1 SUMMARY

Constructs a system of plane contours $f(x,y)=c_i$, $i=0,1,2,...,k$ over the rectangular region $x_{min} \leq x \leq x_{max}$, $y_{min} \leq y \leq y_{max}$ and **calculates the areas between successive contours.** The contour heights c_i are regularly spaced over a specified range $[f_{min}, f_{max}]$.

A mesh of isoceles triangles is constructed over the region and the contours are generated using linear interpolation.

The user must provide code to evaluate $f(x,y)$ at any point in the region.

ATTRIBUTES — **Version:** 1.0.0. **Types:** GA03A; GA03AD. **Calls:** FD05A. **Original date:** May 1967. **Origin:** E.J.York, Harwell.

2 HOW TO USE THE PACKAGE

2.1 Argument lists and calling sequence

The single precision version

```
      CALL GA03A(XMIN,XMAX,YMIN,YMAX,FMIN,FMAX,
     +           K,M,N,F,G,KAY,FF,X,Y)
```

The double precision version

```
      CALL GA03AD(XMIN,XMAX,YMIN,YMAX,FMIN,FMAX,
     +           K,M,N,F,G,KAY,FF,X,Y)
```

Arguments

XMIN   is a REAL (DOUBLE PRECISION in the D version) variable which must be set by the user to the minimum x value over the range to be considered.

XMAX   is a REAL (DOUBLE PRECISION in the D version) variable which must be set by the user to the maximum x value over the range to be considered.

YMIN   is a REAL (DOUBLE PRECISION in the D version) variable which must be set by the user to the minimum y value over the range to be considered.

YMAX   is a REAL (DOUBLE PRECISION in the D version) variable which must be set by the user to the maximum y value over the range to be considered.

FMIN   is a REAL (DOUBLE PRECISION in the D version) variable which must be set by the user to the minimum value of $f(x,y)$ to be considered, i.e. it is the value of the first contour c_0, see §1.

FMAX   is a REAL (DOUBLE PRECISION in the D version) variable which must be set by the user to the maximum value of $f(x,y)$ to be considered, i.e. it is the value of the last contour c_k, see §1.

K   is an INTEGER variable which must be set by the user to the number of areas to be calculated.

M   is an INTEGER variable which must be set by the user to the number of isoceles triangles which the x range is to be divided.

N   is an INTEGER variable which must be set by the user to the number of isoceles triangles which the y range is to be divided.

F   is a REAL (DOUBLE PRECISION in the D version) two-dimensional array of dimensions at least $(2,n+2)$ which

the subroutine uses for workspace.

G is a REAL (DOUBLE PRECISION in the D version) array of length at least $k+1$ in which the subroutine returns the values of the areas. The subroutine sets $c_0 = f_{min}$, $c_k = f_{max}$, with intermediate values of c linearly spaced, i.e.

$$c_i = f_{min} + \frac{i}{k}(f_{max} - f_{min}), \quad \text{for } i=0,1,2,...,k.$$

Then

G(i) = area between c_{i-1} and c_i, $i=1,2,...,k$.

Note that the element G(K+1) is used internally by the subroutine.

KAY is an INTEGER variable which is used to control the calling sequence of the reverse communication with the subroutine (see below). It must be set to one initially by the user and thereafter the following control values are returned:

2 set the argument variable FF to the value of $f(x,y)$ at the point x and y requested by the subroutine in the arguments X and Y; then call the subroutine again.

3 a normal return with the calculated area values in G.

4 an error return, see §2.2.

FF is a REAL (DOUBLE PRECISION in the D version) variable which is used to return the function values to the subroutine when KAY=2, see argument KAY. On the first entry to the subroutine (KAY=1) it need not be set.

X is a REAL (DOUBLE PRECISION in the D version) variable which is used by the subroutine to specify the x value when it is requesting a function value (KAY=2).

Y is a REAL (DOUBLE PRECISION in the D version) variable which is used by the subroutine to specify the y value when it is requesting a function value (KAY=2).

Calling sequence

Reverse communication based on the argument KAY is used.

```
       - -
     KAY=1
10 CALL GA03A(XMIN,XMAX,YMIN,YMAX,FMIN,FMAX,
   +            K,M,N,F,G,KAY,FF,X,Y)
     GO TO(20,30,40),KAY-1
20 set FF to f(x, y), x and y in X and Y
     GO TO 10
30 normal return
       - -
40 errors, see §2.2
       - -
```

2.2 Error return

If a value of FF is detected outside the range FMIN to FMAX, the subroutine returns control to the calling subroutine with KAY set to 4, G(I) set to 0 for I=1,...,K and a error message is printed.

3 GENERAL INFORMATION

Use of common: None.

Workspace: Argument F requiring $2(n+2)$ words.

Other routines called directly: None.

Input/output: An error message is printed on Fortran unit 6 when errors occur.

4 METHOD

The subroutine constructs a mesh consisting of isoceles triangles in the rectangle defined by (XMIN, XMAX, YMIN, YMAX) and by linear interpolation along the sides of the triangles it constructs the contours; or rather the points at which the contours cross these sides. Approximately (M+1)*(N+2) function evaluations are made.