Baking With Arrays Vs. Cooking With Hash In-Memory Look Up Techniques

MINSUG

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Adoption Services

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Baking With Arrays Vs. Cooking With Hash In-Memory Look Up Techniques

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With a background in computer systems management. SAS Instructor Charu Shankar engages with logic, visuals, and analogies to spark critical thinking since 2007.

Charu curates and delivers unique content on SAS, SQL, Viya, etc. to support users in the adoption of SAS software.

When not coding, Charu teaches yoga and loves to explore Canadian trails with her service dog & husky Miko.

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Poll
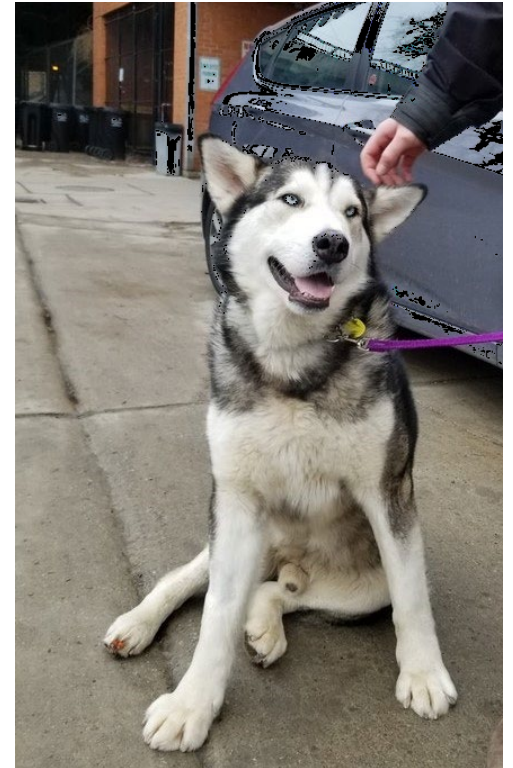
Do you have experience with arrays/hash objects in a programming language? If so, which languages?

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Agenda

Introduction to Lookup Techniques

Baking With Arrays

Cooking With Hash Objects

Compare and Contrast

Handy Links

Introduction to Lookup Techniques

What Is A Table Lookup?

Code	Food	Description
1	Meat pie	A savory pie that covers a filling of meat and other savory ingredients.
1	Fish and chips	Deep-fried fish in batter or breadcrumbs with deep-fried potatoes.
2	Cassoulet	A rich, slow-cooked bean stew or casserole containing meat, pork skin and white haricot beans.
2	Truffles	A group of confectionery, traditionally made with a chocolate ganache center coated in chocolate or cocoa powder, usually in a spherical, conical or curved shape.
3	Samosas	Consists of a fried triangular shaped pastry shell with a savory potato, onion, fresh coriander, cottage cheese and pea stuffing, but other stuffings like minced meat and fish are often used but not traditional.
3	Tandoori chicken	Chicken marinated in a yogurt seasoned with tandoori masala.

Code	Country
1	Australia
2	France
3	India

What are some Lookup Techniques?

Disk/In Memory	Technique
Disk	Conditional Processing
Disk	Data Step Merge
Disk	SQL Join
In-Memory	Arrays
In-Memory	Hash Objects
In-Memory	Formats

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Baking Using Arrays

Objectives

Chef wants to create a food theme with an international menu for the summer
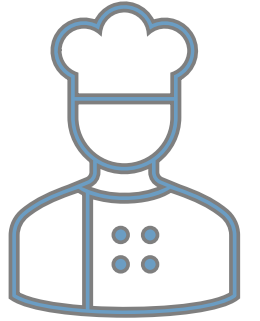
You have been asked to provide food names with country origin(match region codes to country names)

- Country contains country name & region code
- Foods contains food name, description & region code
- Load an array from the Country dataset
- Use the Array as a lookup table to match records from the Foods table.

Business Scenario – Tables

Foods

code	Food	Description
1	Meat pie	A savoury pie that covers a filling of meat and other savoury ingredients.
1	Fish and chips	Deep-fried fish in batter or breadcrumbs with deep-fried potatoes.
2	Cassoulet	A rich, slow-cooked bean stew or casserole containing meat, pork skin and white haricot beans.
2	Truffles	A group of confectionery, traditionally made with a chocolate ganache center coated in chocolate or cocoa powder, usually in a spherical, conical or curved shape.
3	Samosas	Consists of a fried triangular shaped pastry shell with a savory potato, onion, fresh coriander, cottage cheese and pea stuffing, but other stuffings like minced meat and fish are often used but not traditional.
3	Tandoori chicken	Chicken marinated in a yogurt seasoned with tandoori masala.

Country

Code	Country
1	Australia
2	France
3	India

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Overview of Arrays

An array is similar to a row of numbered buckets.
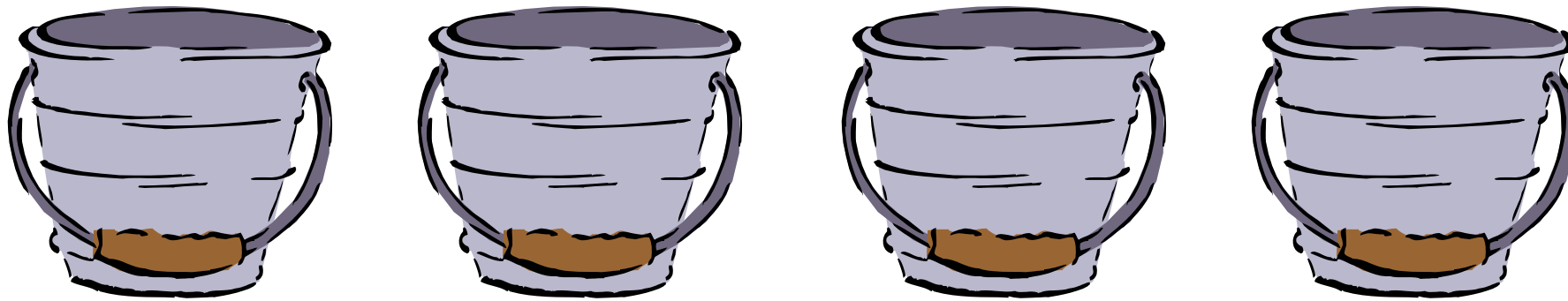
- SAS puts a value in a bucket based on the bucket number.
- A value is retrieved from a bucket based on the bucket number.

Defining Arrays

An *array* is a temporary grouping of SAS variables that are arranged in a particular order and identified by an array name.

The following tasks can be accomplished using an array*:*

- performing repetitive calculations on a group of variables

- creating many variables with the same attributes

- restructuring data

- performing a table lookup with one or more numeric factors

🖉 An array exists only for the duration of the current DATA step.

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Syntax For One-Dimensional Arrays

- To use an array, declare the array by using an ARRAY statement.

- General form of the one-dimensional ARRAY statement:

ARRAY *array-name {number-of-elements} <$> <length>*
  *<list-of-variables> <(initial-values)>***;**

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Using a One-Dimensional Array

```
data baking(keep=code country food description);
    retain C1 C2 C3;
    array C{3} $16  ;


    if _n_=1 then do code =1 to 3;
        set bakecook.country;
        C{code}=country;
    end;


    set bakecook.foods;
    country=c{code};
run;
```

1 (array C{3} $16 ;)

2 (if _n_=1 then do code =1 to 3;)

3 (C{code}=country;)

4 (country=c{code};)

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Execution

```
data baking(keep=code country food description);
    retain C1 C2 C3:
    array C{3}  $16;

    if _n_=1 then do code =1 to 3;
        set bakecook.country;
        C{code}=country;
    end;

    set bakecook.foods;
    country=c{code};
run;
```

Country

Code	Country
1	Australia
2	France
3	India

PDV

C1	D	C2	D	C3	D	Code	Country	Food	Description	_N_	D
						.				1	

Execution

```
data baking(keep=code country food description);
    retain C1 C2 C3:
    array C{3} $16;

    if _n_=1 then do code =1 to 3;
        set bakecook.country;
        C{code}=country;
    end;

    set bakecook.foods;
    country=c{code};
run;
```

Country

Code	Country
1	Australia
2	France
3	India

PDV

C1	D	C2	D	C3	D

us

Code	Country	Food	Description	_N_	D
1	Australia			1	

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Execution

```
data baking(keep=code country food description);
    retain C1 C2 C3:
    array C{3} $16;

    if _n_=1 then do code =1 to 3;
        set bakecook.country;
        C{code}=country;
    end;

    set bakecook.foods;
    country=c{code};
run;
```

Country

Code	Country
1	Australia
2	France
3	India

PDV

C1	D	C2	D	C3	D						

us

Code	Country	Food	Description	_N_	D
1	Australia			1	

Australia ←

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Execution – Fully Loaded Array

```
data baking(keep=code country food description);
    retain C1 C2 C3:
    array C{3}  $16;

    if _n_=1 then do code =1 to 3;
        set bakecook.country;
        C{code}=country;
    end;

    set bakecook.foods;
    country=c{code};
run;
```

Country

Code	Country
1	Australia
2	France
3	India

PDV

C1	C2	C3	Code	Country	Food	Description	_N_
Australia	France	India	3	India			1

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Execution – LookUp

Foods

code	Food	Description
1	Meat pie	A savory pie that covers ingredients.
1	Fish and chips	Deep-fried fish in batter o
2	Cassoulet	A rich, slow-cooked bean and white haricot beans.
2	Truffles	A group of confectionery, center coated in chocolat conical or curved shape.
3	Samosas	Consists of a fried triangu onion, fresh coriander, co stuffings like minced mea
3	Tandoori chicken	Chicken marinated in a yogurt seasoned with tandoori masala.

```sas
data baking(keep=code country food description);
    retain C1 C2 C3:
    array C{3} $11;

    if _n_=1 then do code =1 to 3;
        set bakecook.country;
        C{code}=country;
    end;

    set bakecook.foods;
    country=c{code};
run;
```

PDV

C1	D	C2	D	C3	D	Code	Country	Food	Description	_N_	D
Australia		France		India		1		Meat pie	A savoury pie that ..	1	

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Execution – Look Up

code	Food	Description
1	Meat pie	A savory pie that covers a ingredients.
1	Fish and chips	Deep-fried fish in batter o
2	Cassoulet	A rich, slow-cooked bean and white haricot beans.
2	Truffles	A group of confectionery, center coated in chocolat conical or curved shape.
3	Samosas	Consists of a fried triangu onion, fresh coriander, co stuffings like minced mea
3	Tandoori chicken	Chicken marinated in a yogurt seasoned with tandoori masala.

```
data baking(keep=code country food description);
    retain C1 C2 C3:
    array C{3} $16;

    if _n_=1 then do code =1 to 3;
        set bakecook.country;
        C{code}=country;
    end;

    set bakecook.foods;
    Country = C(code);
run;
```

PDV

C1	D	C2	D	C3	D	Code	Country	Food	Description	_N_	D
Australia		France		India		1	Australia	Meat pie	A savoury pie that ..	1	

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Execution – Look Up

code	Food	Description
1	Meat pie	A savoury pie that covers ingredients.
1	Fish and chips	Deep-fried fish in batter o
2	Cassoulet	A rich, slow-cooked bean and white haricot beans.
2	Truffles	A group of confectionery, center coated in chocolat conical or curved shape.
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3	Tandoori chicken	Chicken marinated in a yogurt seasoned with tandoori masala.

```
data baking(keep=code country food description);
    retain C1 C2 C3;
    array C{3} $16;

    if _n_=1 then do code =1 to 3;
        set bakecook.country;
        C{code}=country
    end;

    set bakecook.foods;
    country=c{code};
run;
```

Implicit OUTPUT;
Implicit RETURN;

PDV

C1		C2		C3		Code	Country	Food	Description	_N_	
Australia	D	France	D	India	D	1	Australia	Meat pie	A savory pie that..	1	D

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Execution – Look Up

code	Food	Description
1	Meat pie	A savoury pie that covers ingredients.
1	Fish and chips	Deep-fried fish in batter o
2	Cassoulet	A rich, slow-cooked bean and white haricot beans.
2	Truffles	A group of confectionery, center coated in chocolat conical or curved shape.
3	Samosas	Consists of a fried triangu onion, fresh coriander, co stuffings like minced mea
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```
data baking(keep=code country food description);
    retain C1 C2 C3:
    array C{3} $16;

    if _n_=1 then do code =1 to 3;
        set bakecook.country;
        C{code}=country;
    end;

    set bakecook.foods;
    country=c{code};
run;
```

PDV

C1		C2		C3		Code	Country	Food	Description		_N_	
Australia	D	France	D	India	D	3	India	Tandoori Chick	Chicken marinated		6	D

Results

Using one dimensional arrays

Obs	code	Country	Food	Description
1	1	Australia	Meat pie	A savoury pie that covers a filling of meat and other savoury ingredients.
2	1	Australia	Fish and chips	Deep-fried fish in batter or breadcrumbs with deep-fried potatoes.
3	2	France	Cassoulet	A rich, slow-cooked bean stew or casserole containing meat, pork skin and white haricot beans.
4	2	France	Truffles	A group of confectionery, traditionally made with a chocolate ganache center coated in chocolate or cocoa powder, usually in a spherical, conical or curved shape.
5	3	India	Samosas	Consists of a fried triangular shaped pastry shell with a savory potato, onion, fresh coriander, cottage cheese and pea stuffing, but other stuffings like minced meat and fish are often used but not traditional.
6	3	India	Tandoori chicken	Chicken marinated in a yogurt seasoned with tandoori masala.

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SAS Hash Objects

Objectives

Chef wants to create a food theme with an international menu for the summer
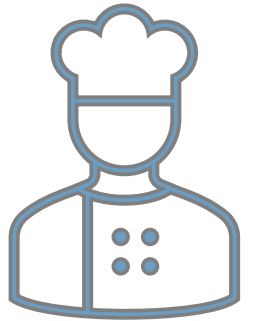
You have been asked to provide food names with country origin(match region codes to country names)

- Country contains country names & country codes
- Foods contains food name, description & region code
- Load a Hash Object from the Country Table
- Use the Hash Object as a lookup table to match records from the Foods table.

Overview of a Hash Object

A hash object is similar to rows of buckets identified by the key value.

DATA Step Hash Objects

The hash object resembles a table with rows and columns. The columns have the following characteristics:

- can be numeric or character
- can be loaded from hardcoded values
- can be loaded from a SAS data set
- exist for the duration of the DATA step
- can be output to a SAS data set

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Using Hash Objects

The DATA step hash object has these characteristics:

is created with a DECLARE statement

has attributes and methods

is manipulated with object dot syntax

Key Component	Data Component
• can consist of numeric and character values • maps key values to data rows	• can contain multiple data values per key value • can consist of numeric and character values
⚠️ Data components and key components are DATA step variables.	

Loading Data - SAS Data Set → Hash Object

```
data cooking(drop=rc);
1       if _n_ =1 then do;
2           length country $16;
3           dcl hash C(dataset:'bakecook.country');
            c.definekey('code');
            c.definedata('country');
            c.definedone();
4           call missing(country);
        end;

5       set bakecook.foods;
        rc=c.find();
run;
```

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Execution

Foods

code	Food	Description
1	Meat pie	A savory pie that covers a filling of meat and other savory ingredients.
2	Cas...	... stew of ...ns.
2	Truf...	...y, traditional...late or cocoa ...erical, coni...
3	Sam...	...gular shape..., cottage ..., but other ...traditional.
3	Tan...	...yogurt seas...

Partial HASH Object C

KEY: Code	DATA: Country
1	Australia
2	France
3	India

```sas
data cooking(drop=rc);
    if _n_=1 then do;
        length country $16;
        dcl hash C(dataset:'bakecook.country');
        c.definekey('code');
        c.definedata('country');
        c.definedone();
        call missing(country);
    end;

    set bakecook.foods;
    rc=c.find();
run;
```

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Country	Food	Description	Code

D ▶ rc	D ▶ _N_
.	1

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Execution

Foods

code	Food	Description
1	Meat pie	A savory pie that covers a filling of meat and other savory ingredients.

Partial HASH Object C

KEY: Code	DATA: Country
1	Australia
2	France
3	India
56	Belgium
64	Bhutan

```
data cooking(drop=rc);
    if _n_=1 then do;
        length country $16;
        dcl hash C(dataset:'bakecook.country');
        c.definekey('code');
        c.definedata('country');
        c.definedone();
        call missing(country);
    end;

    set bakecook.foods;
    rc=c.find();
run;
```

PDV

Country	Food	Description	Code	rc	_N_
	Meat Pie	A savory pie that covers a filling of …	1	.	1

...

Execution

Foods

code Food		Description
1	Meat pie	A savory pie that covers a filling of meat and other savory ingredients.

Partial HASH Object C

KEY: Code	DATA: Country
1	Australia
2	France
3	India
56	Belgium
64	Bhutan

```
data cooking(drop=rc);
    if _n_=1 then do;
        length country $16;
        dcl hash C(dataset:'bakecook.country');
        c.definekey('code');
        c.definedata('country');
        c.definedone();
        call missing(country);
    end;

    set bakecook.foods;
    rc=c.find();
run;
```

PDV

Country	Food	Description	Code	rc	_N_
	Meat Pie	A savory pie that covers a filling of..	1	.	1

Execution

Foods

code	Food	Description
1	Meat pie	A savory pie that covers a filling of meat and other savory ingredients.

Partial HASH Object C

KEY: Code	DATA: Country
1	Australia
2	France
3	India
56	Belgium
64	Bhutan

```
data cooking(drop=rc);
    if _n_=1 then do;
        length country $16;
        dcl hash C(dataset:'bakecook.country');
        c.definekey('code');
        c.definedata('country');
        c.definedone();
        call missing(country);
    end;

    set bakecook.foods;
    rc=c.find();
run;
```

True

PDV

Country	Food	Description	Code	rc	_N_
	Meat Pie	A savory pie that covers a filling of..	1	0	1

Execution

Foods

code	Food	Description
1	Meat pie	A savory pie that covers a filling of meat and other savory ingredients.

Partial HASH Object C

KEY: Code	DATA: Country
1	Australia
2	France
3	India
56	Belgium
64	Bhutan

```
data cooking(drop=rc);
    if _n_=1 then do;
        length country $16;
        dcl hash C(dataset:'bakecook.country');
        c.definekey('code');
        c.definedata('country');
        c.definedone();
        call missing(country);
    end;

    set bakecook.foods;
    rc=c.find();
run;
```

True

PDV

Country	Food	Description	Code	rc	_N_
Australia	Meat Pie	A savory pie that covers a filling of ..	1	0	1	...

Execution

Foods

code	Food	Description
1	Meat pie	A savory pie that covers a filling of meat and other savory ingredients.

Partial HASH Object C

KEY: Code	DATA: Country
1	Australia
2	France
3	India
56	Belgium
64	Bhutan

```
data cooking(drop=rc);
    if _n_=1 then do;
        length country $16;
        dcl hash C(dataset:'bakecook.country');
        c.definekey('code');
        c.definedata('country');
        c.definedone();
        call missing(country);
    end;

    set bakecook.foods;
    rc=c.find();
run;
```

Implicit OUTPUT;
Implicit RETURN;

PDV

Country	Food	Description	Code	rc	_N_
Australia	Meat Pie	A savory pie that covers a filling of ..	1	0	1

...

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Execution

Code	Food	Description
3	Butter Chicken	Marinated Chicken in a Butter Tomato Sauce

Partial HASH Object C

KEY: Code	DATA: Country
1	Australia
2	France
3	India
.	.
56	Belgium
64	Bhutan

```
data cooking(drop=rc);
    if _n_=1 then do;
        length country $16;
        dcl hash C(dataset:'bakecook.country');
        c.definekey('code');
        c.definedata('country');
        c.definedone();
        call missing(country);
    end;

    set bakecook.foods;
    rc=c.find();
run;
```

Continue until EOF.

PDV

Country	Food	Description	Code	rc	_N_
India	Butter Chicken	Marinated Chicken in	3	0	1

...

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Results

PROC PRINT Output

Using a Hash Object

Obs	code	Country	Food	Description
1	1	Australia	Meat pie	A savoury pie that covers a filling of meat and other savoury ingredients.
2	1	Australia	Fish and chips	Deep-fried fish in batter or breadcrumbs with deep-fried potatoes.
3	2	France	Cassoulet	A rich, slow-cooked bean stew or casserole containing meat, pork skin and white haricot beans.
4	2	France	Truffles	A group of confectionery, traditionally made with a chocolate ganache center coated in chocolate or cocoa powder, usually in a spherical, conical or curved shape.
5	3	India	Samosas	Consists of a fried triangular shaped pastry shell with a savory potato, onion, fresh coriander, cottage cheese and pea stuffing, but other stuffings like minced meat and fish are often used but not traditional.
6	3	India	Tandoori chicken	Chicken marinated in a yogurt seasoned with tandoori masala.

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Compare and Contrast

Compare & Contrast

Quality	Array	Hash Object
Subscript	Numeric	Character/numeric/both
Data Values	One data value	Multiple data items
Size	Lesser memory than a hash object.	More memory than an array.
Memory Allocation	Array Size is determined at compilation time.	Hash object size is determined at execution time.
Subscript/keys	Subscript values must be consecutive integers.	The keys do not have to be consecutive or sorted.
Value Selection	An array selects values by direct access based on the subscript value.	A hash object uses a hash function for the lookup process.
Usage	Arrays can only be used in the DATA step.	Hash objects can only be used in the DATA step.

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Handy Resources

Using Arrays in SAS Programming

Off and Running with Arrays in SAS

Table Lookups: From IF-THEN To Key-Indexing

No More Merge – Alternative Table Lookup Techniques

I Cut My Processing Time By 90% By Using Hash Objects

Table Lookup Techniques: From the Basics To The Innovative

Poll ☑

Did you find this session valuable and are able to look at arrays and hash objects with more clarity?

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Course Recommendations based on this content

SAS® Programming 3: Advanced Techniques

Thank You

✓ Did you enjoy this session, Let us know in the **evaluation**

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LINKEDIN   https://www.linkedin.com/in/charushankar/

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