Project Euler #719: Number Splitting

Solved December 2, 2021

We define an S-number to be a natural number, n, that is a perfect square and its square root can be obtained by splitting the decimal representation of n into two or more numbers then adding the numbers.

For example, 81 is an S-number because $\sqrt{81} = 8 + 1$.

6724 is an S-number: $\sqrt{6724} = 6 + 72 + 4$.

8281 is an S-number: $\sqrt{8281} = 82 + 8 + 1$.

9801 is an S-number: $\sqrt{9801} = 98 + 0 + 1$.

Further we define $T(N)$ to be the sum of all S numbers $n \leq N$. You are given $T(10^4) = 41333$.

Find $T(10^{12})$.

Solution

```
N = 10^12;
```

```
g (generic function with 1 method)
```

```
function g(n, s)
    n ≤ s && return n == s
    for i in 1:ndigits(n)-1
        g(n % 10^i, s - n ÷ 10^i) && return true
    end
    return false
end
```

```
T (generic function with 1 method)
```

```
T(N) = sum(n^2 for n in 2:isqrt(N) if g(n^2, n))
```

```
128088830547982
```

```
T(10^12)
```

```
BenchmarkTools.Trial: 6 samples with 1 evaluation.
 Range (min … max):  10.401 s …   12.052 s  ┊ GC (min … max): 0.00% … 0.00%
 Time  (median):     11.486 s               ┊ GC (median):    0.00%
 Time  (mean ± σ):   11.365 s ± 636.055 ms  ┊ GC (mean ± σ):  0.00% ± 0.00%

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  10.4 s          Histogram: frequency by time         12.1 s <

 Memory estimate: 0 bytes, allocs estimate: 0.
```

Validation

```
@assert T(10^4) == 41333
```