

Advent of Code

Day Eight

LucidBrot

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1 About

The task at adventofcode 2019 day 8 is fairly straightforward itself. It can be summarized as

Read the input line of N numeric characters into *layers* of size $width * height$ (which are known) to find the layer that contains the lowest number of zeros. Then return the number of '1' digits multiplied by the number of '2' digits within that layer.

However, we're doing this in \LaTeX , which is typeset in spongebob-case for a reason.

2 The \LaTeX Experience

First of all, we're doing something that it was not meant to be used for – so that means we never get the search results we want. Searching about arrays in \LaTeX for example gives you an explanation about how to typeset matrices. Very useful, but not what I wanted. Thankfully, the pgfplots sourceforge page contains a pdf with *Notes On Programming in \TeX* .

Secondly, there don't seem to be any variables. Just *counters*, *counts* which are the \TeX version. and *ifdefs* and most importantly *macros*. But I did not read up on the internals of \TeX and \LaTeX , so I have no clue about the exact way that macros are evaluated. Sometimes you can define a command that works perfectly well for a constant argument, but if you dare use it on the result of another command, you're being had from multiple directions. Because that result has not already been evaluated (expanded) and is passed as-is into the other command. My version of pdfLaTeX does not feature the primitive \expanded yet. Using \expandafter feels very clunky. Luckily there's a hack around that to be found here. And sometimes the problem was actually the `xstring` package which also breaks the hack.

The macros of this package are not purely expandable, i.e. they cannot be put in the argument of an `\edef`. Nestling macros is not possible neither.

For this reason, all the macros returning a result (i.e. all excepted the tests) have an optional argument in last position. The syntax is `[name]`, where `name` is the name of the control sequence that will receive the result of the macro: the assignment is made with an `\edef` which make the result of the macro name purely expandable. Of course, if an optional argument is present, the macro does not display anything.[1]

After eliminating some problems of this sort by storing the result in a new command by virtue of the optional argument, the same problem still appeared because some commands just don't work due to the same issue, even if they are making use of the optional argument to return that in turn (See Figure 1, Figure 2).

```
\def\getchar[#1]#2{%  
\StrMid{#1}{#2}{\numexpr #2 + 0\relax}[\mychar]%  
\mychar}
```

Figure 1: This command does not like to be used on a non-constant string.

Finally, the performance of the `xstring` package is whack. It takes more than two minutes to figure out the length of a 15'000 character string. The bash command `wc -c inputfile.txt` does that in less than a second.

...	@@ -143,8 +143,8 @@ \section{Introduction}
143	143 % assign current char
144	144 \def\currentchar{\getchar[\fileline]{\digitctr}}
145	145 Char Char Bins: \currentchar\\
146	- % % check if zero
147	- % \IfEq {0}{\currentchar}{
146	+ % check if zero
147	+ \IfEq {0}{\currentchar}{
148	148 \advance \currentlayerzerocount 1
149	149 Advanced currentlayerzerocount to \the\currentlayerzerocount
150	150
...	@@ -157,9 +157,9 @@ \section{Introduction}
157	157 \digitctr={\the\numexpr \layersize * \currentlayer + \layersize}
158	158 Layer \the\currentlayer has more zeros than the current best layer (\the\bestlayer) so we skip ahead to character at index \digitctr to start the next layer.
159	159 \fi
160	- % }{\%else
160	+ }{\%else
161	161 The current char \currentchar~does not equal 0. It is \meaning\currentchar whereas 0 is \meaning0.
162	- % }{\%fi
162	+ }{\%fi
163	163 \ifnum \digitctr<\interval{\layersize * \currentlayer + \layersize}
164	164 \repeat
165	165 % if there were very little zeros, we can update the best layer
....	

Figure 2: The difference between wrong code that compiles (red) and seemingly correct code that produces a compiler error (green).

3 StrLen

Since `xstring`'s `StrLen` is so slow, how about creating a faster one? We'll just have to run `tex` with the `--shell-escape` flag.[2]. Using that allows us to escape to the shell - which is either `bash` or the windows `cmd.exe`.

A simple `\input{"echo test"}` already works! test!

But I cannot figure out how to correctly call `wc -c inputfile.tex` because the shell spawns in the wrong path. And also, for some reason the following code does not even create a file `outfile.blubb` anywhere on my machine.

```
\input{"echo a > outfile.blubb"}
```

The problem seems to be, according to the logs, that the pipe closes before the left side is finished writing to `stdout`. But that is actually happening due to the `echo` earlier. When I leave it out, that's not logged.

Maybe using `python` is easier? You'd have to read the source to get this one though.[3]

```
\begin{pycode}{abc}
print(1+12)
\end{pycode}
```

But no, that also results in a problem with writing to a file... So let me try something I understand!

```
\input{"python -c "print(1+2);"}"
```

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And as you should be able to see, it works!

So for computing `stringlength`, a quick `python` call should speed things up.

```
\input{"python -c "print(len('mystringofunkownlength'));"}"
```

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It is notable that spaces within that string get lost before they are passed to `python`. Thankfully we don't need this here. But this reminds me of `PyAuCalc`.

We can make `LATEX` paste a string into that as well...

```
\def\mystr{hello}
\def\mystrtwo{\mystr}
\input{"python -c "print(len('\mystrtwo'));"}"
```

5 ...but for some reason it fails when used with our included `inputstring`. There's a site with an example on how to include text from a file, but it does not work at all for me[4]. I guess I'll just hardcode it inside this file here instead... For that, however, the line length limit becomes an issue. So I've declared 74 commands and combined them into one. Aand turns out that also didn't help. The string just ends after some two hundred characters.

So to quote a professor of mine, J. Hromkovic, "**Strategy: We Give Up!** *What can we do to still be able to state something impressive?*". Well, I can just hardcode the damn string length. That's not really worse than hardcoding the input.

4 Get Head Performance

Again, `xstring` is extremely slow with big strings. So I split everything into layers of 100 chars. But that's still noticeably slower at the end of the layer than at the start of the layer... even though it's only supposed to be a quick character access. So I'm transforming everything into head accesses at index zero.

5 Execution

We had 34 Strawberries for this year's harvest. Probably not enough. So we are sad now and solve <https://adventofcode.com/2019/day/8>.

```
h e
1
6
000000100001220022
hello world 3 3 300
Image Width: 3      Image Height: 2
I want to loop 6 times for the first layer.
The input file contains 18characters.
Advanced currentlayerzerocount to 1 for layer 0.
Advanced currentlayerzerocount to 2 for layer 0.
Advanced currentlayerzerocount to 3 for layer 0.
Advanced currentlayerzerocount to 4 for layer 0.
Advanced currentlayerzerocount to 5 for layer 0.
Advanced currentlayerzerocount to 6 for layer 0.      Found a new best
layer (0) with zerocount 6.
Best Layer Zero Count is 6 for layer 0.
```

Advanced currentlayer to 1.

```
Advanced currentlayerzerocount to 1 for layer 1.
Advanced currentlayerzerocount to 2 for layer 1.
Advanced currentlayerzerocount to 3 for layer 1.
Advanced currentlayerzerocount to 4 for layer 1.
Advanced currentlayerzerocount to 5 for layer 1.
Advanced currentlayerzerocount to 6 for layer 1.
Layer 1has more zeros than the current best layer (0) so we skip ahead to
character at index 12to start the next layer.
Current Layer (1) with zerocount 6 is worse than Best Layer (0, zerocount 6).
Best Layer Zero Count is 6 for layer 0.
```

Advanced currentlayer to 2.

Advanced currentlayerzerocount to 1 for layer 2.

Advanced currentlayerzerocount to 2 for layer 2.

Advanced currentlayerzerocount to 3 for layer 2.

Advanced currentlayerzerocount to 4 for layer 2.

Advanced currentlayerzerocount to 5 for layer 2.

Advanced currentlayerzerocount to 6 for layer 2.

Layer 2 has more zeros than the current best layer (0) so we skip ahead to character at index 18 to start the next layer.

Current Layer (2) with zerocount 6 is worse than Best Layer (0, zerocount 6).

Best Layer Zero Count is 6 for layer 0.

The current layer is now 2

References

- [1] Gonzalo Medina, *Nest StrLen and ifthenelse commands*, <https://tex.stackexchange.com/a/15424/102826>. Accessed 05.08.2020.
- [2] Dimitrios Desyllas, *texify.exe in TeXworks in MSWindows 10: MiKTeX encountered internal error when compile with -shell-escape*, <https://tex.stackexchange.com/a/437933/1028266>. Accessed 05.08.2020.
- [3] Uwe Ziegenhagen, *Combining L^AT_EX with Python* (09.08.2019), <https://tug.org/tug2019/slides/slides-ziegenhagen-python.pdf>. Accessed 05.08.2020.
- [4] Jason Gross, *Why is everyeof needed to avoid...*, <https://tex.stackexchange.com/q/516031/102826>. Accessed 07.08.2020.