In[399]:=
```
input = "..." // StringTrim ;
```

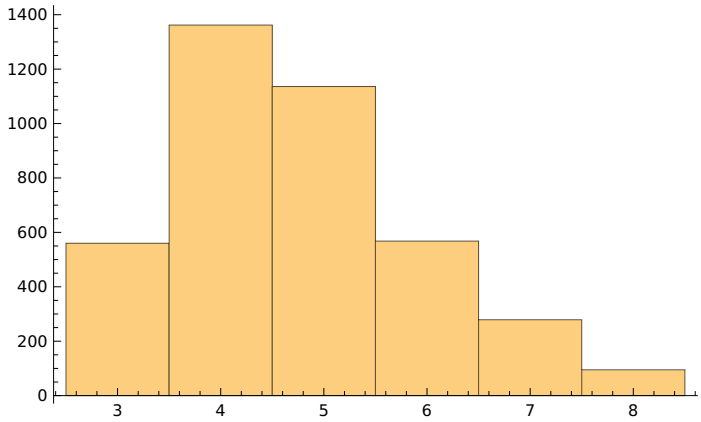
In[400]:=
```
inputSplit = StringSplit[input , ","];
```

In[401]:=
```
inputSplit // Length
```

Out[401]=
```
4000
```

In[402]:=
```
StringLength /@ inputSplit // Histogram
```

Out[402]=



We can see, the problem is, the length of each “steps” is not the same, so we must use some kind of recursion function.

In[403]:=
```
Fold[f, x, {a, b, c, d}]
```

Out[403]=
```
f[f[f[f[x, a], b], c], d]
```

In[404]:=
```
convertStepToValue[currentValue_Integer, char_String] := Module[{
    ascii = ToCharacterCode[char][[1]]
   },
   QuotientRemainder[((currentValue + ascii) * 17 ), 256][[2]]
  ];
```

In[405]:=
```
Fold[convertStepToValue, 0, StringSplit["HASH", ""]]
```

Out[405]=
```
52
```

Good!

In[406]:=
```
Fold[convertStepToValue, 0, StringSplit[#, ""]] & /@ inputSplit  // Total
```

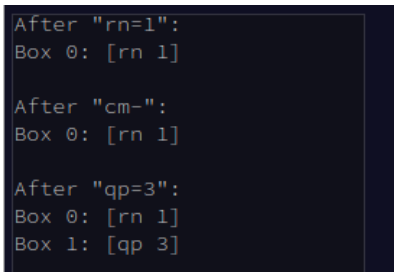
Out[406]=
```
513 172
```

Actually we can finish part 1 in just 1 line .

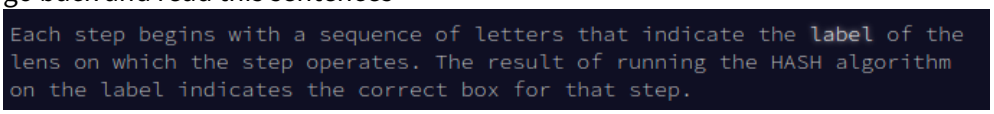
(ノ＞▽＜。)ノ, this problem seem easy. I just got lucky after skip the second week did not solve anything!

Part 2

Hilarious, part 2 description is the most confusing thing I have to read . The problem of AOC is that, the statements given is so lengthy and wordy, normally we just skim thought a few sentences that related to the example. But today the example lack of the explanation steps by steps.

In[407]:=


How we know what box each “step” we need to put in. There is no explanation. Until I read try to go back and read this sentences



Oh, it clears, we must understand here “label” mean only “rn” in “rn=1”. After pipe the “rn” to part 1 hash algorithm we will receive 0 as output. Similar to other step. That explain why there is exactly 256 boxes, because the remaining <= divisor.

Now, everything seem easy . Strategy is here.

We find the box number each step belong to. Simply just using the algorithm in part 1.

We treat each box as a main element. Apply all the step related to each box using folding as above.

You can see the beautiful of Wolfram language than python, it using most of functional style - recursive folding but still apply a same result like for loop in other imperative language. Mathematic is truly language of natural, it can model anything.

In[408]:=
```
parseStep[step_String] := Module[{},

    <|"step" → step,                                    StringSplit[step, ""][[-1]] == "-"
     "operator" → "-",
     "box" → Fold[convertStepToValue,
         0, StringSplit[#, ""]] & @
      StringTake[step, {1, -2}],

     "label" → StringTake[step, {1, -2}] |>


    <|"step" → step,                                    (StringSplit[step, "="] // Length) =
     "operator" → "=",
     "box" → Fold[convertStepToValue,
         0, StringSplit[#, ""]] & @
      StringSplit[step, "="][[1]],
     "focusLength" →
      (StringSplit[step, "="][[2]] // ToExpression),
     "label" → StringSplit[step, "="][[1]]
     |>
    -1                                                  True

 ]
```

In[409]:=
```
{parseStep["dxd=1"], parseStep["yes-"]}
```

Out[409]=
```
{<|step → dxd=1, operator → =, box → 64, focusLength → 1, label → dxd|>,
 <|step → yes-, operator → -, box → 209, label → yes|>}
```

In[410]:=
```
steps = parseStep /@ inputSplit ;
```

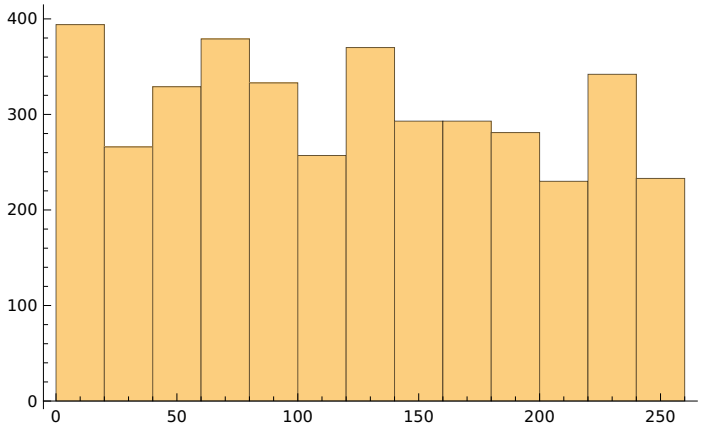
In[411]:=
```
steps // Select[#, -1] &
```

Out[411]=
```
{}
```

In[412]:=

```
#["box"] & /@ steps // Histogram
```

Out[412]=



Nice, now we group those steps base on box

In[413]:=

```
boxs = GroupBy[steps, #["box"] &] // KeySort;
```

In[414]:=

```
boxs
```

Out[414]=

```
⟨|0 → {<|step → vjzjnn−, operator → −, box → 0, label → vjzjnn|>,
    <|step → vjzjnn=8, operator → =, box → 0, focusLength → 8, label → vjzjnn|>,
    <|step → vrtgm=7, operator → =, box → 0, focusLength → 7, label → vrtgm|>,
    <|step → vjzjnn−, operator → −, box → 0, label → vjzjnn|>,
    <|step → vrtgm−, operator → −, box → 0, label → vrtgm|>, ··· 9 ···,
    <|step → vjzjnn=1, operator → =, box → 0, focusLength → 1, label → vjzjnn|>,
    <|step → vrtgm−, operator → −, box → 0, label → vrtgm|>,
    <|step → vrtgm=6, operator → =, box → 0, focusLength → 6, label → vrtgm|>,
    <|step → vjzjnn−, operator → −, box → 0, label → vjzjnn|>,
    <|step → vjzjnn−, operator → −, box → 0, label → vjzjnn|>}, ··· 237 ···, 255 → {··· 1 ···}|⟩
```

Size in memory: 3.4 MB | + Show more | Show all | Iconize | Store full expression in notebook

In[415]:=
```
box0Ds = boxs[0] // Dataset
```

Out[415]=

step	operator	box	focusLength	label
vjzjnn–	–	0	—	vjzjnn
vjzjnn=8	=	0	8	vjzjnn
vrtgm=7	=	0	7	vrtgm
vjzjnn–	–	0	—	vjzjnn
vrtgm–	–	0	—	vrtgm
vrtgm–	–	0	—	vrtgm
vjzjnn=8	=	0	8	vjzjnn
vjzjnn=8	=	0	8	vjzjnn
vjzjnn–	–	0	—	vjzjnn
vjzjnn–	–	0	—	vjzjnn
vjzjnn–	–	0	—	vjzjnn
vrtgm–	–	0	—	vrtgm
vjzjnn=2	=	0	2	vjzjnn
vrtgm=7	=	0	7	vrtgm
vjzjnn=1	=	0	1	vjzjnn
vrtgm–	–	0	—	vrtgm
vrtgm=6	=	0	6	vrtgm
vjzjnn–	–	0	—	vjzjnn
vjzjnn–	–	0	—	vjzjnn

In[416]:=

In[417]:=
```
box0Ds[All, "label", # == "vjzjnn" &] // Select[#, TrueQ] & // Length
```

Out[417]=

12

In[418]:=
```
#["label"] & /@ steps // Select[#, # == "vjzjnn" &] & // Length
```

Out[418]=

12

Okie, I just want to check if data is corrupted or not

Now, the problems is, how to model the solution, **never using those imperative loop in wol-**

fram or lisp language

In[419]:=
```
boxs[0]
```

Out[419]=
```
{<|step → vjzjnn−, operator → −, box → 0, label → vjzjnn|>,
 <|step → vjzjnn=8, operator → =, box → 0, focusLength → 8, label → vjzjnn|>,
 <|step → vrtgm=7, operator → =, box → 0, focusLength → 7, label → vrtgm|>,
 <|step → vjzjnn−, operator → −, box → 0, label → vjzjnn|>,
 <|step → vrtgm−, operator → −, box → 0, label → vrtgm|>,
 <|step → vrtgm−, operator → −, box → 0, label → vrtgm|>,
 <|step → vjzjnn=8, operator → =, box → 0, focusLength → 8, label → vjzjnn|>,
 <|step → vjzjnn=8, operator → =, box → 0, focusLength → 8, label → vjzjnn|>,
 <|step → vjzjnn−, operator → −, box → 0, label → vjzjnn|>,
 <|step → vjzjnn−, operator → −, box → 0, label → vjzjnn|>,
 <|step → vjzjnn−, operator → −, box → 0, label → vjzjnn|>,
 <|step → vrtgm−, operator → −, box → 0, label → vrtgm|>,
 <|step → vjzjnn=2, operator → =, box → 0, focusLength → 2, label → vjzjnn|>,
 <|step → vrtgm=7, operator → =, box → 0, focusLength → 7, label → vrtgm|>,
 <|step → vjzjnn=1, operator → =, box → 0, focusLength → 1, label → vjzjnn|>,
 <|step → vrtgm−, operator → −, box → 0, label → vrtgm|>,
 <|step → vrtgm=6, operator → =, box → 0, focusLength → 6, label → vrtgm|>,
 <|step → vjzjnn−, operator → −, box → 0, label → vjzjnn|>,
 <|step → vjzjnn−, operator → −, box → 0, label → vjzjnn|>}
```

In[420]:=
```
boxs // Length
```

Out[420]=
```
239
```

In[421]:=
```
addLensToBoxByStep[box_List, step_Association] := Module[{},

    box /. s_ /; s["label"] ==
        step["label"] → step

  {{
    Append[box, step]

    DeleteCases[box, s_ /; s["label"] == step["label"]]

  ]
```

In[422]:=
```
addLensToBoxByStep[{},
 <|"step" → "rn=1", "operator" → "=", "box" → 0, "focusLength" → 1, "label" → "rn"|>]
```
Out[422]=
```
{<|step → rn=1, operator → =, box → 0, focusLength → 1, label → rn|>}
```

In[423]:=
```
Fold[addLensToBoxByStep, {}, boxs[3]]
```
Out[423]=
```
{<|step → vlq=8, operator → =, box → 3, focusLength → 8, label → vlq|>}
```

In[424]:=
```
boxesAfterPutLens = Fold[addLensToBoxByStep, {}, #] & /@ boxs;
```

In[425]:=
```
boxesAfterPutLens // Shallow
```
Out[425]//Shallow=
```
<|0 → {<|step → vrtgm=6, operator → =, box → 0, focusLength → 6, label → vrtgm|>},
 1 → {<|step → qp=9, operator → =, box → 1, focusLength → 9, label → qp|>},
 2 → {<|step → jfr=1, operator → =, box → 2, focusLength → 1, label → jfr|>},
 3 → {<|step → vlq=8, operator → =, box → 3, focusLength → 8, label → vlq|>},
 4 → {<|step → jtf=7, operator → =, box → 4, focusLength → 7, label → jtf|>},
 5 → {<|step → rrq=9, operator → =, box → 5, focusLength → 9, label → rrq|>,
    <|step → fsbtv=3, operator → =, box → 5, focusLength → 3, label → fsbtv|>},
 7 → {<|step → qsc=5, operator → =, box → 7, focusLength → 5, label → qsc|>,
    <|step → lk=5, operator → =, box → 7, focusLength → 5, label → lk|>},
 8 → {<|step → km=6, operator → =, box → 8, focusLength → 6, label → km|>},
 9 → {<|step → tkj=3, operator → =, box → 9, focusLength → 3, label → tkj|>},
 10 → {<|step → xr=8, operator → =, box → 10, focusLength → 8, label → xr|>,
    <|step → nvf=2, operator → =, box → 10, focusLength → 2, label → nvf|>}, ≪229≫|>
```

In[440]:=
```
Length /@ boxesAfterPutLens
```

Out[440]=
```
<|0 → 1, 1 → 1, 2 → 1, 3 → 1, 4 → 1, 5 → 2, 7 → 2, 8 → 1, 9 → 1, 10 → 2, 11 → 4, 12 → 1,
 13 → 0, 14 → 0, 15 → 0, 16 → 1, 17 → 1, 18 → 1, 19 → 4, 20 → 1, 21 → 1, 22 → 1, 23 → 3,
 24 → 3, 25 → 2, 27 → 0, 28 → 1, 29 → 0, 30 → 1, 32 → 2, 33 → 1, 34 → 0, 35 → 2, 36 → 1,
 37 → 2, 38 → 1, 39 → 1, 40 → 0, 41 → 0, 42 → 0, 43 → 1, 44 → 2, 45 → 1, 46 → 0, 47 → 0,
 48 → 1, 49 → 1, 50 → 1, 51 → 1, 52 → 0, 53 → 0, 54 → 0, 55 → 0, 56 → 0, 57 → 2,
 59 → 2, 60 → 1, 61 → 1, 62 → 2, 63 → 2, 64 → 2, 65 → 2, 66 → 1, 67 → 0, 68 → 0,
 69 → 2, 70 → 0, 71 → 2, 72 → 3, 73 → 2, 74 → 0, 75 → 3, 76 → 0, 77 → 1, 78 → 1,
 79 → 2, 80 → 1, 81 → 2, 82 → 1, 83 → 0, 84 → 1, 85 → 2, 86 → 2, 87 → 1, 88 → 2,
 89 → 2, 90 → 0, 91 → 1, 92 → 2, 93 → 2, 94 → 2, 95 → 1, 96 → 0, 97 → 0, 98 → 2,
 99 → 0, 100 → 1, 101 → 0, 102 → 2, 104 → 1, 106 → 1, 107 → 1, 108 → 0, 109 → 1,
 110 → 1, 111 → 2, 112 → 0, 113 → 1, 114 → 1, 115 → 1, 117 → 2, 118 → 1, 119 → 1,
 120 → 0, 121 → 0, 122 → 2, 123 → 1, 124 → 0, 125 → 1, 126 → 1, 127 → 0, 128 → 2,
 129 → 1, 130 → 3, 131 → 2, 132 → 0, 133 → 0, 134 → 2, 135 → 4, 136 → 1, 137 → 1,
 138 → 0, 140 → 0, 142 → 0, 143 → 1, 144 → 3, 145 → 1, 146 → 2, 147 → 1, 148 → 3,
 149 → 1, 150 → 4, 151 → 1, 152 → 1, 153 → 0, 154 → 1, 155 → 1, 156 → 0, 157 → 1,
 158 → 1, 159 → 2, 160 → 0, 161 → 0, 162 → 2, 163 → 2, 164 → 1, 165 → 0, 166 → 0,
 168 → 2, 169 → 1, 170 → 1, 171 → 1, 172 → 3, 174 → 0, 175 → 0, 176 → 2, 177 → 1,
 178 → 0, 179 → 1, 180 → 3, 181 → 1, 182 → 0, 183 → 3, 184 → 2, 185 → 1, 186 → 2,
 187 → 0, 188 → 3, 189 → 1, 190 → 1, 191 → 1, 193 → 0, 194 → 1, 195 → 2, 197 → 1,
 198 → 0, 199 → 2, 200 → 0, 201 → 1, 202 → 2, 203 → 0, 204 → 1, 205 → 0, 206 → 0,
 207 → 1, 208 → 1, 210 → 2, 211 → 1, 212 → 1, 213 → 0, 214 → 0, 215 → 1, 216 → 2,
 218 → 2, 219 → 0, 220 → 1, 221 → 1, 222 → 1, 224 → 1, 225 → 0, 226 → 1, 227 → 1,
 228 → 0, 229 → 1, 230 → 0, 231 → 0, 232 → 2, 233 → 2, 234 → 0, 235 → 1, 236 → 1,
 237 → 2, 238 → 3, 239 → 3, 240 → 0, 242 → 1, 243 → 0, 244 → 0, 245 → 2, 246 → 0,
 247 → 0, 248 → 2, 249 → 1, 250 → 2, 251 → 3, 252 → 1, 253 → 1, 254 → 0, 255 → 0|>
```

Good, we have 256 boxes , some box don't have any lens suitable and some box have multi lens;

Now thing seem easy, a function to calculate the power of each box contain

In[426]:=
```
To confirm that all of the lenses are installed correctly, add up the
focusing power of all of the lenses. The focusing power of a single lens is
the result of multiplying together:

  - One plus the box number of the lens in question.
  - The slot number of the lens within the box: 1 for the first lens, 2
    for the second lens, and so on.
  - The focal length of the lens.
```

In[428]:=
```
valueOfBox[box_List] := Module[{
   lenPositions = PositionIndex[box]
  },
  (#["box"] + 1) * lenPositions[#][[1]] * #["focusLength"] & /@ box // Total

 ]
```

In[429]:=
```
valueOfBox[boxesAfterPutLens[[1]]]
```

Out[429]=
```
6
```

Good!

In[430]:=
```
valueOfBox /@ boxesAfterPutLens // Total
```

Out[430]=
```
237 806
```

Scratchpad

In[433]:=
```
PositionIndex[{a, b, c, a, a}]
```

Out[433]=
```
<|a → {1, 4, 5}, b → {2}, c → {3}|>
```

In[434]:=
```
StringTake["abc", {1, -2}]
```

Out[434]=
```
ab
```

In[435]:=
```
SetDirectory["~/nhannht-projects/aoc2023"];
```

In[436]:=
```
NotebookSave[EvaluationNotebook[], FileNameJoin[{Directory[], "15.nb"}]]
```

In[437]:=
```
(Fold[convertStepToValue, 0, StringSplit[#, ""]] & /@ inputSplit) // Max
```

Out[437]=
```
255
```

In[438]:=
```
Fold[convertStepToValue, 0, StringSplit["rn", ""]]
```

Out[438]=
```
0
```

```
SetOptions[SelectedNotebook[],
 PrintingStyleEnvironment → "Printout", ShowSyntaxStyles → True]
```

In[450]:=
```
Export["15.pdf", EvaluationNotebook[]]
```
Out[449]=
```
15.pdf
```
In[444]:=
```
SystemOpen["15.pdf"]
```
In[442]:=
```
SystemOpen["15.pdf"]
```