DAY 24 SOLUTIONS

CHAD GROFT

1. Initial constraints

- $i_0, \ldots, i_{13}$ range from 1 to 9.
- $v_0 = 1$ if $13 = i_0$, 0 otherwise (so $v_0 = 0$).
- $v_1 = 1$ if $v_0 = 0$, 0 otherwise (so $v_1 = 1$).
- $v_2 = 1$ if $i_0 \bmod 26 + 11 = i_0 + 11 = i_1$, 0 otherwise (so $v_2 = 0$).
- $v_3 = 1$ if $v_2 = 0$, 0 otherwise (so $v_3 = 1$).
- $v_4 = 1$ if $(i_1 + 3) \bmod 26 + 14 = i_1 + 17 = i_2$, 0 otherwise (so $v_4 = 0$).
- $v_5 = 1$ if $v_4 = 0$, 0 otherwise (so $v_5 = 1$).
- $v_6 = 1$ if $(i_2 + 8) \bmod 26 - 5 = i_2 + 3 = i_3$, 0 otherwise (so unclear).
- $v_7 = 1$ if $v_6 = 0$, 0 otherwise (so unclear).
- $v_8 = 1$ if (complex expression mod 26) $+ 14 = i_4$, 0 otherwise (so $v_8 = 0$).
- $v_9 = 1$ if $v_8 = 0$, 0 otherwise (so $v_9 = 1$).
- $v_{10} = 1$ if $(i_4 + 13) \bmod 26 + 10 = i_5$, 0 otherwise (so $v_{10} = 0$).
- $v_{11} = 1$ if $v_{10} = 0$ (so $v_{11} = 1$).
- $v_{12} = 1$ if $(i_5 + 9) \bmod 26 + 12 = i_6$, 0 otherwise (so $v_{12} = 0$).
- $v_{13} = 1$ if $v_{12} = 0$ (so $v_{13} = 1$).
- $v_{14} = 1$ if $(i_6 + 6) \bmod 26 - 14 = i_6 - 8 = i_7$, 0 otherwise (so unclear).
- $v_{15} = 1$ if $v_{14} = 0$, 0 otherwise (so unclear).
- $v_{16} = 1$ if

$$\Big(v_{15}(i_7 + 1) + (25v_{15} + 1)\Big(26i_4 + i_5 + 26^2 v_7(i_3 + 5) \\ + 26^2(25v_7 + 1)(\text{expr}) + \Big\lfloor \frac{i_6}{26} + \frac{43}{13} \Big\rfloor\Big)\Big) \bmod 26 - 8 = i_8,$$

  which reduces to

$$\big(v_{15}(i_7 + 1) + (25v_{15} + 1)(i_5 + 3)\big) \bmod 26 - 8 = i_8,$$

  which is so far unclear.
- $v_{17} = 1$ if $v_{16} = 0$, 0 otherwise, so unclear.
- $v_{18} = 1$ if (complicated expression) mod $26 + 13 = i_9$, 0 otherwise, so $v_{18} = 0$.
- $v_{19} = 1$ if $v_{18} = 0$, so $v_{19} = 1$.
- $v_{20} = 1$ if $i_9 + 2 = i_10$, 0 otherwise, so unclear.
- $v_{21} = 1$ if $v_{20} = 0$, 0 otherwise, so unclear.
- $v_{22} = 1$ through v_{27} are all determined by complicated expressions.

2. Constraints from the tail end

We want $v_{27}(i_{13} + 15) + (25v_{27} + 1)$(complex nonnegative expression) $= 0$. We must therefore have $v_{27} = 0$ and $v_{26} = 1$. (We will figure out how to do this later.)

From here the constraints are too complex to approach directly. Instead (after some brute-force exploration) I guessed that $v_{2n} = 1$ and $v_{2n+1} = 0$ for all n where these were not yet determined. This gave several equations relating the digits which were easy to satisfy with a greedy search.