To define the grid points, let $y = -1$ to 2 in increments of 0.3 to make 11 horizontal lines. The intersections account for a total of 109 grid points. It is possible to graph rapidly the 21 parabolas, because they are translates of $Y^2 = X$. The replacement segments, identical on each parabola, are also sketched rapidly. A computer graphic is shown in Figure 3 which closely resembles a hand-made graphic. Compare it to the graphic for the uniform grid method, Figure 2, page 72.

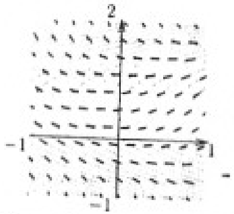


Figure 3. Direction field by the isocline grid method for $y' = x + y(1-y)$ on $-1 \le x \le 1$, $-1 \le y \le 2$.

The `maple` code that produced Figure 3 is included below as evidence that a hand computation is conceptually and mechanically easier. Sometimes a computer algebra system helps, especially to solve the equation $f(x, y) = M_i$ for y.

```
a:=-1:b:=1:n:=21:c:=-1:d:=2:m:=11:
H:=0.1:F:=-3:G:=1:f:=(x,y)->x+y*(1-y):
Slope:=x->F+1/4+(G-F)*(x-1)/(n-1):
Y:=x->c+(d-c)*(x-1)/(m-1): P:=[]:
for j from 1 to n do
  M:=Slope(j):
  h:=evalf(H*0.5/sqrt(1+M^2)):
  for k from 1 to m do
   y0:=Y(k): x0:=evalf(M-0.25+(y0-0.5)^2):
   if x0<a or x0>b then next: fi:
   P:=P,[[x0-h,y0-h*M],[x0+h,y0+h*M]]:
  od:
od:
Data:=[P[2..-1]]: opts:=color=BLACK,axes=FRAMED:
Plot1:=plot(Data,x=a..b,y=c..d,opts):
with(plots):
eq:={seq((y-0.5)^2=x-Slope(j)+1/4,j=1..n)}:
Plot2:=implicitplot(eq,x=a..b,y=c..d):
display([Plot1,Plot2]);
```

Exercises 1.7

Uniform Grid Method. Apply the uniform grid method as in Example 1, page 72 to make a direction field of 11×11 points for the given differential equation on $-1 \le x \le 1$, $-2 \le y \le 2$.

1. $y' = x + y(2-y)$

2. $y' = x + y(1-2y)$

3. $y' = 1 + y(2 \ldots$

---

p 26 #12

Due #11, #15

$\frac{dy}{dx} = x+y$ Sketch by the method of isoclines a direction field on $|x| \le 2$, $|y| \le 3$

$m = -3$ to 3, step $= 0.5$

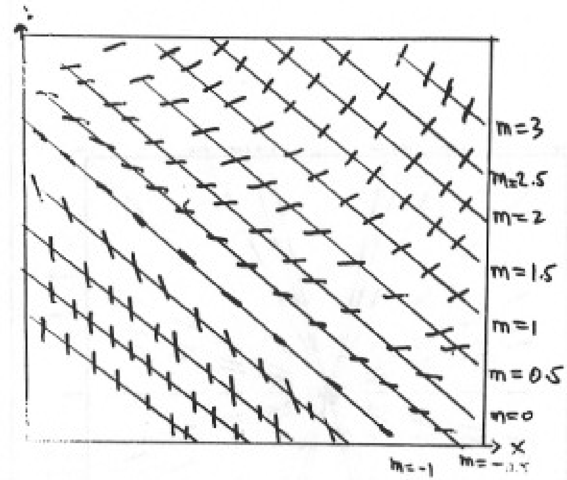
There are 13 slopes.

$x+y=m$ [isocline]

Def: an isocline is an equation $f(x,y) = m$ where $f(x,y)$ = RHS of the DE

$y - m = -x$

std form of a line, $y - y_0 = k(x - x_0)$



Each isocline is a straight line of slope -1.

segments lie atop the isocline!

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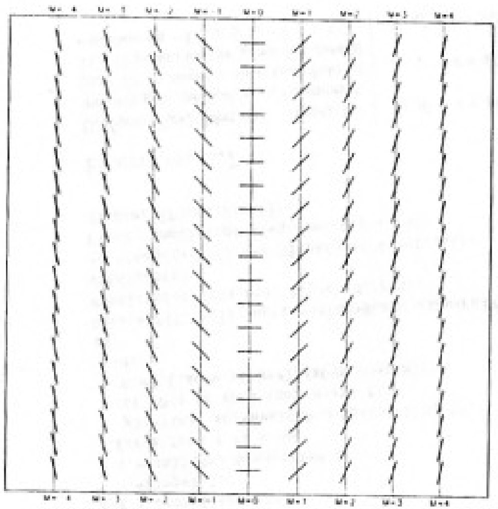
y = 2x

... to the correct slope

Given D.E.

An isocline is an equation f(x,y) = m where m is the slope of the D.E.

Eq. of a line $y - y_0 = k(x - x_0)$



Each isocline is a straight line running vertically

Drawn via AutoCad

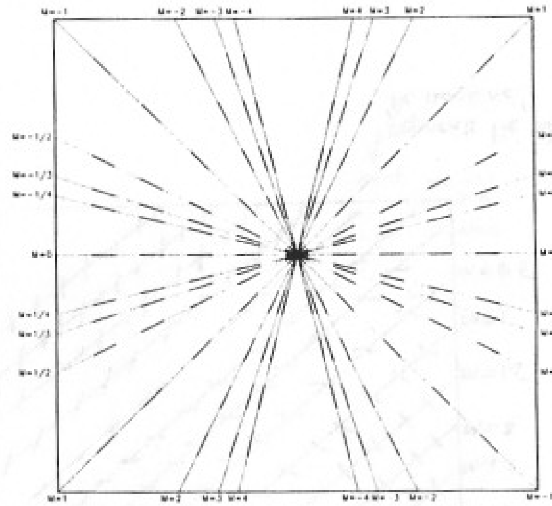
I ... the slope of the ... of the isocline ... to bring the correct slope.

$\frac{dy}{dx} = \frac{y}{x}$

$m = \frac{y}{x}$

$mx = y$

$m = -4$ to 4



Given D.E.

Same method as previous.