

GoodAWACK/E10 Finite Grammar Closure Packet

Denis Saltykov

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Review request

Please check one local structural point in the Branch B / GoodAWACK closure. This is not a request to review the full Goldbach proof, nor the separate CKP/X10, X16/Shiu, or Davenport/AP analytic inputs.

The exact question is:

Does the listed B1/B3/F3/F4/E5 routing grammar exhaust all possible sources of rank-dropping affine regrouping in terminal GoodAWACK skeletons, so that E10M and E10K legitimately exclude an untagged FreeAffineHighTC residual, using E10Y as the grammar-completeness theorem?

Equivalently, the packet asks whether the following local implication is valid inside the recorded proof source:

$$\begin{array}{ccc} \text{actual terminal GoodAWACK skeleton} & \implies & \text{(E10M)} \\ \text{no untagged rank-dropping AFF occurrence} & & \end{array}$$

If this implication is sound, then the remaining HighTC GoodAWACK residual is empty and E10L may combine this with the separately reviewed TC1 route to obtain

$$R_{\text{GoodAWACK}}(N) = o(N).$$

Minimal context

The proof route decomposes Branch B into terminal classes. The GoodAWACK class contains terms where a Liouville-type factor remains attached to an affine system after the B1/B3/F3/F4 routing.

For each terminal GoodAWACK cell one records a finite skeleton

$$\mathfrak{S} = (\mathcal{B}, \Gamma, \mathfrak{r}, \Lambda_{\mathfrak{S}}, \Omega_{\mathfrak{S}}, \mathcal{L}_{\mathfrak{S}}, \mathcal{M}_{\mathfrak{S}}, \text{orig}_{\mathfrak{S}}, \mathcal{W}_{\mathfrak{S}}).$$

Here \mathcal{B} is the parent B1 product block, Γ is the B3 grouping choice, \mathfrak{r} is the F3/F4 routing record, $\Lambda_{\mathfrak{S}}$ and $\Omega_{\mathfrak{S}}$ are the active lattice and domain data,

$$\mathcal{L}_{\mathfrak{S}} = \{L_{\rho}(z) = \ell_{\rho} \cdot z + c_{\rho}\}$$

is the active affine system, $\mathcal{M}_{\mathfrak{S}}$ is the marked Liouville-form set, $\text{orig}_{\mathfrak{S}}$ records the origin of each active form and each rank-affecting operation, and $\mathcal{W}_{\mathfrak{S}}$ is the associated bounded product weight.

The important restriction is that \mathfrak{S} is an actual terminal skeleton generated by the listed routing grammar, not an arbitrary affine system written down after the fact.

TC1 and HighTC test

For each active form L_{ρ} , put

$$Q_{\rho} = \ell_{\rho} \otimes \ell_{\rho}.$$

A terminal GoodAWACK skeleton is in the TC1 case if some marked tensor Q_m is not in the rational span of the other tensors. It is in the HighTC case if no marked form has this property; equivalently, for each marked m , there is a non-trivial rational relation

$$\sum_{\rho} c_{\rho} Q_{\rho} = 0, \quad c_m \neq 0.$$

The TC1 case is handled outside this packet by the global testing route. This packet concerns the HighTC case.

HGO2R proves that origin-degenerate HighTC certificates reroute to CKP, LocalDiag, Edge, or the empty/impossible class. The only possible structural

residual is a FreeAffineHighTC skeleton: a formal high-true-complexity affine pattern whose rank drop has no allowed origin tag. E10M/E10K claim that this residual cannot occur for actual B1 descendants.

Rank-dropping AFF occurrences

A rank-dropping AFF occurrence is a bounded affine map used in the skeleton record whose linear part drops rank on the active affine span.

Here bounded means that the coefficients, denominators, and induced lattice index of the affine map are controlled by the fixed routing complexity and the polylogarithmic parameter hierarchy. Thus “bounded” refers to the bounded-complexity maps already present in the B1/B3/F3/F4/E5 routing record, not to an extra unrecorded freedom.

Such an occurrence is tagged if its origin is one of the following:

1. fixing or projection already recorded by the routing;
2. congruence compatibility or an inconsistent fibre;
3. fixed-divisor quotient;
4. variable-quotient or local-dependence route from F4;
5. CKP route;
6. Edge route;
7. impossible or empty route;
8. post-terminal analytic slicing after terminal vectors are fixed.

It is untagged if it appears only as a free affine regrouping or affine parametrization with no such origin.

The central structural assertion is:

No actual terminal GoodAWACK skeleton contains an untagged rank-dropping AFF occurrence.

Complete routing grammar

In the active interface, F3 routing-level operations are exactly:

1. controlled CRT absorption;

2. the F4 large-divisor decision;
3. square-divisor routing;
4. finite grouping selection or elimination;
5. terminal LocalDiag detection;
6. terminal Edge detection by C1P predicates;
7. terminal class labelling into CKP, GoodAWACK, LongAP/Local, Edge, or LocalDiag.

Generic Cauchy/cube manipulations and Fourier expansion are post-terminal proof subroutines. They are not additional F3 routing operations and are not allowed to create a new terminal GoodAWACK skeleton after the TC1/HighTC test has been declared.

F4 is responsible for ordinary large-divisor and quotient decisions. Surviving quotient or divisor data in a GoodAWACK terminal cell must be either controlled, tagged by F4, or already routed to Edge, CKP, LocalDiag, LongAP/Local, or the empty class. In particular, F4 should leave no untagged variable divisor or rank-dropping quotient in a terminal GoodAWACK skeleton.

E5 is used only as content and transport stability. Its phrase “affine regrouping” is read through the clean interface as one of:

1. a full-rank coordinate change;
2. a rank-dropping map with an explicit allowed origin tag;
3. a post-terminal analytic slicing after terminal affine vectors are fixed.

Thus E5 is not an independent terminal generator.

Formal transition table

Write the current routing state as

$$s = (V, L, C, Q, T, O),$$

where V is the active variable list, L the visible affine forms, C the congruence/content restrictions, Q the quotient and divisor data, T the current

routing tag, and O the origin record. The table below is the state-level grammar used by E10Y and E10X.

Operation	Input state	Output state	Rank effect	Required tag	Failure outcome
B1 start	none	B1 variables, dyadic cell, weights	no affine rank drop	start	not a Branch B descendant
B3 grouping	B1 state	grouped candidate and preliminary labels	finite selection only	B3 origin	removed or routed by F3
controlled CRT	$L_0(z) \equiv a \pmod{q}$	restricted lattice/coset	full-rank finite-index restriction or empty	CRT	empty fibre
F4 quotient/divisor	$d \mid L$ or $L = ds$	updated quotient data and tag	possible rank drop only through recorded data	FixedDiv, VarQuot, LocalDiag, CKP, Edge	decreases zero/strict saving
square-divisor routing	square-divisor predicate	Edge, controlled divisibility, or empty	no untagged rank drop	Edge or CRT	
grouping selection	finite candidate list	selected or eliminated candidate	finite selection only	B3/F3 origin	candidate removed
LocalDiag detection	forced equality/local relation	terminal LocalDiag	rank collapse leaves GoodAWACK	LocalDiag	continue routing
Edge detection	C1/C1A predicate	terminal Edge	collapse absorbed into saving route	Edge	continue routing
CKP detection	balanced bilinear structure	terminal CKP	CKP-origin relation	CKP	continue routing
GoodAWACK labelling	no other terminal predicate and no unresolved divisor	terminal GoodAWACK skeleton	labelling only	terminal label	not terminal GoodAWACK
E5 clean transport	generated B1/B3/F3/F4 record	transported content/auxiliary data	full-rank or inherited tagged rank drop	inherited tag, or none if full-rank	not E5-clean
post-terminal analytic non-generator	fixed terminal skeleton	test, slice, coarea/Fourier family, estimate	cannot replace terminal tensor-test vectors	PostTerminalNonGenerator	if Generator changes terminal vectors, it must be pre-terminal

There is no transition whose output is a free affine rank-dropping regrouping with no origin tag.

F4 quotient/divisor case table

F4 situation	Operation	Rank effect	Tag	Destination
controlled fixed divisor $d \leq (\log N)^B$	restrict lattice and replace L by L/d	finite-index CRT; content controlled	CRT, FixedDiv	F3 continues with decreased measure
fixed divisor with short fibre	C1 short-volume/Type-I saving	no terminal GoodAWACK skeleton	Edge	Edge
fixed divisor forcing equal-ity/proportionality/local relation	record local dependence	local rank collapse	LocalDiag	LocalDiag
fixed divisor producing balanced bilinear structure	expose CKP variables	CKP-origin relation	CKP	CKP
fixed divisor with central-long affine residual	absorb quotient/content data	no unresolved quotient predicate	FixedDiv or inherited tag	GoodAWACK
variable quotient $L = ds$ with short d , short s , or short fibre	strict saving	no terminal GoodAWACK skeleton	Edge	Edge
variable quotient forcing local dependence	record forced relation	local rank collapse	LocalDiag	LocalDiag
variable quotient producing balanced bilinear structure	group into CKP variables	CKP-origin relation	CKP	CKP
variable quotient producing central-long affine residual	keep quotient origin and controlled content	possible rank effect is tagged	VarQuot	GoodAWACK
incompatible quotient/divisor condition	discard cell	empty support	empty/impossible	zero

Thus F4 has no output class consisting of an untagged GoodAWACK quotient residual.

The table is read with deterministic F3/F4 routing precedence. If several rows visually apply to the same algebraic configuration, the earliest applicable terminal predicate in the F3/F4 decision order is chosen and recorded in the origin tag. Later algebraic similarity to another row does not create a second terminal skeleton and does not leave an additional untagged quotient or divisor residual.

E5 full-rank criterion

Let $U_L = \text{span}_{\mathbb{Q}}\{\ell_i - \ell_j\}$ be the active affine difference span and let U_{TC} be the span of the terminal vectors used in the TC1/HighTC test. An E5 affine transport T is clean full-rank only if

$$\ker(T_{\text{lin}}|_{U_L}) = 0 \quad \text{and} \quad \ker(T_{\text{lin}}|_{U_{\text{TC}}}) = 0$$

in the terminal GoodAWACK setting. If either kernel is nontrivial, E5 may be used only with an already recorded Fix/Proj, CRT, FixedDiv, VarQuot, LocalDiag, CKP, Edge, or PostTerminalNonGenerator origin. Hence E5 cannot serve as an independent terminal skeleton generator.

E10Y grammar completeness and E10X finite grammar invariant

The proof source separates two assertions. First, E10Y proves grammar completeness: every actual-generated skeleton-generating pre-terminal operation in an actual B1-origin GoodAWACK descendant is extracted from a finite B1/B3/F3/F4/E5 routing record and is one of the B1/B3 start-state operations, the F3/F4 routing operations, E5 full-rank or tagged content-stability transport, or a post-terminal analytic non-generator. E10Y also records terminal tensor-test immutability: post-terminal analytic tests may restrict or average the sums but cannot replace the terminal affine-vector list.

Here "actual-generated" has a non-circular meaning: it means lying in the image of the independently defined B1/B3/F3/F4/E5 construction, not "allowed because E10Y allows it." E10Y contains a bidirectional source-grammar table: each B1/B3/F3/F4/E5 operation is mapped to its E10Y transition class, and each E10Y transition class is mapped back to its only possible proof-tree sources.

Second, E10X proves the finite-grammar invariant on that E10Y-certified grammar. The GoodAWACK grammar state is schematically

$$s = (V, L, C, Q, T, O),$$

where V is the active variable list, L the affine forms, C the congruence and divisibility constraints, Q the quotient data, T the routing tags, and O the origin map.

The permitted transitions are:

1. fixing/projection;
2. controlled CRT restriction;
3. fixed-divisor quotient;
4. variable quotient residual with an F4 tag;
5. bounded affine regrouping preserving B1/B3 origin;
6. primitive slicing that does not replace the terminal tensor-test vectors;
7. auxiliary inheritance from E5, with no new terminal affine generator;
8. terminal labelling by the F3T routing table.

The invariant proved in E10X is that every E10Y-certified transition either preserves rank on the active affine span or attaches one of the allowed origin tags:

Fix/Proj, CRT, FixedDiv, VarQuot, LocalDiag, CKP, Edge, PostTerminalNonGenerator.

Consequently, an untagged rank-dropping affine regrouping cannot first appear at the terminal GoodAWACK stage. E10Y supplies the completeness of the transition universe; E10X supplies the invariant on that universe; E10M/E10K supply the no-untagged and AFF-origin consequences.

Compressed E10Y proof

Let

$$s_0 \rightarrow s_1 \rightarrow \cdots \rightarrow s_T$$

be the derivation history of an actual terminal GoodAWACK skeleton. The invariant is

$I(s_t)$: every rank-changing operation up to s_t is E10Y-classified and carries an allowed origin tag

At $t = 0$, B1/B3 have only product coordinates, dyadic cells and finite grouping choices, so no free affine rank drop has occurred. If $s_t \rightarrow s_{t+1}$ is an F3/F4 operation, the transition table above classifies it as CRT, quotient/divisor, square-divisor, grouping, LocalDiag, Edge, CKP, or terminal

labelling; every rank-changing case either attaches an allowed tag or leaves the GoodAWACK class. If $s_t \rightarrow s_{t+1}$ is E5 transport, the E5 full-rank criterion says that the transport is either rank-preserving on both relevant spans or inherits an already recorded tag. After terminality, post-terminal analytic operations may test or restrict the fixed terminal object but may not replace the terminal tensor-test vectors.

Thus $I(s_t)$ is preserved for all t , and the terminal state contains no unclassified skeleton-generating rank drop.

Finite classification classes

The following table is the finite mathematical classification used by E10Y, E10M, E10X, and E10K. It is part of the mathematical classification argument, not an external meta-check. The optional E10S and E10S-MECH records are non-logical source-maintenance records included only to make the maintained source-list check reproducible.

Class	Source	Rank-relevant phrase	Normalized operation	E10Y class	Tag/outcome
G0	B1	product variables, dyadic cell	start-state creation	B1/B3 start	no rank drop
G1	B3	grouping, grouped coordinate	finite grouping selection	B1/B3 start	B3 origin
G2a	F3/F3A/F3T	CRT, congruence absorption	controlled CRT absorption	F3/F4 routing	CRT or empty
G2b	F3/F3A/F3T	square-divisor, square tail	square-divisor routing	F3/F4 routing	Edge, CRT, or empty
G2c	F3/F3A/F3T	LocalDiag, repeated/proportional form	LocalDiag detection	F3/F4 routing	LocalDiag
G2d	F3/F3A/F3T	Edge, short volume, strict saving	Edge detection	F3/F4 routing	Edge
G2e	F3/F3A/F3T	terminal class label	terminal labelling	F3/F4 routing	terminal label only
G3a	F4	fixed divisor, divisor absorption	fixed-divisor quotient	F3/F4 routing	FixedDiv, CRT, or routed away
G3b	F4	$L = ds$, quotient residual	variable quotient decision	F3/F4 routing	VarQuot, CKP, LocalDiag, Edge, or empty

G3c	F4	gcd-local or quotient-determined relation	forced local dependence	F3/F4 routing	LocalDiag
G4a	E5	affine regrouping, affine change	E5-clean full-rank transport	E5 transport	rank preserved
G4b	E5	rank-dropping transport	E5 tagged transport	E5 transport	inherited allowed tag
G4c	E5/analytic layers	primitive/fibre slicing after terminality	post-terminal non-generator	post-terminal	PostTerminalNonGenerator
G5	BGS	skeleton record, origin map	upstream terminal record	skeleton recording	inherited tags
G6	BAOC/E10G/E10H/E10I/E10J	matrix-origin, rank-dropping residual	diagnostic reduction	catalogue/reduction	reduces to E10Y/E10M
G7	E10Y/E10M/E10X/E10K/E10L	completeness, no untagged AFF	closure theorem layer	completion	no new generator
G8	TC1/BRS/TTT/Calderbank/Fourier/Carson/local	projection	terminal data	post-terminal	no replacement of terminal tensor-test vectors

E10Y proves that the listed grammar exhausts the actual-generated skeleton-generating operations. E10M checks the finite classification classes and concludes that an untagged rank-dropping AFF source is impossible.

The source-maintenance records are source-list-sensitive. Any change to the listed Branch B source files, any new Branch B source file, or any new rank-affecting term or synonym invalidates the E10S-MECH reproducibility record and requires refreshing that non-logical record unless the term is already classified by the controlled vocabulary. This refresh requirement is a maintenance rule, not an additional premise of the proof.

The table above is the compressed class table. For reproducibility, the longer source-maintenance inspection is organized by the following source map:

Class range	Full source node(s) to inspect
G0	B1
G1	B3
G2a–G2e	F3, F3A, F3T
G3a–G3c	F4
G4a–G4c	E5
G5	BGS
G6	BAOC, E10G, E10H, E10I, E10J
G7	E10Y, E10M, E10X, E10K, E10L

The packet is intended to be self-contained at the level of this finite structural interface. The longer source files remain available if any occurrence class or transition needs inspection.

How the HighTC residual is closed

The structural chain is:

BGS records actual terminal GoodAWACK skeletons,
HGO2R reroutes origin-degenerate HighTC certificates,
E10Y proves completeness of the finite routing grammar,
E10M excludes untagged rank-dropping AFF occurrences,
E10X proves the finite-grammar invariant,
E10K derives AFF-origin completeness,
E10L concludes that the HighTC GoodAWACK residual is empty.

The formal 4AP-like affine pattern isolated in HGO2R is treated only as a diagnostic obstruction. It is not automatically declared LocalDiag. Instead, E10Y/E10X/E10M/E10K must show that such a free-affine untagged rank drop is not generated by the actual B1/B3/F3/F4/E5 grammar.

Representative derivations

1. **Controlled divisor residual.** A B1/B3 atom reaches F3 with $d \mid L$. F4 first checks whether d is controlled. If it is, the state is replaced by a restricted lattice and L/d , carrying CRT and FixedDiv origin data. If the resulting atom remains GoodAWACK, the quotient is tagged; it is not a free affine regrouping.
2. **Variable quotient.** If $L = ds$ introduces a long quotient variable, F4 routes short fibres to Edge, forced relations to LocalDiag, balanced bilinear structure to CKP, and only the central-long residual to GoodAWACK with the VarQuot origin recorded. Hence no untagged quotient residual survives.

3. **E5 transport.** If a later E5 affine change is full-rank on the active affine span and on the terminal tensor-test span, it preserves the terminal rank data. If it drops rank, the drop must already have a Fix/Proj, CRT, FixedDiv, VarQuot, LocalDiag, CKP, Edge, or PostTerminal-NonGenerator origin. Otherwise the operation is not E5-clean and is not an admissible terminal GoodAWACK generator.

What a positive check would confirm

A positive check should confirm the following local statement:

For the recorded B1/B3/F3/F4/E5 routing grammar, E10Y proves completeness of the actual-generated skeleton-generating operations, E10M correctly classifies every possible rank-dropping AFF occurrence, E10X proves the finite-grammar invariant, and E10K legitimately derives AFF-origin completeness. Hence no untagged FreeAffineHighTC terminal GoodAWACK skeleton remains.

Failure modes to look for

A negative check should identify the first concrete failure, for example:

1. a listed B1/B3/F3/F4/E5 rank-changing operation not represented by an E10Y transition or an E10M classification row;
2. a hidden F3 routing operation beyond the seven-item F3.6 list;
3. a quotient/divisor case in F4 that survives without an allowed tag;
4. a use of E5 affine regrouping as an independent terminal generator;
5. a diagnostic residual not discharged by E10M/E10K;
6. post-terminal slicing creating a new terminal GoodAWACK skeleton;
7. an actual B1 descendant realizing FreeAffineHighTC with no tag.