Using SAS® to Parse External Data

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- Introduction
- Parsers – A Primer (*a quick primer*)
- Identifying Unique Character Strings
- Input Statement – Named Input
- Input Statement – Line & Column pointers
- Useful Character Functions
- Looping & Conditional Execution

Putting it all together

Warning !

The Future (?)

Conclusion

For our purposes:

parse

The analysis of a string of characters and subsequent breakdown into a group of components.

EXAMPLE 1 : *Using a known character string as a guidepost through a document.*

```
BROWSE - USERID.SASRUN.LISTING  ---- CHARS ' Cary' FOUND
COMMAND ===>                                  SCROLL ===> CSR
NOTE: Copyright (c) 2002-2003 by SAS Institute Inc.,
      Cary, NC, USA.
NOTE: SAS (r) 9.1 (TS1M3)
       Licensed to COMPANY NAME, Site SITENUM.
NOTE: This session is executing on the z/OS V01R07M00
      platform.
                              …   …   …
```

EXAMPLE 1 : *Using a known character string as a guidepost through a document.*

```
BROWSE - USERID.SASRUN.LISTING  ---- CHARS ' Cary' FOUND
COMMAND ===>                                  SCROLL ===> CSR
NOTE: The address space has used a maximum of 620K below
NOTE: SAS Institute Inc., SAS Campus Drive, Cary, NC USA
1                                              The SAS System
                Obs     Index     Random1     Random2
                  1         1     0.79940          90
                  2         2     0.58974          53
                                …   …   …
```

Now, let's deal with a more complex situation, and do it programmatically in SAS.

The human factor in parsing:

How do you separate your information into noise and useful data?

"Noise" will be rejected.

Useful data can be broken into 2 groups:

- **data to be kept and subsequently processed**
- **identifiers that help to determine the difference between data and noise.**

Using SAS® to Parse External Data
Identifying Unique Character Strings

```
NOTE: There were 20000 observations read from the data set WORK.T1
NOTE: The PROCEDURE PRINT printed pages 1-364.
NOTE: The PROCEDURE PRINT used 0.24 CPU seconds and 7036K.
NOTE: The address space has used a maximum of 620K below the line
NOTE: The SAS session used 0.40 CPU seconds and 7036K.
15          The SAS System          10:36 Sunday, January 20, 2008

NOTE: The address space has used a maximum of 620K below the line
NOTE: SAS Institute Inc., SAS Campus Drive, Cary, NC USA 27513-
1          The SAS System      10:36 Sunday, January 20, 2008   1

                    Loop
          Obs       Index     Random1     Random2
            1         1       0.79940        90
            2         2       0.58974        53
            3         3       0.33958        79
            4         1       0.33424        37
            5         2       0.79739         3
```

Noise

Identifier

Data

Named Input:

```
INPUT  Variable= ;
```

Has been a part of SAS since, well since I got started using it over 25 years ago!

Input data must contain data in format:

```
FieldName=value
```

Named Input:

```
INPUT  Variable= ;
```

This follows the same premise as the data parser we are discussing:

- **Noise is ignored**
- ***FieldName* becomes the identifier**
- ***Value* is the useful data**

Using SAS® to Parse External Data
Input Statement – Named Input

EXAMPLE 2 : *Basic use of Named Input.*

```
DATA Example2;
   INPUT  RANDOM3=;
   DATALINES4;
RANDOM3=94
RANDOM3=334
RANDOM3=966
RANDOM3=809
RANDOM3=934
RANDOM3=889
;;;;
proc print uniform;
run;
```

The SAS System

Obs	RANDOM3
1	94
2	334
3	966
4	809
5	934
6	889

EXAMPLE 2b : *Basic use of Named Input.*

```
DATA Example2;
   INPUT  RANDOM3= ;
   DATALINES4;
Sample Header Line
1 RANDOM2=94 RANDOM3=94
2 RANDOM2=334 RANDOM3=334
3 RANDOM2=966 RANDOM3=966
4 RANDOM2=809 RANDOM3=809
5 RANDOM2=934 RANDOM3=934
6 RANDOM2=889 RANDOM3=889
;;;;
```

EXAMPLE 2b : *Basic use of Named Input.*

```
47  DATA Example2;
48      INPUT  RANDOM3= ;
49  DATALINES4;
NOTE: EQUAL SIGN not found.
NOTE: NAME, '1 RANDOM2' is not defined.
RULE:       ----+----1----+----2----+---
951         1 RANDOM2=94 RANDOM3=94
RANDOM3=94 _ERROR_=1 _N_=2
                        ... ... ...
NOTE: The data set WORK.EXAMPLE2 has
      7 observations and 1 variables.
```

EXAMPLE 2b : *Basic use of Named Input.*

```
DATA Example2;
    INPUT  RANDOM3= ;
    DATALINES4;
Sample Header Line
1 RANDOM2=94 RANDOM3=94
2 RANDOM2=334 RANDOM3=334
3 RANDOM2=966 RANDOM3=966
4 RANDOM2=809 RANDOM3=809
5 RANDOM2=934 RANDOM3=934
6 RANDOM2=889 RANDOM3=889
;;;;
```

Using SAS® to Parse External Data
Input Statement – Named Input

EXAMPLE 2b: *Basic use of Named Input.*

```
DATA Example2(KEEP=RANDOM3);
OR  RETAIN   RANDOM2   0;
OR  LENGTH   RANDOM2   8. ;
    INPUT    dummyval    $CHAR1.
             RANDOM3=   FIRSTOBS=2;
OR  IF  RANDOM3 ^= .  THEN OUTPUT;
    DATALINES4;
 Sample Header Line
 1 RANDOM2=94 RANDOM3=94
 2 RANDOM2=334 RANDOM3=334
 3 RANDOM2=966 RANDOM3=966
 4 RANDOM2=809 RANDOM3=809
 5 RANDOM2=934 RANDOM3=934
 6 RANDOM2=889 RANDOM3=889
 ;;;;
```

Using SAS® to Parse External Data
Input Statement – Named Input

EXAMPLE 2b: *Basic use of Named Input.*

```
66  DATA Example2(KEEP=RANDOM3);
67      RETAIN  RANDOM2  0;
68      INPUT  dummyval $CHAR1.
69             RANDOM3= ;
70      IF  RANDOM3 ^= .  THEN OUTPUT;
71  DATALINES4;
NOTE: EQUAL SIGN not found.
NOTE: The data set WORK.EXAMPLE2 has 6
      observations and 1 variables.
NOTE: DATA statement used (Total
      process time):
      real time              0.00 seconds
      cpu time               0.00 seconds
```

(modified)

WHY?

Line and Column Pointers:

```
INPUT   /          Variable ;
INPUT   # <num>    Variable ;
```

Line Pointers

/ : Relative – Jump one line down.

Values not allowed; 1 slash = 1 line down.

 # : Absolute - Specifies a line in the current buffer, up or down. Limited by size of buffer. N= option on INFILE statement.

Positive values, variables & expressions allowed.

Line and Column Pointers:

```
INPUT   /          Variable ;
INPUT   # <num> Variable ;
```

Line Pointers

~~**Can only go forward – not backwards.**~~

`N=` option on `INFILE` statement controls the number of lines available.
The default is 1.

EXAMPLE 3 : *Absolute and Relative Column pointer.*

```
DATA TEMP;
  RETAIN  pnt 2 ;
  INFILE DATALINES4;
  INPUT # 1    X
        # pnt Y
        # (pnt**2-1) Z ;
DATALINES;
1
2
3
4
5
6
;;;;
```

```
                The SAS System
Obs    pnt    X     Y     Z
 1      2     1     2     3
 2      2     4     5     6
```

EXAMPLE 3 : *Absolute and Relative Column pointer.*

```
DATA TEMP;
  RETAIN  pnt 3 ;
  INFILE DATALINES4;
  INPUT # 1   X
        # pnt Y
        # (pnt-1) Z ;
DATALINES;
1
2
3
4
5
6
;;;;
```

→

```
55 DATA TEMP;
56   RETAIN  pnt 3 ;
57   INFILE DATALINES4;
58   INPUT # 1   X
59         # pnt Y
60         # (pnt-1) Z ;
61 DATALINES;
ERROR: Old line 63 wanted but SAS
       is at line 64.
       Use: INFILE N=X; , with
       a suitable value of x.
RULE:  ----+----1----+----2----+-
64     3
pnt=3 X=1 Y=3 Z=. _ERROR_=1 _N_=1
```

Using SAS® to Parse External Data
Input Statement – Named Input

EXAMPLE 3 : *Absolute and Relative Column pointer.*

```
DATA TEMP;
  RETAIN  pnt 3 ;
  INFILE DATALINES4;
  INPUT # 1    X
        # pnt Y
        # (pnt-1) Z ;
DATALINES;
1
2
3
4
5
6
;;;;
```

```
RULE:  ----+----1----+----2----+-
64      3
pnt=3 X=1 Y=3 Z=. _ERROR_=1 _N_=1
NOTE: The SAS System stopped
      processing this step
      because of errors.
WARNING: The data set WORK.TEMP
         may be incomplete.  When
         this step was stopped
         there were 0 observations
         and 4 variables.
WARNING: Data set WORK.TEMP was
         not replaced because
         this step was stopped.
```

Line and Column Pointers:

```
INPUT  + <num> Variable ;
INPUT  @ <pos> Variable ;
```

Column Pointers

+ : Relative – Move to left (or right).

@ : Absolute - Specifies a line in the current buffer, up or down.

Values, variables, and expressions are allowed.

Line and Column Pointers:

```
INPUT  + (-NegativePos) Variable ;
```

Column Pointers

Relative – Can specify a negative number or expression – use parentheses.

Line and Column Pointers:

```
INPUT  @ "CharStr" Variable ;
```

Column Pointers

Absolute – Can specify a character string. Column pointer will be moved 1 position to the right after the character string.

Line and Column Pointers:

```
INPUT  @ "CharStr" Variable ;
```

Column Pointers

```
INPUT  @ "20" TwoDigitYear 2.;
The current date is March 18 2008
```

~~EXAMPLE 2b: *Basic use of Named Input.*~~

EXAMPLE 4:

Using character-based column pointer.

```
DATA Example2;
    INPUT   @ "RANDOM3="   RANDOM3;
    DATALINES4;
Sample Header Line
1 RANDOM2=94 RANDOM3=94
2 RANDOM2=334 RANDOM3=334
3 RANDOM2=966 RANDOM3=966
4 RANDOM2=809 RANDOM3=809
5 RANDOM2=934 RANDOM3=934
6 RANDOM2=889 RANDOM3=889
;;;;
```

(modified differently)

EXAMPLE 4:

Using character-based column pointer.

```
The SAS System                    14:24 Thursday, January 17, 2008   1

   RANDOM6=20   RANDOM7=5564   RANDOM3=94   RANDOM2=8534   RANDOM4=69
  RANDOM3=334   RANDOM6=20   RANDOM8=2805   RANDOM1=8   RANDOM4=38
RANDOM2=5495   RANDOM8=8324   RANDOM6=72   RANDOM4=76   RANDOM3=966
 RANDOM5=8675   RANDOM2=6437   RANDOM1=6   RANDOM3=809   RANDOM6=68
RANDOM2=1753   RANDOM5=6451   RANDOM6=69   RANDOM4=93   RANDOM3=934
   RANDOM8=231   RANDOM3=889   RANDOM1=9   RANDOM4=55   RANDOM7=3448
   RANDOM4=12   RANDOM2=2910   RANDOM6=43   RANDOM3=312
  RANDOM7=8442   RANDOM6=26   RANDOM3=145   RANDOM2=3227   RANDOM1=3
 RANDOM2=5202   RANDOM1=3   RANDOM8=5330   RANDOM4=55   RANDOM6=24
RANDOM4=45   RANDOM1=4   RANDOM7=4885   RANDOM2=8639   RANDOM5=7358
RANDOM1=2   RANDOM2=6694   RANDOM6=6   RANDOM3=639   RANDOM4=85
  RANDOM5=5437   RANDOM3=836   RANDOM6=51   RANDOM7=3761   RANDOM1=5
```

Using SAS® to Parse External Data
Useful Character Functions

EXAMPLE 4b:

Using character-based column pointer.

```
DATA Example3;
  INFILE 'C:\HOW\Kuligowski\Example2.txt';
  INPUT ;
  IF  FIND( _INFILE_, "RANDOM8=" )  THEN
   Result = 'success';
  ELSE
     Result = 'failure';
  PUT _ALL_ ;
RUN;
proc print uniform; run;
```

Locate a set of characters in a larger set of characters:

```
INDEX( haystack, needle)
FIND( haystack, needle <,mods>, <startpos>)
```

How to remember? – “One of these things is not like the others”:

```
INDEX( haystack, needle)
```

Cut the string back:

```
SUBSTR( string, start-pos <, length> )
SCAN( string, word-number <, delimiters> )
```

Check a string against another string:

```
COMPARE( string1, string2 )
```

Look for the presence of … :

```
ANYALNUM( string, <,start-pos> )
ANYALPHA( string, <,start-pos> )
ANYCNTRL( string, <,start-pos> )
ANYDIGIT( string, <,start-pos> )
ANYFIRST( string, <,start-pos> )
ANYGRAPH( string, <,start-pos> )
ANYLOWER( string, <,start-pos> )
```

… and 6 other similar functions.

Quick list of conditional constructs:

```
IF expression  THEN  / ELSE
SELECT <expression> / WHEN  / OTHERWISE
```

Quick list of looping constructs:

```
DO WHILE expression
DO UNTIL expression
```

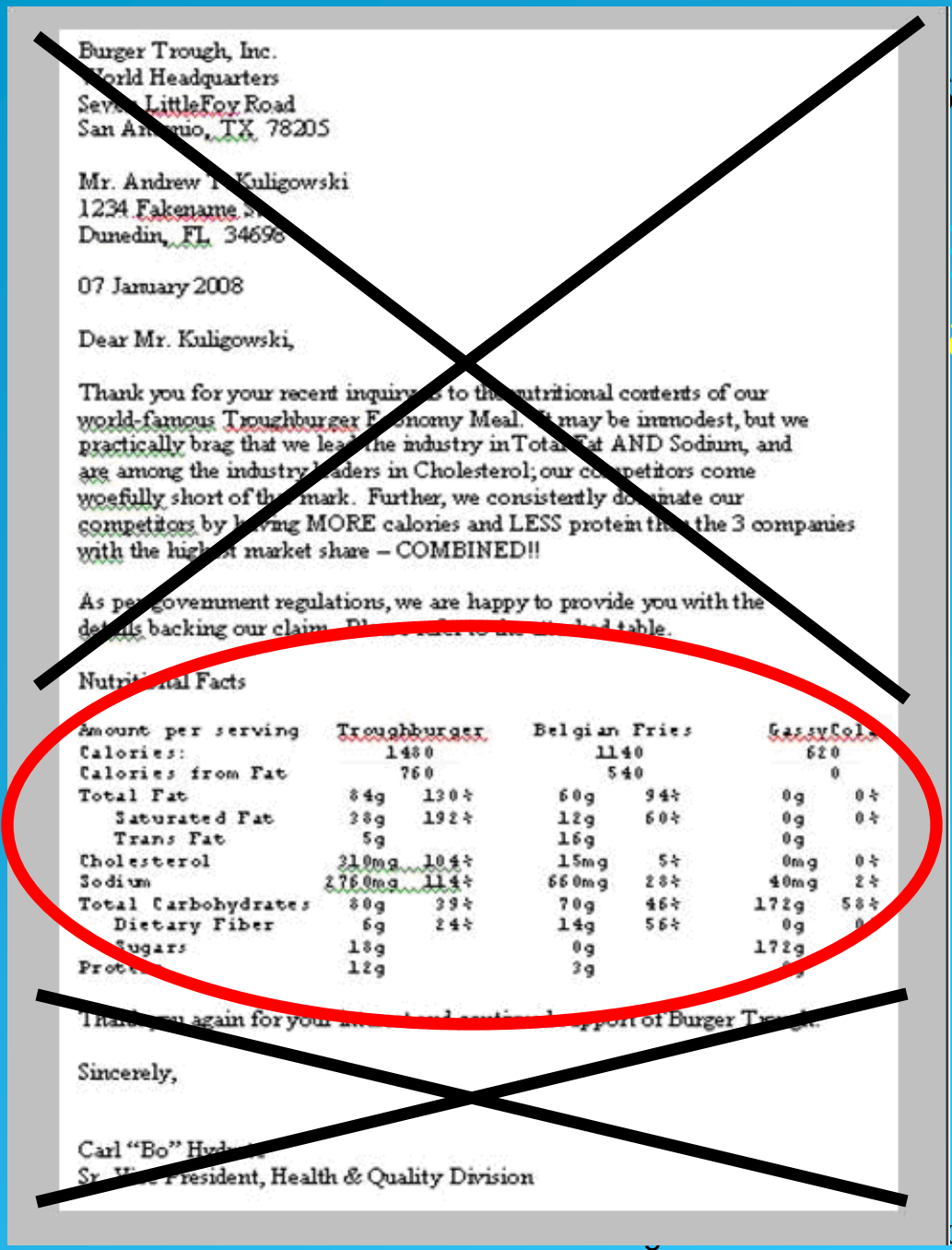
To get out immediately, simply `LEAVE`

Now the fun begins!

Pull out / dust off your toolkit.

You won't need everything you've collected to date.

On the other hand, you may have to research some new technique.



Burger Trough, Inc.
World Headquarters
Seven LittleFoy Road
San Antonio, TX 78205

Mr. Andrew T. Kuligowski
1234 Fakename St.
Dunedin, FL 34698

07 January 2008

Dear Mr. Kuligowski,

Thank you for your recent inquiry as to the nutritional contents of our world-famous Troughburger Economy Meal. It may be immodest, but we practically brag that we lead the industry in Total Fat AND Sodium, and are among the industry leaders in Cholesterol; our competitors come woefully short of the mark. Further, we consistently dominate our competitors by having MORE calories and LESS protein than the 3 companies with the highest market share – COMBINED!!

As per government regulations, we are happy to provide you with the details backing our claim. Please refer to the attached table.

Nutritional Facts

Amount per serving	Troughburger		Belgian Fries		GassyCola	
Calories:	1480		1140		620	
Calories from Fat	760		540		0	
Total Fat	84g	130%	60g	94%	0g	0%
Saturated Fat	38g	192%	12g	60%	0g	0%
Trans Fat	5g		16g		0g	
Cholesterol	310mg	104%	15mg	5%	0mg	0%
Sodium	2760mg	114%	660mg	28%	40mg	2%
Total Carbohydrates	80g	39%	70g	46%	172g	58%
Dietary Fiber	6g	24%	14g	56%	0g	0%
Sugars	18g		0g		172g	
Protein	12g		3g		0g	

Thank you again for your interest and continued support of Burger Trough.

Sincerely,

Carl "Bo" Hydraulic
Sr. Vice President, Health & Quality Division

® to Parse External Data
Putting it all together …

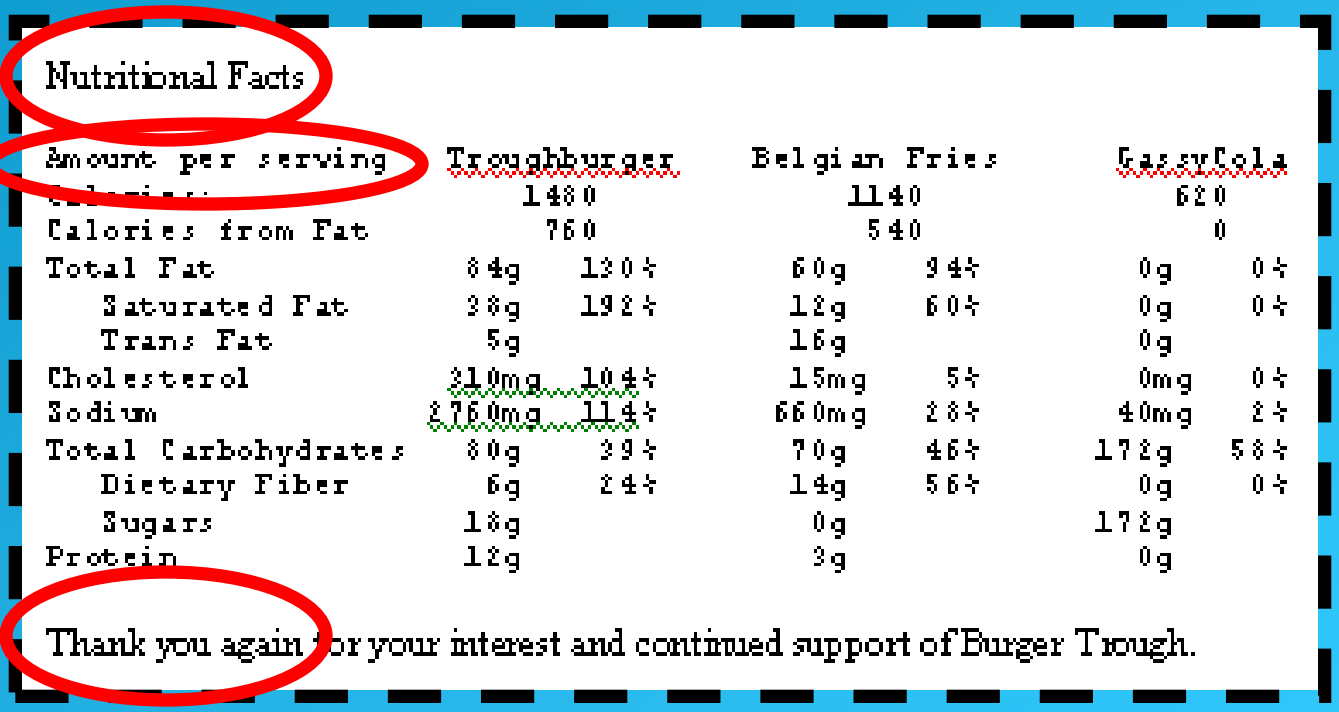
all together

Noise

Data

Noise

EXAMPLE 5 : Putting it all together



Nutritional Facts

Amount per serving	Troughburger		Belgian Fries		GassyCola	
Calories	1480		1140		620	
Calories from Fat	760		540		0	
Total Fat	84g	130%	60g	94%	0g	0%
Saturated Fat	38g	192%	12g	60%	0g	0%
Trans Fat	5g		16g		0g	
Cholesterol	210mg	104%	15mg	5%	0mg	0%
Sodium	2760mg	114%	660mg	28%	40mg	2%
Total Carbohydrates	80g	39%	70g	46%	172g	58%
Dietary Fiber	6g	24%	14g	56%	0g	0%
Sugars	18g		0g		172g	
Protein	12g		3g		0g	

Thank you again for your interest and continued support of Burger Trough.

Identifier
Start of Data

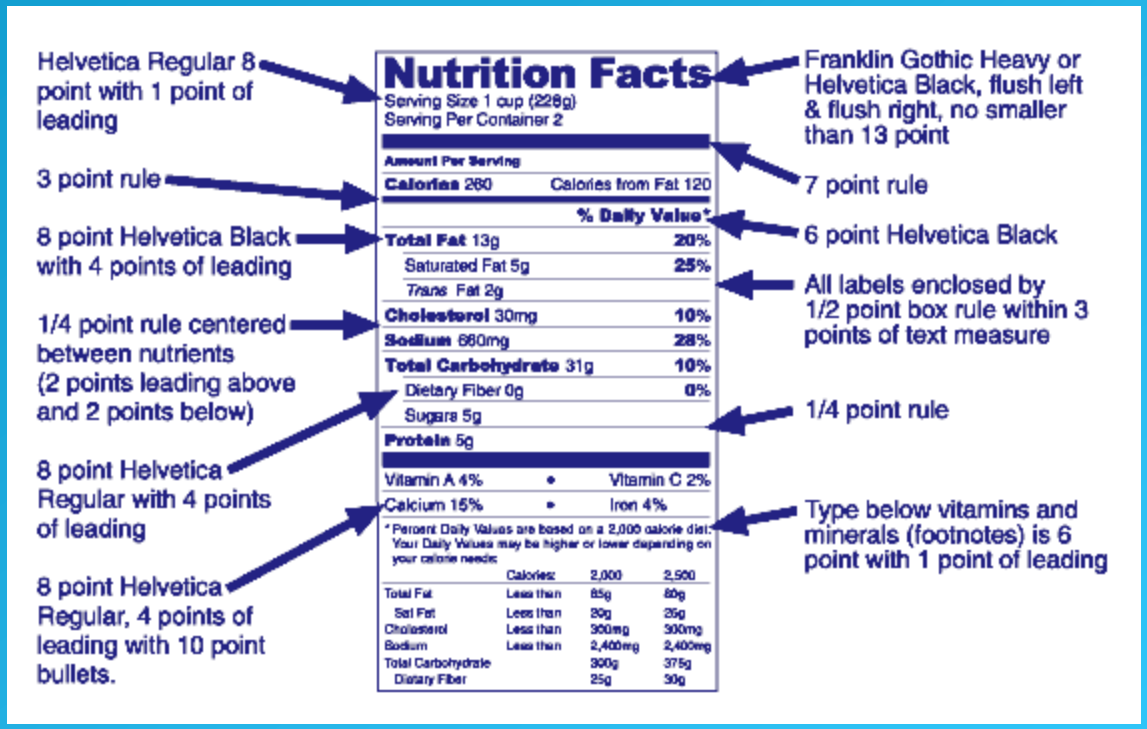
Identifier
Body of Data

Identifier
End of Data

An aside ...

Using SAS® to Parse External Data
Putting it all together …

EXAMPLE 5 : Putting it all together



EXAMPLE 5 : Putting it all together

```
DATA Example4;
  RETAIN  KeepRec_Ind 0;
  INFILE < filename / fileref >;
  INPUT ;
*  Identify start of the nutritional table.  ;
*IF INDEX(_INFILE_,'Nutritional Facts') > 0 THEN DO;
*IF INDEX(UPCASE(_INFILE_),'Nutritional Facts') > 0 THEN DO;
 IF INDEX(UPCASE(_INFILE_),'NUTRITIONAL FACTS') > 0 THEN DO;
    PUTLOG 'Start of Nutritional Table identified' ;
    KeepRec_Ind = 1 ;
  END;

…
```

EXAMPLE 5 : Putting it all together

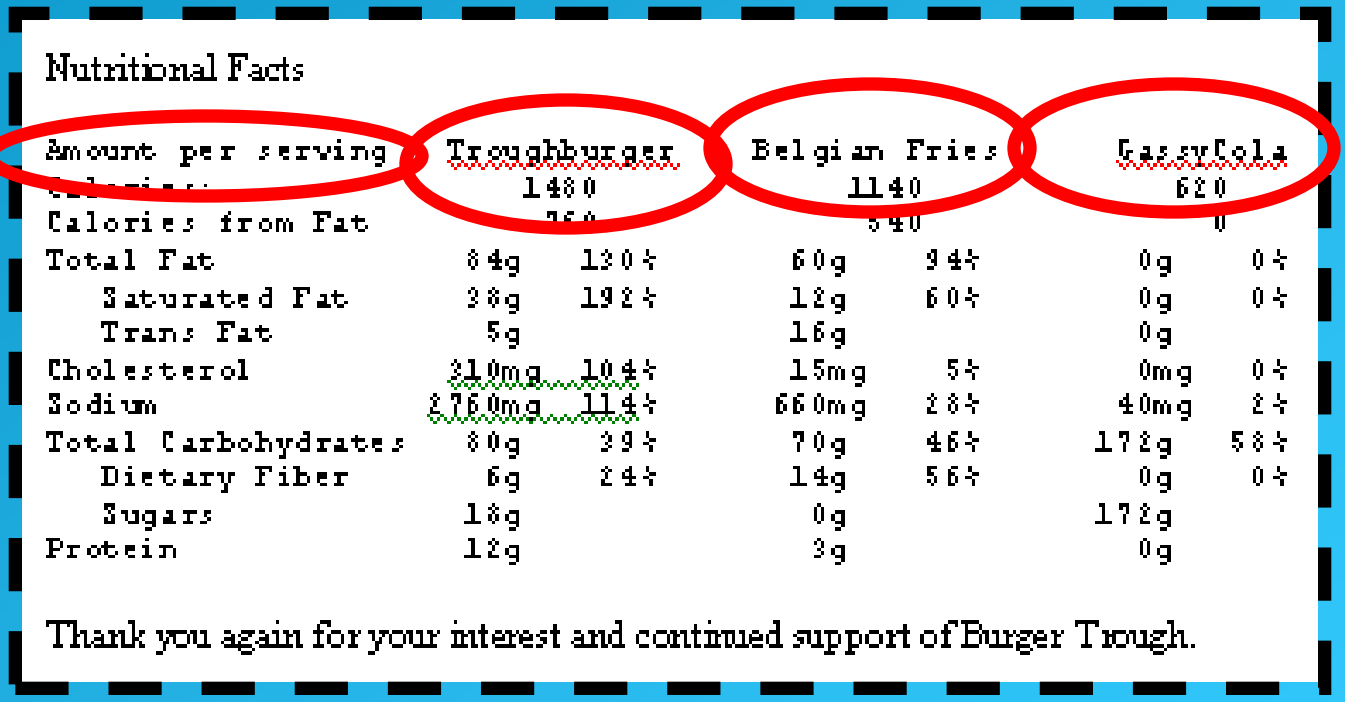
```
…
 *  Identify body of the nutritional table.        ;
*IF INDEX(_INFILE_,'Amount per Serving') > 0  THEN  DO;
*IF INDEX(UPCASE(_INFILE_),'Amount per Serving') > 0 THEN DO;
 IF INDEX(UPCASE(_INFILE_),'AMOUNT PER SERVING') > 0 THEN  DO;
    PUTLOG 'Body of Nutritional Table identified' ;
    KeepRec_Ind = 2 ;
 END;

…
```

EXAMPLE 5 : Putting it all together

```
…
*  Identify termination of the nutritional table. ;
   IF  KeepRec_Ind = 2  AND  _INFILE_ = " "  THEN  DO;
      PUTLOG 'End of Nutritional Table identified' ;
  KeepRec_Ind = 0 ;
   END;
   IF  KeepRec_Ind  THEN  DO;
      OutRec = _INFILE_ ;
  OUTPUT;
   END;
RUN;
```

EXAMPLE 5 : Putting it all together



Nutritional Facts

Amount per serving	Troughburger		Belgian Fries		SassyCola	
Calories	1480		1140		620	
Calories from Fat	760		540		0	
Total Fat	84g	130%	60g	94%	0g	0%
Saturated Fat	38g	192%	12g	60%	0g	0%
Trans Fat	5g		16g		0g	
Cholesterol	210mg	104%	15mg	5%	0mg	0%
Sodium	2760mg	114%	660mg	28%	40mg	2%
Total Carbohydrates	80g	39%	70g	46%	172g	58%
Dietary Fiber	6g	24%	14g	56%	0g	0%
Sugars	18g		0g		172g	
Protein	12g		3g		0g	

Thank you again for your interest and continued support of Burger Trough.

Identifier

Labels

Label

Label *with embedded blank*

Label

EXAMPLE 5 : Putting it all together

```
…
 IF INDEX(UPCASE(_INFILE_),'NUTRITIONAL FACTS') > 0 THEN DO;
    PUTLOG 'Start of Nutritional Table identified' ;
    KeepRec_Ind = 1 ;
  END;
*  Identify body of the nutritional table.        ;
 IF INDEX(UPCASE(_INFILE_),'AMOUNT PER SERVING') > 0 THEN
DO;
    PUTLOG 'Body of Nutritional Table identified' ;
    KeepRec_Ind = 2 ;
 END;

…
```

EXAMPLE 5 : Putting it all together

```
…
 ELSE IF INDEX(UPCASE(_INFILE_),'AMOUNT PER SERVING') > 0
THEN  DO;
     PUTLOG 'Body of Nutritional Table identified' ;
     KeepRec_Ind = 2 ;
     LengthStr = LENGTH( TRIM(_INFILE_) ) ;
     ScanPos = LENGTH('AMOUNT PER SERVING');

…
```

Toggle to the routine (Example 4b)

EXAMPLE 5 : Putting it all together

```
…
    DO WHILE( ScanPos < LengthStr);
       ScanPos = ScanPos + 1 ;
       NextChar = SUBSTR( _INFILE_, ScanPos, 1 );
       IF NextChar = ' ' OR ScanPos = LengthStr  THEN  DO;
         IF  ScanPos = LengthStr  THEN  DO;
           OneBlankInd = 1;
        Product_Label = TRIM(Product_Label) || NextChar;
         END;

…
```

EXAMPLE 5 : Putting it all together

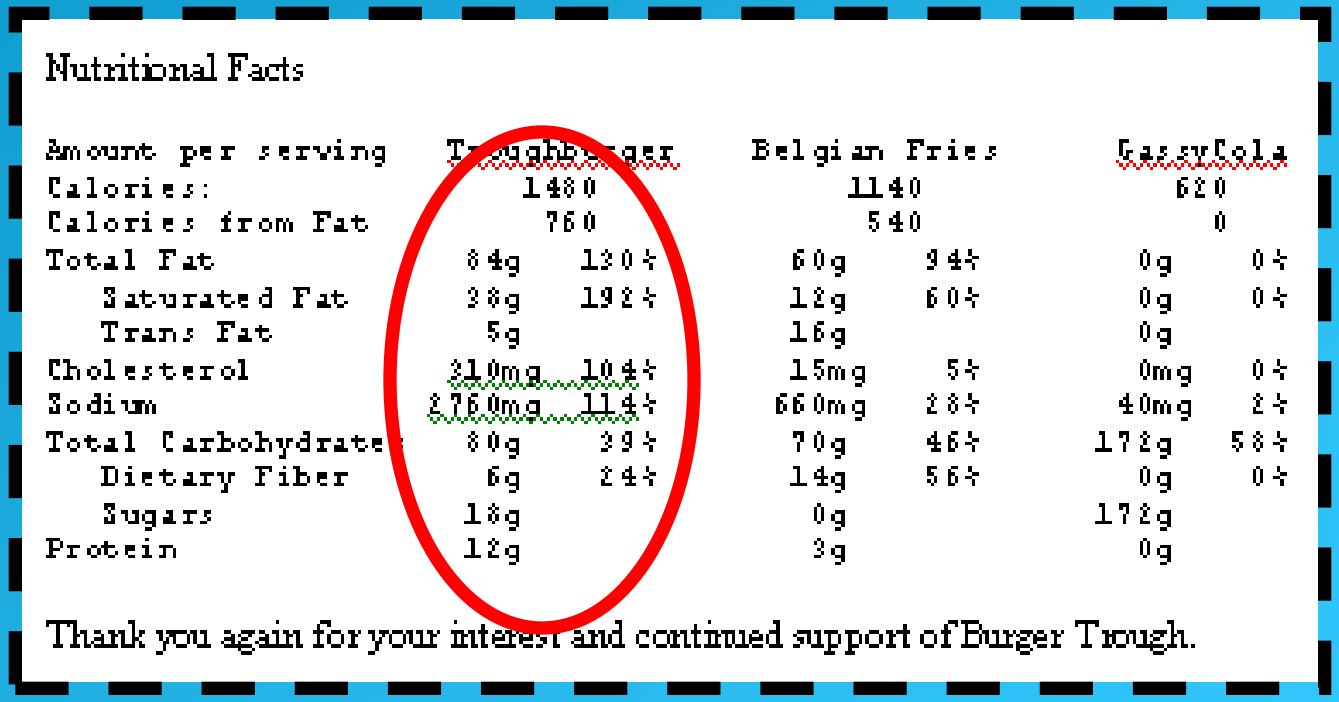
```
…
        IF  OneBlankInd AND Product_Label ^= ' ' THEN DO;
            Product_Cnt + 1;
            OUTPUT;
            OneBlankInd = 0;
            Product_Label = '';
          END;
          ELSE  OneBlankInd = 1;
        END;


…
```

EXAMPLE 5 : Putting it all together

```
…
        ELSE  DO;
          IF  OneBlankInd  THEN  DO;
            Product_Label = TRIM(Product_Label) || ' ' ||
                                NextChar ;
            OneBlankInd = 0;
          END;
          ELSE Product_Label = TRIM(Product_Label) ||
                               NextChar ;
        END;
      END;
  KeepRec_Ind = 3;
…
```

EXAMPLE 5 : Putting it all together



Nutritional Facts

Amount per serving	Trough Burger		Belgian Fries		Gassy Cola	
Calories:	1480		1140		620	
Calories from Fat	760		540		0	
Total Fat	84g	130%	60g	94%	0g	0%
Saturated Fat	38g	192%	12g	60%	0g	0%
Trans Fat	5g		16g		0g	
Cholesterol	210mg	104%	15mg	5%	0mg	0%
Sodium	2760mg	114%	660mg	28%	40mg	2%
Total Carbohydrate	80g	39%	70g	46%	172g	58%
Dietary Fiber	6g	24%	14g	56%	0g	0%
Sugars	18g		0g		172g	
Protein	12g		3g		0g	

Thank you again for your interest and continued support of Burger Trough.

1 Column vs. 2 Columns

Position of Single Column Numbers

Units – Yes or No?

Additional Challenges

EXAM… Putting it all together

Toggle to the routine (Example 4c & 4d)

Nutritional Facts

Amount per serving	Troughburger				GassyCola	
Calories:	1480				620	
Calories from Fat	760				0	
Total Fat	84g	130%	60g	92%	0g	0%
Saturated Fat	38g	192%	12g	60%	0g	0%
Trans Fat	5g		16g			
Cholesterol	210mg	104%	15mg	5%	0mg	0%
Sodium	2760mg	114%	660mg	28%	40mg	2%
Total Carbohydrate	80g	39%	70g	46%	172g	58%
Dietary Fiber	6g	24%	14g	56%	0g	0%
Sugars	18g		0g		172g	
Protein	12g		3g		0g	

Thank you again for your interest and continued support of Burger Trough.

1 Column
vs.
2 Columns

Position of
…le
Co…mn
Numbers

Additional Challenges

Units –
Yes or No?

The next challenge(s) …

- Make the routine flexible – what if the letter contains a 4th product or more?
- Make the routine flexible – what if the letter spanned the page, and there was some additional header info at the top of the next page?
- Make the parser table driven.

WARNING!

Many parsers can take a long time to code and test.

Parsers are only as good as the stability of the data they are reading. If you are sent an update – will *the data* still be in the same format?

WARNING!

Consider an alternative to writing a data parser:

a) **Ask the data supplier to send it in a more “friendly” format.**

b) **Cut-and-paste the data?**

c) **Manual data entry?**

SAS 9.2 offers additional tools to assist parsing:

For example, from Version 9.2:

`DLMSTR='xx'` instead of `DLM='x'` will permit the use of multiple characters as a delimiter.

What does 9.3 offer in this area? tbd

Using SAS® to Parse External Data
Conclusion

Make sure you have a good understanding of the input “format” (such as it is).

Using SAS® to Parse External Data
Conclusion

Any tool in your SAS arsenal may prove useful when writing a data parser.

INFILE & INPUT

IF / THEN / ELSE

SELECT / WHEN / OTHERWISE

DO UNTIL & DO WHILE

Functions – Character evaluation

BIG RED FLAG:

See if you can get the data in a cleaner format before undertaking the effort!

Chances are, your “special format” will not look anything like any of the ones we discussed in this presentation.

However, the concepts of analysis and coding should be VERY similar!

Using SAS® to Parse External Data
Conclusion

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My lawyer