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# MCNP Output File Conversion

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## Abstract

The ASCII MCNP output file is converted to an interactive PDF using legacy printer control characters.

## Historical Background

The ANSI standardized a set of printer carriage control characters that are used to control the movement of paper through line printers [1]. Early versions of FORTRAN adopted this standard in their Input/Output statements [2], **and the '1' printer carriage control character is still found in many places throughout the ASCII MCNP output file [3]**.

Character in First Column	Action
<i>blank</i>	Advance 1 line before printing (single spacing)
0	Advance 2 lines before printing (double spacing)
-	Advance 3 lines before printing (triple spacing)
+	Do not advance any lines before printing (overstrike)
<b>1</b>	<b>Advance to next page before printing (form feed)</b>

# Examples

Notice the ‘1’ in the first column as well as the first *blank* characters.

```
1cells                                         print table 60

          cell      mat      atom      gram      neutron
                  density    density    volume     mass    pieces importance

        1      10      100s  9.92700E-02 1.24127E+00 1.92311E+04 2.38710E+04 1  1.0000E+00
        2      20          0  0.00000E+00 0.00000E+00 3.06109E+04 0.00000E+00 1  1.0000E+00
        3      30      200   8.63600E-02 7.93363E+00 3.45092E+03 2.73783E+04 1  1.0000E+00
        4      40          0  0.00000E+00 0.00000E+00 0.00000E+00 0.00000E+00 0  0.0000E+00

total                                         5.32929E+04 5.12493E+04

1 warning message so far.
```

```
1estimated keff results by cycle                                         print table 175

cycle      1      k(collision)  1.220526      prompt removal lifetime(abs)  6.6303E+02      source points generated  1208
           source_entropy =      0.79510
           extend mesh to:  4 x 3 x 6

cycle      2      k(collision)  1.059739      prompt removal lifetime(abs)  5.9337E+02      source points generated  893
           source_entropy =      0.80008
           extend mesh to:  5 x 3 x 7
```

# Conversion to PDF Using Python

- Read the ASCII MCNP output file. Find and store the lines with a '1' as the character in the first column
- Write a LaTeX file using the **fancyvrb** package to pull the ASCII MCNP output file in verbatim
- Compile the LaTeX file and generate a PDF

(pseudocode →)

```
1 # Read ASCII MCNP output file
2 firstline = [1]; sections = list()
3 file = open(file_name, "r")
4 text = file.readlines()
5 for line, x in enumerate(text, 1):
6     if x[0] == "1":
7         firstline.append(line)
8         sections.append(x[1:])
9 # Write LaTeX file
10 with open(tex_file, "w") as latex:
11     latex.write("\section{"+sections[n]+"}")
12     latex.write(
13         "\VerbatimInput[frame=single"
14         +",firstline="+str(firstline[n])
15         +",lastline="+str(firstline[n+1]-1)
16         +"."+file_name+"\n")
17     latex.write("\newpage\n")
18 # Make PDF
19 subprocess.run(["latexmk", "-pdf", tex_file])
```

# Results

outp.pdf

All tools

Find text or tools

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2 cells print table 60

cell	atom density	gram density	volume	mass	neutron pieces	importance
1	10 100e 9.92700E-02	1.24127E+00	1.92311E+04	2.38710E+04	1	1.0000E+00
2	20 0 0.00000E+00	0.00000E+00	3.06109E+04	0.00000E+00	1	1.0000E+00
3	30 200 8.63600E-02	7.93363E+00	3.45092E+03	2.73783E+04	1	1.0000E+00
4	40 0 0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0	0.0000E+00
total			5.32929E+04	5.12493E+04		

1 warning message so far.

Bookmarks

- mcnp6 version 6.3.0 ld=01/26/23 06/18/24 09:42:26
- cells print table 60
- cross-section tables print table 100
- particles and energy limits print table 101
- estimated keff results by cycle print table 175
- problem summary (active cycles only) source particle weight for summary table normalization = 75000.00

# Discussion

- *Benefits*
  - The MCNP output PDF contains everything that is in the original file but is easier to search and navigate
  - The PDF takes up less memory than the ASCII file
  - The conversion does not require any changes to the orginal file or the source code
- *Considerations*
  - Only the '1' control character is used. Is there good reason to use the other control characters (see below) or introduce new ones?
  - Is an ASCII file or a PDF the best way to convey MCNP results to users? What about HTML or something else?

```
1problem summary (active cycles only)          source particle weight for summary table normalization =      75000.00
run terminated when      100 kcode cycles were done.
+                                         06/18/24 09:42:32
=====>      191.05 M histories/hr    (based on wall-clock time in mcrun)

puc1 - single cylinder      probid =  06/18/24 09:42:26
```

## References

- [1] American National Standards Institute. *ANSI X3.78-1981(R1992) representation of vertical carriage positioning characters in information interchange.*
- [2] IBM Corporation. *Fortran Specifications and Operating Procedures IBM 1401.* 1964, p. 18.
- [3] Joel Aaron Kulesza et al. *MCNP® Code Version 6.3.0 Theory & User Manual.* Tech. rep. LA-UR-22-30006, Rev. 1. Los Alamos, NM, USA: Los Alamos National Laboratory, Sept. 2022. DOI: 10.2172/1889957. URL: <https://www.osti.gov/biblio/1889957>.