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1985/17. A brief outline of computer program specification

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Abstract

A concise outline of program specification is given to help users provide the specification for a projected program for the programmer; this will form the basis for further discussion.

INTRODUCTION

If you wish to have a computer program written, you must write a detailed specification.

Three things are vital:

What is the exact form of input?
What manipulations of data are to be done?
What is the exact form of the outputs?

There are three broad types of program:

Data bases
Plotting
Calculations

DATA BASES

Input can most easily be specified by writing out, with typical values, a specimen of the data in the form that it will be input from the keyboard.

Note that in Figure 1 (an input sheet for CARS), each line has a label, a number of character positions and that number in brackets. This indicates the size of field available for each item.

Some items - Agency Type, Category, and Geology are indicated by ticks in boxes.

Questions to answer in your specification:

Do you want the line label to appear as a prompt?
How many characters do you want for each item?
Do you want tick-in-box coding for some items?

Next consider what is to happen to the data:

It can be sorted, searched, units can be converted.

Which items do you want to search on?

Do you want them searched singly,
by x *and* y?, x *or* y? or larger groups?

Do you want searches on map references by point-in-a-polygon algorithm?

Do you want an indication of how many items are found by a search?

Last consider how you want your output:

On Screen?
On Printer?
On Plotter?
One of the above or a choice?

An example of CARS ouput is given (fig. 2). The same questions arise as in Input. Labels, field sizes, layout, codings if any are best specified by drawing or typing out a sample of what you require and this will be a fair model for what the line printer can achieve.

PLOTTING

Specification for a plotting program is more complicated, but the same methods and principles apply.

As an example a stick histogram is used (fig. 3). The input consists of a year of months with two readings per month — questions to answer will be:

What is the marking and labelling of the vertical axis?
How are the months to be represented?
Do you want more than one year (conjoined diagrams)?
Do you want a title and year number, and where?
What size should the whole diagram be?
What are the extreme values of the data?

All this information can be contained in a carefully thought out and drawn sketch.

CALCULATION

For calculation ('number crunching') input specification is similar. A sample of data will show number of items, of characters and of decimal places, prompts may be as labels (fig. 4).

Output may also be minimal in which case data base output rules apply. If output is a plot, then plot output description applies.

For what happens between, a detailed algorithm or group of algorithms is essential (fig. 5), so that no doubt or ambiguity is present. This may turn out to be the most difficult part and require discussion as well as specification and possibly a hand calculated specimen. Obviously any variations from the strict specification will require detailed and time-consuming discussion.

(4 April 1985)

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CARS (COMPUTER ASSISTED RECORDS SYSTEM)

NAME: MRS S LAWRENCE (24)

JOB LOCATION: DEVICT PROPOSED SUBDIV (36)

AGENCY: BEACONSFIELD COUNCIL (24)

[0 ✓] GOVERNMENT [1] PROFESSIONAL [2] INDIVIDUAL

RECORDS REFERENCE NO.: 2-5042183

GEOLOGIST: WRM (3)

AMG MAP REFERENCE: 4935543533 (9)

CATEGORY:*

- [0] GROUNDWATER
- [1 ✓] SLOPE STABILITY
- [2] EXPANSIVE SOILS
- [3] FOUNDATION INVESTIGATION
- [4] MISCELLANEOUS

GEOLOGY:*

Qu	0 ✓	Tert.Sed.	1 ✓	Triassic	2	Permian	3	L-Pal	4
C	5	Pre-C	6	Tb	7	Jdl	8	Granite	9

*Cross two (2) maximum

Figure 1. *An example of a data base input sheet.*

M 1681

NAME	JOB LOCATION	AGENCY NAME	NO	RECORDS NO	INIT	MAPREF	CAT	GEOL
S R & E M SIMMONS	DEVIOT WEST TAMAR	BEACONSFIELD COUNCIL	0	3550/75	PCS	494454341	1	18
P BAILEY	DEVIOT		2	4415/75	CJK	494354348	1	17
BEACONSFIELD COUNCIL	FORESHORE ROAD DEVIOT		0	5220/75	WLM	494454345	1	1
BEACONSFIELD COUNCIL	FORESHORE ROAD DEVIOT		0	5855/75	PCS	494454345	1	1
	FORESHORE ROAD DEVIOT	BEACONSFIELD COUNCIL	0	6081/75	IBJ	494454345	1	1
G I WHERETT, S W STEVENS	LOT AT DEVIOT (G WEBB OWNER)		2	917/76	WLM	494454345	1	1
G I WHERETT/S W STEVENS	LOT AT DEVIOT (G WEBB OWNER)		2	1240/76	WLM	494454345	1	1
P BAILEY	MOTOR ROAD DEVIOT	CTCP	0	3280/76	CJK	494254347	1	1
LANDSLIP	DEVIOT RD TAMAR RIVER DEVIOT		0	25061/76	CJK	494454348	1	1
LANDSLIP	DEVIOT POST OFFICE	BEACONSFIELD COUNCIL	0	25047/79	WLM	493654358	1	17
G R PADGETT	DEVIOT	CAMPBELL SMITH	1	10927/83	WLM	494254351	1	17
MRS S LAWRENCE	DEVIOT-PROPOSED SUBDIV	BEACONSFIELD COUNCIL	0	25042/83	WRM	493554353	1	01
DOUGLAS COLLINS	DEVIOT		1	916/84	PCS	904554350	12	1
	FORESHORE RD DEVIOT	DOUGLAS COLLINS	1	1529/84	WLM	493054363	1	18
	FORESHORE RD DEVIOT	DOUGLAS AND COLLINS	1	3315/84	WLM	493054363	3	1
R E ADAMS	NO. E 2085 RSD FORESHORE RD DEVIOT		2	12824/84	WRM	429454351	1	1

Figure 2. *An example of data base output (CARS).*

INPUT FOR STICK HISTOGRAM

Jan	1st	11·7
	15th	8·4
Feb	1st	19·3
	15th	20·1
Mar	1st	3·3
	15th	18·7
Apr	1st	19·2
	15th	7·3
May	1st	7·4
	15th	17·4
June	1st	8·8
	15th	9·6
July	1st	21·7
	15th	29·8
Aug	1st	35·4
	15th	40·1
Sept	1st	17·3
	15th	7·3
Oct	1st	8·4
	15th	8·2
Nov	1st	7·1
	15th	17·3
Dec	1st	4·7
	15th	0·5

Do you want prompts on input?
(data, scales, marks, labels, title?)

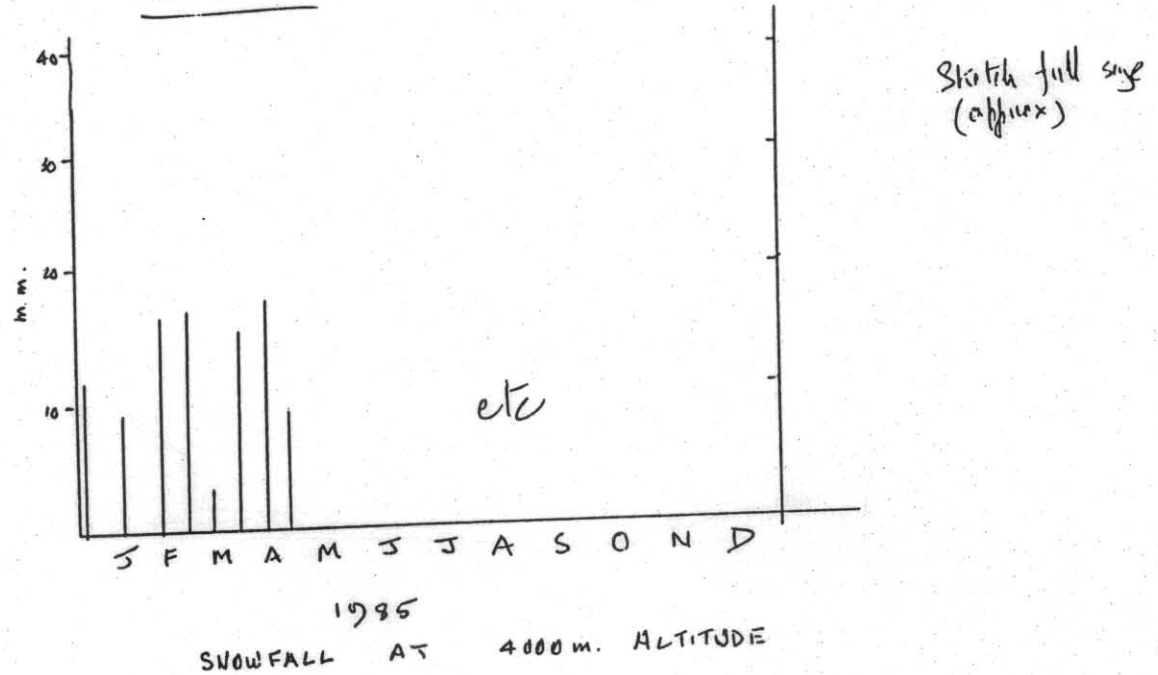
What are extreme values? 0.0 and 40.1

Is one decimal place enough?

Are you likely to want contiguous years?

How many characters maximum in title?

OUTPUT



Sketch full size (approx)

Figure 3. *Input and output for plotting.*

5 cm

SAMPLE DATA

$n = 8$

$b = 8\ m$

$\gamma = 18\ kN/m^3$

h_1	$= 1.7\ m$	α_1	$= -27^\circ$
h_2	3.8	α_2	-16
h_3	5.6	α_3	-3
h_4	7.6	α_4	5
h_5	8.7	α_5	12
h_6	7.9	α_6	19
h_7	5.4	α_7	27
h_8	4.3	α_8	35°

$c' = 7\ kPa$

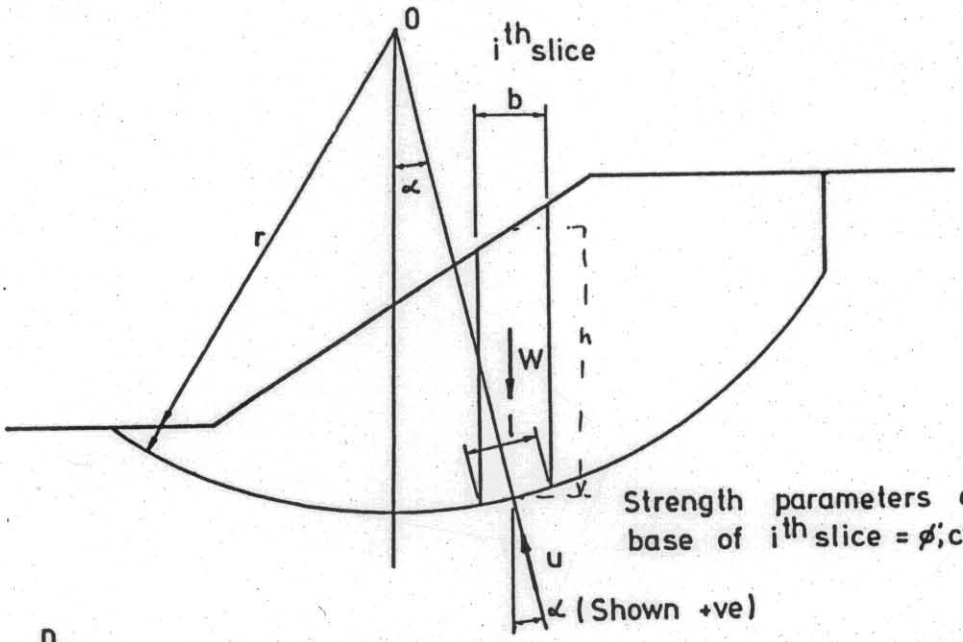
$\phi = 19^\circ$

$u = 5\ kN$

Figure 4. *A sample of input data for calculation.*

STABILITY OF SLOPES — BISHOP'S METHOD

Notation



$$F = \frac{\sum_{i=1}^{n} [l\,c'b + \tan\phi'\,(W - ub)]/m_\alpha}{\sum_{i=1}^{n} W \sin\alpha} \qquad m_\alpha = \cos\alpha + \frac{\sin\alpha \tan\phi'}{F}$$

THIS EXPRESSION REQUIRES AN ITERATIVE SOLUTION

BISHOP'S ANALYSIS

INPUT

n	number of slices	(<20)	
b	width of 1 slice	m (≈2-10)	W_i weight of slice i
γ	density of soil	12-35 kN/m³	W_i weight of slice i
$h_1 \cdots h_i \cdots h_n$	height of slice	(20-30.0) m	W_i weight of slice i
$\alpha_1 \cdots \alpha_i \cdots \alpha_n$	angle of base		
c'	cohesion	kPa 0 – 50.0	
ϕ'	angle of friction		
u	uplift force	kPa	
F	factor of safety (initially = 1 before iteration)		

OUTPUT VALUE OF F AFTER CONVERGENCE

Figure 5. *An algorithm for calculation.*

5 cm