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Title: MCNP Output File Conversion

Author(s): Weaver, Colin Andrew

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MCNP Output File Conversion

C.A. Weaver

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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) |
| 1 | Advance to next page before printing (form feed) |

Examples

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

```
1cells print table 60

```

| | cell | mat | atom density | gram density | volume | mass | pieces | neutron 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 x

All tools

Find text or tools 🔍 📄 🖨️ ✉️



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2 cells print table 60

| cell | mat | 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.

x 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

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

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 original 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.
+
=====>      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>.