**Solmate Project Solution**

**Since**: Wednesday, December 15, 2021

**Version**: 2

**Table of Content**

[**1.** **Problem** 2](#_Toc90504723)

[**2.** **Model Deep Analysis** 2](#_Toc90504724)

[**3.** **Data Architecture** 3](#_Toc90504725)

[**3.1.** **Data Model** 3](#_Toc90504726)

[**3.2.** **Data Size Evaluation in Worst Case** 4](#_Toc90504727)

[**4.** **Idea** 5](#_Toc90504728)

[**5.** **Algo Per Use Case** 5](#_Toc90504729)

[**5.1.** **Stake** 5](#_Toc90504730)

[**5.2.** **View Reward** 7](#_Toc90504731)

[**6.** **Tests** 8](#_Toc90504732)

[**6.1.** **Case I** 8](#_Toc90504733)

[**6.2.** **Case II** 8](#_Toc90504734)

[**7.** **Analysis & Conclusion** 23](#_Toc90504735)

1. **Problem**

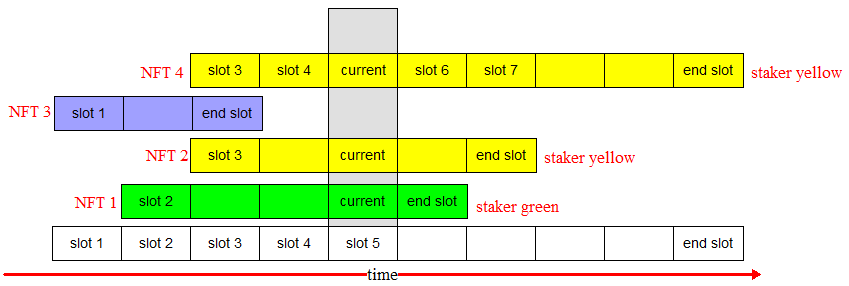
* Previously it’s found that the follow algo can exaust comput unit very soon, just few stekd NFTs can exaust it.

Loop through a slot gap

Loop through (wallet, nfts) over BtreeMap

Loop through nfts

1. **Model Deep Analysis**



As long as the reward calculation is based on $CIETY emission of per slot, the per slot caculation can’t be avoided, is a MUST, no matter:

* Whether veNFT is used or not
* Whether a outside trigger is empoyed or not

As illustrated in the above diagram, on slot 5,

Staker Yellow contributes 2 cells

Staker Green contrubutes 1 cells

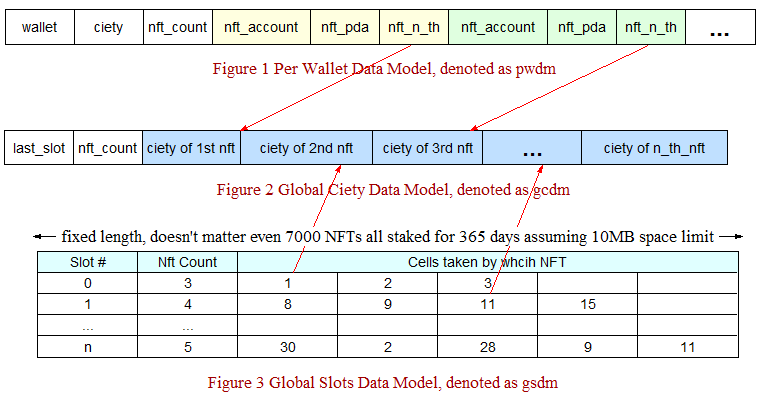
So,

Staker Yellow’s share is: 2/3

Staker Green’s share is: 1/3

Any share calculating mechanism is a variant of this.

1. **Data Architecture**
   1. **Data Model**



* 1. **Data Size Evaluation in Worst Case**
* Pwdm, wallet(32) + ciety(4) + nft\_count(2) + (nft\_account(32) + nft\_pda(32) + nft\_n\_th(2)) \* 7000 = 462038 bytes, each wallet has an account holding this
* Gcdm, last\_slot(2) + nft\_count(2) + ciety\_of\_nth\_nft(4) \* 7000 = 28004 bytes, globally only one account holding this
* Gsdm, 365 \* (slot(2) + nft\_count(2) + nft\_nth(2) \* 7000) = 5111460 bytes = 4992 kb, meaning all NFTs staked for 365 days, globally only one account holding this

1. **Idea**

We used to use to use hilgh capsulated data structure, like Vec and BtreeMap, actually it’s not absolutely necessary given a fixed data volume.

DATA STRUCTURE WITH FIXED STRUCTURE AND SIZES ARE EXTREMELY EFFICIENT, we drop any high level collection struct, like Vec and BtreeMap, instead WE DO EVERYTHING ON RAW BYTES ARRAY DIRECTLY.

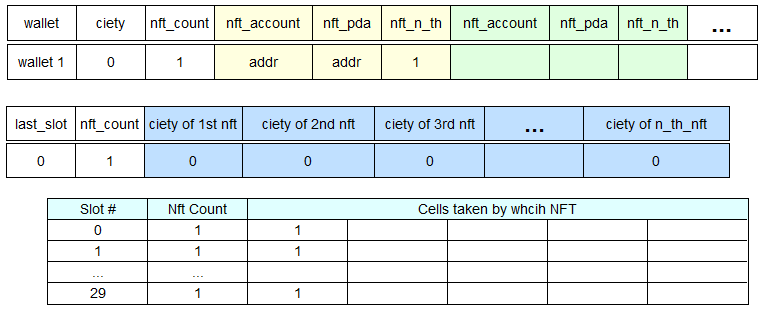
1. **Algo Per Use Case**
   1. **Stake**

Input = a wallet + multiple NFTs

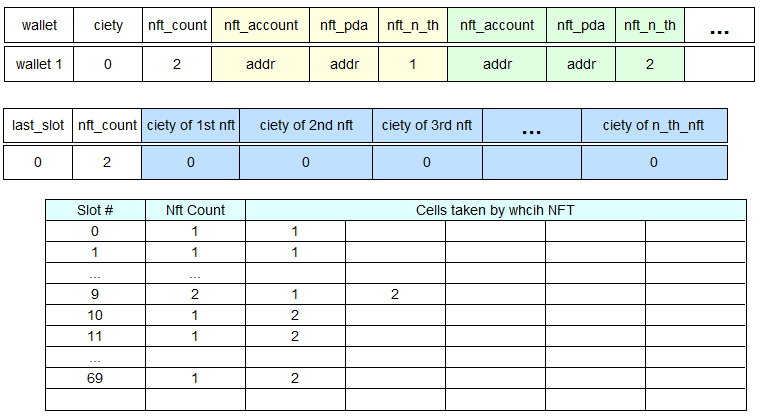
Given one time of staking, for each staked NFT:

* nft\_nth = gcdm.get(‘nft\_count’) + 1, O(1)
* gcdm.set (‘nft\_count’, nft\_nth), O(1)
* pwdm.add( (nft\_account, nft\_pda, nft\_nth) ), O(3)
* loop all slots taken by given NFT, O( number of slots \* 2), 365\*2 at most, assuming only one NFT can be staked at one time.
  + gsdm.get(slot).set(‘nft\_count’), O(1)
  + gsdm.get(slot).appendOnSlot(nft\_nth), O(1)

for example, if right after initialization there is an NFT staked which has a time length 30 days, then all data model will look like this:



If this staker staked another NFT for 60 days after 10 days, the data models will look like this:



* 1. **View Reward**

Input = a wallet

* Curr\_slot = clac\_curr\_slot(now), O(1)
* Last\_slot = gcdm.get(‘last\_slot’)
* For slot in [curr\_slot, last\_slot], worst case O((last\_slot – curr\_slot)\*7000)

For nft\_nth in [0, gsdm.nft\_count)

Shere = 1/gsdm.nft\_count

Accumulate gcdm.ciety on nft\_th

* Update gcdm.last\_slot
* Calculate total rewards of a staker, for i in [0, pwdm.nft\_count), O(pwdm.nft\_count \* 2)
  + total\_ciety = total\_ciety + gcdm.getCiety(nft\_th)
  + pwdm.set(‘ciety’, total\_ciety)

1. **Tests**
   1. **Case I**

* Right after initialization, a staker can stake 21 NFTs for 365 days.
* Only update gsdm, not include any other operations, like escrowing etc
* Remaining compute units are 3501

There MUST be a limit to how many NFTs a staker can stake at one time.

This updates 365 \* (2 + 2 + 21\*2) = 16790 bytes in 2 levels of nested loops, the time complexity is O(16790).

This big improvement conviced me it may be feasible with the idea of DO EVERYTHING ON RAW BYTES ARRAY DIRECTLY.

* 1. **Case II**

With gsdm, imagine a trigger call the calculation of reward everyday, the worst case is that the slot of calculating day has 7000 NFTs.

This will update 2 + 2 + 7000\*2 = 14004 bytes, O(14004) < O(16790), so it’s reasonable that there is no worries of exausting the limited compute units given we have this trigger even in the worst case.

But this doesn’t include updating gcdm.ciety 7000 times and update N wallets’ ciety.

But if we don’t employ a trigger, then there is a balance between slots\_gap and num\_nfts:

slots\_gap \* (2 + 2 + num\_nfts\*2) <=16790

Test I is a simulation of staking though, in case of viewing rewards, algorithmically it’s similar, just writing byets becomes reading bytes, so it’s reasonable in this way to estimate the situation of the case of viewing rewarding.

**In the following estimating resutls based on the above inequality:**

* **slots\_gap means how often rewards are viewed by stakers.**
* **num\_nfts means an average number of NFTs staked on the slots of a gap**
* **All possible balanced combination are (NOTE: within a gap, on each its slot, it all has num\_nfts NFTs):**

slots\_gap= 1 num\_nfts= 7000

slots\_gap= 2 num\_nfts= 4196

slots\_gap= 3 num\_nfts= 2797

slots\_gap= 4 num\_nfts= 2097

slots\_gap= 5 num\_nfts= 1678

slots\_gap= 6 num\_nfts= 1398

slots\_gap= 7 num\_nfts= 1198

slots\_gap= 8 num\_nfts= 1048

slots\_gap= 9 num\_nfts= 931

slots\_gap= 10 num\_nfts= 838

slots\_gap= 11 num\_nfts= 762

slots\_gap= 12 num\_nfts= 698

slots\_gap= 13 num\_nfts= 644

slots\_gap= 14 num\_nfts= 598

slots\_gap= 15 num\_nfts= 558

slots\_gap= 16 num\_nfts= 523

slots\_gap= 17 num\_nfts= 492

slots\_gap= 18 num\_nfts= 465

slots\_gap= 19 num\_nfts= 440

slots\_gap= 20 num\_nfts= 418

slots\_gap= 21 num\_nfts= 398

slots\_gap= 22 num\_nfts= 380

slots\_gap= 23 num\_nfts= 364

slots\_gap= 24 num\_nfts= 348

slots\_gap= 25 num\_nfts= 334

slots\_gap= 26 num\_nfts= 321

slots\_gap= 27 num\_nfts= 309

slots\_gap= 28 num\_nfts= 298

slots\_gap= 29 num\_nfts= 288

slots\_gap= 30 num\_nfts= 278

slots\_gap= 31 num\_nfts= 269

slots\_gap= 32 num\_nfts= 261

slots\_gap= 33 num\_nfts= 253

slots\_gap= 34 num\_nfts= 245

slots\_gap= 35 num\_nfts= 238

slots\_gap= 36 num\_nfts= 232

slots\_gap= 37 num\_nfts= 225

slots\_gap= 38 num\_nfts= 219

slots\_gap= 39 num\_nfts= 214

slots\_gap= 40 num\_nfts= 208

slots\_gap= 41 num\_nfts= 203

slots\_gap= 42 num\_nfts= 198

slots\_gap= 43 num\_nfts= 194

slots\_gap= 44 num\_nfts= 189

slots\_gap= 45 num\_nfts= 185

slots\_gap= 46 num\_nfts= 181

slots\_gap= 47 num\_nfts= 177

slots\_gap= 48 num\_nfts= 173

slots\_gap= 49 num\_nfts= 170

slots\_gap= 50 num\_nfts= 166

slots\_gap= 51 num\_nfts= 163

slots\_gap= 52 num\_nfts= 160

slots\_gap= 53 num\_nfts= 157

slots\_gap= 54 num\_nfts= 154

slots\_gap= 55 num\_nfts= 151

slots\_gap= 56 num\_nfts= 148

slots\_gap= 57 num\_nfts= 146

slots\_gap= 58 num\_nfts= 143

slots\_gap= 59 num\_nfts= 141

slots\_gap= 60 num\_nfts= 138

slots\_gap= 61 num\_nfts= 136

slots\_gap= 62 num\_nfts= 134

slots\_gap= 63 num\_nfts= 132

slots\_gap= 64 num\_nfts= 130

slots\_gap= 65 num\_nfts= 128

slots\_gap= 66 num\_nfts= 126

slots\_gap= 67 num\_nfts= 124

slots\_gap= 68 num\_nfts= 122

slots\_gap= 69 num\_nfts= 120

slots\_gap= 70 num\_nfts= 118

slots\_gap= 71 num\_nfts= 117

slots\_gap= 72 num\_nfts= 115

slots\_gap= 73 num\_nfts= 114

slots\_gap= 74 num\_nfts= 112

slots\_gap= 75 num\_nfts= 110

slots\_gap= 76 num\_nfts= 109

slots\_gap= 77 num\_nfts= 108

slots\_gap= 78 num\_nfts= 106

slots\_gap= 79 num\_nfts= 105

slots\_gap= 80 num\_nfts= 103

slots\_gap= 81 num\_nfts= 102

slots\_gap= 82 num\_nfts= 101

slots\_gap= 83 num\_nfts= 100

slots\_gap= 84 num\_nfts= 98

slots\_gap= 85 num\_nfts= 97

slots\_gap= 86 num\_nfts= 96

slots\_gap= 87 num\_nfts= 95

slots\_gap= 88 num\_nfts= 94

slots\_gap= 89 num\_nfts= 93

slots\_gap= 90 num\_nfts= 92

slots\_gap= 91 num\_nfts= 91

slots\_gap= 92 num\_nfts= 90

slots\_gap= 93 num\_nfts= 89

slots\_gap= 94 num\_nfts= 88

slots\_gap= 95 num\_nfts= 87

slots\_gap= 96 num\_nfts= 86

slots\_gap= 97 num\_nfts= 85

slots\_gap= 98 num\_nfts= 84

slots\_gap= 99 num\_nfts= 83

slots\_gap= 100 num\_nfts= 82

slots\_gap= 101 num\_nfts= 82

slots\_gap= 102 num\_nfts= 81

slots\_gap= 103 num\_nfts= 80

slots\_gap= 104 num\_nfts= 79

slots\_gap= 105 num\_nfts= 78

slots\_gap= 106 num\_nfts= 78

slots\_gap= 107 num\_nfts= 77

slots\_gap= 108 num\_nfts= 76

slots\_gap= 109 num\_nfts= 76

slots\_gap= 110 num\_nfts= 75

slots\_gap= 111 num\_nfts= 74

slots\_gap= 112 num\_nfts= 73

slots\_gap= 113 num\_nfts= 73

slots\_gap= 114 num\_nfts= 72

slots\_gap= 115 num\_nfts= 72

slots\_gap= 116 num\_nfts= 71

slots\_gap= 117 num\_nfts= 70

slots\_gap= 118 num\_nfts= 70

slots\_gap= 119 num\_nfts= 69

slots\_gap= 120 num\_nfts= 68

slots\_gap= 121 num\_nfts= 68

slots\_gap= 122 num\_nfts= 67

slots\_gap= 123 num\_nfts= 67

slots\_gap= 124 num\_nfts= 66

slots\_gap= 125 num\_nfts= 66

slots\_gap= 126 num\_nfts= 65

slots\_gap= 127 num\_nfts= 65

slots\_gap= 128 num\_nfts= 64

slots\_gap= 129 num\_nfts= 64

slots\_gap= 130 num\_nfts= 63

slots\_gap= 131 num\_nfts= 63

slots\_gap= 132 num\_nfts= 62

slots\_gap= 133 num\_nfts= 62

slots\_gap= 134 num\_nfts= 61

slots\_gap= 135 num\_nfts= 61

slots\_gap= 136 num\_nfts= 60

slots\_gap= 137 num\_nfts= 60

slots\_gap= 138 num\_nfts= 59

slots\_gap= 139 num\_nfts= 59

slots\_gap= 140 num\_nfts= 58

slots\_gap= 141 num\_nfts= 58

slots\_gap= 142 num\_nfts= 58

slots\_gap= 143 num\_nfts= 57

slots\_gap= 144 num\_nfts= 57

slots\_gap= 145 num\_nfts= 56

slots\_gap= 146 num\_nfts= 56

slots\_gap= 147 num\_nfts= 56

slots\_gap= 148 num\_nfts= 55

slots\_gap= 149 num\_nfts= 55

slots\_gap= 150 num\_nfts= 54

slots\_gap= 151 num\_nfts= 54

slots\_gap= 152 num\_nfts= 54

slots\_gap= 153 num\_nfts= 53

slots\_gap= 154 num\_nfts= 53

slots\_gap= 155 num\_nfts= 53

slots\_gap= 156 num\_nfts= 52

slots\_gap= 157 num\_nfts= 52

slots\_gap= 158 num\_nfts= 52

slots\_gap= 159 num\_nfts= 51

slots\_gap= 160 num\_nfts= 51

slots\_gap= 161 num\_nfts= 51

slots\_gap= 162 num\_nfts= 50

slots\_gap= 163 num\_nfts= 50

slots\_gap= 164 num\_nfts= 50

slots\_gap= 165 num\_nfts= 49

slots\_gap= 166 num\_nfts= 49

slots\_gap= 167 num\_nfts= 49

slots\_gap= 168 num\_nfts= 48

slots\_gap= 169 num\_nfts= 48

slots\_gap= 170 num\_nfts= 48

slots\_gap= 171 num\_nfts= 48

slots\_gap= 172 num\_nfts= 47

slots\_gap= 173 num\_nfts= 47

slots\_gap= 174 num\_nfts= 47

slots\_gap= 175 num\_nfts= 46

slots\_gap= 176 num\_nfts= 46

slots\_gap= 177 num\_nfts= 46

slots\_gap= 178 num\_nfts= 46

slots\_gap= 179 num\_nfts= 45

slots\_gap= 180 num\_nfts= 45

slots\_gap= 181 num\_nfts= 45

slots\_gap= 182 num\_nfts= 45

slots\_gap= 183 num\_nfts= 44

slots\_gap= 184 num\_nfts= 44

slots\_gap= 185 num\_nfts= 44

slots\_gap= 186 num\_nfts= 44

slots\_gap= 187 num\_nfts= 43

slots\_gap= 188 num\_nfts= 43

slots\_gap= 189 num\_nfts= 43

slots\_gap= 190 num\_nfts= 43

slots\_gap= 191 num\_nfts= 42

slots\_gap= 192 num\_nfts= 42

slots\_gap= 193 num\_nfts= 42

slots\_gap= 194 num\_nfts= 42

slots\_gap= 195 num\_nfts= 42

slots\_gap= 196 num\_nfts= 41

slots\_gap= 197 num\_nfts= 41

slots\_gap= 198 num\_nfts= 41

slots\_gap= 199 num\_nfts= 41

slots\_gap= 200 num\_nfts= 40

slots\_gap= 201 num\_nfts= 40

slots\_gap= 202 num\_nfts= 40

slots\_gap= 203 num\_nfts= 40

slots\_gap= 204 num\_nfts= 40

slots\_gap= 205 num\_nfts= 39

slots\_gap= 206 num\_nfts= 39

slots\_gap= 207 num\_nfts= 39

slots\_gap= 208 num\_nfts= 39

slots\_gap= 209 num\_nfts= 39

slots\_gap= 210 num\_nfts= 38

slots\_gap= 211 num\_nfts= 38

slots\_gap= 212 num\_nfts= 38

slots\_gap= 213 num\_nfts= 38

slots\_gap= 214 num\_nfts= 38

slots\_gap= 215 num\_nfts= 38

slots\_gap= 216 num\_nfts= 37

slots\_gap= 217 num\_nfts= 37

slots\_gap= 218 num\_nfts= 37

slots\_gap= 219 num\_nfts= 37

slots\_gap= 220 num\_nfts= 37

slots\_gap= 221 num\_nfts= 36

slots\_gap= 222 num\_nfts= 36

slots\_gap= 223 num\_nfts= 36

slots\_gap= 224 num\_nfts= 36

slots\_gap= 225 num\_nfts= 36

slots\_gap= 226 num\_nfts= 36

slots\_gap= 227 num\_nfts= 35

slots\_gap= 228 num\_nfts= 35

slots\_gap= 229 num\_nfts= 35

slots\_gap= 230 num\_nfts= 35

slots\_gap= 231 num\_nfts= 35

slots\_gap= 232 num\_nfts= 35

slots\_gap= 233 num\_nfts= 35

slots\_gap= 234 num\_nfts= 34

slots\_gap= 235 num\_nfts= 34

slots\_gap= 236 num\_nfts= 34

slots\_gap= 237 num\_nfts= 34

slots\_gap= 238 num\_nfts= 34

slots\_gap= 239 num\_nfts= 34

slots\_gap= 240 num\_nfts= 33

slots\_gap= 241 num\_nfts= 33

slots\_gap= 242 num\_nfts= 33

slots\_gap= 243 num\_nfts= 33

slots\_gap= 244 num\_nfts= 33

slots\_gap= 245 num\_nfts= 33

slots\_gap= 246 num\_nfts= 33

slots\_gap= 247 num\_nfts= 32

slots\_gap= 248 num\_nfts= 32

slots\_gap= 249 num\_nfts= 32

slots\_gap= 250 num\_nfts= 32

slots\_gap= 251 num\_nfts= 32

slots\_gap= 252 num\_nfts= 32

slots\_gap= 253 num\_nfts= 32

slots\_gap= 254 num\_nfts= 32

slots\_gap= 255 num\_nfts= 31

slots\_gap= 256 num\_nfts= 31

slots\_gap= 257 num\_nfts= 31

slots\_gap= 258 num\_nfts= 31

slots\_gap= 259 num\_nfts= 31

slots\_gap= 260 num\_nfts= 31

slots\_gap= 261 num\_nfts= 31

slots\_gap= 262 num\_nfts= 31

slots\_gap= 263 num\_nfts= 30

slots\_gap= 264 num\_nfts= 30

slots\_gap= 265 num\_nfts= 30

slots\_gap= 266 num\_nfts= 30

slots\_gap= 267 num\_nfts= 30

slots\_gap= 268 num\_nfts= 30

slots\_gap= 269 num\_nfts= 30

slots\_gap= 270 num\_nfts= 30

slots\_gap= 271 num\_nfts= 29

slots\_gap= 272 num\_nfts= 29

slots\_gap= 273 num\_nfts= 29

slots\_gap= 274 num\_nfts= 29

slots\_gap= 275 num\_nfts= 29

slots\_gap= 276 num\_nfts= 29

slots\_gap= 277 num\_nfts= 29

slots\_gap= 278 num\_nfts= 29

slots\_gap= 279 num\_nfts= 29

slots\_gap= 280 num\_nfts= 28

slots\_gap= 281 num\_nfts= 28

slots\_gap= 282 num\_nfts= 28

slots\_gap= 283 num\_nfts= 28

slots\_gap= 284 num\_nfts= 28

slots\_gap= 285 num\_nfts= 28

slots\_gap= 286 num\_nfts= 28

slots\_gap= 287 num\_nfts= 28

slots\_gap= 288 num\_nfts= 28

slots\_gap= 289 num\_nfts= 28

slots\_gap= 290 num\_nfts= 27

slots\_gap= 291 num\_nfts= 27

slots\_gap= 292 num\_nfts= 27

slots\_gap= 293 num\_nfts= 27

slots\_gap= 294 num\_nfts= 27

slots\_gap= 295 num\_nfts= 27

slots\_gap= 296 num\_nfts= 27

slots\_gap= 297 num\_nfts= 27

slots\_gap= 298 num\_nfts= 27

slots\_gap= 299 num\_nfts= 27

slots\_gap= 300 num\_nfts= 26

slots\_gap= 301 num\_nfts= 26

slots\_gap= 302 num\_nfts= 26

slots\_gap= 303 num\_nfts= 26

slots\_gap= 304 num\_nfts= 26

slots\_gap= 305 num\_nfts= 26

slots\_gap= 306 num\_nfts= 26

slots\_gap= 307 num\_nfts= 26

slots\_gap= 308 num\_nfts= 26

slots\_gap= 309 num\_nfts= 26

slots\_gap= 310 num\_nfts= 26

slots\_gap= 311 num\_nfts= 25

slots\_gap= 312 num\_nfts= 25

slots\_gap= 313 num\_nfts= 25

slots\_gap= 314 num\_nfts= 25

slots\_gap= 315 num\_nfts= 25

slots\_gap= 316 num\_nfts= 25

slots\_gap= 317 num\_nfts= 25

slots\_gap= 318 num\_nfts= 25

slots\_gap= 319 num\_nfts= 25

slots\_gap= 320 num\_nfts= 25

slots\_gap= 321 num\_nfts= 25

slots\_gap= 322 num\_nfts= 25

slots\_gap= 323 num\_nfts= 24

slots\_gap= 324 num\_nfts= 24

slots\_gap= 325 num\_nfts= 24

slots\_gap= 326 num\_nfts= 24

slots\_gap= 327 num\_nfts= 24

slots\_gap= 328 num\_nfts= 24

slots\_gap= 329 num\_nfts= 24

slots\_gap= 330 num\_nfts= 24

slots\_gap= 331 num\_nfts= 24

slots\_gap= 332 num\_nfts= 24

slots\_gap= 333 num\_nfts= 24

slots\_gap= 334 num\_nfts= 24

slots\_gap= 335 num\_nfts= 24

slots\_gap= 336 num\_nfts= 23

slots\_gap= 337 num\_nfts= 23

slots\_gap= 338 num\_nfts= 23

slots\_gap= 339 num\_nfts= 23

slots\_gap= 340 num\_nfts= 23

slots\_gap= 341 num\_nfts= 23

slots\_gap= 342 num\_nfts= 23

slots\_gap= 343 num\_nfts= 23

slots\_gap= 344 num\_nfts= 23

slots\_gap= 345 num\_nfts= 23

slots\_gap= 346 num\_nfts= 23

slots\_gap= 347 num\_nfts= 23

slots\_gap= 348 num\_nfts= 23

slots\_gap= 349 num\_nfts= 23

slots\_gap= 350 num\_nfts= 22

slots\_gap= 351 num\_nfts= 22

slots\_gap= 352 num\_nfts= 22

slots\_gap= 353 num\_nfts= 22

slots\_gap= 354 num\_nfts= 22

slots\_gap= 355 num\_nfts= 22

slots\_gap= 356 num\_nfts= 22

slots\_gap= 357 num\_nfts= 22

slots\_gap= 358 num\_nfts= 22

slots\_gap= 359 num\_nfts= 22

slots\_gap= 360 num\_nfts= 22

slots\_gap= 361 num\_nfts= 22

slots\_gap= 362 num\_nfts= 22

slots\_gap= 363 num\_nfts= 22

slots\_gap= 364 num\_nfts= 22

slots\_gap= 365 num\_nfts= 22

1. **Analysis & Conclusion**

* Basically it’s safe to have trigger, But this doesn’t include updating gcdm.ciety 7000 times and update N wallets’ ciety.
* Don’t call other functions, due to taking stake frame is not free.
* If we have a trigger, we have to let host\_wallet own accounts of all stakers about staking info, host\_wallet is the only payer for calcualiting rewards.
* Once a compute unit overflow occurs, no one can see his rewards and unstakes.
* Solution B: modify contracts and wirte a special client to calculate rewards by stages from last slot down to current slot.