

Crazy Sequential Representations: Base 13 (0000 up to CCCC)

**A.E. Bras
V.H.J. van der Velden**

Laboratory Medical Immunology (LMI), Department of Immunology, Erasmus Medical Center, Erasmus University, Rotterdam, the Netherlands
Correspondence: a.e.bras@gmail.com / a.bras@erasmusmc.nl / v.h.j.vandervelden@erasmusmc.nl

DOI

10.5281/zenodo.2530978

License

Creative Commons - Attribution 4.0 International (CC BY 4.0)

Historic Overview Decimal Crazy Sequential Representations

Inder Taneja published five papers on arXiv (for 1 up to 11111):

ARXIV Version	Evaluated Range	Allowed Operations	Missing Increasing	Missing Decreasing	Valid Representations
1 (06-02-2013) ¹	44 to 1000	+ * ^	2	10	1902 (of 1914)
2 (19-03-2013) ²	44 to 4444	+ * ^	50	53	8699 (of 8802)
3 (05-06-2013) ³	44 to 11111	+ * ^ ()	590	605	20941 (of 22136)
4 (05-08-2013) ⁴	0 to 11111	+ * ^ () -	449	315	21460 (of 22224)
5 (08-01-2014) ⁵	0 to 11111	+ * ^ () - /	9	10	22205 (of 22224)

Authors published three papers on Figshare/Zenodo (for -2147483647 up to 2147483647):

Date	Title
12-06-2018	Crazy Sequential Representations: Exhaustive Search ⁶
14-06-2018	Crazy Sequential Representations: Negative Integers ⁷
18-06-2018	Crazy Sequential Representations: Without Subtraction and/or Division ⁸

Inder Taneja published three papers on RGMIA (for 11112 up to 30000):

Date	Title
12-09-2018	Crazy Representations of Natural Numbers From 11112 to 20000 ⁹
10-11-2018	Crazy Representations of Natural Numbers From 20001 to 25000 ¹⁰
10-11-2018	Crazy Representations of Natural Numbers From 25001 to 30000 ¹¹

Authors published one paper on Figshare/Zenodo (comparing results for 11112 up to 30000):

Date	Title
06-12-2018	Crazy Sequential Representations: 11112 up to 30000 ¹²

Authors published three papers on Figshare/Zenodo (improving our previous work):

Date	Title
14-12-2018	Crazy Sequential Representations: Simplifications (01) ¹³
24-12-2018	Crazy Sequential Representations: Fill the Gaps (01) ¹⁴
02-01-2019	Crazy Sequential Representations: Fill the Gaps (02) ¹⁵

Historic Overview Non-Decimal Crazy Sequential Representations

Tim Wylie published one paper on arXiv (focusing on bases 3 through 10):

Date	Title
11-10-2018	Crazy Sequential Representations of Numbers for Small Bases

Base 13 Crazy Sequential Representation

For example, two valid base 13 crazy sequential representations:

$$\begin{array}{c} \text{8460}_{10} \quad \text{3B0A}_{13} \\ \hline -1_{13}/2_{13}*(3_{13}-4_{13}+5_{13})^6_{13}+7_{13}*89A_{13}+BC_{13} \\ \hline \end{array} \qquad \begin{array}{c} \text{605}_{10} \quad \text{377}_{13} \\ \hline CB_{13}+A9_{13}^{(8_{13}-7_{13})}*6_{13}/(-5_{13}+4_{13}+3_{13})+21_{13} \\ \hline \end{array}$$

For clarity, the corresponding base 10 representations:

$$\begin{array}{c} -1_{10}/2_{10}*(3_{10}-4_{10}+5_{10})^6_{10}+7_{10}*1479_{10}+155_{10} \\ \hline \end{array} \qquad \begin{array}{c} 167_{10}+139_{10}^{(8_{10}-7_{10})}*6_{10}/(-5_{10}+4_{10}+3_{10})+21_{10} \\ \hline \end{array}$$

Definition

Valid mathematical expression, thus well-formed interpretable syntactic construct.
Evaluation results is an integer value, thus a number without a fractional component.
Notation as used by most programming languages, thus restricted to following characters:

$$\begin{array}{c} 1 \quad 2 \quad 3 \quad 4 \quad 5 \quad 6 \quad 7 \quad 8 \quad 9 \quad A \quad B \quad C \quad + \quad - \quad * \quad / \quad ^ \quad (\quad) \\ \hline \end{array}$$

Digits 1 up to C occur in **increasing** or **decreasing** order:

$$\begin{array}{c} -1/2*(3-4+5)^6+7*89A+BC \\ \hline \end{array} \qquad \begin{array}{c} CB+A9^{(8-7)}*6/(-5+4+3)+21 \\ \hline \end{array}$$

Digits represent **single-digit** or **multi-digit** numbers (concatenation of digits is allowed):

$$\begin{array}{c} -1/2*(3-4+5)^6+7*89A+BC \\ \hline \end{array} \qquad \begin{array}{c} CB+A9^{(8-7)}*6/(-5+4+3)+21 \\ \hline \end{array}$$

Numbers occur in **positive form** or **negative form** (negation of numbers by “-” is allowed).

$$\begin{array}{c} -1/2*(3-4+5)^6+7*89A+BC \\ \hline \end{array} \qquad \begin{array}{c} CB+A9^{(8-7)}*6/(-5+4+3)+21 \\ \hline \end{array}$$

Allowed operations; **addition**, **subtraction**, **multiplication**, **division** and/or **exponentiation**.

$$\begin{array}{c} -1/2*(3-4+5)^6+7*89A+BC \\ \hline \end{array} \qquad \begin{array}{c} CB+A9^{(8-7)}*6/(-5+4+3)+21 \\ \hline \end{array}$$

Order of evaluation may be influenced by **parentheses** (also nested parentheses).

$$\begin{array}{c} -1/2*(3-4+5)^6+7*89A+BC \\ \hline \end{array} \qquad \begin{array}{c} CB+A9^{(8-7)}*6/(-5+4+3)+21 \\ \hline \end{array}$$

Representations with **negation** of **segments in brackets** are referred to as “pseudo”.

$$\begin{array}{c} (1+2-3)*(45*-(6^7)+8-9ABC) \\ \hline (1+2-3)*(45/-(6^7)+8-9ABC) \\ \hline (1+2-3)*(45^-(6^7)+8-9ABC) \\ \hline (-(1+2)+3)*(45^(6^7)+8-9ABC) \\ \hline -(1-2+234*(6-(7+8-9))*ABC) \\ \hline \end{array} \qquad \begin{array}{c} (CBA98+7*-(6^5)+4)*(3-2-1) \\ \hline (CBA98+7/-(6^5)+4)*(3-2-1) \\ \hline (CBA98+7^-(6^5)+4)*(3-2-1) \\ \hline (CBA98+7^(6^5)+4)*(-(3-2)+1) \\ \hline -(CBA*(9-(8+7-6))*543-2+1) \\ \hline \end{array}$$

Representations without negation of segments in brackets are referred to as “genuine”.

Aim

Identify genuine base 13 crazy sequential representations for 0000_{13} up to CCC_{13}

Expected number of representations = $2_{13} + CCC_{13} + CCC_{13} = 20000_{13} = 57122_{10}$

Results

57111_{10} out of 57122_{10} were identified, see supplement.

Missing

Increasing	None
-------------------	------

Decreasing	2A62, 2B12, 5243, 5921, 6415, 7281, 7B75, 8C3B, 9083, A402, B676
-------------------	--

Notes

Authors consider base 13 crazy sequential representations to be proof-of-work, as identification is computationally expensive, while verification is trivial. Authors did not simplify and/or optimize the crazy sequential representations.

Other Bases

Authors also identified genuine crazy sequential representations for other bases:

Date	Title
04-01-2018	Crazy Sequential Representations: Base 11 (0000 up to AAAA) ¹⁷
04-01-2018	Crazy Sequential Representations: Base 12 (0000 up to BBBB) ¹⁸
04-01-2018	Crazy Sequential Representations: Base 13 (0000 up to CCCC) ¹⁹
04-01-2018	Crazy Sequential Representations: Base 14 (0000 up to DDDD) ²⁰
04-01-2018	Crazy Sequential Representations: Base 15 (0000 up to EEEE) ²¹
04-01-2018	Crazy Sequential Representations: Base 16 (0000 up to FFFF) ²²

References

1. <https://arxiv.org/abs/1302.1479v1>
Natural Numbers from 44 to 1000 in terms of
Increasing and Decreasing Orders of 1 to 9
Inder J. Taneja. Wednesday 6 Feb 2013.
2. <https://arxiv.org/abs/1302.1479v2>
Crazy Sequential Representation: Numbers from 44 to 4444 in terms of
Increasing and Decreasing Orders of 1 to 9
Inder J. Taneja. Tuesday 19 Mar 2013
3. <https://arxiv.org/abs/1302.1479v3>
Crazy Sequential Representation: Numbers from 1 to 11111 in terms of
Increasing and Decreasing Orders of 1 to 9
Inder J. Taneja. Wednesday 5 Jun 2013
4. <https://arxiv.org/abs/1302.1479v4>
More on Crazy Sequential Representation of Natural Numbers with Subtraction
Inder J. Taneja. Monday 5 Aug 2013
5. <https://arxiv.org/abs/1302.1479v5>
Crazy Sequential Representation: Numbers from 0 to 11111 in terms of
Increasing and Decreasing Orders of 1 to 9
Inder J. Taneja. Wednesday 8 Jan 2014
6. <https://doi.org/10.6084/m9.figshare.6483968>
<https://doi.org/10.5281/zenodo.1288822>
Crazy Sequential Representations: Exhaustive Search
A.E. Bras, V.H.J. van der Velden. Tuesday 12 Jun 2018
7. <https://doi.org/10.6084/m9.figshare.6516131>
<https://doi.org/10.5281/zenodo.1288892>
Crazy Sequential Representations: Negative Integers
A.E. Bras, V.H.J. van der Velden. Thursday 14 Jun 2018
8. <https://doi.org/10.6084/m9.figshare.6587117>
<https://doi.org/10.5281/zenodo.1292115>
Crazy Sequential Representations: Without Subtraction and/or Division
A.E. Bras, V.H.J. van der Velden. Monday 18 Jun 2018
9. <https://rgmia.org/papers/v21/v21a108.pdf>
MD5: BB89800FB86BDF830D28EB07241D78C1
Crazy Representations of Natural Numbers From 11112 to 20000
Inder J. Taneja. Wednesday 12 Sep 2018

10. <https://rgmia.org/papers/v21/v21a131.pdf>
MD5: D135C0F9A417B7221AEBB1225FDF7B8D
Crazy Representations of Natural Numbers From 20001 to 25000
Inder J. Taneja. Saturday 10 Nov 2018
11. <https://rgmia.org/papers/v21/v21a132.pdf>
MD5: 87BF426B1827555F5FB701F7DAE33969
Crazy Representations of Natural Numbers From 25001 to 30000
Inder J. Taneja. Saturday 10 Nov 2018
12. <https://doi.org/10.6084/m9.figshare.7429967>
<https://doi.org/10.5281/zenodo.1998118>
Crazy Sequential Representations: 11112 up to 30000
A.E. Bras, V.H.J. van der Velden. Thursday 06 Dec 2018
13. <https://doi.org/10.6084/m9.figshare.7467665>
<https://doi.org/10.5281/zenodo.2276623>
Crazy Sequential Representations: Simplifications (01)
A.E. Bras, V.H.J. van der Velden. Friday 14 Dec 2018
14. <https://doi.org/10.6084/m9.figshare.7505690>
<https://doi.org/10.5281/zenodo.2525823>
Crazy Sequential Representations: Fill the Gaps (01)
A.E. Bras, V.H.J. van der Velden. Monday 24 Dec 2018
15. <https://doi.org/10.6084/m9.figshare.7539311>
<https://doi.org/10.5281/zenodo.2530025>
Crazy Sequential Representations: Fill the Gaps (02)
A.E. Bras, V.H.J. van der Velden. Wednesday 02 Jan 2019
16. <https://arxiv.org/abs/1810.05070v1>
Crazy Sequential Representations of Numbers for Small Bases
Tim Wylie. Thursday 11 Oct 2018
17. <https://doi.org/10.6084/m9.figshare.7546955>
<https://doi.org/10.5281/zenodo.2530974>
Crazy Sequential Representations: Base 11 (0000 up to AAAA)
A.E. Bras, V.H.J. van der Velden. Friday 04 Jan 2019
18. <https://doi.org/10.6084/m9.figshare.7546958>
<https://doi.org/10.5281/zenodo.2530976>
Crazy Sequential Representations: Base 12 (0000 up to BBBB)
A.E. Bras, V.H.J. van der Velden. Friday 04 Jan 2019
19. <https://doi.org/10.6084/m9.figshare.7546970>
<https://doi.org/10.5281/zenodo.2530978>
Crazy Sequential Representations: Base 13 (0000 up to CCCC)
A.E. Bras, V.H.J. van der Velden. Friday 04 Jan 2019

20. <https://doi.org/10.6084/m9.figshare.7546982>
<https://doi.org/10.5281/zenodo.2530980>
Crazy Sequential Representations: Base 14 (0000 up to DDDD)
A.E. Bras, V.H.J. van der Velden. Friday 04 Jan 2019

21. <https://doi.org/10.6084/m9.figshare.7546985>
<https://doi.org/10.5281/zenodo.2530982>
Crazy Sequential Representations: Base 15 (0000 up to EEEE)
A.E. Bras, V.H.J. van der Velden. Friday 04 Jan 2019

22. <https://doi.org/10.6084/m9.figshare.7546991>
<https://doi.org/10.5281/zenodo.2530984>
Crazy Sequential Representations: Base 16 (0000 up to FFFF)
A.E. Bras, V.H.J. van der Velden. Friday 04 Jan 2019