Lab Problem 11.1(a), Physics 430

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> restart;
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Finite-difference Poisson's equation, then solve for the center value of V

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> pois:=(V(i+1,j)-2*V(i,j)+V(i-1,j))/dx^2+(V(i,j+1)-2*V(i,j)+V(i,j-1
  ))/dy^2=-rho/e0;
```

$$pois := \frac{V(i+1,j) - 2\,V(i,j) + V(i-1,j)}{dx^2} + \frac{V(i,j+1) - 2\,V(i,j) + V(i,j-1)}{dy^2} = -\frac{\rho}{e0}$$

```
> Vij:=solve(pois,V(i,j));
```

$$Vij := \frac{1}{2}\,\frac{dy^2\,e0\,V(i+1,j) + dy^2\,e0\,V(i-1,j) + dx^2\,e0\,V(i,j+1) + dx^2\,e0\,V(i,j-1) + \rho\,dx^2\,dy^2}{e0\,(dy^2 + dx^2)}$$

To put it in the form of the equation in Lab 12, multiply by the denominator of the equation and expand

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> Vij*(2/dx^2+2/dy^2);
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$$\frac{1}{2}\,(dy^2\,e0\,V(i+1,j) + dy^2\,e0\,V(i-1,j) + dx^2\,e0\,V(i,j+1) + dx^2\,e0\,V(i,j-1) + \rho\,dx^2\,dy^2)\left(2\,\frac{1}{dx^2} + \frac{2}{dy^2}\right) \Big/ (e0\,(dy^2 + dx^2))$$

```
> expand(simplify(%));
```

$$\frac{V(i+1,j)}{dx^2} + \frac{V(i-1,j)}{dx^2} + \frac{V(i,j+1)}{dy^2} + \frac{V(i,j-1)}{dy^2} + \frac{\rho}{e0}$$

This is the numerator of the equation in the lab, so all it needs is the denominator to be put back underneath.

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>
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