast illi soluuntur frigore membra
uitaque cum gemitu fugit indignata sub umbras.

“Refrain from troubling war, Ithacans, in
order to separate without bloodshed most
quickly.” So said Athena, and pale dread
seized them. In their dread, their weapons
flew from their hands, and they all fell to
the earth when the goddess’s voice spoke.

“... are you to be snatched away from me?
With this wound Pallas sacrifices you,
Pallas exacts the penalty from your vicious
blood.” So saying, he seethes, and buries
the steel in the enemy breast; his limbs
melted in the cold, and, with a groan, his
life fled, undeservedly, to the shades below.



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Similar projects

- Papakitsos, “Computerized Scansion of Ancient Greek Hexameter,” *Literary and Linguistic Computing* 26(1) (2011): 57–69.
- Schumann, Beierle, and Blößner, “A Finite-State Approach to Automatic Greek Hexameter Analysis,” *DH2019*.
- Fusi, *Chiron* (fusisoft.net/chiron).
- Winge, *Latin Macronizer* (alatius.com/macronizer).
- Chamberlain, *Greek and Latin Meter* (at hypotactic.com).
- Colombi et al., *Pede Certo* (pedecerto.eu).



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Chiron (Daniele Fusi) (fusisoft.net/chiron)

- Part of a modular system for text analysis
- Tested on Greek and Latin, but created to be multi-lingual
- Chained “layers” of analysis, including:
 - phonology
 - syntax
 - metrical scansion
- Still under development
- Word-breaks seem to have been a problem here too!

Homerus, Ilias

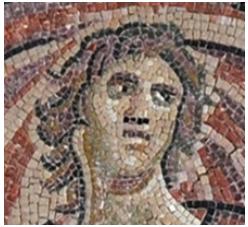
formatting
Greek (full) ▾ appositives ▾ 6 | I

1 μῆνιν δειδε θεά Πηληϊάδεω Αχιλῆος
2 ούλομένην, ἦ μυρί' Ακαιοῖς ἄλγε' ἔθηκε,
3 πολλάς δ' ἵφθιμους ψυχὰς Άιδι προΐαψεν
4 ἡρώων, αύτοὺς δὲ ἐλώρια τεῦχε κύνεσσιν
5 **οίωνοισί τε πᾶσι, Διός δ' ἐτελείετο βουλή,**
6 ἐξ οὗ δὴ τὰ πρῶτα διαστήτην ἐρίσαντε
7 Ατρεΐδης τε ἄναξ ἀνδρῶν καὶ δῖος Αχιλλεύς.
8 τις τ' ἄρ σφιε θεῶν ἔριδι ξυνέηκε μάχεσθαι;
9 Λητοῦς καὶ Διός υἱός· ὃ γάρ βασιλῆϊ χολωθείς
10 νοῦσον ἀνά στρατὸν ὅρσε κακήν, ὀλέκοντο δέ λαοί,

Result Unit Editor Appositive Editor

o	i	w	v	o	ī	c	i	τ	ε	π	ᾶ	c	t,	Δ	t
o	i		o	n	o	i	s	t	e	p	a	s	i	d	i
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
0	1	2	3	4	5	6	7	U	U	—	U	U	U	U	U
1a	1B	2a			2ba			2bb		3a	3ba		3bb		4

name value X



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*Latin Macronizer (Johan Winge)
(alatius.com/macronizer)*

- Ceased development in 2017
- Latin only
- Marks up user input; no searching capability
- Uses a robust dictionary
- A few scansions remain ambiguous

A Latin Macronizer

Please enter a Latin text!

Mark long vowels.

Also mark *māius* etc.

To improve the result, try to scan the text as .

Compare result with correctly macronized input text.

Convert u to v.

Convert i to j.

(Please be patient!)

Result

(Ambiguous forms are marked yellow; unknown forms are orange. You ma

SSDDDT	nec nōn et līnī segetem et Cereāle papāuer
DDSSDS	tempus humō tegere et iamdūdum incumbere arātrīs,
SSDSDS	dum siccā tellūre licet, dum nūbila pendent.
DSDDDT	uērē fabīs satiō; tum tē quoque, medica, putrēs
DSDSDS	accipiunt sulcī et miliō uenit annua cūra,
DSSDDS	candidus aurātīs aperit cum cornibus annum
SDSSDT	Taurus et āuersō cēdēns Canis occidit astrō.
SDSSDS	at sī trīticeam in messem rōbustaque farra
DSSSDS	exercēbis humum sōlisque Instābis aristīs,
DSSSDT	ante tibi Eōae Atlantidēs abscondantur
SDSSDS	Cnōsiaque ārdentis dēcēdat stēlla Corōnae,
	dēbita quam sulcīs committās sēmina quamque
	inuītae properēs anni spem crēdere terrae.



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Greek and Latin Meter (David Chamberlain) (hypotactic.com)

- Much corrected, or even entered, by hand
- No search or user-entered text, but has a large database
- Both Greek and Latin
- Many different meters (even lyric!)
- An attractive user interface

1

Pindar,

Olympian 1::IEΡΩ

Strophe 1

ἀριστον μὲν ὕδωρ, ὁ δὲ χρυσὸς αἰθόμενον πῦρ
ἄτε διὰ πρέπει νυκτὶ μεγάνορος ἔξοχα πλούτου·
εἰ δ' ἄ εθλα γαρύεν
ἔλδεαι, φίλον ἥτορ,
μηκέτ' ἀελίου σκόπει
ἄλλο θαλπνότερον ἐν ἀμέρᾳ φαεννὸν ἄστρον ἐρήμας δι
μηδ' Ὄλυμπίας ἀγῶνα φέρτερον αύδάσομεν.
ὅθεν ὁ πολύφατος ὕμνος ἀμφιβάλλεται
σοφῶν μητί εσσι, κελαδεῖν
Κρόνου παῖδ' ἐς ἀφνεὰν ἵκομένους
μάκαιραν ἢ ἐρωνος ἐστίαν,



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Pede Certo (Emanuele Colombi et al.)
(pedecerto.eu).

- Algorithmic scansion, plus some corrected by hand
- Latin only (from a large data set)
- Search by pattern, word-breaks, hiatus, and elision/synaloepha
- Search one line of dactylic hexameter or elegiac pentameter
- Attractive user interface

The screenshot shows the pedecerto search interface. At the top, there's a logo of a person at a desk and the text "pedecerto". Below the logo is a blue navigation bar with buttons for "Indexes", "Export", "Statistics", and "New search". The main area displays a search result for "13291 hexameters found (6.2)". Below this, there's a visual representation of a hexameter line consisting of six yellow boxes (representing feet) and a grey box (representing a vowel). Below the visualization is a page navigation bar with buttons for "<<", "<", "5", "6", "7" (which is highlighted in blue), "8", "9", ">", and ">>". The main content area lists search results in two columns:

VERG. georg. 4, 69	Cōntīnūōque_ānímōs uūlg
VERG. georg. 4, 80	Prācīpítēsque ē cādūnt; nō
VERG. georg. 4, 105	Ínstābīlīs ánímōs lūdō pr
VERG. georg. 4, 114	Ípsē lābōrē ē mānūm dūrō
VERG. georg. 4, 128	Iúgērā rūrīs ērānt, nēc fēr
VERG. georg. 4, 133	Nōctē dōmūm dāpībūs m
VERG. georg. 4, 148	Prātērēo_ātque_ālīs pōst
VERG. georg. 4, 189	Pōst, ūbī iām thālāmīs sē



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Future directions

- Expanded word dictionary functions
- Bigger dictionaries
- Accounting for adpositives
- A user interface that allows search for more meters
- More texts



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Questions? Corrections?

<http://www.hylas.org>

mike_tueller@asu.edu

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